

**SPECIFICATIONS**  
**FOR**  
**SOUTH BREAKWATER REPAIRS**  
**PORT ELGIN, ONTARIO**

**REGION PROJECT**  
**NO.**



Department of Fisheries & Oceans  
Small Craft Harbours Branch  
Burlington, Ontario

**2019**





PART 1 - GENERAL

1.1 MINIMUM STANDARDS

- .1 Execute work to meet or exceed:
- .1 National Building Code of Canada 2015, National Fire Code of Canada 2015, Ontario Building Code 2012 and any other code of provincial or local application, including all amendments up to project date, provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.
  - .2 Rules and regulations of authorities having jurisdiction.
  - .3 Fire Commissioner of Canada, No. 301, Standard for Construction Operations, and No. 302, Standard for Welding and Cutting, June 1982 and Fire Protection Standard for Correctional Institutions - Treasury Board Personnel Management Manual, Occupational Safety and Health, Chapter 3-6, Feb. 1992.
  - .4 Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 1990, Chapter O.1 as amended, O. Reg. 213/91 as amended by O. Reg. 631/94, R.R.O. 1990, Reg. 834, Diving Operations, O. Reg. 629/94, as amended.
  - .5 Environmental Protection Act, O. Reg. 102/94 and O. Reg. 103/94.

1.2 TAXES

- .1 Pay applicable Federal, Provincial and Municipal taxes.

1.3 EXAMINATION

- .1 Before submitting bid, examine existing conditions and determine conditions affecting work.
- .2 Obtain all information which may be necessary for proper execution of Contract.

1.4 EXISTING  
CONDITIONS

- .1 The geotechnical investigations are bound in Appendix A - Geotechnical Investigations.
- .2 Contractor shall be familiarized with all available data and scope, and price accordingly.

1.5 SITE

- .1 Confine work, including temporary structures, plants, equipment and materials to established limits of site.

- .2 Locate temporary buildings, roads, walks, drainage facilities, services as directed and maintain in clean and orderly manner.
- 1.6 CONSTRUCTION AND STORAGE AREA
- .1 The limits of the Construction and Storage Area will be designated by the Departmental Representative prior to commencement of work unless otherwise shown on the drawings. One permanent construction staging area has been identified on the contract drawings. See drawings S-2 for details. The Contractor shall take responsibility for the use, maintenance and reinstatement of the staging area. Construction access is to come from Green St.
- 1.7 DOCUMENTS
- .1 Keep on site one copy of contract documents, reviewed shop drawings and submissions.
- .2 Specifications shall govern over Drawings.
- .3 Post documents on site conforming to local Occupational Health and Safety Regulations.
- 1.8 CONTRACT METHOD
- .1 Construct Work under a combined price contract. All costs for work not specifically identified as a unit price item shall be included in the lump sum arrangement.
- 1.9 MEASUREMENT PROCEDURES
- .1 Within 48 hours of bid acceptance submit a list of subcontractors and a detailed breakdown of costs associated with the lump sum arrangement.
- .2 Items measured for payment are in metric (SI) units.
- .3 Submit requests for payment in metric units corresponding with items on the Unit Price Table.
- .4 Submit supporting documents in metric units. Perform all necessary conversions required.
- 1.10 LAYOUT OF WORK
- .1 Immediately upon entering site for purpose of beginning work on this project, locate all general reference points and take proper action necessary to prevent their disturbance.
- .2 Supply stakes and other survey markers required for this work. Employ competent personnel to lay out

work in accordance with lines and grades provided.

- .3 Maintain all reference points and markers for duration of contract.

1.11 CO-OPERATION AND PROTECTION

- .1 Execute work with minimum disturbance to occupants public and normal use of site work area. Make arrangements with Departmental Representative to facilitate execution of work.
- .2 Maintain access and exits.
- .3 Provide necessary barriers, warning lights and signs. Protect work from damage. Replace damaged existing work with material and finish to match original.

1.12 INTERFERENCE TO NAVIGATION

- .1 Do not impede navigation during progress of work in accordance with the Collision Regulation with Canadian Modifications 1983.
- .2 Obtain schedule of vessel movements and fishery activities in area affected by dredging operations including movement of vessels at adjacent wharves. The area is subject to heavy navigational traffic both commercial and recreational.
- .3 Plan and execute work in manner that will not interfere with fishing operations, marina operations, construction activities at pier sites, or access to piers by land or water.
- .4 No claims for delays will be permitted resulting from the above constraints. No claims are permitted for loss of time, equipment, material or any other cost related to interference with moored vessels in harbour or due to other Contractor's operations.
- .5 Keep Operations Centre, Watchkeeper at 1-800-265-0237, Canadian Coast Guard, (CCG) Transport Canada, Sarnia, Ontario informed of dredging operations in order that necessary Notices to Shipping and Notices to Mariners will be issued. Make arrangements with CCG to relocate and replace buoys for execution of work. Advise nearest Coast Guard Base of any requirements to relocate channel markers/buoys within work area.
- .6 Mark floating equipment with lights in accordance with the Collision Regulations with the Canadian Modifications, 1983, and maintain a VHF marine radio watch of board.

1.13 EXISTING  
UTILITIES

- .1 Establish location, protect and maintain existing utility lines.
- .2 Connect to existing utilities with minimum disturbance to pedestrian and vehicular traffic.

1.14 MATERIALS AND  
EQUIPMENT

- .1 Use new products unless otherwise specified.
- .2 Deliver and store material and equipment to manufacturer's instructions with manufacturer's labels and seals intact.
- .3 When material or equipment is specified by standard or performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.

1.15 INSPECTION AND  
TESTING

- .1 The Departmental Representative may employ an Inspection and Testing company to ensure work conforms with Contract Documents.
- .2 When initial tests and inspections reveal work not to contract requirements, pay for tests and inspections required by Departmental Representative on corrected work.
- .3 Submit timely inspection and test reports to Departmental Representative.

1.16 MILESTONE DATES

- .1 Interim completion milestone targets:
  - .1 March 15, 2020, Completion of all in water work including installation of steel sheet piling and armour stone.
  - .2 May 15, 2020, Completion of all work on both structures.

1.17 SCHEDULING OF  
WORK

- .1 On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion.
- .2 When schedule has been reviewed by the Departmental Representative take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.

1.18 AS-BUILT  
RECORD DRAWINGS

- .1 As work progresses, neatly record significant deviations from the Contract drawings using fine, red marker on full size white prints.

- .2 Neatly print lettering and numbers in size to match original. Lines may be drawn free-hand but shall be neat and accurate. Add at each title block note: "AS BUILT RECORD".
- .3 Record following significant deviations:
  - .1 Depths of various elements and foundations.
  - .2 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement.
  - .3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
  - .4 Field changes of dimension.
  - .5 Other significant deviations which are concealed in construction and cannot be identified by visual inspection.
- .4 Turn one set of As-Built Record Drawings over to Departmental Representative upon completion of work.
- .5 If project is completed without significant deviations from contract drawings declare this in writing and submit to Departmental Representative in lieu of As-Built Record Drawings.

#### 1.19 ADDITIONAL DRAWINGS

- .1 Departmental Representative may furnish additional drawings to clarify work.
- .2 Such drawings become part of Contract Documents.

#### 1.20 FIRES AND TEMPORARY HEATERS

- .1 Burning of rubbish on site not permitted.
- .2 Only fires for temporary heaters are permitted on site.
- .3 Maintain temperature required to prevent frost damage to work.

#### 1.21 DATUM

- .1 Elevations and soundings shown on Drawings are expressed in metres relative to chart datum.
- .2 Chart datum for Lake Huron is 176.0 metres I.G.L.D (1985).

#### 1.22 OPSS AND OPSD

- .1 Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD) quoted in these specifications are available online at <http://www.raqsa.mto.gov.on.ca/techpubs/ops.nsf/OPS>

Homepage.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements prior to submissions and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.
- .11 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as pdf files. Forward pdf files on CD or through email.

1.2 SHOP DRAWINGS  
AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work. Refer to individual specifications sections for submission requirements.
- .2 Where required by specifications, submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 5 working days for Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:

- .1 Subcontractor.
- .2 Supplier.
- .3 Manufacturer.
  
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.
  
- .9 After Departmental Representative's review, distribute copies.
  
- .10 Submit 3 prints and 1 electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
  
- .11 Submit 3 hard copies and 1 electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
  
- .12 Submit 3 hard copies and 1 electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
  
- .13 Submit 3 hard copies and 1 electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.

- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit 3 hard copies and 1 electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit 3 hard copies and 1 electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that the Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract

Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 CERTIFICATES  
AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Safety and Insurance Board Experience Report.
- .2 Submit transcription of insurance immediately after award of Contract.

1.4 FEES, PERMITS  
AND CERTIFICATES

- .1 Provide authorities having jurisdiction with information requested.
- .2 Pay fees and obtain certificates and permits required.
- .3 Furnish certificates and permits.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act, R.S.O. [1990 Updated 2017].

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1 Results of site specific safety hazard assessment.
  - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
- .3 Submit 1 digital copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative weekly.
- .4 Submit copies of reports or directions issued by safety inspectors of authority having jurisdiction.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce

the Contractor's overall responsibility for construction Health and Safety.

- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF  
NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 SAFETY  
ASSESSMENT

- .1 Perform site specific safety hazard assessments related to project.

1.5 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.6 REGULATORY  
REQUIREMENTS

- .1 Comply with the Acts and regulations of the Province of Ontario.
- .2 Comply with specified standards and regulations to ensure safe operation at site.

1.7 PROJECT/SITE  
CONDITIONS

- .1 Work at site will involve contact with:
  - .1 Work around water.

1.8 GENERAL  
REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or rejecting improvements.
- .3 Relief from or substitution for any portion or

provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 The Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act for the Province of Ontario.

1.10 COMPLIANCE  
REQUIREMENTS

- .1 Comply with Ontario Health and Safety Act, R.S.O.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.11 UNFORSEEN  
HAZARDS

- .1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Departmental Representative verbally and in writing.
- .2 Follow procedures in place for Employee's Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

1.12 HEALTH AND  
SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have working knowledge of occupational safety and health regulations.
  - .2 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .4 Be on site during execution of Work and

report directly to and be under direction of site supervisor.

1.13 POSTING OF  
DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province of Ontario, and in consultation with Departmental Representative. The following criteria is to be posted on site:
- .1 Contractor's Safety Policy.
  - .2 Constructor's Name.
  - .3 Notice of Project.
  - .4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
  - .5 Ministry of Labour Orders and reports.
  - .6 Occupational Health and Safety Act and Regulations for Construction Projects for the Province of Ontario.
  - .7 Address and phone number of nearest Ministry of Labour office.
  - .8 Material Safety Data Sheets.
  - .9 Written emergency Response Plan.
  - .10 Site Specific Safety Plan.
  - .11 Valid certificate of first aider on duty.
  - .12 WSIB "In Case of Injury At Work" poster.
  - .13 Location of toilet and cleanup facilities.

1.14 CORRECTION OF  
NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.16 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.
- .2 Assign responsibility and obligation to health and safety coordinator to stop or start Work when, at health and safety coordinator's discretion, it is

necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

PART 1 - GENERAL

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review and approval by Departmental Representative.
- .3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
  - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
  - .3 Names and qualifications of persons responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.
  - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls

to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.

.6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

.7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to clean and minimize amount of mud transported onto paved public and private roads by vehicles or runoff.

.8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.9 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

.14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

.15 Pesticide treatment plan to be included and updated, as required.

- 1.3 FIRES .1 Fires and burning of rubbish on site not permitted.
- 1.4 DRAINAGE .1 Provide Erosion and Sediment Control Plan identifying type and location of erosion and sediment controls provided. Ensure plan includes monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- 1.5 SITE CLEARING AND PLANT PROTECTION .1 Protect trees and plants on site and adjacent properties.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Departmental Representative.
- 1.6 WORK ADJACENT TO WATERWAYS .1 Construction equipment to be operated on land only unless placed on barges.
- .2 Do not use waterway beds for borrow material without Departmental Representative's approval.
- .3 Waterways shall be free of excavated fill, waste material and debris.
- .4 Design and construct temporary crossings to minimize erosion to waterways.

- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- .7 Blasting to be above water and 100 m minimum from indicated spawning beds.

1.7 POLLUTION  
CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where indicated or directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.8 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
  - .1 Do not take action until after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 CLEANING .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Access and Construction aids.  
.2 Office Trailers.  
.3 Parking.  
.4 Project identification.
- 1.2 REFERENCES .1 National Building Code of Canada.  
.2 Provincial Legislation.  
.1 Ontario Traffic Manual Book 7.  
.2 Ontario Building Code.  
.3 Occupational Health and Safety Act
- 1.3 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- 1.4 INSTALLATION AND REMOVAL .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.  
.2 Identify areas to receive a granular base to prevent tracking of mud.  
.3 Indicate use of supplemental or other staging areas.  
.4 Provide construction facilities in order to execute work expeditiously.  
.5 Remove from site all such work after use.
- 1.5 HOISTING .1 Provide, operate and maintain hoists/cranes required for moving of workers, materials and equipment.
- 1.6 SITE STORAGE/LOADINGS .1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.  
.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.7 CONSTRUCTION  
STAGING AND PARKING

- .1 A site storage and construction staging area is permitted as illustrated on the Contract Drawings. The Contractor shall take responsibility for the use, maintenance and reinstatement of the staging areas.
- .2 Provide and maintain adequate access to project site.
- .3 Parking will be permitted on site provided it does not disrupt performance of Work.
- .4 Build and maintain temporary roads as required to undertake the Work and provide snow removal during period of Work.
- .5 When using existing public and private roads for access to project site, maintain such roads for duration of Contract and repair damage resulting from Contractors' use of the roads.

1.8 SITE ACCESS

- .1 Provide access to piers via the land side or water side as required.
- .2 Minimize disruption to normal marina functions.
- .3 Provide snow clearing of the work site as required to undertake the work. Maintain the parking area and road leading up to the work site where the laydown area impedes snow clearing by others.

1.9 OFFICES

- .1 Provide a climate-controlled office with lighting and ventilation, of sufficient size to accommodate site meetings, and furnished with desk, chairs and drawing laydown table.
- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors may provide their own offices as necessary. Direct location of these offices.
- .4 Maintain in clean condition.

1.10 EQUIPMENT, TOOL  
AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.11 SANITARY  
FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.12 CONSTRUCTION  
SIGNAGE

- .1 Provide and erect, within 3 weeks of signing Contract, two project identification signs in locations designated by Departmental Representative.
  - .1 Indicate on sign, name of Owner, Consultant and Contractor, of a design style approved by Departmental Representative.
  - .2 Provide 1200 x 2400 mm identification site sign comprising of foundations and framing.
- .2 Provide and erect all local construction safety, notice and warning signage around the site.
- .3 Provide and erect construction signage on public and private roads leading to the project site, to provide advance warning of a work zone for long duration operations.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.
- .5 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.13 PROTECTION AND  
MAINTENANCE OF TRAFFIC

- .1 Provide access to temporary facilities as applicable.
- .2 Maintain and protect traffic on affected roads during construction period.
- .3 Provide measures for protection and temporary diversion of traffic, including provision of flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site shall interfere as little as possible with public traffic.

- .6 Verify adequacy of existing roads and allowable load limit on these roads. The Contractor shall be responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary with suitable grades and widths.
- .8 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .9 Dust control: adequate to ensure safe operation at all times.
- .10 Provide snow removal where required during period of Work.
- .11 Remove, upon completion of work, all temporary facilities required to undertake the work.

## PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

## PART 3 - EXECUTION

- 3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL
- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed from removal.
- 3.2 CLEAN-UP
- .1 Remove construction debris, waste materials, packaging material from work site daily.
  - .2 Clean dirt or mud tracked onto paved or surfaced roadways.

