# Appendix B.1

## Summary of Previous Environmental Investigations

June 2017 – 16-3774

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This appendix presents summaries of the P1ESA (Dillon, 2015) and P2ESA (Dillon, 2016), and the P2ESA Addendum (Dillon, 2017) conducted for Pier 8, Hamilton, Ontario (the "Site"). For the purposes of the P1ESA, P2ESA, P2ESA Addendum and Risk Assessment (RA), the terms "Site", "study area", or "risk assessment property" are used to describe the P2ESA property.

Figures and tables from the previous environmental reports, referenced herein, are included in Appendix B of the RA report. These figures and tables summarize the groundwater levels and LNAPL thickness measurements and the soil, groundwater, and soil vapour analytical results obtained to date.

# 1.0 Phase One Environmental Site Assessment

The P1ESA (Dillon, 2015) was conducted in accordance with the requirements of O.Reg. 153/04 and consisted of a historical records review, site reconnaissance, interviews, evaluation, and reporting. The scope of the P1ESA included both the Pier 8 P2ESA Property, and the adjoining Piers 5 to 7 properties.

## 1.1 Property Information

The Site is located north of the intersection of Guise Street East and John Street North, comprising the majority of Pier 8, along the west side of the Hamilton Harbour in Hamilton, Ontario. Figure 1 (Appendix B, Risk Assessment Report, Dillon, 2017) presents the site location and study area. Details on the Site are as follows.

| Phase Two Property Information | |
|---|---|
| Pier 8 | |
| Property Name | City of Hamilton, majority of Pier 8 (excludes land in the northwest corner of Pier 8 formerly owned by the federal government) |
| Municipal Addresses included in the study area | 659, 695 Catharine Street North<br>31, 33, 65 Guise Street East |
| Description<br>PIN 17579-0061 (LT) | Part of the Bed of Hamilton Harbour in front of Lots 14 and 15 Concession Broken Front, Barton and in front of Road Allowance between Lots 14 and 15, Concession Broken Front, Barton, Parts 10, 11, 14, 18, 19, 46, 47 and 51 on Plan 62R-15663, S/T VM249790, T/W WM249791, ST VM234017 and VM242052, in the City of Hamilton, designated as Parts 30 – 35 on a draft Reference Plan No. 15-16-546-00. |

| Phase Two Property Information | |
|---|---|
| Pier 8 | |
| Description<br>PIN 17579-0071 (LT) | Part of Water Lot in Front of Lot 14, Part of Lot 14, Broken Front Concession, in the City of Hamilton, designated as Part 37 on a draft Reference Plan No. 15-16-546-00. |
| Description<br>PIN 17579-0072 (LT) | Part of the Bed of Hamilton Harbour; Part of Water Lot in Front of Lot 14, Broken Front Concession; Part of Lot 13, N. Hughson Survey; Part of Lot 14, Broken Front Concession; Part of Lots 1, 2 & 3, J. Hughson Survey, in the City of Hamilton, designated as Parts 1-3, 8-11, 13, 17-29 on draft Reference Plan No. 15-16-546-00. |
| Description<br>PIN 17579-0076 (LT) | Part Water Lot in Front of Lot 14, Concession Broken Front being a Forced Road (aka Catherine Street, Catharine Street and Catharine St. North), in the City of Hamilton, designated as Part 38 on a draft Reference Plan No. 15-16-546-00. |
| Property Owner(s)<br>Property Owner Contact Details | The Corporation of the City of Hamilton<br>77 James Street North, Suite 400,<br>Hamilton, ON, L8R 2K3<br>Tel: (905) 546-2489 |
| Approximate Area and Dimensions of Property | Figure 1 presents the limits of the portion of Pier 8 included as part of the Phase Two Property. The approximate dimensions of the site are 430 m E-W x 390 m N-S with an area of 10.48 hectares. |

It is noted that reference to water lots in the description above is archaic, reflecting the previous status of these areas as water lots prior to infilling. The site does not include any current water lots.

The Site is located near the west side of the Hamilton Harbour, in an area of predominantly residential and commercial land use. Land use east and south of the site is primarily residential and institutional. Land use west of Pier 8 is predominantly commercial, consisting of Piers 5 through 7.