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Barriers.  
.2 Environmental Controls.  
.3 Traffic Controls.  
.4 Fire Routes.
- 1.2 RELATED SECTIONS .1 Section 01 52 00 - Construction Facilities.
- 1.3 REFERENCES .1 National Building Code of Canada.  
.2 Provincial Legislation:  
.1 Ontario Building Code.  
.2 Occupational Health and Safety Act.
- 1.4 INSTALLATION AND REMOVAL .1 Provide temporary controls in order to execute Work expeditiously.  
.2 Remove from site all such work after use.
- 1.5 PROTECTION .1 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.  
.2 Maintain barriers in good working order. Daily inspect barriers and repair expeditiously.
- 1.6 SECURITY .1 Provide temporary site enclosure around the Work areas and construction staging area, using modular freestanding fencing.  
.1 Galvanized, 1.8 m high chain link or welded steel mesh with pipe rails.  
.2 Provide spaced lockable entrances for equipment and workers, with locks and keys.  
.2 Maintain barriers in good working order. Daily inspect barriers and repair expeditiously.
- 1.7 GUARD RAILS AND BARRICADES .1 Provide secure, rigid guard rails and barricades around deep excavations and open edges as required by governing authorities.

- 1.8 ACCESS TO SITE .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.
- 1.9 PUBLIC ACCESS ROUTES AND PROPERTY .1 Maintain and safeguard public access to areas outside of the Work area. Temporary utilization or obstruction of public areas are not permitted unless approved by Departmental Representative.
- .2 Protect surrounding private and public property from damage during performance of Work.
- .3 Be responsible for damage incurred.
- 1.10 FIRE ROUTES .1 Maintain access to properties including overhead clearances for use by emergency response vehicles.
- 1.11 PROTECTION OF BUILDING FINISHES .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Be responsible for damage incurred due to lack of or improper protection.
- PART 2 - PRODUCTS
- 2.1 NOT USED .1 Not Used.
- PART 3 - EXECUTION
- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers the requirements for management of construction/demolition materials.
- 1.2 REFERENCES .1 Canadian Environmental Protection Act (CEPA 1999)  
.2 Ontario Regulations  
.1 Ontario Regulation 102/94.  
.2 Ontario Regulation 103/94.  
.3 Ontario Regulation 347 / 558.  
.4 Ontario Regulation 213/91 (Occupational Health and Safety Act, OHSA).
- 1.3 CONSTRUCTION AND DEMOLITION WASTE .1 Carefully remove, deconstruct, source separate materials and divert from waste destined for landfill to maximum extent possible. Reuse, recycle, compose, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.  
.2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.  
.1 Provide facilities for collection, handling and storage of source separated wastes.  
.2 Source separate the following waste:  
.1 Concrete  
.2 Wood  
.3 Steel  
.4 Aggregate  
.5 Bituminous Pavement  
.6 Organic vegetation  
.3 Identify opportunities for reduction, reuse, and recycling of materials, where possible.  
.4 Accomplish maximum control of solid construction waste.  
.5 Preserve environment and prevent pollution and environment damage.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to removing materials, provide written authorization from the third party property owner(s) accepting disposal materials as non-hazardous solid waste.
- .3 Provide a summary report of the disposed material (by quantity or weight) sent to third party property owner(s) versus material that was reused, sold or recycled.
- .4 Submit a Waste Reduction Work Plan indicating the materials and quantities of material that will be recycled and diverted from landfill, where possible.

1.5 WASTE  
PROCESSING SITES

- .1 Contact local and Provincial governments for information on area waste management facilities.
- .2 For the Province of Ontario, contact the Ministry of Environment and Climate Change, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.
- .3 Contact the Recycling Council of Ontario ([www.rco.on.ca](http://www.rco.on.ca)) for listings of companies and agencies providing services and products related to the waste diversion and recycling.

1.6 STORAGE,  
HANDLING AND  
PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal do become Contractor's property. Contractor is responsible for disposing of these materials and choosing authorized landfill site.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect, stockpile, store and catalogue salvaged items.
- .5 Protect structural components not removed for demolition from movement or damage. In the event of damage, make repairs and replacements to the approval of, and at no additional cost, to the Departmental Representative.
- .6 Support affected structures. If the safety of any component is endangered, cease operations and

immediately notify Departmental Representative.

- .7 Separate and store materials produced during dismantling of structures in designated areas.
- .8 Store treated wood on site in a temporary containment area set up for this purpose to prevent streaming water from reaching aquatic environment.

#### 1.7 DISPOSAL OF WASTES

- .1 Do not bury or burn rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil or paint thinner into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .4 All waste materials should be disposed of in a legal manner at a site approved by Local Authorities.
- .5 Evacuate waste materials out of site along with work progress.
- .6 Prepare project summary to verify destination and quantities on a material-by-material basis as identified.
- .7 Recover, sort and separate waste generated by demolition into categories in preparation for transfer to various licensed sites. Contractor shall recover (reuse and/or recycle) non contaminated materials before disposal:

.1 Rock and other granular materials to be removed from existing structures will be recovered and reused for the construction of new structures, if they meet the specification requirements.

.2 Wood residues from construction must be managed according to the best practices and standards in effect.

#### 1.8 SCHEDULING

- .1 Co-ordinate waste management and source separation with other activities at site to ensure timely and orderly progress
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil or paint thinner into waterways, storm, or sanitary sewers.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 GENERAL .1 Arrange for suitable disposal for waste materials.  
.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.  
.3 Source separate materials to be reused/recycled into specified sort areas.

3.2 CLEANING .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.  
.2 Clean-up work area as work progresses.

PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers all work related to demolition, salvage, removal, and in-place abandonment, either completely or partially, of materials and structures.
- 1.2 MEASUREMENT PROCEDURES .1 All items for removal will be covered under the Lump Sum arrangement, including but not limited to specific items as outlined below.
- .1 Concrete cores (60 - 150 mm diameter) through the full depth of parapet wall along the South Breakwater Extension to facilitate tie rods.
- .2 Full depth removal of the concrete deck along the South Breakwater Extension.
- .3 Full depth removal of the concrete deck and parapet wall along the South Breakwater.
- .4 Full depth removal of the concrete deck at the end of the South Wharf to facilitate the construction of a ramp.
- .5 Full depth removal of concrete parapet wall at end of South Breakwater Extension.
- .6 Miscellaneous removals of side portions of the timber crib to facilitate installation of the steel sheet piling and clear stone (anticipated potentially in failed sections of the timber cribs).
- .7 Removal of chainlink fence.
- .8 Removal of mooring anchors.
- .9 Removal of ladders.
- .10 Removal of bollards.
- .11 Removal of stairs on West Wharf.
- .12 Removal of materials identified for salvage as described in Section 1.9.
- .2 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, permits, equipment and material to do the work.

- .3 Expansion joints, joint filler, reinforcing steel, dowels, anchor bolts, nuts and washers and bolt grouting shall be considered included in the removal of concrete and will not be measured separately for payment.

### 1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code of Canada
- .3 Occupational Health and Safety Act, OHSA / O. Reg. 213/91

### 1.4 RELATED REQUIREMENTS

- .1 Section 01 74 21 - Construction / Demolition Waste Management and Disposal.

### 1.5 UNDERSTANDING THE SITE

- .1 As part of the tender process, the Contractor shall become familiar with the site. Sufficiently assess all relevant information and constraints of the site to provide a clear understanding of the state and condition of the site.
- .2 Assess access routes those are safe and convenient to use, to / from and around the site.
- .3 Contractors should be satisfied that they have all the information necessary to undertake the work in a safe and efficient manner, including the development of a Health and Safety Plan.

### 1.6 PROTECTION

- .1 Prevent movement, settlement or damage of existing structures during construction. Do not use equipment that will compromise the integrity of the existing structures. Heavy equipment used on existing structures shall be limited to 16 tonnes (fully loaded).
- .2 The structural competency of the existing structures is not guaranteed in undertaking any removal or new construction. The Contractor shall undertake his/her own evaluations and plan the work accordingly with or without access on the existing structures.
- .3 Perform removals with methods and equipment as to leave undisturbed and undamaged any portion not designated for removal or salvage. All damaged or

disturbed portions shall be corrected and repaired to the satisfaction of the Departmental Representative. Broken edges of components to be left in place shall be squared and neatly trimmed.

- .4 The Contractor shall fully review the scope of work at the existing structure for planning, operational constraints and movement of equipment.
- .5 The Contractor shall be held responsible for damage to adjacent facilities caused through the performance of the work.
- .6 The Contractor may use the existing structure at their own risk to complete removals. The Department will not be held liable for the structural competency of the existing structure during demolition.
- .7 Provide area utility locates prior to removals.

#### 1.7 PERSONAL PROTECTION

- .1 Provide appropriate Personal Protective Equipment (such as gloves, long-sleeve shirt, dust masks and eye protection, etc.) for workers handling designated substances including, but not limited to:
  - .1 chemicals found in treated timbers.
  - .2 quartz silica found in common construction materials.
  - .3 benzene found in equipment fuels.
  - .4 zinc found in galvanized materials.
  - .5 vinyl chloride found in PVC duct work.
  - .6 other hazards and substances which may be present on the site.
- .2 Ensure that sufficient ventilation is provided where sawcutting is occurring.
- .3 Provide suitable hand washing stations for workers to wash hands immediately after handling and prior to eating or drinking.

#### 1.8 DESIGN AND SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Design and plan for:
  - .1 The demolition work to occur following the installation of steel sheet pile, for containment of debris, unless otherwise approved by the Departmental Representative.
  - .2 The protection of the public, workers,

adjacent properties, existing structures and the environment.

.3 The effects of component removals on the remaining / existing structure.

.4 The provision of temporary supports as required to resist forces in any direction for structural integrity during construction.

.5 The effects of weather on demolition activities.

.6 Surveying and monitoring during removal processes to ensure structural competency.

.7 Working platforms, as required, to undertake the demolition work.

.8 Use of hand-held equipment, as required, to reduce risk in localized areas of the work.

.9 Accumulation of debris, efficient materials handling and controlled removals.

.3 Submit a Removals and Operational Plan sealed by a Professional Engineer licensed in the Province of Ontario. The submission shall be submitted 2 weeks prior to the commencement of removals, shall have sufficient detail and shall including:

.1 Work drawings showing the extents of removals.

.2 Layout and description of removal sequences and proposed equipment.

.3 The locations, loadings, and detailed descriptions of heavy equipment and vehicles to be supported on existing structure.

.4 Access methodologies, planned vehicle routes and all equipment.

.5 Movement and storage of materials on-site prior to removal off site.

.6 Dust and debris control.

.4 Refer to Section 01 74 21 for additional requirements.

## 1.9 MATERIALS FOR SALVAGE

.1 Any material designated for salvage in the Contract Documents shall remain the property of the Owner and shall be maintained in a reasonable condition and stockpiled in a manner acceptable to the Department Representative.

.2 Materials to be removed and salvaged are identified in the Contract Drawings and include:

.1 mooring anchors

.2 signage

.3 life safety station

.3 Materials to be removed, refinished and reinstated are identified in the Contract Drawings and

include:

- .1 railing on south wharf
- .4 The removal of large armour stone is noted in several locations of the site on the Contract Drawings. These materials have to be temporarily moved, relocated and reinstated following the completion of new construction.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- .1 Utilize appropriate equipment and machinery for the performance of the work. Use alternative equipment and machinery when they prove to be insufficient.
- .2 Restrict the size of equipment and machinery being used for materials being salvaged, to ensure best condition possible.
- .3 Provide equipment and machinery such as barges for access, as required.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- .1 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements and CSA 350.
- .2 Protection:
  - .1 Prevent movement, settlement, or damage to structure prior to removal. Provide bracing and shoring as required.
  - .2 Keep noise, dust, and inconvenience to occupants to minimum.
  - .3 Provide temporary dust screens, covers, railings, supports and other protection as required.

### 3.2 GENERAL DEMOLITION AND DISPOSAL

- .1 Remove the existing superstructure and portions of the substructure to permit new construction. Sort materials into piles for reuse and recycling.
- .2 Legally dispose all removed materials off the site, conforming to Section 01 74 21.
- .3 Neatly demolish and remove all components within

the limits of removal as indicated on the drawings.

- .4 During and after construction, all remaining scraps, cuttings, wood chips and sawdust must be collected efficiently and in a timely manner. All wood waste must be collected and disposed of in accordance with local and provincial regulations.
- .5 Progressive removals should be employed on sections of the structure, while retaining the stability of the remaining structures to avoid collapse.
- .6 Remove materials from deconstruction as demolition and disassembly Work progresses.

### 3.3 MATERIALS FOR SALVAGE

- .1 Remove and adequately store identified materials identified for salvage.
- .2 Take all precautions possible to remove components without damage and to suitably store the components on at a designated location on site as determined by the Departmental Representative.

### 3.4 STRUCTURAL COMPETENCY

- .1 Limit the weight of rig-mounted breakers, concrete crushers, cranes, vehicles and other heavy equipment used for removals.
- .2 The structural competency of the existing piers is not guaranteed in undertaking any removal or new construction. Undertake an assessment and load evaluation to plan the work.
- .3 Utilize barges as required to minimize loading on the existing structures.

### 3.5 CLEANING AND RESTORATION

- .1 Keep site clean and organized throughout demolition procedure. Upon completion of project, reinstate areas affected by Work to condition which existed prior to beginning of Work or better subject to the approval of Departmental Representative.

PART 1 - GENERAL

1.1 SCOPE

- .1 This Section covers all work related to Cast-in-Place Concrete (for deck, deadman anchors and parapet wall) including concrete material, accessories, placement, finishing, curing and protection.

1.2 MEASUREMENT PROCEDURES

- .1 Concrete in Deck will be measured by volume in cubic metres of concrete placed, as calculated from neat dimensions as indicated on drawing.
- .2 Concrete Deadman (Type 1 and Type 2) will be measured in number of units constructed including steel sleeves and plates, reinforcing steel, formwork and concrete.
- .3 Concrete in Parapet Wall will be measured by volume in cubic metres of concrete placed, as calculated from neat dimensions as indicated on drawing.
- .4 Concrete removal and repair will be measured by area in square metres of deteriorated/unsound concrete removed and repaired to depth shown on contract drawings, and shall include all materials, labour and equipment to complete the work. Removals will be determined with the Departmental Representative and shall consist of visual observation and hammer sounding.
- .5 Pigmented concrete sealer and surface preparation applied on existing concrete parapet wall along South Breakwater Extension will be considered as part of the lump sum arrangement.
- .6 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, equipment and material to do the work, including reinforcing steel.
- .7 No deductions will be made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
- .8 Expansion joints, control joints, reinforcing steel, splices, wire ties, bar supports, chairs, spacers, dowels, anchor bolts, nuts and washers and bolt grouting shall be considered included in the placing of concrete and will not be measured separately for payment.

- .9 Hot and cold weather protection will be considered included in the unit rate of concrete and will not be measured separately for payment.
- .10 Concrete tickets may be submitted for reference only but will not form the basis of calculated volume. Concrete wastage will not be included in the volume for payment.

### 1.3 PAYMENT

- .1 Concrete work will be valued for payment in accordance with the following schedule, subject to any applicable holdbacks.
  - .1 60 percent at completion of casting (times volume times tender item unit rate)
  - .2 30 percent at completion of curing (times volume times tender item unit rate)
  - .3 10 percent at completion of final finishing after curing (times volume times tender item unit rate)

### 1.4 REFERENCES

- .1 Reference Standards:
  - .1 Reinforcing Steel Manual of Standard Practice, Reinforcing Steel Institute of Canada
  - .2 ASTM International
    - .1 ASTM A 82/A 82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
    - .2 ASTM A 185/A 185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
    - .3 ASTM C 260/C 260M-10, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .4 ASTM C 494/C 494M-17, Standard Specification for Chemical Admixtures for Concrete.
    - .5 ASTM C 1017/C 1017M-07 (E2015), Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - .6 ASTM D 1751-18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
    - .7 ASTM D 1752-18, Standard Specification for Preformed Sponge Rubber Cork and Recycled

PVC Expansion Joint Fillers for Concrete  
Paving and Structural Construction.

.3 CSA International

.1 CSA A23.1/A23.2-14, Concrete Materials  
and Methods of Concrete Construction/Methods  
of Test and Standard Practices for Concrete.

.2 CSA A3000-18, Cementitious Materials  
Compendium (Consists of A3001, A3002, A3003,  
A3004 and A3005).

.3 CSA-G30.18-09 (R2014), Carbon Steel  
Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21-13, General  
Requirements for Rolled or Welded Structural  
Quality Steel/Structural Quality Steel.

.5 CSA W186-M1990(R2016), Welding of  
Reinforcing Bars in Reinforced Concrete  
Construction.

.6 CSA S269.1-16, Falsework and Formwork.

1.5 SUBMITTALS

.1 Provide submittals in accordance with Section  
01 33 00 - Submittal Procedures.

.2 Submit shop drawings for formwork exceeding 1.0 m  
in height.

.1 Indicate formwork design data: permissible  
rate of concrete placement, and temperature of  
concrete, in forms.

.3 Prepare and submit detailed reinforcement placement  
drawings in accordance with RSIC Manual of Standard  
Practice. Shop drawings shall include:

.1 Layout of steel reinforcement including  
sizing, spacing, lap lengths and bar mark.

.2 General dimensions of the structure upon which  
the bar details were based upon.

.3 Bar lists including sizes, bends details, and  
quantities

.4 Bar identification, marks, etc. for organizing  
placement

.5 Indicate sizes, spacings and locations of  
chairs, spacers and hangers

.6 Provide type B tension lap splices unless  
otherwise indicated.

.7 Pour limits shall be indicated.

.4 Concrete Pour Release forms (filled prior to each  
pour).

.5 Provide concrete supplier certification that the  
plant is certified with Concrete Ontario (formerly  
the Ready-Mix Concrete Association of Ontario).

- .6 Provide concrete mix designs including statement that the admixtures are compatible with each other.
- .7 Provide documentation that the aggregates comply with CSA A23.1 and are from an MTO approved source. Submit gradations of the coarse and fine aggregates.
- .8 Weather Protection Plans (hot and cold temperature weather conditions)
  - .1 It shall be the full responsibility of the Contractor to review the schedule, anticipate the impacts of work / concreting, and incorporate the costs for such weather protection schemes and associated works. (For example, this may include incorporating measures such as ice or liquid nitrogen for concrete in hot weather concrete).
  - .2 When concrete is to be placed and cured in extreme temperature conditions (less than 5 degrees Celsius and more than 25 degrees Celsius), the Contractor shall submit written descriptions of proposed methods of providing appropriate concreting conditions, and preventing cold weather damage (with drawings or sketches, as required).
  - .3 Incorporate modification (from comments provided) for protective measures before placing concrete.
- .9 Provide a concrete finishing plan including procedures for curing and final finishing.
- .10 Provide a concrete repair submission as required to address defects in the poured concrete.
- .11 Provide the source of the concrete sealer, manufacturer's installation guidelines and data, and material data sheets.

1.6 QUALITY  
ASSURANCE

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- .1 Provide certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, prior to beginning reinforcing work.
- .2 Provide The concrete supplier shall be certified member of the Concrete Ontario (formerly the Ready-Mix Concrete Association of Ontario).
- .3 No water is to be added to the mix following initial batching at the plant without the consent of the Concrete Supplier designated representative and the Departmental Representative

- 1.7 DELIVERY, STORAGE AND HANDLING
- .1 Concrete Delivery and Acceptance Requirements:
    - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

## PART 2 - PRODUCTS

- 2.1 DESIGN CRITERIA
- .1 Establish the proportions of cementing materials, aggregates, water, and admixtures required to produce consistent / workable concrete that has the required strength and other properties required for improved durability, reduced shrinkage and reduced cracking.
  - .2 Performance Method for specifying concrete: Performance criteria according to this specification as permitted by CSA Standard A23.1.

- 2.2 QUALITY CONTROL PLAN
- .1 The Contractor and Concrete Supplier shall implement a Quality Control Plan to ensure verification and compliance that the concrete meets performance criteria established in this specification.

- 2.3 MATERIALS
- .1 Concrete
    - .1 Cementing materials to CSA Standard A3000:
      - .1 Type GU.
      - .2 Slag (as a cement replacement 20% to 35% by mass of the quantity of total cement content) is permitted
    - .2 Compressive strength: 30 MPa at 28 days.
    - .3 Exposure class: F-1 to CSA-A23.1/A23.2.
    - .4 Aggregate conforming to CSA Standard A23.1 with sizes:
      - .1 20 mm for standard mixes.
      - .2 13 mm for repair patches.
    - .5 Admixtures:
      - .1 Air entraining.

- .2 Water reducing agents, as required.
- .2 Plant added.
- .2 Calcium chloride not permitted.
  
- .6 Water: to CSA-A23.1/A23.2.
- .7 Slump: 80 mm at time of deposit,  $\pm 20$  mm or as amended by the Contractor to suit the work.
  
- .2 Grout shall be flowable course fill cementitious grout, with a compressive strength of 15 MPa at 28 days and a slump of 120 mm  $\pm 30$  mm.
  
- .3 Reinforcing steel bars: carbon steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
  
- .4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
  
- .5 Chairs, bolsters, bar supports, spacers: to CSA Standard A23.1/A23.2.
  
- .6 Formwork materials: Wood product formwork materials to CSA Standard O86.
  
- .7 Form ties: To be removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
  
- .8 Form release agent: non-toxic, biodegradable, and low VOC.
  
- .9 Bituminous impregnated fiber board: to ASTM D 1751.
  
- .1 Joint sealant: Cold applied, single component, chemically curing silicone to ASTM D5893
  - .1 low modulus
  - .2 weather and UV resistant
  - .3 unprimed adhesion (primer not required for adhesive to concrete)
  
- .10 Anchors into concrete shall be chemical adhesive.
  - .1 Hilti HIT HY 200 or Redhead A7+ Adhesive Fastening System with zinc plated threaded rods.
  - .2 Hilti HIT-RE 500 V3 or Redhead C6+ Adhesive Fastening System with zinc plated threaded rods.
  - .2 Alternate anchoring systems may be substituted in place as specified above, with the approval of the Departmental Representative.
  - .3 Expansion type anchors are not permitted.
  
- .11 Heavy Duty Screw Anchors shall be carbon steel and shall be zinc plated or mechanically galvanized.

- .12 Steel welded wire mesh shall be galvanized.
- .13 Joint Filler and Sealant:
  - .1 Sheet for joints: Flexible foam expansion joint filler comprised of a closed-cell structure, which is ultraviolet resistant.
  - .2 Caulking for joints: single component, non-staining, silicone sealant, grey.
- .14 Concrete sealer shall be a pigmented acrylic sealer for concrete with a concrete grey color:
  - .1 Sikagard Color A-50 Lo-VOC, MasterProtect HB 300SB or approved equivalent.

#### 2.4 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA Standard A23.1/A23.2, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Do not weld reinforcement unless otherwise approved by the Departmental Representative.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

#### 2.5 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.
- .2 Upon request, inform Departmental Representative of proposed source of material to be supplied.

#### 2.6 MIXES

- .1 Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
- .2 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Obtain Departmental Representative's release before ordering and placing concrete.
  - .1 Provide Pour Release Form and notice to pour concrete 24 hours minimum prior to placing concrete.
  - .2 Provide a completed Concrete Pour Release Form (to be provided) prior to each pour and allow the Departmental Representative 2 hours for inspection. Have each trade sign to indicate its work is complete and ready for checking, as well as the General Contractor's representative. The use of the pour release form does not relieve the Contractor of his responsibility to complete the Work accurately.
  - .3 Do not order concrete until the Concrete Pour Release Form has been signed by the Contract Administrator.
- .2 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Protect previous Work from staining.
- .6 Clean and remove stains prior to application for concrete finishes.
- .7 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy adhesive to anchor and hold dowels in positions as indicated.
- .9 Thoroughly clean joints to receive sealant. Place foam backer rod. Do not apply sealant to wet or

damp concrete.

- .10 Do not place load upon new concrete until authorized by Departmental Representative.
- .11 Comply with CSA Standard A23.1 'Concrete Materials and Methods of Concrete Construction.'

### 3.2 PREPARATION

- .1 Remove unsound/deteriorated concrete from the existing parapet wall along the South Breakwater Extension, as indicated on drawings. Removals will be determined with the Departmental Representative through a visual and delamination survey by hammer sounding.
- .2 Verify lines, levels and centres before proceeding with formwork/falsework. Ensure dimensions and elevations agree with drawings.
  - .1 Form 12 mm chamfers at concrete edges, unless shown otherwise on the Drawings.
  - .2 Laterally brace formwork and falsework and prevent displacement during concrete placement. Form chases, openings, projections, recesses, expansion joints and construction joints. Incorporate frames, castings, pipes, sleeves, and similar items into the formwork
- .3 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
- .4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .5 Fabricate and erect formwork to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA Standard A23.1.
- .6 Verify concrete elevations in advance of the pour. Mark on forms, install screed markers or provide other means establishing final elevations during concrete pours.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Align form joints and make watertight. Keep form joints to minimum.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .10 Build in anchors, sleeves, and other inserts

required to suit Work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

- .11 Remove all waste material, cut tie wire and other materials from the pour area. Clean formwork in accordance with CSA Standard A23.1 before placing concrete.
- .12 Coordinate the requirements of all trades and assume responsibility for location, installation and quality of all items which affect the Work of this Section.

### 3.3 FIELD BENDING OF REINFORCEMENT

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

### 3.4 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA Standard A23.1/A23.2.
- .2 Prior to placing concrete, allow for sufficient time for the review of reinforcing steel and arrangement of the Departmental Representative.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

### 3.5 PLACING CONCRETE

- .1 Undertake cast-in-place concrete work conforming to CSA Standard A23.1/A23.2.
- .2 Plan concrete pours to suit the weather conditions. Adjust pour sequences or schedules to avoid adverse weather conditions. Do not cast concrete during rainfalls. Do not cast slabs during high winds. Follow cold weather and hot weather procedures when those temperatures exist or may be expected.
- .3 Do not commence concrete placing until sufficient manpower and equipment is available to complete the placement expeditiously preventing the formation of cold joints, and to produce the specified surface finish.
- .4 Joint fillers:

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
- .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .3 Locate and form isolation joints as indicated.
- .4 Install joint filler.
- .5 Install joint sealant where indicated on the drawings.
  
- .5 Verify that accessories, inserts, bollards, and reinforcement are set correctly and are not disturbed during concrete placement.
  
- .6 Place concrete on dry and clean substrate.
  
- .7 Place concrete within 1 metre of its final position. In formed sections, provide sufficient elephant trunks to meet this requirement.
  
- .8 Do not move concrete laterally with vibrators. Lower vibrators vertically, and vibrate within 1 m of the point of placement.
  
- .9 Depositing and consolidation.
  - .1 Deposit concrete in a manner that prevents segregation in accordance with CSA Standard A23.1.
  - .2 Consolidate the concrete during and immediately after depositing, thoroughly and uniformly by means of tamping, hand tools, finishing machines, and vibrators in order to obtain dense, watertight, homogeneous concrete well bonded to reinforcing bars. Carefully vibrate concrete around appertenances to ensure thorough contact.
  - .3 Deposit concrete adjacent to the pile cap member and consolidate adequately to minimize voids below the pile cap.

3.6 SURFACE  
TOLERANCE

- .1 Finish unformed surfaces true to grade and free of surface irregularities exceeding 3 mm under a 3 metre straight edge in any direction.

3.7 POUR LIMITS

- .1 To reduce shrinkage induced cracking, the Contractor shall plan for the following limitations in pour lengths.

- .1 18 m maximum horizontally
- .2 Pour deck in segments along the piers to increase daily production.
- .3 Allow 3 days between adjacent segments.

### 3.8 FINISHING AND INITIAL CURING

- .1 Finish concrete to CSA Standard A23.1/A23.2.
- .2 In addition to cold weather requirements listed in CSA Standard A23.1, protect concrete against drying shrinkage and plastic shrinkage for slabs. Take special precautions to control and eliminate initial drying shrinkage and plastic shrinkage for slabs. Provide wind breaks, shelters or shades.
- .3 Keep concrete surfaces moist continuously while the concrete is protected.
- .4 Initial finishing shall be by bull floats and darbies, sloped as indicated on drawings.
- .5 Finish finishing for air entrained concrete shall be using magnesium float for slabs or other means as approved by the Departmental Representative. Use a concrete broom on deck slabs for a non-slip finish.
- .6 During curing period, uncover only such areas as are immediately needed for finish treatment. Recover and continue curing.
- .7 When concrete has set sufficiently, give surface a uniform broom finish free from porous spots, irregularities, depressions, small pockets or rough spots
- .8 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

### 3.9 FIELD QUALITY CONTROL

- .1 Concrete testing: to CSA A23.1/A23.2 by CSA certified concrete testing laboratory independent of the concrete supplier and paid for by the Contractor.
- .2 Every load of concrete shall be tested for air content and slump.
- .3 One complete set of test cylinders shall be cast at the commencement of each concrete pour and every 75 cubic metres thereafter, to determine the 7 day and 28-day compressive strength.

### 3.10 CURING

- .1 Immediately after placing fresh concrete and until finishing, maintain 100% humidity in the air at the concrete surface with a spray fogging device (or other means) to prevent plastic shrinkage cracks in the concrete surface. The fresh concrete surface must be kept damp, but with no standing water, until finishing is complete.
- .2 When the finishing is complete immediately cover the concrete with a continuous polyethylene sheet.
- .3 Continuously wet cure concrete for 5 days. Provide the equipment necessary for the proper curing adjacent to the Work before commencing pouring.
- .4 Be responsible for protection of concrete from damage by all trades and the public. Do not pile or store materials on slabs nor wheel nor handle materials over slabs until concrete has been in place for 10 days (under normal conditions).
- .5 Leave formwork in place for 5 days following placing of concrete.
- .6 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .7 Re-use formwork subject to requirements of CSA Standard A23.1/A23.2.

### 3.11 HOT WEATHER WORK

- .1 Take hot weather precautions when the concrete temperature at any time exceeds 25 degrees C and do not place concrete, whose temperature exceeds 30 degrees C. in the mixer.
- .2 Incorporate the cost of these measures between (and including) the months of June and August.
- .3 Concrete, whose temperature in the mixer is between 27 degrees C. and 30 degrees C. must contain a retarder which reduces mixing water requirements and increases strength and must contain high early strength cement.
- .4 Protect forms and equipment, including both mixing and placing equipment, from the rays of the sun and cool by wetting as necessary to maintain a temperature of not more than 5 degrees C. in excess of ambient temperature nor more than 40 degrees C.
- .5 Keep mixing time to the minimum, consistent with the production of the quality of concrete specified

and place mixed concrete immediately.

- .6 Provide wind breaks, sun shades, plastic sheeting or other materials as required by CSA Standard A23.1 when the evaporation is expected to exceed the limits shown.
- .7 Commence continuous wet curing as soon as the concrete has hardened sufficiently to prevent surface damage.

### 3.12 COLD WEATHER WORK

- .1 Take cold weather precautions whenever the ambient temperature is, or is expected to be, at or below 5 degrees C.
- .2 Incorporate the cost of these measures between (and including) the months of October and April.
- .3 Have protective measures in place, or adjacent to the Work, and approved by the Contract Administrator before any concrete is mixed or ordered.
- .4 Maintain concrete temperatures between 10 degrees C. and 20 degrees C. for a minimum of 3 days for unloaded areas, and 6 days for areas receiving partial load.
- .5 At the termination of the protection period, do not drop the concrete temperature more than 20 degrees Celsius in the first 24 hr.

### 3.13 REPAIRS

- .1 Upon review of concrete finish, undertake all preventative and correction actions to prevent further concrete defects from occurring.
- .2 Concrete elements having one or more defects and deficiencies shall be repaired according to an acceptable procedure with the Department Representative. Standard finishing shall be completed after such repairs are carried out.
- .3 Concrete defects are defined as
  - .1 Air voids, honeycombing, cavities, spalling, delamination, greater than 5 mm in size in any direction.
  - .2 Bugholes greater than 10 mm in diameter or 5 mm in depth
  - .3 Plastic shrinkage cracking with a width greater than 0.4 mm.
  - .4 General shrinkage cracking with a width greater than 0.7 mm.