## 1.2 Site History

The Site was most recently used as a construction equipment yard, commercial area (boat maintenance, boat equipment hardware supply, tug-boat operations yard, parking area for HWT Centre), off-season boat storage associated with the Hamilton West Marina, and community use (sea cadets). Portions of the site were formerly used for ferry and ship docking, large-scale cargo storage and shipping. The proposed future land uses of the site has yet to be determined, but are expected to include a mixture of residential, commercial and recreational/community properties. As a result of the potential change in

land use to a more sensitive condition, a Record of Site Condition (RSC) will be required as per section 168.3.1 of the *Environmental Protection Act*.

The Site has a long history of industrial and commercial land uses related to port activities. Records indicate that the area encompassing the Site was first developed in the mid-1800s. Numerous stages of land reclamation activities have occurred, culminating in the expansion of Pier 8 in the 1960s. Historical records show that the early use of the Pier 8 area was for warehousing and storage. Later activities involved boat storage and maintenance associated with the marina and yacht club, aircraft hangar, trucking terminal and continued use of the land for warehousing and shipyard. The western portion of Pier 8 (excluded from the P2ESA Property) has been redeveloped for commercial and recreational use (HWT Centre, restaurant and office complex, outdoor ice rink, parking) following the completion of a risk assessment and implementation of risk management measures in the early 2000s (following federal requirements).

A table of the summarized current and past uses is presented below

| Current and Past Land Use Summary | | | | |
|---|---|---|---|---|
| Year[1] | Name of Owner | Description of Property Use | Property Use | Supporting Information |
| Pre 1830s | Various | Wharf and Break-Bulk Shipping | Commercial | Historical Information (Hamilton Public Library) |
| 1912 - 1962 | Hamilton Harbour Commissioners | Wharf and Break-Bulk Shipping, warehousing, Brewery, Float Plane terminal, Navy League | Commercial | Historical Information (HHC created on April 1st, 1912) |
| 1962-2000 | Hamilton Harbour Commissioners | Trucking Terminal<br>Shipping terminal<br>Navy League<br>Maintenance Garage<br>Canadian Coast Guard | Commercial | Expansion of Pier 8 via lake reclamation<br>City Directory Search<br>Aerial Photographs |
| 2000 - current | City of Hamilton (transfer of land to Hamilton Port Authority with exception of NW corner of P2ESA Property) | Trucking Terminal<br>Shipping terminal<br>Navy League<br>Maintenance Garage<br>Canadian Coast Guard<br>Construction Yard | Commercial | Parcel Registry Information<br>City Directory Search |
| 2015 - current | City of Hamilton (NW Corner of P2ESA Property transferred from Federal Government) | Vehicle Parking for Discovery Centre/HWT Centre (2003 – current) | Commercial | Transfer of land ownership from Federal Government to City of Hamilton |

Note 1: Approximate years

## 1.3 Physical Setting

The topography of Pier 8 is generally flat with a downward slope to the north towards Hamilton Harbour (see Figure 1). Land elevation ranges between 75 and 80 metres above sea level (masl). Surface water drainage is towards Hamilton Harbour.

The principal water feature in the area is Hamilton Harbour (Lake Ontario), which borders Pier 8 on the north, east and west sides. The nearest area of natural significance is Hendrie Valley which is approximately 2.5 km north of the site. Cootes Paradise, classified as an Area of Natural and Scientific Interest (ANSI), is located approximately 3 km west of the Site. The nearest surface water tributary is approximately 1.7 km from the Site and flows into Hamilton Harbour via Cootes Paradise, an enclosed embayment at the western limit of Lake Ontario. The Hamilton Conservation Authority indicated that a portion of Pier 8, along the harbour, is within the flood hazard zone of the Hamilton Harbour.

## 1.4 Hydrostratigraphy

Subsurface conditions at Pier 8 consisted of a variable textured fill material overlying native fine grained silts and clays. The fill material, which contains a mixture of sand, gravel, clay, silt mixed with slag, coal, bricks, concrete and other debris, had a thickness which varied from approximately 1 m along Guise Street in the south, thickening northwards towards the harbour, where up to 12 m was observed at the northern edge of Pier 8. A shallow watertable aquifer exists in the fill. The depth of the water table has been measured to be 0.5 to 2 mbgs, depending upon location and season. The fill was historically deposited as lakefill into Lake Ontario to create new harbor lands. The hydraulic conductivity of the fill is estimated to be relatively high (up to $10^{-5}$ m/s) based on grain size analyses of soil samples and in-situ hydraulic conductivity tests performed on monitoring wells. Directly underlying the fill was interbedded lacustrine silt, clay and sand, with a measured hydraulic conductivity ranging from $10^{-7}$ to $10^{-6}$ m/s. In some locations, especially near the south end of the Site, sand was present on top of the lacustrine deposits. Underlying the interbedded clay, silt and sand was a clay and silt unit, which extended across the entire P2ESA Study Area. This unit, which at depth includes Halton Till, is considered a regional aquitard, and has a low hydraulic conductivity ($10^{-10}$ to $10^{-9}$ m/s). Measurements of groundwater hydraulic gradients indicate that a shallow water table groundwater flow divide appears near the center of Pier 8, with shallow groundwater flow radiating outwards to the east, north and west. Along Guise Street, shallow groundwater flow is estimated to be directed northward. The thickness of the overburden is approximately 28 to 33 m, and overlies shale bedrock of the Queenston Formation. The Queenston shale is considered a regional aquifer, and in the area of the Site is confined by the overlying lower permeability Halton Tills. Water level measurements indicate a upward gradient between the shale bedrock and the water table in some areas; however, downward hydraulic gradients are measured in some locations within the shallow fill, and in one location between the shale bedrock and the water table.

## 1.5 Areas of Potential Environmental Concern (APECs)

The P1ESA identified 29 APECs related to historical land uses on-the Site and adjacent properties. Areas of Potential Environmental Concern (APEC) are summarized in the following table. Following the completion of the P2ESA, 19 of the APECs were closed, with 10 APECs remaining open (closed refers to APECs where the data indicates that there are no impacts above SCS as a result of the underlying PCA, and therefore, no further consideration of the APEC is required; open refers to APECs where impacts above SCS associated with the underlying PCA are either confirmed or suspected, and the APEC is carried forward in the assessment process). APECs were closed if the P2ESA results met the Table 1 SCS in both soil and groundwater for the tested parameters. APECs were also closed if the observed impacts could not be attributed to the PCA associated with the APEC in question, but instead impacts were deemed to be associated with another overlapping APEC. APEC and PCA locations are depicted in Figure 2, and summarized in the following table. Descriptions of each of the APECs (both open and closed) and the results of P2ESA investigations are provided in the following subsections.

| Phase Two ESA APECs | | | | | |
|---|---|---|---|---|---|
| Area of Potential Concern | Location of APEC on Phase One Property | Potentially Contaminating Activity | Location of PCA on-site or of-site) | Contaminants of Potential Concern | Media Potentially Impacted |
| APEC 20a (open) | Entire Pier 8 Area | 30. Importation of Fill Material of Unknown Quality | On-site | Metals, Inorganics, PHC/BTEX, PAH, VOC, PCB | Soil, groundwater |
| APEC 20b (closed) | Entire Pier 8 Area | 44. Port Activities, including operation and maintenance of Docks and Wharves. | On-site | Metals, Inorganics, PHC/BTEX, PAH, VOC, PCB | Soil, groundwater |
| APEC 20c (closed) | Entire Pier 8 Area | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | Metals, Inorganics, PHC/BTEX, VOC, PAH | Soil, groundwater |
| APEC 21 (closed) | NW Corner of Pier 8, Former Fertilizer Storage | 22. Fertilizer Manufacturing, Processing and Storage | On-site | Inorganics | Soil, Groundwater |