- 3.14 JOINTS
- .1 Sawcut control joints within 24 hours of the final concrete set time. Install 25 mm bead of silicone sealant in each joint.
  - .2 Install joint filler between each pour at expansion joints. Install 25 mm bead of silicone sealant in each joint.
- 3.15 CONCRETE SEALER
- .1 Concrete sealer to be applied after unsound and delaminated concrete has been removed and repaired.
  - .2 The surface of the concrete shall be clean and dry at the time of sealer application. Relative humidity conditions during time of application shall be per manufacturer's application instructions. Material shall not be applied under rainy conditions or during wet conditions. The material shall be applied only after the concrete has air cured for a minimum of seven days or as specified in manufacturer's application instructions.
  - .3 Existing concrete surfaces shall receive a light abrasive blast cleaning. The surface shall be free of all dust, grit, chalk marks, paints, curing compounds and other substances that may inhibit penetration or bonding of the sealer.
  - .4 Sealer shall be applied in strict accordance with manufacturer's recommendations, observing all necessary safety precautions required by regulating authorities. Delivery, storage and handling, applicable temperature range and environmental restrictions on use shall be in accordance with manufacturer's recommendations.
  - .5 The contractor shall take precautions to ensure that workers and work areas are adequately protected from fire and health hazards resulting from handling, mixing and application of material, observing all necessary safety precautions required by regulating authorities.
- 3.16 DOWELS INTO CONCRETE
- .1 Drill holes to the required dimensions.
  - .2 The holes shall be cleaned using compressed air to remove all deleterious material including dust, debris and water prior to placing the epoxy adhesive.
  - .3 The handling and placement of the epoxy adhesive shall conform to the manufacturer's written instructions. All excess epoxy adhesive shall be

struck-off flush with the concrete surface and removed from the surrounding concrete surface area.

- .4 Doweling operations shall not cause spalling, cracking or other damage to the surrounding concrete. Concrete spalled or otherwise damaged shall be repaired in a manner acceptable to the Departmental Representative.
- .5 Dowels shall be clean and free of deleterious material.
- .6 The Contractor shall maintain dowels within the specified dimensions during the setting of the epoxy adhesive. Prevent the loss of epoxy adhesive from the holes.
- .7 Pull testing of dowels is not required.

### 3.17 CLEANING

- .1 Promptly as the Work proceeds and upon completion, clean-up and remove from the site, rubbish and surplus material resulting from the Work of this Section.

PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers all work related to underwater placed concrete by tremie, pumped concrete, bottom dump bucket, or bagged concrete method.
- 1.2 RELATED REQUIREMENTS .1 Section 03 30 00 - Cast-in-Place Concrete.  
.2 Section 31 62 16.13 - Steel Sheet Piles.
- 1.3 MEASUREMENT PROCEDURES .1 Tremie Concrete placed to seal bottom of steel sheet pile at end of South Breakwater will be measured by volume in cubic metres of concrete placed, as measured by theoretical neat lines of concrete volume indicated.  
.2 Bagged concrete placed at closures are considered to be covered as part of closures under section 31 62 16.13.
- 1.4 REFERENCES .1 Reference Standards:  
.1 CSA International  
.1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- 1.5 DEFINITIONS .1 Definitions:  
.1 Tremie concrete: concrete placed underwater through tube called tremie pipe.  
.2 Tremie pipe: pipe has hopper at upper end and may be open ended or may have foot valve, plug or travelling plug to control flow of concrete. Pipe has diameter of 200 mm minimum, constructed from sections with flange couplings fitted with gaskets.  
.1 Concrete is placed in hopper and sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.  
.3 Pumped concrete method: method of placing concrete underwater uses concrete pump with discharge line used in similar manner to tremie pipe.  
.4 Bottom-dump bucket method: method of placing concrete underwater requires use of bucket designed

to discharge from bottom after it has contacted foundation or surface of previously placed concrete.

- .5 Bagged concrete method: method of placing underwater concrete consists of diver placing bags partially filled with dry concrete mix.

#### 1.6 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete and include product characteristics, performance criteria, physical size, finish and limitations.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect concrete from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- .1 Concrete materials: to section 03 30 00.

#### 2.2 CONCRETE MIXES

- .1 Use type GU cement.
- .2 Minimum compressive strength at 28 days: 30 MPa.
- .3 Class of exposure: F-1.
- .4 Maximum water cement ratio by mass: 0.45.
- .5 Nominal size of coarse aggregate: 20 mm.
- .6 Cement content for mixtures: 415 kg/m<sup>3</sup> minimum.
- .7 Slump at point and time of discharge: 170 mm for concrete placed with tremie pipes, 100 to 125 mm for pumped and bottom dumped concrete, 0 to 25 mm for bagged concrete.
- .8 Admixtures: as approved in writing by Departmental Representative. Use admixtures to correct deficiencies in mix or to improve placement of concrete.
  - .1 Departmental Representative may withdraw

prior approval of admixture if conditions encountered during course of work indicate unsatisfactory results.

.2 Do not use calcium chloride or materials containing calcium chloride.

.3 Submit admixtures to produce self consolidating concrete to Departmental Representative for review.

.2 Anti-washout admixtures as required.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete placement installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### 3.2 PREPARATION

- .1 Where concrete must bond to existing surfaces, clean surfaces before starting concrete placement.
- .1 Use water jets, mechanical scrapers or other means, and when quantities of mud or rock cuttings are present, remove by air lift.

#### 3.5 INSTALLATION

- .1 Do concrete work in accordance with Section 03 30 00 and to CSA A23.1/A23.2.
- .2 Place concrete in one continuous operation to full depth required.
- .1 Supply complete equipment for every phase of operation.
- .2 Provide sufficient supply of concrete to complete pour without interruption.
- .3 Place bagged concrete following fabrication and installation of closures.
- .4 Place concrete seal following installation of steel sheet piles at end of South Breakwater to prevent loss of concrete.
- .3 Tremie method:
- .1 Provide water-tight tremie pipe sized to allow free flow of concrete. Diameter of tremie pipe to be minimum 200 mm and minimum eight times maximum size of coarse aggregate.
- .2 Provide hopper at top of tremie pipe and

means to raise and lower tremie pipe.

.3 Provide plug or foot valve at bottom of tremie pipe to permit filling pipe with concrete initially.

.4 Provide minimum of one tremie pipe for every 30 m<sup>2</sup> of plan area and to maximum spacing of 6 m centre to centre. Do not move tremie pipes laterally through concrete.

.5 Start placement with tremie pipe full of concrete. Keep bottom of pipe buried minimum 100 mm in freshly placed concrete.

.6 If seal is lost, allowing water to enter pipe, withdraw pipe immediately. Refill pipe and continue placing as specified.

.7 If tremie operation is interrupted so that horizontal construction joint has to be made, cut surface laitance by jetting, [within 24 to 36 hours] and remove loose material by pumping or air lifting before placing next lift.

.8 Do not place concrete in flowing water when current exceeds 3 m/min. Do not vibrate, disturb or puddle concrete after placement.

.4 Pumped concrete method:

.1 Follow procedures as for tremie method in placing concrete using discharge line from concrete pump as tremie pipe.

.2 Pump discharge line diameter: 125 mm minimum.

.5 Bottom-dump bucket method:

.1 Fill bucket with concrete, cover top surface and lower slowly through water to prevent backwash.

.2 Discharge concrete only when bucket is in contact with surface on which concrete is to be deposited.

.3 Withdraw bucket until it is above concrete to maintain still water at point of discharge to approval of Departmental Representative.

.4 Do not place concrete in flowing water when current exceeds 3 m/min. Do not vibrate, disturb or puddle concrete after placement.

.6 Bagged concrete method:

.1 Use bags made of coarsely woven material to allow concrete to bond between bags.

.2 Fill bags with dry concrete mix not more than 80% full before placing.

.3 Place each concrete bag individually so that bag is stable and securely resting on foundation material or previously placed bags.

### 3.16 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers aggregate fill materials for structures.
- 1.2 MEASUREMENT PROCEDURES .1 Clear Stone fill will be measured in tonnes of material placed.
- .2 Granular A fill will be measured in tonnes of material placed.
- .3 Armour Stone will be measured in tonnes of material placed.
- .4 Excavation, stock-piling and reuse of native fill will be considered as part of the Lump Sum arrangement
- .5 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, equipment and material to do the work.
- .6 Aggregate weigh tickets may be submitted in support of material placed, provided that the material is confirmed installed.
- 1.3 RELATED REQUIREMENTS .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Section 31 62 16.13 - Steel Sheet Piles.
- 1.4 REFERENCES .1 American Society for Testing and Materials (ASTM)
- .1 ASTM D 4791-[99], Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 Ontario Provincial Standard Specifications (OPSS)
- .1 OPSS.MUNI 1004 November 2013, Material Specification for Aggregate - Miscellaneous.
- .2 OPSS.MUNI 1010 November 2013, Material Specification for Aggregate - Base, Subbase, Select Subgrade, and Backfill Material.
- 1.5 SAMPLING .1 Allow sampling by Departmental Representative as required.

- .2 Provide Departmental Representative with access to source and processed material for sampling.
- .3 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

#### 1.6 SUBMITTALS

- .1 Provide the source of aggregates and provide access for sampling at least 2 weeks prior to commencing production.
- .2 Four weeks in advance of aggregate delivery, provide an Aggregate Management Plan (AMP) outlining local haul routes, storage locations, schedules and planned movement plans within the site. With the assistance of the Department Representative, the AMP will be reviewed with various area stakeholders. Cooperate and modify the AMP according to the comments returned.
- .3 Provide an Aggregate Placement Procedure for all aggregate installed below water.

#### 1.7 COORDINATION

- .1 The marina shall be considered to be in operation at all times. Ensure all activities associated with this construction are done in a manner that is compatible with the use and operation of the marina. Protect the public, the marina facilities, the boats, and the boaters from adverse effects from all construction activities.
- .2 Keep the Department Representative advised of the installation activities and schedule. Propose and submit an Access and Procedures Work Program outlining a safety related work area and control of access by facility users for the duration required. Await review, input and acceptance prior to implementation.

#### 1.8 LAYOUT

- .1 The Contractor shall be responsible for all the layout of all new construction.

#### 1.9 DIVERS

- .1 The Contractor shall employ divers during the duration of work to complete the work. The diver shall be on site for the removal of obstruction along new sheet pile work, placement of rock, and verification of work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
  - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
  - .1 Natural sand.
  - .2 Manufactured sand.
  - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
  - .1 Crushed rock.
  - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
  - .3 Light weight aggregate, including slag and expanded shale.
- .5 Armour Stone shall be clean, hard, durable, angular nonfriable limestone or igneous rock, free from cracks, seams, chert or other defects which may impair durability, and shall satisfy the following requirements:
  - .1 Rough angular quarried stone with a minimum specific gravity of 2.3.
  - .2 3.0-4.0 tonne (Size range 1000 mm to 1300 mm).
  - .3 The least dimension of each armour stone shall not be less than 1/3 of its greatest dimension.
- .6 Clear stone for sheet pile fill: to Ontario Provincial Standard Specification OPSS.MUNI.1004.
  - .1 Size range 19 mm to 75mm, with gradation:

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| <u>Sieve Designation</u> | <u>% Passing</u> |
|--------------------------|------------------|
| 75 mm                    | 100              |
| 40 mm                    | 20               |
| 19 mm                    | 0                |

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- .7 Granular A: to Ontario Provincial Standard Specification OPSS.MUNI.1010.

## 2.2 SOURCE QUALITY CONTROL

- .1 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .2 Advise Departmental Representative 4 weeks in advance of proposed change of material source.
- .3 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- .1 Processing
- .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
- .2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified. Use methods and equipment approved by Departmental Representative.
- .3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.
- .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate.
- .2 Handling
- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Stockpiling
- .1 Do not stockpile aggregates on site approved otherwise by Departmental Representative.
- .4 Secure the areas of work from public access.

- .5 Prepare and shape underwater surfaces along the harbour bottom. Clear all obstructions.

### 3.2 PLACEMENT

- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .2 Where indicated on the drawings, place geotextiles free of wrinkles and support until covered with aggregate. Provide a minimum overlap of 1 m.
- .3 Carefully place stone uniformly to the sizes as indicated on the Contract Drawings.
- .4 Do not drop the stone from excessive heights. End dumping of aggregate is not permitted.
- .5 Generally work from the lower elevations and working progressively up the slope. Place materials according to the accepted Aggregate Placement Procedures.
- .6 Divers shall coordinate placement of rock, ensure even coverage and protect against displacement of fabric during rock placement.

### 3.3 CLEANING

- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .2 Promptly as the work proceeds and upon completion, clean-up and remove from the site, rubbish and surplus material resulting from the Work of this Section.

PART 1 - GENERAL

- 1.1 SCOPE
- .1 Minor clearing and grubbing is required to suit new work. The extents are not identified on the drawings, but is required at the armour stone along the lake side of the South Breakwater where new sheet pile work is to be completed and along the South Breakwater Extension where concrete anchors are to be constructed.
  - .2 Clearing involves removal of brush vegetative growth. Grubbing consists of excavation to clear roots, boulders and rock fragments of specified size, to a depth below existing ground surface required to suit new Work.
- 1.2 MEASUREMENT PROCEDURES
- .1 Clearing and grubbing as specified is considered part of the lump sum arrangement. There will be no measurement for payment.
- 1.3 STORAGE AND PROTECTION
- .1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses and root systems of trees which are to remain. Repair damaged items to approval of Departmental Representative.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuel wood can be produced as saleable timber.

PART 2 - PRODUCTS

- 2.1 NOT USED
- .1 Not used.

PART 3 - EXECUTION

- 3.1 PREPARATION
- .1 Inspect site and verify with Departmental Representative, items that require.
  - .2 Obtain area locates and protect affected utility services in the area. Notify Departmental

Representative immediately of unknown existing utility lines

- .3 Keep roads and walks free of dirt and debris.

### 3.2 CLEARING

- .1 Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.
- .2 Remove cleared materials and dispose off site.

### 3.3 GRUBBING

- .1 Remove and dispose off site stumps and roots larger than 25 mm in diameter, in the designated working areas.
- .2 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

### 3.4 TREES

- .1 Except where indicated for removal on the Contract Drawings, retain existing trees where possible in place.
- .2 Review with Department Representative the trees on site. Where possible and practical, retain existing trees in place or temporarily remove the tree. For larger diameter trees, where temporarily removal is not practical, obtain permission from the Department Representative to permanently remove.
- .3 Where a tree is designated for temporarily removal but deemed an obstruction, remove the tree and root ball with appropriately sized equipment. Set the tree aside, wrap the root ball, protect and water the tree until reinstallation.

### 3.5 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for excavation work and other operations to approval of Departmental Representative.

### 3.6 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers Work related to excavation, trenching and backfilling.
- 1.2 MEASUREMENT PROCEDURES .1 Excavation, stock-piling and reuse of native fills will be considered as part of the Lump Sum arrangement.
- .2 Excavation and legal disposal of fill materials will be considered as part of the Lump Sum arrangement.
- .3 Clearing of the driveline will be considered part of the lump sum arrangement, and will include clearance of miscellaneous obstructions necessary to prepare the surface for sheet pile work including, but not limited to, timber cribwork, ballast rock, and armour stone.
- .4 Removal, salvage and re-installation of armour stone is considered part of the lump sum arrangement.
- .5 Supply and installation of silt fence barrier is considered incidental to excavating and backfilling of native fill and will not be measured separately for payment.
- .6 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, equipment and material to do the work.
- .7 Compaction shall be considered incidental and not measured separately for payment.
- 1.3 RELATED REQUIREMENTS .1 Section 01 74 21 - Construction / Demolition Waste Management and Disposal.
- .2 Section 02 41 16 - Structure Demolition.
- .3 Section 31 05 16 - Aggregate Materials.
- .4 Section 31 11 00 - Clearing and Grubbing.
- .5 Section 31 32 19.01 - Geotextiles.
- 1.4 REFERENCES .1 Ontario Provincial Standard Specifications (OPSS)

- .1 OPSS.MUNI 1004 November 2013, Material Specification for Aggregates - Miscellaneous.
- .2 OPSS.MUNI 1010 November 2013, Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

- |  |    |   |
|--|----|---|
| <u>1.5 SUBMITTALS</u>                    | .1 | Provide the source of all materials.  |
| <u>1.6 WASTE MANAGEMENT AND DISPOSAL</u> | .1 | Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |

## PART 2 - PRODUCTS

- |                      |    |  |
|----------------------|----|--|
| <u>2.1 MATERIALS</u> | .1 | Refer to section 31 05 16 - Aggregate Materials. |
|----------------------|----|--|

## PART 3 - EXECUTION

- |                            |    |  |
|----------------------------|----|--|
| <u>3.1 UTILITY LOCATES</u> | .1 | Before commencing work, establish location and extent of underground utility lines in area of excavation. Notify Departmental Representative of findings.                                |
|                            | .2 | Arrange for and de-energize existing electrical lines. Retain, protect and support, as required, existing conduit and lines.   |
|                            | .3 | Record and submit the locations of all lines.  |
| <u>3.2 EXCAVATION</u>      | .1 | Excavate and stockpile native material as required.  |
|                            | .3 | Remove concrete, masonry, paving, walks, demolished foundations, rubble and other obstructions encountered during excavation in accordance with Section 02 41 16 - Structure Demolition. |
|                            | .4 | Keep excavated and stockpiled materials safe distance away from edge of excavations.   |
|                            | .5 | Dispose of surplus and unsuitable excavated material off site.   |

- .6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .7 Correct over-excavation by backfilling with an approved material (without cost to the Owner), to the satisfaction of the Departmental Representative.
- .8 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil
- .9 Employ divers as required to complete the work.