| Phase Two ESA APECs | | | | | |
|---|---|---|---|---|---|
| Area of Potential Concern | Location of APEC on Phase One Property | Potentially Contaminating Activity | Location of PCA on-site or of-site) | Contaminants of Potential Concern | Media Potentially Impacted |
| APEC 22 (closed) | Transformer Area West of Shed 6 | 55. Transformer Manufacturing, Processing and Use | On-site | Metals, PHC, PAH, PCB | Soil, groundwater |
| APEC 23 (open) | Shed 6 Heating oil UST/AST S side | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site | PHC/BTEX, PAH | Soil, groundwater |
| APEC 24 (closed) | Shed 6 Boat (Tug Boat) Maintenance | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation vehicles | On-site | PHC/BTEX, VOC | Soil, Groundwater |
| APEC 25 (open) | Shed 6 Heating oil UST/AST NE | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site; | PHC/BTEX, PAH | Soil, groundwater |
| APEC 26 (open) | Shed 6 Bulk Storage of Oil Drums | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site; | PHC/BTEX, PAH | Soil, groundwater |
| APEC 27 (open) | Fuel UST at NW corner of Shed 7 | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site | PHC/BTEX, PAH | Soil, Groundwater |
| APEC 28 (closed) | Shed 7 and surrounding area | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | Metals, Inorganics, PHC/BTEX, VOC | Soil, Groundwater |
| APEC 29 (closed) | Bermingham Foundations, outdoor equipment storage | PCA other 1. Construction Equipment Storage | On-site | Metals, Inorganics, PHC/BTEX,VOC | Soil, groundwater |

| Phase Two ESA APECs | | | | | |
|---|---|---|---|---|---|
| Area of Potential Concern | Location of APEC on Phase One Property | Potentially Contaminating Activity | Location of PCA on-site or of-site) | Contaminants of Potential Concern | Media Potentially Impacted |
| APEC 30 (closed) | Former Trucking Terminal | 11. Commercial Trucking and Container Terminals | On-site | Metals, Inorganics, PHC/BTEX, VOC | Soil, groundwater |
| APEC 31 (open) | Former Trucking Terminal | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | PHC/BTEX, VOC | Soil, groundwater |
| APEC 32 (open) | Former Canadian Coast Guard Building/Marine Garage | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | PHC/BTEX, VOC | Soil, groundwater |
| APEC 33 (open) | Former UST Location near Brewers Marine | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site | PHC/BTEX, PAH | Soil, Groundwater |
| APEC 34 (closed) | West of Brewers Marine | 3. Airstrips and Hangars Operations | On-Site | Metals, Inorganics, PHC/BTEX, VOC | Soil, Groundwater |
| APEC 35a (open) | Former operation of a truck maintenance garage | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | Metals, Inorganics, PHC/BTEX, PAH, VOC, PCB | Soil, Groundwater |
| APEC 35b (closed) | Current use of building as distribution warehouse | 39. Paint Manufacturing, Processing and Bulk Storage | On-site | Metals, Inorganics, VOC | Soil, Groundwater |

| Phase Two ESA APECs | | | | | |
|---|---|---|---|---|---|
| Area of Potential Concern | Location of APEC on Phase One Property | Potentially Contaminating Activity | Location of PCA on-site or of-site) | Contaminants of Potential Concern | Media Potentially Impacted |
| APEC 36 (closed) | Navy League General Area | 30. Importation of Fill Material of Unknown Quality | On-site | Metals, Inorganics, PHC, PAH, VOC, PCB | Soil, Groundwater |
| APEC 37 (closed) | Navy League Workshop | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | On-site | PHC/BTEX, VOC | Soil, Groundwater |
| APEC 38 (open) | former heating oil UST south of Navy League Building | 28. Gasoline and Associated Products Storage in Fixed Tanks | On-site | PHC/BTEX, PAH | Soil, Groundwater |
| APEC 39 (closed) | Former Federal Lands NW corner of Pier 8 | 30. Importation of Fill Material of Unknown Quality | On-site | Metals, Inorganics, PHC/BTEX, PAH, VOC, PCB | Soil, Groundwater |
| APEC 40 (closed) | Oil Pipeline | 14. Crude oil refining, Processing and Bulk Storage | On-site | PHC/BTEX, PAH | Soil, groundwater |
| APEC 41 (closed) | Pier8 | 30. Importation of Fill Material of Unknown Quality | Off-site (Former Federal Lands); | Metals, Inorganics, PHC/BTEX, VOC | Groundwater |