### 3.3 BACKFILLING

- .1 Do not proceed with backfilling until tie rod and waler installation has been inspected and approved by Departmental Representatives.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Place backfill all spaces not occupied by parts of the structure, or other permanent works, with specified material, placed as shown on the drawings
- .4 Place Granular A materials in areas as indicated. Place material in uniform layers not exceeding 200 mm compacted thickness up to grades indicated and be uniformly compacted to at least 98% SPMDD.
- .5 Backfill not explicitly identified on the drawings shall assumed to be Granular A.
- .6 When geotextile is shown in the Contract Drawings, place Granular fill in a manner so as not to damage the geotextile.

### 3.4 VOIDS

- .1 When approved by Departmental Representatives, install Clear Stone into voids or cavities in the existing timber crib structure.

## PART 1 - GENERAL

- 1.1 SCOPE .1 This Section covers Work related to Geotextiles.
- 1.2 MEASUREMENT AND PAYMENT .1 Measure geotextiles in square metres of surface covered by material. No allowance will be made for seams and overlaps.
- 1.3 REFERENCES .1 Ontario Provincial Standard Specifications (OPSS)
- .1 OPSS 1860, April 2011, Material Specification for Geotextiles.
- 1.4 SUBMITTALS .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.5 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
- .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect geotextiles from direct sunlight and UV rays.
- .3 Replace defective or damaged material.

## PART 2 - PRODUCTS

- 2.1 MATERIAL .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
- .2 Physical properties:

- .1 OPSS 1860 Table 1 (Class II)
- .3 Hydraulic properties:
  - .1 Filtration opening size (FOS): 75 to 150 um.
- .4 Factory seams: sewn in accordance with manufacturer's recommendations.
- .5 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- .1 Place geotextile materials as indicated on drawings.
- .2 Place geotextile materials smooth and free of tension stress, folds, wrinkles and creases.
- .3 Overlap each successive strip of geotextile 1 m over previously laid strip.
- .4 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .5 After installation, cover with overlying layer within 4 hours of placement.
- .6 Replace damaged or deteriorated geotextile to approval of Departmental Representative.
- .7 Place and compact soil layers.

#### 3.2 PROTECTION

- .1 Heavy equipment is not permitted directly on geotextile.

#### 3.3 CLEANING

- .1 Upon completion remove surplus materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 SCOPE

- .1 This Section covers Work related to steel sheet piles including tie rods, anchor walls, wales, closure ends, toe anchors and quality assurance testing requirements.

1.2 MEASUREMENT PROCEDURES

- .1 Steel sheet pile will be measured by length in linear metres of steel sheet pile installed, as calculated from neat dimensions measured on-site along the centerline. The measurement will not include bends of the actual steel sheet pile section or bends in the arrangement.
- .1 The length of steel sheet pile is based on the supplied length of the sheet pile as detailed on the Contract Drawings, plus a 0.1 m added length for cutoff (used for lifting holes and potential pile damage during installation).
- .2 There will not be separate payment for drilled holes and cutting of sheet piles.
- .3 There will be not separate payment for tack welding sheets during driving, to avoid down drag.
- .4 There will be not separate payment for custom or standard corner pieces.
- .5 There is no separate payment for supply and welding of shear connectors.
- .2 Steel wales will be measured by length in linear metres of wales installed, as measured on-site along the centerline of wall.
- .1 Splices, bolts, nuts, tapered plates/washers, washers, spacer plates, shear studs, field welding, and field drilling of holes shall be considered included in the unit price of wales and will not be measured separately for payment.
- .3 Tie rods will be measured by length in linear metres of tie rod installed, as calculated from neat dimensions measured on-site from fill/inside edges of sheet pile to sheet pile (or anchor wall).
- .1 Turnbuckles, nuts, tapered plates/washers, washers, shall be considered included in the unit price of tie rods and will not be measured separately for payment.
- .4 Closure ends will be measured by each end suitably installed.
- .1 Steel member, field welds, custom sheet pile

sheets, anchors, and concrete shall be considered included in the unit price of closure end and will not be measured separately for payment.

- .5 Toe anchors will be measured by each toe anchor suitably installed.

.1 Field welds, steel forms, steel sections (plates, W-sections and/or tubes), rock coring, excavation and tremie concrete shall be considered included in the unit price of toe anchors and will not be measured separately for payment.

- .6 Temporary support of the steel sheet pile wall will be considered as part of the lump sum arrangement.

- .7 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, equipment and material to do the work.

- .8 Mobilization and de-mobilization of equipment, including access for installation will be considered part of the Lump Sum Arrangement

### 1.3 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast in Place Concrete
- .2 Section 31 05 16 - Aggregate Materials.
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .4 Section 35 59 14 - Miscellaneous Metals

### 1.4 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A6/A6M-17a, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- .2 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod, 60,000 PSI Tensile Strength.
- .3 ASTM A328/A328M-13, Standard Specification for Steel Sheet Piling.
- .4 ASTM A615/A615M-18, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- .5 ASTM A857/A857M-19, Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage.
- .6 ASTM F3125/F3125M-15a, Standard Specification for High Strength Structural Bolts and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 105 ksi (1040 MPa ) Minimum Tensile Strength.

- .7 ASTM A 1011/A 1011M-17, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA Standard S16.1-14
  - .3 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel Structures.
  - .4 CSA W59-2018, Welded Steel Construction (Metal Arc Welding).

#### 1.5 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 General sheet pile submission requirements.
  - .1 A plan layout of steel sheet piling sections indicating all dimensions.
  - .2 Details of piling sections including lengths.
  - .3 Layout and details of the steel double channel waler indicating location of splices, splice details, tie bolt details and steel washer plate details.
  - .4 For end and corner locations not suitable for a prefabricated corner section, provide a suitable welded custom corner detail.
  - .5 Details of steel tie rods, steel plate washers, nuts, lock nuts and couplers.
  - .6 Details of tapered steel plate washers.
  - .7 Submit a list of equipment and access methods to be used for pile driving.
  - .8 Submit full details of method and sequence of installation of piling for approval prior to start of pile installation work. Details must include templates, bracing, setting and driving sequence and number of piles in panels for driving.
- .3 Where the Contractor's supplied steel sheet piling consists of different dimensions to the design, submit a plan with details outlining the arrangement and modifications to design, such as tie spacing. It will be the Contractor's responsibility to certify if the design is equivalent and the submission shall be sealed by a Professional Engineer.

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- .4 Document and submit the installation depth of all piles.
- .5 Provide test results for tension and bend testing of sheet pile and tie rod materials.
- 1.6 STEEL CERTIFICATES
- .1 Submit mill test data and certification that all steel piling, delivered to job site, meets requirements of this section. This data shall include a tension test from each heat for quantities of finished material.
- 1.7 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address
- .3 Storage and Handling Requirements:
- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect sheet piles from nicks, scratches and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Use slings for lifting piling so that mass is evenly distributed and piling is not subjected to excessive bending stresses.
- .5 Store sheet piling on level ground or provide supports so that sheet piling is level when stored.
- .1 Provide blocking at spacing not exceeding 5 m so that there is no excessive sagging in piling.
- .2 Overhang at ends not to exceed 0.5 m.
- .3 Block between lifts directly above blocking in lower lift.
- .6 If material is stock-piled on structure, ensure that structure is not overloaded.
- 1.8 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Divert unused metal materials from landfill to metal recycling facility for disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Steel sheet piles: to CSA Standard G40.21, Grade 350W, and following:
  - .2 Continuous interlocking Z sections:
    - .1 Common Steel Sheet Piling
      - .1 Minimum effective section modulus of  $839 \times 10^3 \text{ mm}^3$  per metre of wall.
      - .2 Minimum thickness of 7.5 mm.
    - .2 Corner Pieces
      - .1 Prefabricated corner sections.
      - .2 Minimum thickness of 7.5 mm.
  - .3 Structural steel for rolled sections including walers and waler splices: to CSA Standard G40.21, Grade 350W.
  - .4 Structural steel for plates and miscellaneous steel: to CSA Standard G40.21, Grade 300W.
  - .5 Tie rods:
    - .1 Material properties: ASTM A615, Grade 75, continuous threaded bar, hot rolled.
    - .2 Bars to be 32 mm diameter continuous threaded bar, with lengths to suit the drawing details.
    - .3 Sleeve nuts, couplers, connector sleeves to have 100% of the tie rod load capacity
    - .4 Preassemble, mark and test tie rod assemblies in shop to ensure quality.
  - .6 Nuts and bolts: hexagon nuts, bolts, and washers: to ASTM F3125M, Grade 830 MPa, Type 1.
  - .7 Steel micropile tubes: to minimum 36 ksi.

2.2 SOURCE QUALITY CONTROL: COLD FORMED STEEL SHEET PILING

- .1 Provide results of tension tests of sheet piling material to be used on project as follows:
  - .1 One tension test from each heat for quantities less than 50 tonnes.
  - .2 Two tension tests from each heat for quantities exceeding 50 tonnes.
- .2 Tension tests in accordance with CSA G40.20/G40.21.

- .3 Provide results of bend tests of sheet piling material to be used on project as follows:
  - .1 Bend tests: to ASTM A6/A6M, with amendments as follows.
    - .1 Perform S14.1 bend tests with material in condition as used in cold forming operation. 3 tests to be made from each heat and each thickness of material produced. Take bend test specimens from edge of each coil. Longitudinal axis of specimen to be transverse to coil rolling direction.
    - .2 S14.1.1 - Except as provided below, bend test specimens to have minimum width to thickness ratio of 8, with both edges parallel throughout section in which bending occurs, and is maintained.
    - .3 S14.2 - Minor surface separations less than 0.8 mm in depth related to superficial steel surface or subsurface discontinuities to not cause rejection. Surface separations in excess of 0.8 mm depth or cracks normal to metal surface are cause for rejection.

2.3 SOURCE QUALITY  
CONTROL:  
TIE RODS

- .1 Provide results of tension tests of tie rod material to be used on project as follows:
  - .1 One tension test from each 50 tie rods to be installed.
  - .2 Tension tests in accordance with ASTM A615/A615M-18.
- .2 Provide results of bend tests of tie rod material to be used on project as follows:
  - .1 One bend test for each 50 tie rods to be installed.
  - .2 Bend tests: to ASTM A615/A615M-18, with amendments as follows.
    - .1 Perform bend tests to 30°.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for steel

sheet piles installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.2 INSTALLATION

- .1 All welding shall be in accordance with CSA W59.
- .2 Do not begin pile installation until required quality control tests have been completed and test results approved by Departmental Representative.
- .3 Prior to installation, provide an underwater dive review of the sheet pile line to identify obstructions. Clear existing rock and other obstructions on the harbour bed prior to sheet piling operations.
- .4 Provide access for sheet piling operations, including by not limited to barges.
- .5 Keep interlocks free of any dirt, sand, mud or other debris.
- .6 Provide a suitable crane boom length long enough to install the piles. Normally at boom length of greater than least twice the length of the sheets being driven is required.
- .7 Select a Vibratory Driver suitable for the site and driving conditions. Upsize the equipment when required to correct drive capacity.
- .8 Steel sheet piling walls:
  - .1 Install temporary templates or bracing to hold piles in alignment during setting and driving.
  - .2 Place panel of four to eight sheet piles in templates to prevent spreading of piles in panel.
- .9 For each type of sheet pile length, install the sheet to the top of pile required.
- .10 Document the depth of all piles and notify the Departmental Representative of all piles which

encounter refusal.

- .11 Prevent the piles from becoming twisted, bent, or otherwise damaged during the pile handling and driving operation and, if applicable, during any adjacent construction work.
- .12 Provide temporary support of the steel sheet pile wall that extends vertically above the deck level along the west side of the South Breakwater.
  - .1 The temporary support system shall include an 89mm x 89mm timber installed longitudinally along the top of the steel sheet pile wall and 89mm x 89mm posts at a 2.44m spacing, installed at a 45-degree angle with a sill plate on the pier for stability.
  - .2 The support system shall remain in place until the construction of the concrete wall is to be undertaken for Scenario C, and shall be left in place at the end of the contract for Scenarios A and B.

### 3.3 REFUSAL

- .1 If refusal is encountered prematurely, use the following procedure:
  - .1 Leave the pile and proceed to drive remaining piles.
  - .2 Return and attempt to complete driving of obstructed pile later.
  - .3 Cut the tops of piles to suit the arrangement. See additional requirements for cutting in Clause 3.6.
- .2 If requested by the Departmental Representative, utilize Impact equipment to further drive the pile. This will be paid for under change order.

### 3.4 TOLERANCES

- .1 The face of wall at top of sheet piles shall be within 50 mm of location and deviation from vertical not to exceed 1 in 100.

### 3.5 OBSTRUCTIONS

- .1 If obstruction encountered during driving, leave obstructed pile and proceed to drive remaining piles. Return and attempt to complete driving of obstructed pile later.
- .2 Advise Departmental Representative immediately if impossible to drive pile to full penetration, and obtain direction from Departmental Representative on further steps required to complete Work.

### 3.6 HOLES

- .1 Place lifting holes in the sheets as required to perform the work. Locate holes in the top 0.1 m designated for cut-off.
- .2 Drill and required holes in piling. Do not use flame cutting without permission of Departmental Representative.

### 3.7 CUTTING

- .1 The top 0.1 m (nominal) is designated for removal. Set a straight line to suit the elevations provided in the Contract Documents prior to cutting.
- .2 When flame cutting tops of piles, and flame cutting holes in piles is approved by Departmental Representative, use following procedure:
  - .1 When air temperature is above 0 degrees Celsius, no pre-heat is necessary.
  - .2 When air temperature is below 0 degrees Celsius, pre-heat until steel 25 mm on each side of line of cut has reached a temperature very warm to hand (approximately 35 degrees Celsius). Temperature indicating crayon marks may be used to measure temperature.
  - .3 Use torch guiding device to ensure smooth round holes or straight edges.
  - .4 Make cut smooth and free from notches throughout thickness. If grinding is employed to remove notch or crack, finished radius to be minimum 5 mm.

### 3.8 SPLICING

- .1 Use full length piles with no splicing.

### 3.9 WALES

- .1 Fabricate and erect steel in accordance with CSA Standard S16.1. Fabricate horizontal members with weep holes for drainage where required.
- .2 Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings. Build and erect Work perfectly rigid, plumb or true to slope, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.
- .3 Set and secure framing brackets, hangers, anchors, inserts or similar supports for proper erection.
- .4 Bolt, splice and field weld members as detailed on the Contract Drawings.
- .5 Install tapered plates and tapered washers where

required to suit skewed tie rods. Provide a minimum thickness of 16 mm on tapered plates.

### 3.10 TIE ROD ANCHORAGE SYSTEM

- .1 Do not place backfill behind anchored bulkhead until piles have been completely driven, adjusted and secured in final position by anchorage system.
- .2 Support tie rods at intervals along their length as indicated.
- .3 Fit and adjust tie rod systems so that connections at waling and anchor end of tie rods are tight and no slack remains before backfilling.
- .4 Saw cut tie rods to required lengths. Do not flame cut.
- .5 At splices, butt the two ends of the tie-rods together. Locate the couplers such that they are centred over the joint. Tighten the locking nuts onto the couplers to create a rigid assembly.
- .6 Place granular material around tie-rods as indicated. Pack granular sub-base material below tie-rods to provide continuous supports.
- .7 Ensure that tie-rods are not disturbed when backfill is placed.

### 3.11 TOE ANCHORS

- .1 Install toe anchors in sheet piles that cannot be fully driven to required embedment depth. Do not place backfill behind piles until toe anchors have been completely installed.
- .2 Employ divers during the duration of work to complete the work.
- .3 Mark all locations of toe anchors above the water line for the review of the Departmental Representative.
- .4 Core holes into the bedrock and install micropile pipe through the fill overburden such that it projects a minimum 300mm above the water line. Excavate fill materials and debris.
- .5 Micropile pipe is to be welded to the sheet pile for a length of 300mm above water line.
- .6 Install tremie-concrete (conforming to Section 03 33 00) and fill the micropile pipe completely to the bottom of the core hole.

3.12 BACKFILLING

- .1 Backfill in accordance with Section 31 23 33.01-  
Excavating, Trenching and Backfilling and as  
indicated.
- .2 Do not commence backfilling until tie-rods and  
anchor blocks have been installed.
- .3 Carefully place backfill materials between the new  
steel sheet piling and the existing structure.
- .4 Ensure that the steel sheet piling, tie-rods and  
anchoring systems, are not damaged when backfill  
material is placed.

PART 1 - GENERAL

1.1 SCOPE

- .1 This Section covers Work related to miscellaneous metal fabrications such as safety ladders, pile caps, and cleats.

1.2 MEASUREMENT PROCEDURES

- .1 Safety ladders will be measured by the number of units installed.
- .1 Anchors, connections, field welding and finishing shall be considered included in the unit price of ladders and will not be measured separately for payment.
- .2 Pile caps will be measured by length in linear metres of cap installed, as calculated from neat dimensions measured on-site along the centerline of cap.
- .1 Splices, anchor plates, field welding and finishing shall be considered included in the unit price of caps and will not be measured separately for payment.
- .3 Cleats will be measured by the number of units supplied and installed.
- .1 Anchors and connections shall be considered included in the unit price of bollards and will not be measured separately for payment.
- .4 Payment at the Contract price of unit rate tender items shall be full compensation for all labour, equipment and material to do the work.
- .5 The removal, refinishing, connections and installation of existing South Wharf railing will be considered part of the Lump Sum Arrangement.
- .6 Cleaning, shop painting and field painting of steel will not be measured separately for payment but shall be considered included in the measurement for payment of each item.

1.3 RELATED REQUIREMENTS

- .1 Section 02 41 16 - Structure Demolition.
- .2 Section 03 30 00 - Cast-In-Place Concrete.
- .3 Section 31 62 16.13 - Steel Sheet Piles.

1.4 REFERENCES

- .1 Canadian Standards Association
  - .1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA Standard S16.1-14
  - .3 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel Structures.
  - .4 CSA W59-2018, Welded Steel Construction (Metal Arc Welding).
- .2 The Society for Protective Coatings (SSPC)
  - .1 SSPC-SP 2-82(R2004), Hand Tool Cleaning.
  - .2 SSPC-SP 6/NACE No. 3-07, Commercial Blast Cleaning.
  - .3 SSPC-Vis-1-89, Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs) Editorial Changes September 1, 2000 (Steel Structures Painting Manual, Chapter 2 - Surface Preparation Spec.).
  - .4 SSPC-PA 2-04, Measurement of Dry Coat Thickness with Magnetic Gauges.
  - .5 SSPC Good Painting Practices, Volume 1, 4th Edition.

1.5 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Prior to fabrication, submit fabrication shop drawings with general layout, detailed dimensions, welding details, fastener details and all other relevant information necessary for fabrication.
  - .2 Submit manufacturer's instructions, printed product literature and data sheets for paint, MSDS sheets, surface preparation requirements, application temperature / conditions, finish and limitations.
  - .3 Submit manufacturer's instructions and product data sheets for dowels into concrete, including required equipment list.
  - .4 Submit finishing system including detailed product data sheet, manufacturer's recommendations for surface preparation and other relevant data for each component.
- .3 Provide a detailed schedule for fabrication and coating work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Structural steel for rolled sections: to CSA Standard G40.21, Grade 350W.
- .2 Structural steel for plates and miscellaneous steel: to CSA Standard G40.21, Grade 300W.
- .3 Paint for general steel components meeting the following requirements.
  - .1 Marine grade, ultra-durable, solvent-free, epoxy based coating with solids content of  $98\% \pm 2\%$ . Where colour is unavailable in epoxy based systems, a polyurethane top coat may be substituted. Dry Film Thickness: 2 coats x 2-3 mils each. Finish colour shall be dark grey for bollards and yellow for ladders, and shall be approved by Departmental Representative.
  - .2 For pile caps, shop prime and field top coat top and side exposed surfaces, after installation, with polyurethane top coat. Dry Film Thickness: 2-3 mils. Finish colour shall be yellow, and shall be approved by the Departmental Representative.
  - .3 Surface profile for shop coating abrasive blasting to SSPC-SP10 with 3 to 4 mils surface profile.
- .4 Zinc-Rich Touch-up coating shall be brush, roller or spray applied.
  - .1 Percent solids: greater than 85% by weight.
  - .2 Zinc content: greater than 88% by weight in dry film.
  - .3 Applied in 2 coats with 1.5 mil dry film thickness.
- .5 Where specified, hot dipped galvanizing shall be according to ASTM A123.
- .6 For drilled in anchors and cast anchorage into concrete, see section 03 33 00.
- .7 Cleats shall be 250 mm high strength aluminum alloy, anchored with stainless steel bolts.

PART 3 - EXECUTION

3.1 STEEL FABRICATION

- .1 Fabricate steel components as detailed on drawings

and weld according to CSA W59.

- .2 All flame cut edges shall be as smooth and regular as those produced by edge planing and shall be free of slag.
- .3 Surfaces to be welded shall be smooth, uniform and free from birs, fins and other defects which would adversely affect the quality and uniformity of the weld.
- .4 Notify Departmental Representative of fabrication and coating schedules. Allow sufficient time for the Departmental Representative to inspect the fabricated components prior to coating work.

### 3.2 SAFETY LADDERS

- .1 Fabricate as detailed on drawings and shop apply painted coatings. Chain ladder shall be hot dipped galvanized. The top grab bar shall be painted similar to the pile caps.
- .2 Provide access and install ladders.
- .3 Field weld ladder to the sheet pile and grind all field welds smooth.
- .4 Apply touch-up coating to ladder components damaged by handling and installation.

### 3.3 PILE CAPS

- .1 Fabricate as detailed on drawings and shop apply painted coatings.
- .2 Install steel pile caps and field weld to sheet piling as indicated on the drawings. Where the cap is not fully supported on the sheet piles due low cutoff elevations, weld angles for support and connection to sheeting.
- .3 Apply touch-up coating on pile caps damaged by handling and installation.

### 3.4 PAINTING PREPARATION

- .1 Clean surfaces of metal to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and foreign substances in accordance with SSPC-SP10 Near-White Metal Blast Cleaning.
- .2 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, by blowing with clean dry compressed air, or by vacuum cleaning.

3.5 PAINTING  
APPLICATION

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Paint shall be applied by spray, brush, or roller. All paint work shall be completed in the shop, unless approved by the Departmental Representative.
- .3 Apply each coat of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow 28 days for coating curing or according to the Manufacturer's recommendations if greater.
- .5 Handling painted metal:
  - .1 Handle painted metal after paint has dried, or when necessary for handling for painting or stacking for drying.
  - .2 Scrape off and touch up paint which is damaged in handling, with same number of coats and kinds of paint as were previously applied to metal.

APPENDIX A

GEOTECHNICAL REPORTS



- **AECOM**

## **Geotechnical Investigation**

**Project Name**

South Breakwater Repairs – Port Elgin Harbour

**Project Location**

Port Elgin, Ontario

**Project Number**

LON-00017212-GE

**Prepared by:**

EXP Services Inc.  
15701 Robin's Hill Road  
London, ON N5V 0A5  
Canada

## AECOM

### Geotechnical Investigation

**Project Name:**  
South Breakwater Repairs – Port Elgin Harbour

**Project Location:**  
Port Elgin, Ontario

**Project Number:**  
LON-00017212-GE

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**Date Submitted:**  
September 9, 2019

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## 1.0 Introduction

### 1.1 Introduction

As requested, EXP Services Ltd. has conducted a geotechnical investigation in conjunction with a proposed sheet-pile retaining wall to be located at Port Elgin Harbour in Port Elgin, Ontario, hereinafter referred to as the 'Site'. It is understood that the proposed wall will consist of installing steel sheet pile (SSP) walls and C250 walers, deadmen and 32 diameter tie rods. It is also understood that the existing deck will be replaced by 200 mm thick new concrete deck.

Based on an interpretation of the factual test hole data and a review of soil and groundwater information from test holes advanced at the site, EXP has provided geotechnical engineering guidelines to support the proposed Site development.

### 1.2 Terms of Reference

The geotechnical investigation was generally completed in accordance with the scope of work outlined through email correspondence with the client. Authorization to proceed with this investigation was received from Mr. Karol Chorostecki of **AECOM** through email correspondence in June 7<sup>th</sup>, 2019 with subconsultant agreement dated June 6, 2019.

The purpose of the investigation was to examine the subsoil and groundwater conditions at the site by advancing a series of boreholes at the locations chosen by **AECOM** and illustrated on the attached Borehole Location Plan (**Drawing 1**).

Based on an interpretation of the factual borehole data, and a review of soil and groundwater information from test holes excavated at the site, EXP Services Inc. has provided engineering guidelines for the geotechnical design and construction of the proposed development. More specifically, this report provides comments on sheet-pile wall design and construction.

This report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning geotechnical aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil. Should specific information in this regard be needed, additional testing may be required.

Reference is made to **Appendix D** of this report, which contains further information necessary for the proper interpretation and use of this report.

## 2.0 Methodology

The fieldwork was carried out on July 12<sup>th</sup> through 18<sup>th</sup>, 2019. In general, the geotechnical investigation consisted of the advancement of four (4) boreholes at the locations denoted on **Drawing 1** as BH1, BH2, BH3a, and BH3b. Borehole BH3a was attempted about 1.0 m east of south breakwater edge but was abandoned at a shallow depth due to auger refusal on the existing cobbly sand and gravel fill. BH3b was drilled 11 to 12 m east of south breakwater edge. An additional borehole was attempted at the south end of South Breakwater #301 (See **Drawing 1**) but was abandoned following several attempts to drill due to barge drifting.

Prior to the drilling, buried service clearances were obtained for the test hole locations by AECOM.

The boreholes were completed by a specialist drilling subcontractor under the full-time supervision of EXP geotechnical staff. The boreholes were advanced utilizing a barge-mounted drill rig equipped with continuous flight hollow stem augers, soil sampling and soil testing equipment, and casing. In each borehole, disturbed soil samples were recovered at depth intervals of 0.75 m and 1.5 m using conventional split spoon sampling equipment and Standard Penetration Test (SPT) methods.

During the drilling, the stratigraphy in the boreholes was examined and logged in the field by EXP geotechnical personnel. Following the drilling, the boreholes were backfilled with the excavated materials.

Representative samples of the various soil strata encountered at the test locations were taken to our laboratory in London for further examination by a geotechnical engineer and laboratory classification testing. Laboratory testing for this investigation comprised thirteen (13) bulk density tests, one grain size analysis and one Atterberg Limits presented in **Appendix B** and routine moisture content determinations, with results presented on the borehole logs found in **Appendix A**.

Samples remaining after the classification testing will be stored for a period of three months following the issuance of report. After this time, they will be discarded unless prior arrangements have been made for longer storage.

The locations of the boreholes were proposed by AECOM. The water elevation recorded in EXP's borehole logs was inferred from information gathered from the US Army Corps of Engineers website.

## 3.0 Site and Subsurface Conditions

### 3.1 Site Description

The Site is bounded by commercial development (restaurants and shops), motels and residential subdivision. The harbour is northeast and the main beach is southeast of the South Breakwater. The subject area is located within Lake Huron.

The following sections provide a summary of the soil conditions.

### 3.2 Soil Stratigraphy

The detailed stratigraphy encountered in the boreholes is shown in the borehole logs found in **Appendix A** and summarized in the following paragraphs. It must be noted that boundaries of soil indicated in the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

#### 3.2.1 Fill

At the top of lake bottom in Borehole BH3a was a layer of sand and gravel fill with frequent cobbles. The grey fill contained trace silt, was very dense (based on an SPT N Value of greater than 50 blows per less than 150 mm split spoon sampler penetration) and wet (based on tactile examination).

#### 3.2.2 Sandy Silt

At the top of lake bottom in Borehole BH2, a 0.6 m thick sandy silt layer was encountered. The sandy silt was grey in colour, with trace clay, trace organics and loose (based on an SPT N Value of 7 blows per 300 mm split spoon sampler penetration). Laboratory testing of the sandy silt yielded an *in situ* moisture content of 25 percent, indicative of wet conditions.

#### 3.2.3 Sand

Extending from the top of lake bottom (Elevation 175.8 m) to Elevation 171.7 m in Borehole BH3b was a layer of sand. The sand was generally grey, fine grained and contained trace silt. It was loose to compact in relative density (SPT N Values of 4 to 14) and wet (based on tactile examination and *in situ* moisture contents of 25 to 26 percent).

#### 3.2.4 Silt

The predominant soil encountered in the boreholes was silt and it was observed in Boreholes BH1, BH2 and BH3b. The silt stratum was 6.0 m to 6.1 m thick in Boreholes BH1 and BH2, and was encountered at an elevation of 174.0 m to 173.7 m respectively. In Borehole BH3b, the silt was found underlying the sand and extended to the termination depth of the borehole. In general, the silt was described as grey in colour with some clay to clayey silt, trace sand, and

slight plasticity. Occasional partings of silt with trace clay, trace sand were observed throughout the stratum. It was loose to dense (SPT N Values of 4 to 31) and wet (typical *in situ* moisture contents of 16 to 24 percent).

Possible cobbles were encountered within the silt stratum in Borehole BH1 near 8.8 m bgs.

Laboratory testing of the silt was carried out with results presented on the borehole logs in **Appendix A** and in **Appendix B**.

### **3.2.5 Sand and Gravel**

Underlying the silt in Boreholes BH1 and BH2 was a layer of sand and gravel. In general, the sand and gravel was described as grey, with trace silt, very dense (SPT N Values of greater than 50 blows per less than 150 mm split spoon sampler penetration) and wet (tactile examination and *in situ* moisture content of 15 percent). Possible cobbles were encountered within the layer in each borehole. Boreholes BH1 and BH2 were terminated in the layer.

### **3.3 Bedrock**

Upon review of bedrock topography mapping in the Chesley-Tiverton Area (Ontario Geological Survey, Preliminary Map P.2315) it was determined that the dolostone or shale bedrock resides at an elevation of approximately 475 feet (145 m) to 500 feet (152 m). The boreholes at the site were advanced to a maximum depth of 11.4 m bgs (Elevation 166.2 m).

## 4.0 Discussion and Recommendations

### 4.1 General

Based on information provided by the client, it is understood that a new buried anchored sheet-pile bulkhead will be installed at an offset of about 0.5 to 1.0 m from edge of the existing deck or the existing sheet-piles along South Breakwater #301 and South Breakwater Extension #403 (See **Drawing 1**). It is also understood that the gap between the existing and new sheet pile walls will be filled up with clear stone. The deck will be constructed with new concrete. The following sections of this report provide geotechnical comments and recommendations regarding sheet-pile wall design and construction.

### 4.2 Anchored Sheet Pile Bulkhead

It is understood that the proposed wall will consist of installing steel sheet piles (SSP) wall and C250 waler, deadman and 32 diameter tie rods.

A single buried anchor was considered for the proposed sheet pile bulkhead/wall.

Design of the tie-rods and their connections should consider corrosion protection. Tie-rod design should also consider potential settlement of the backfill and measures to protect the tie-rods from loading by the overlying fill and deck surcharge, and potential sag if vertical support is removed beneath the rod.

It is believed that steel sheet-piles are able to penetrate the soils above the sand and gravel with no or minimal damage, but could have difficulty penetrating through the sand and gravel stratum without causing significant damage to the sheet-piles.

Based on the thickness and compactness of the soils encountered within borehole depths, it is anticipated that achieving toe-penetration of the sheet-piling should be sufficient by conventional pile driving techniques; however, the designer of the retaining structure should verify its adequacy. Alternatively, the penetration required for stability may be achieved by installing shear keys such as driven or drilled piles in front of the sheet piles.

The following soil parameters are recommended as a guide for design, based on the stratigraphy encountered in the boreholes during the investigation and proposed backfill material:

**Table 1 – Lateral Earth Pressures & Soil Design Parameters**

| Design Parameters                                      | Front Side of Wall |                 |                 | Back Side of Wall |
|--|--------------------|-----------------|-----------------|-------------------|
|  | Sand               | Sandy Silt/Silt | Sand and Gravel | Clear Stone*      |
| Unit Weight, $\gamma$ (kN/m <sup>3</sup> )             | 18.5               | 21.0            | 21.5            | 17.0              |
| Unit Weight of Water, $\gamma_w$ (kN/m <sup>3</sup> )  | 9.8                | 9.8             | 9.8             | 9.8               |
| Submerged Unit Weight, $\gamma_s$ (kN/m <sup>3</sup> ) | 8.7                | 11.2            | 11.7            | 7.2               |
| Cohesion, C' (kPa)                                     | 0                  | 2               | 0               | 0                 |
| Angle of Internal Friction, $\phi'$ (degrees)          | 26                 | 28              | 34              | 34                |
| Coefficient of Earth Pressure 'At Rest', $K_0$         | 0.56               | 0.53            | 0.44            | 0.44              |
| Coefficient of Active Earth Pressure, $K_a$            | 0.39               | 0.36            | 0.28            | 0.28              |
| Coefficient of Passive Earth Pressure, $K_p$           | 2.56               | 2.77            | 3.54            | 3.54              |
| Friction Factor Against Concrete ( $\tan \delta$ )     | 0.31               | 0.34            | 0.42            | 0.42              |

Notes: \*It is assumed that the clear stone is a crushed stone placed in thin lifts (100 to 150 mm) and tamped/compacted with small equipment.

A Factor of Safety (FOS) of 1.4 should be considered in the calculation to determine the depth of toe-embedment.

Anchors for the sheet-pile wall will be located within the clear stone behind the proposed wall and will extend further into the backfill of the existing sheet pile wall. An angle of internal friction of 28 degrees and unit weight of 18 kN/m<sup>3</sup> can be used for the existing backfill materials in preliminary calculations until later stages of design when the backfill materials are exposed and then defined. Sheet pile anchors for the south breakwater construction is anticipated to be placed above the low water level.

It is understood that a new concrete deck will be constructed. If large surcharge loads are anticipated on the platform, it is suggested to use a reinforced concrete relieving platform, if feasible, to reduce the lateral pressures on the wall and to avoid the subsidence of the platform in the future.

It is also recommended to use a concrete capping beam, if possible, along the top of the sheet piles to stiffen the wall top.

With changing water levels in the lake, weeping tiles should be provided behind the wall and placed above the mean low water level to provide drainage for the backfill and then to eliminate hydrostatic pressure on the sheet pile wall.

The existing cobbly fill should be removed from the wall alignment prior to SSP installation to avoid significant damage to the sheet-piles.

### **4.3 Inspection and Testing Requirements**

An effective inspection and testing program is an essential part of construction monitoring. The Inspection and Testing Program typically includes the following items:

- Inspection and Materials testing during fill placement (full-time supervision is recommended) including soil sampling, laboratory testing (grain size analyses), and monitoring of fill placement;

EXP would be pleased to prepare an inspection and testing work program prior to construction, incorporating the above items.

## 5.0 General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an assessment of the current geotechnical conditions within the subject property. The conclusions and recommendations presented in this report reflect site conditions existing at the time of the investigation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, EXP Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. EXP has qualified personnel to provide assistance in regards to any future geotechnical and environmental issues related to this property.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession.

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in this report.

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We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

**Client:** AECOM  
**Project Name:** South Breakwater Repairs – Port Elgin Harbour  
**Project Number:** LON-00017212-GE

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## Drawings



**-LEGEND-**

◆ BH1 Approximate Borehole Location

**-NOTES-**

1. The boundaries and soil types have been established only at test hole locations. Between test holes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for 3 months and then destroyed unless client advises that an extended time period is required.
3. Topsoil quantities should not be established from the information provided at the test hole locations.
4. The site plan was reproduced from Google Earth Pro (2014) and should be read in conjunction with EXP Geotechnical Report LON-00017212-GE.

**Geotechnical Investigation**  
**South Breakwater Repairs**  
**Port Elgin Harbour**  
 Port Elgin, Ontario

|  |                   |
|--|-------------------|
| <b>CLIENT</b> AECOM Canada Ltd.  |                   |
| <b>TITLE</b> Borehole Location Plan                                      |                   |
| Prepared By: E.B.  | Reviewed By: I.S. |
| <b>EXP Services Inc.</b><br>15701 Robin's Hill Road, London, ON, N5V 0A5 |                   |
| <b>DATE</b> AUGUST 2019  | <b>SCALE</b> NTS  |
| <b>PROJECT NO.</b> LON-00017212-GE                                       | <b>DWG.</b> 1     |

## **Appendix A – Borehole Logs**

## NOTES ON SAMPLE DESCRIPTIONS

- All descriptions included in this report follow the 'modified' Massachusetts Institute of Technology (M.I.T.) soil classification system. The laboratory grain-size analysis also follows this classification system. Others may designate the Unified Classification System as their source; a comparison of the two is shown for your information. Please note that, with the exception of those samples where the grain size analysis has been carried out, all samples are classified visually and the accuracy of the visual examination is not sufficient to differentiate between the classification systems or exact grain sizing. The M.I.T. system has been modified and the EXP classification includes a designation for cobbles above the 75 mm size and boulders above the 200 mm size.

| UNIFIED SOIL CLASSIFICATION | Fines (silt and clay) |       | Sand                |                 |           | Gravel   |           | Cobbles |
|-----------------------------|-----------------------|-------|---------------------|-----------------|-----------|----------|-----------|---------|
|                             |                       |       | Fine                | Medium          | Coarse    | Fine     | Coarse    |         |
| M.I.T. SOIL CLASSIFICATION  | Clay                  | Silt  | Sand                |                 |           | Gravel   |           |         |
|                             |                       |       | Fine                | Medium          | Coarse    |          |           |         |
|                             | Sieve Sizes           |       |                     |                 |           |          |           |         |
|                             | Particle Size (mm)    | 0.002 | 0.06<br>0.075 - 200 | 0.2<br>0.6 - 40 | 2.0<br>10 | 5.0<br>4 | 20<br>3/4 | 80      |

- Fill:** Where fill is designated on the borehole log, it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description therefore, may not be applicable as a general description of the site fill material. All fills should be expected to contain obstructions such as large concrete pieces or subsurface basements, floors, tanks, even though none of these obstructions may have been encountered in the borehole. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact and correct composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. The fill at this site has been monitored for the presence of methane gas and the results are recorded on the borehole logs. The monitoring process neither indicates the volume of gas that can be potentially generated or pinpoints the source of the gas. These readings are to advise of a potential or existing problem (if they exist) and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic waste that renders the material unacceptable for deposition in any but designated land fill sites; unless specifically stated, the fill on the site has not been tested for contaminants that may be considered hazardous. This testing and a potential hazard study can be carried out if you so request. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common, but not detectable using conventional geotechnical procedures.
- Glacial Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process, the till must be considered heterogeneous in composition and as such, may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm in diameter) or boulders (greater than 200 mm diameter) and therefore, contractors may encounter them during excavation, even if they are not indicated on the borehole logs. It should be appreciated that normal sampling equipment can not differentiate the size or type of obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited area; therefore, caution is essential when dealing with sensitive excavations or dewatering programs in till material.



# BOREHOLE LOG

BH1

Sheet 1 of 1

CLIENT AECOM PROJECT NO. LON-00017212-GE  
 PROJECT Port Elgin Harbour DATUM Geodetic  
 LOCATION Port Elgin, Ontario DATES: Boring July 12, 2019 Water Level \_\_\_\_\_

| DEPTH<br>(m bgs) | ELEVATION<br>(-m) | STRATA<br>DESCRIPTION   | STRATA<br>PLOT | WELL<br>LOG | SAMPLES |        |                  | MOISTURE<br>CONTENT<br>(%) | SHEAR STRENGTH        |                                     |                |           |  |  |  |  |    |
|------------------|-------------------|---|----------------|-------------|---------|--------|------------------|----------------------------|-----------------------|-------------------------------------|----------------|-----------|--|--|--|--|----|
|                  |                   |   |                |             | TYPE    | NUMBER | RECOVERY<br>(mm) |                            | N<br>VALUE<br>(blows) | ◆ S Field Vane Test (#=Sensitivity) | ▲ Penetrometer | ■ Torvane | Atterberg Limits and Moisture<br>W <sub>p</sub> W W <sub>L</sub> |  |  |  |    |
| 0                | 177.6             | BARGE DECK - AIR<br>WATER   |                | ▼           |         |        |                  |                            |                       |                                     |                |           |  |  |  |  |    |
| 1                |                   |   |                |             |         |        |                  |                            |                       |                                     |                |           |  |  |  |  |    |
| 2                |                   |   |                |             |         |        |                  |                            |                       |                                     |                |           |  |  |  |  |    |
| 3                |                   |   |                |             |         |        |                  |                            |                       |                                     |                |           |  |  |  |  |    |
| 4                | 174.0             | SILT - grey, some clay to clayey, trace sand,<br>occasional silt partings, slight plasticity, loose<br>to compact, wet<br>Bulk Density = 19.6 kN/m <sup>3</sup> |                |             | SS      | S1     | 610              | 4                          | 20                    | ●                                   | ○              |           |  |  |  |  |    |
| 5                |                   | Bulk Density = 21.3 kN/m <sup>3</sup>   |                |             | SS      | S2     | 510              | 14                         | 17                    | ●                                   | ○              |           |  |  |  |  |    |
| 6                | 171.4             | Bulk Density = 21.7 kN/m <sup>3</sup>   |                |             | SS      | S3     | 560              | 31                         | 16                    |                                     | ○              |           |  |  |  |  |    |
| 7                |                   | SILT - grey, trace clay, trace sand, compact<br>to dense, wet<br>Bulk Density = 21.6 kN/m <sup>3</sup>  |                |             | SS      | S4     | 510              | 23                         | 19                    |                                     | ○              | ●         |  |  |  |  |    |
| 8                | 169.8             |   |                |             | SS      | S5     | 510              | 9                          | 12                    | ●                                   | ○              |           |  |  |  |  |    |
| 9                |                   | - possible cobbles encountered near 8.8 m bgs   |                |             | SS      | S6     | 150              | 68                         |                       |                                     |                |           |  |  |  |  | 68 |
| 10               | 168.0             | SAND AND GRAVEL - grey, trace silt, very<br>dense, wet<br>- possible cobbles encountered near 9.9 m bgs   |                |             | SS      | S7     | 150              | 50 *                       |                       |                                     |                |           |  |  |  |  |    |
| 11               | 166.2             |   |                |             | SS      | S8     | 80               | 50 *                       |                       |                                     |                |           |  |  |  |  |    |
| 12               |                   | End of Borehole at 11.4 m bgs.  |                |             |         |        |                  |                            |                       |                                     |                |           |  |  |  |  |    |

**NOTES**

- Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON00017212-GE.
- \* denotes 50 blows per less than 150 mm split spoon sampler penetration.
- The water elevation was inferred from information gathered from the US Army Corps of Engineers website.

**SAMPLE LEGEND**

- AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

**OTHER TESTS**

- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

**WATER LEVELS**

- ▽ Apparent
- ▼ Measured
- ▲ Artesian (see Notes)



# BOREHOLE LOG

BH2

Sheet 1 of 1

CLIENT AECOM PROJECT NO. LON-00017212-GE  
 PROJECT Port Elgin Harbour DATUM Geodetic  
 LOCATION Port Elgin, Ontario DATES: Boring July 12, 2019 Water Level \_\_\_\_\_

| DEPTH<br>(m bgs) | ELEVATION<br>(-m) | STRATA DESCRIPTION   | STRATA<br>PLOT            | WELL<br>LOG | SAMPLES |        |                  | MOISTURE<br>CONTENT<br>(%) | SHEAR STRENGTH        |                                     |                          |
|------------------|-------------------|--|---------------------------|-------------|---------|--------|------------------|----------------------------|-----------------------|-------------------------------------|--------------------------|
|                  |                   |  |                           |             | TYPE    | NUMBER | RECOVERY<br>(mm) |                            | N<br>VALUE<br>(blows) | ◆ S Field Vane Test (#=Sensitivity) | ▲ Penetrometer ■ Torvane |
| 0                | 177.5             | BARGE DECK - AIR<br>WATER  |                           |             |         |        |                  |                            |                       |                                     |                          |
| 0                | 177.3             |  |                           |             |         |        |                  |                            |                       |                                     |                          |
| 3                | 174.3             | SANDY SILT - grey, trace clay, trace organics, loose, wet  |                           |             | SS      | S1     | 150              | 7                          | 25                    |                                     |                          |
| 4                | 173.7             | SILT - grey, some clay to clayey, trace sand, occasional silt partings, slight plasticity, compact, wet<br>Bulk Density = 21.4 kN/m3<br>Bulk Density = 21.3 kN/m3  |                           |             | SS      | S2     | 150              | 10                         | 23                    |                                     |                          |
| 5                |                   | Grain Size Analysis<br><b>Clay Silt Sand</b><br>20 75 5<br>Liquid Limit: 20%<br>Plastic Limit: 14%<br>Plasticity Index: 6<br>Bulk Density (S4) = 21.0 kN/m3<br>Bulk Density (S5) = 21.9 kN/m3                    |                           |             | SS      | S3     | 460              | 15                         | 21                    |                                     |                          |
| 6                |                   |  |                           |             | SS      | S4     | 460              | 12                         | 20                    |                                     |                          |
| 7                |                   |  |                           |             | SS      | S5     | 510              | 19                         | 17                    |                                     |                          |
| 8                |                   |  | Bulk Density = 21.3 kN/m3 |             |         | SS     | S6               | 250                        | 10                    | 19                                  |                          |
| 10               | 167.6             |  | Bulk Density = 19.7 kN/m3 |             |         | SS     | S7               | 150                        | 21                    | 24                                  |                          |
| 11               | 166.3             | SAND AND GRAVEL - grey, trace silt, compact to very dense, wet<br><br>- possible cobble encountered near 10.7 m bgs<br>- transitioning to fine to medium sand below 10.8 m bgs<br>End of Borehole at 11.2 m bgs. |                           |             | SS      | S8     | 380              | 50*                        | 15                    |                                     |                          |

**NOTES**

- Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON00017212-GE.
- \* denotes 50 blows per less than 150 mm split spoon sampler penetration.
- The water elevation was inferred from information gathered from the US Army Corps of Engineers website.

**SAMPLE LEGEND**  
 ☒ AS Auger Sample    ☒ SS Split Spoon    ■ ST Shelby Tube  
 ☐ Rock Core (eg. BQ, NQ, etc.)    ☐ VN Vane Sample

**OTHER TESTS**  
 G Specific Gravity    C Consolidation  
 H Hydrometer    CD Consolidated Drained Triaxial  
 S Sieve Analysis    CU Consolidated Undrained Triaxial  
 γ Unit Weight    UU Unconsolidated Undrained Triaxial  
 P Field Permeability    UC Unconfined Compression  
 K Lab Permeability    DS Direct Shear

**WATER LEVELS**  
 ▽ Apparent    ▼ Measured    ▲ Artesian (see Notes)



# BOREHOLE LOG

BH3a

Sheet 1 of 1

CLIENT AECOM PROJECT NO. LON-00017212-GE  
 PROJECT Port Elgin Harbour DATUM Geodetic  
 LOCATION Port Elgin, Ontario DATES: Boring July 15, 2019 Water Level \_\_\_\_\_

| DEPTH<br>(m bgs) | ELEVATION<br>(-m) | STRATA<br>DESCRIPTION   | STRATA<br>PLOT | WELL<br>LOG | SAMPLES |        |                  | MOISTURE<br>CONTENT<br>(%) | SHEAR STRENGTH        |                                     |
|------------------|-------------------|---|----------------|-------------|---------|--------|------------------|----------------------------|-----------------------|-------------------------------------|
|                  |                   |   |                |             | TYPE    | NUMBER | RECOVERY<br>(mm) |                            | N<br>VALUE<br>(blows) | ◆ S Field Vane Test (#=Sensitivity) |
| 0                | 177.6             | BARGE DECK - AIR  |                | ▼           |         |        |                  |                            | 100                   | 200 kPa                             |
|                  | 177.3             | WATER   |                |             |         |        |                  |                            |                       |                                     |
| 1                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 2                | 175.8             | FILL - sand and gravel, grey, trace silt, frequent cobbles, very dense, wet |                |             |         |        |                  |                            |                       |                                     |
| 3                | 174.6             |   |                |             | SS      | S1     | 200              | 50*                        |                       |                                     |
| 4                |                   | End of Borehole at 3.1 m bgs due to auger refusal on existing rock fill.    |                |             |         |        |                  |                            |                       |                                     |
| 5                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 6                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 7                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 8                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 9                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 10               |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 11               |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 12               |                   |   |                |             |         |        |                  |                            |                       |                                     |

**NOTES**

- Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON00017212-GE.
- \* denotes 50 blows per less than 150 mm split spoon sampler penetration.
- The water elevation was inferred from information gathered from the US Army Corps of Engineers website.

**SAMPLE LEGEND**  
 ☒ AS Auger Sample    ☒ SS Split Spoon    ■ ST Shelby Tube  
 ☐ Rock Core (eg. BQ, NQ, etc.)    ☐ VN Vane Sample

**OTHER TESTS**  
 G Specific Gravity    C Consolidation  
 H Hydrometer    CD Consolidated Drained Triaxial  
 S Sieve Analysis    CU Consolidated Undrained Triaxial  
 γ Unit Weight    UU Unconsolidated Undrained Triaxial  
 P Field Permeability    UC Unconfined Compression  
 K Lab Permeability    DS Direct Shear

**WATER LEVELS**  
 ▽ Apparent    ▼ Measured    ▲ Artesian (see Notes)



# BOREHOLE LOG

BH3b

Sheet 1 of 1

CLIENT AECOM PROJECT NO. LON-00017212-GE  
 PROJECT Port Elgin Harbour DATUM Geodetic  
 LOCATION Port Elgin, Ontario DATES: Boring July 18, 2019 Water Level \_\_\_\_\_

| DEPTH<br>(m bgs) | ELEVATION<br>(-m) | STRATA<br>DESCRIPTION   | STRATA<br>PLOT | WELL<br>LOG | SAMPLES |        |                  | MOISTURE<br>CONTENT<br>(%) | SHEAR STRENGTH        |                                     |
|------------------|-------------------|---|----------------|-------------|---------|--------|------------------|----------------------------|-----------------------|-------------------------------------|
|                  |                   |   |                |             | TYPE    | NUMBER | RECOVERY<br>(mm) |                            | N<br>VALUE<br>(blows) | ◆ S Field Vane Test (#=Sensitivity) |
| 0                | 177.6             | BARGE DECK - AIR  |                |             |         |        |                  |                            |                       |                                     |
|                  | 177.3             | WATER   |                |             |         |        |                  |                            |                       |                                     |
| 1                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 2                | 175.8             | SAND - grey, fine grained, trace silt, loose to compact, wet  |                |             |         |        |                  |                            |                       |                                     |
| 3                |                   |   |                |             | SS      | S1     | 50               | 7                          |                       |                                     |
| 4                |                   |   |                |             | SS      | S2     | 150              | 14                         | 25                    |                                     |
| 5                |                   |   |                |             | SS      | S3     | 100              | 4                          | 26                    |                                     |
| 6                |                   |   |                |             | SS      | S4     | 150              | 6                          | 25                    |                                     |
| 7                | 171.7             | SILT - grey, some clay to clayey, trace sand, occasional silt partings, slight plasticity, loose to compact, wet<br>Bulk Density = 20.7 kN/m3 |                |             | SS      | S5     | 610              | 5                          | 19                    |                                     |
| 8                |                   | Bulk Density = 21.1 kN/m3   |                |             | SS      | S6     | 610              | 14                         | 18                    |                                     |
| 9                |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 10               | 167.6             | Bulk Density = 21.2 kN/m3   |                |             | SS      | S7     |                  | 8                          | 20                    |                                     |
|                  |                   | End of Borehole at 10.1 m bgs.  |                |             |         |        |                  |                            |                       |                                     |
| 11               |                   |   |                |             |         |        |                  |                            |                       |                                     |
| 12               |                   |   |                |             |         |        |                  |                            |                       |                                     |

**NOTES**  
 1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON00017212-GE.  
 2) The water elevation was inferred from information gathered from the US Army Corps of Engineers website.

**SAMPLE LEGEND**  
 ☒ AS Auger Sample    ☒ SS Split Spoon    ■ ST Shelby Tube  
 ☒ Rock Core (eg. BQ, NQ, etc.)    ☒ VN Vane Sample

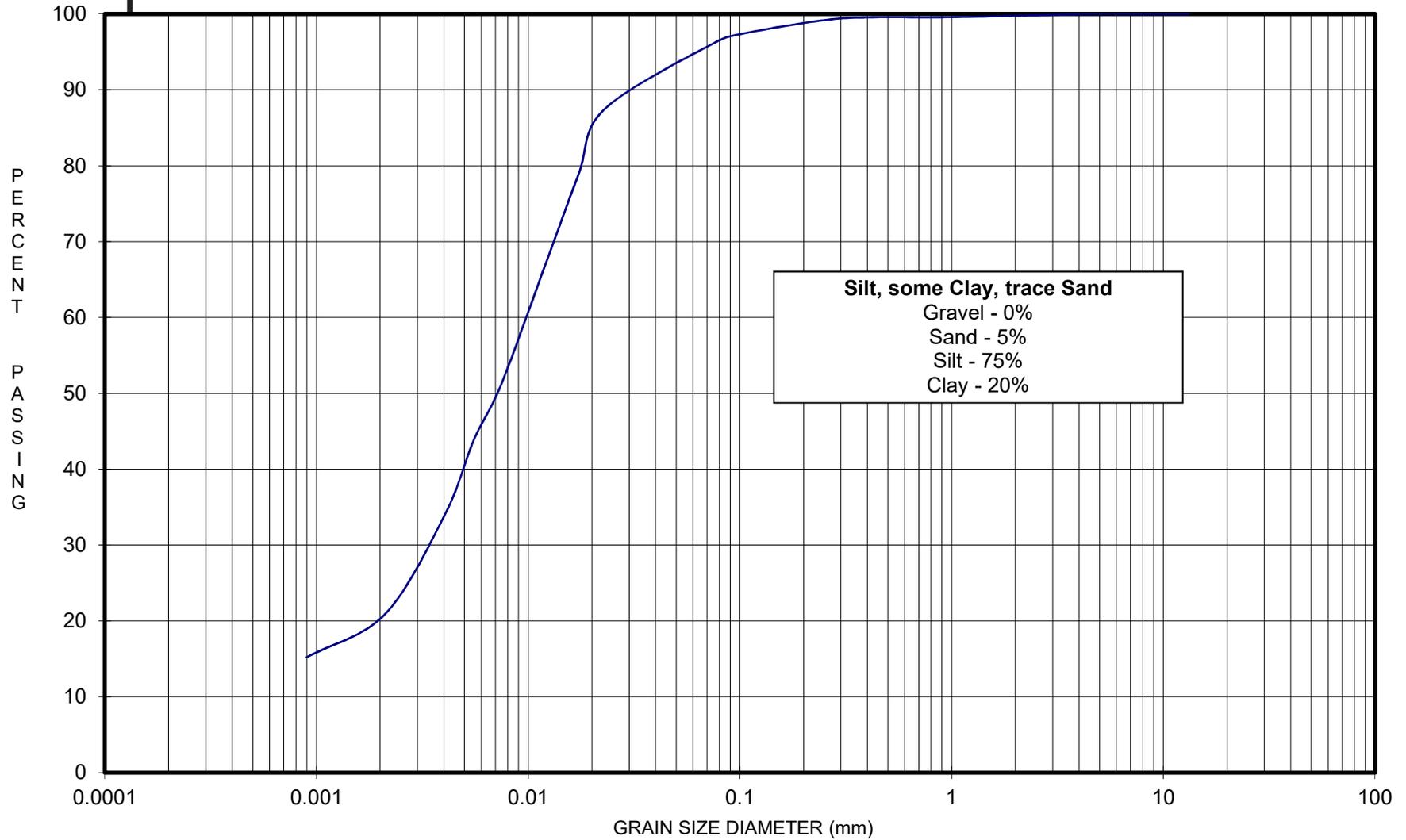
**OTHER TESTS**  
 G Specific Gravity    C Consolidation  
 H Hydrometer    CD Consolidated Drained Triaxial  
 S Sieve Analysis    CU Consolidated Undrained Triaxial  
 γ Unit Weight    UU Unconsolidated Undrained Triaxial  
 P Field Permeability    UC Unconfined Compression  
 K Lab Permeability    DS Direct Shear

**WATER LEVELS**  
 ▽ Apparent    ▼ Measured    ▲ Artesian (see Notes)

## **Appendix B – Geotechnical Laboratory Test Results**



# MECHANICAL GRAIN SIZE ANALYSIS



|                                |   |        |        |      |        |  |        |        |                 |
|--------------------------------|---|--------|--------|------|--------|--|--------|--------|-----------------|
| CLAY                           | FINE  | MEDIUM | COARSE | FINE | MEDIUM | COARSE   | FINE   | MEDIUM | COARSE          |
|                                | SILT  |        |        | SAND |        |  | GRAVEL |        |                 |
| MODIFIED M.I.T. CLASSIFICATION | <b>Sample Description:</b><br><b>Silt (BH2 S4, 2.3 - 2.9 m depth)</b> |        |        |      |        | <b>Project: LON-00017212-GE</b><br><b>Port Elgin Harbour</b> |        |        | <b>Figure 1</b> |



LABORATORY  
TEST RESULTS

exp Services Inc.

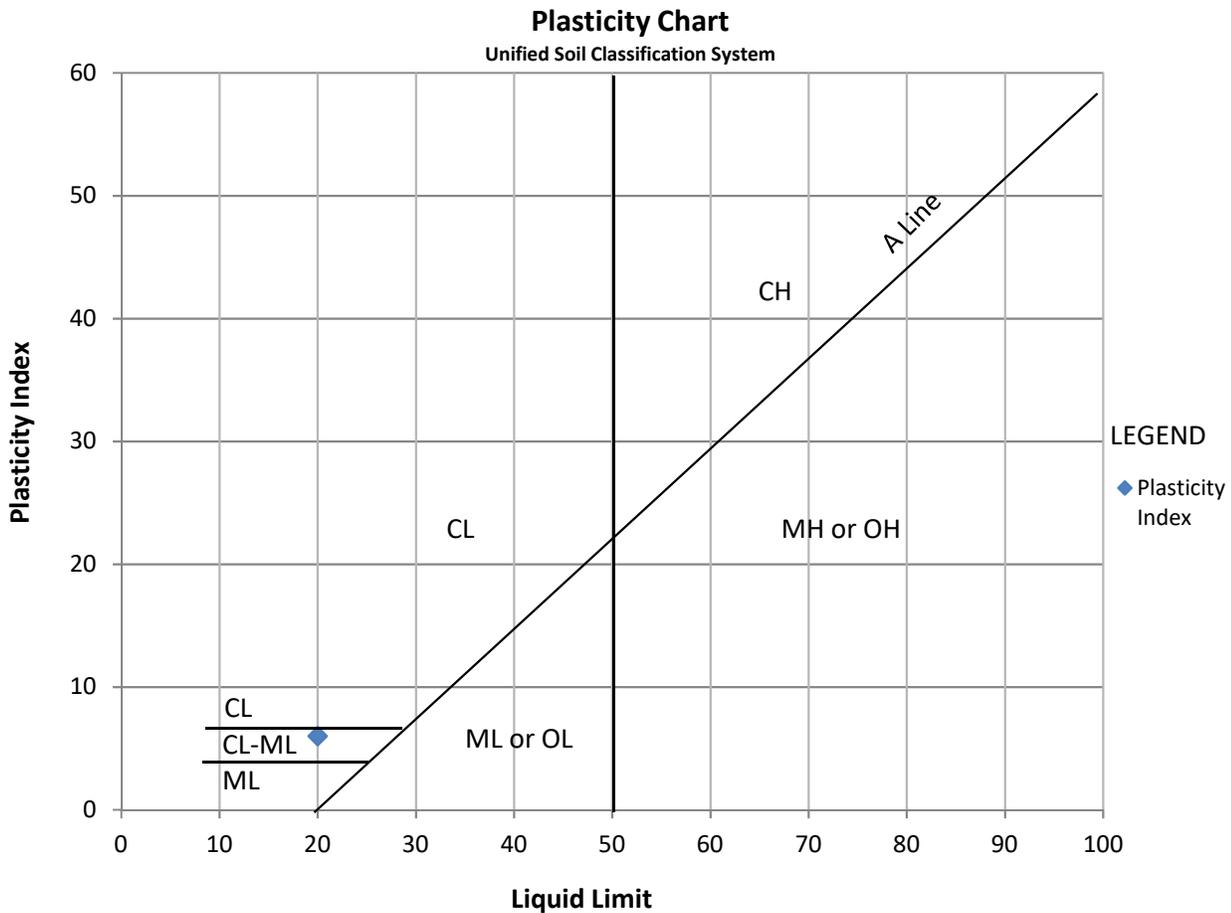
15701 Robin's Hill Road London, Ontario N5V 0A5  
tel: 519.963.3000 fax: 519.963.1152  
email: london@exp.com

Project Number LON-00017212-GE  
Project Name Port Elgin Harbour  
Sample Description Clayey Silt  
Sampling Date 7/12/2019  
Sample Location 2.3 - 2.9 m depth  
Lab Sample No.

Report Date  
Sampled By B. Webster  
Sample Source BH2 S4  
Date Tested 7/25/2019

Atterberg Test Results

Liquid Limit 20 %  
Plasticity Index 6  
Plastic Limit 14 %



## **Appendix C – Inspection and Testing Schedule**

## INSPECTION & TESTING SCHEDULE

The following program outlines suggested minimum testing requirements during backfilling of service trenches and construction of pavements. In adverse weather conditions (wet/freezing), increased testing will be required. The testing frequencies are general requirements and may be adjusted at the discretion of the engineer based on test results and prevailing construction conditions.

### I TRENCH BACKFILL

#### **ZONE A**

- one in situ density test per 100 cubic meters or 50 linear metres of trench whichever is less
- one laboratory grain size and Proctor density test per 50 density tests or 4000 cubic metres or on change of material (source, visual)

#### **ZONE A1**

- one in situ density test per 75 cubic metres of material or 25 linear metres of each lift of fill
- one laboratory grain size and Proctor density test per each 50 density tests or 4000 cubic metres of material placed or as directed by the engineer

#### **ZONES B & C**

- one in situ density test per 150 cubic metres of material or 50 linear metres or each lift whichever is less
- one laboratory grain size and Proctor density test per 50 density tests or 4000 cubic metres of material placed or as directed by the engineer

### II PAVEMENT MATERIALS

#### **GRANULAR SUBBASE**

- one in situ density test per 50 linear metres of road
- one laboratory grain size and standard Proctor test per 50 density tests or 4000 cubic metres or each change of material (visual, source), as determined by the engineer

#### **GRANULAR BASE**

- one in situ density test per 50 linear metres of road
- one laboratory grain size and Proctor per 50 density tests or 8000 cubic metres or change in material (visual, source), as determined by the engineer
- Benkelman beam testing at 10 metre intervals per lane, after final grading and compaction. Asphaltic concrete should not be placed until rebound criteria have been satisfied.

#### **ASPHALTIC CONCRETE**

- one in situ density test per 25 linear metres of roadway
- one complete Marshall Compliance test including stability flow, etc. for each mix type to check mix acceptability. One extraction and gradation test per each day of paving to be compared to job mix formula

**NOTES:** Where testing indicates inadequate compaction, additional fill should not be placed until the area is recompacted and retested at the discretion of the engineer.

## **Appendix D – Limitations and Use of Report**

## **LIMITATIONS AND USE OF REPORT**

### **BASIS OF REPORT**

This report (“Report”) is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of exp may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by exp. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and exp’s recommendations. Any reduction in the level of services recommended will result in exp providing qualified opinions regarding the adequacy of the work. exp can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the borehole results contained in the Report. The number of boreholes necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to exp to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

### **RELIANCE ON INFORMATION PROVIDED**

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to exp by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. exp has relied in good faith upon such representations, information and instructions and accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to exp.

### **STANDARD OF CARE**

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, expressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

### **COMPLETE REPORT**

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to exp by its client (“Client”), communications between exp and the Client, other reports, proposals or documents prepared by exp for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions expressed in the Report, reference must be made to the Report in its entirety. exp is not responsible for use by any party of portions of the Report.