| Phase Two ESA APECs | | | | | |
|---|---|---|---|---|---|
| Area of Potential Concern | Location of APEC on Phase One Property | Potentially Contaminating Activity | Location of PCA on-site or of-site) | Contaminants of Potential Concern | Media Potentially Impacted |
| APEC 42 (closed) | Pier 7 | 30. Importation of Fill Material of Unknown Quality<br>44. Port Activities, including operation and maintenance of Docks and Wharves.<br>27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | Off-site | Metals, Inorganics, PHC/BTEX, VOC | Groundwater |
| APEC 43 (closed) | Former Machine Shop on Brock Street | 34. Metal Fabrication | Off-site | PHC/BTEX, VOC | Groundwater |
| APEC44 (closed) | Fill on Guise Street | 30. Importation of Fill Material of Unknown Quality | Off-site | Metals, Inorganics, PHC/BTEX | Groundwater |
| APEC 45 (closed) | Former Landfill | 58. Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners. | Off-site | PHC/BTEX, PAH, VOC | Groundwater |
| | Department of Defence Base | 27. Garages and Maintenance and Repair of Railcars, Marine Vehicles and Aviation Vehicles | Off-site | Metals, Inorganics, PHC, VOC | Groundwater |

# 2.0 Phase Two Environmental Site Assessment

The P2ESA was completed in 2016 (Dillon, 2016). The study area was expanded in 2017 to include the adjacent Brewer Marine property, located at the south side of the original P2ESA Property along Guise Street. Additional soil and groundwater investigations were performed on the Brewer Marine property and are presented in the P2ESA Addendum Report (Appendix B.2 of the Risk Assessment Report). The P2CSM was updated to include this additional information.

## 2.1 Applicable Site Condition Standards

Soil and groundwater samples were evaluated against the Ontario Ministry of the Environment and Climate Change (MOECC) 2011 Soil, Ground Water and Sediment Standards (MOECC, 2011). In particular, Table 1 Full Depth Generic Site Condition Standards (SCSs) were used as the comparison Standards. Quality Standards applicable to residential/ parkland/ institutional/ industrial/ commercial/ community (R/P/I/I/C/C) land use settings were used in the comparison. These standards are hereafter referred to as "Table 1 SCS" in this report. Sediment and surface water samples were not obtained as the Site does not contain a water lot or other surface water bodies.

Table 1 SCS were applied as the soil pH was greater than 9 in some areas, and since Section 41 of the Regulation has been considered applicable to the Site since portions of the Site may provide habitat for species classified as threatened or endangered under Section 7 of the *Endangered Species Act*, 2007. Dillon completed a Species at Risk (SAR) screening for the Site which identified the potential presence of SAR. This included a high level of probability for the presence of Barn Swallow, as suitable habitat is provided by a number of the structures at the Site and since a species with similar habitat requirements (Cliff Swallow) was observed at the site in 2012. A moderate probability for the presence of Little Brown Myotis (bat) was also identified. Follow-up field survey work to assess the potential presence of these species was completed in May of 2017, with the result that no evidence of either Barn Swallow or Little Brown Myotis presence was observed (i.e., no observation of individuals or nests), although potential habitat for these species was present..

Standards identified were used to evaluate the soil and groundwater quality conditions at the Site. These SCS are applicable as the anticipated property use will be a mixture of residential and commercial. Although the Table 1 SCS do not distinguish between soil textures, it is noted that the soils at the site consist of both fine-grained and coarse-grained soils. As such, the coarse-grained SCS are conservatively considered to be applicable at the Site in situations where other generic SCS may be applied (e.g., for comparison purposes or in future risk assessments). In addition, the fill that covers the majority of the Site, is deemed to have a coarse grained composition, as determined from grain size analyses conducted during this assessment.

## 2.2 Reliance on Other Studies

Information from several reports, authored by other parties, was used as input into the assessment of the physical and chemical quality conditions of soil and groundwater at the P2ESA Site. These reports include:

1) Peto MacCallum Ltd., Pier 8, Baseline Environmental Assessment, Hamilton, Ontario, May, 1993
2) Peto MacCallum Ltd., Geo-Environmental Investigation, Pier 8, Baseline Environmental Assessment, Hamilton, Ontario, July, 1995
3) Golder Associates Ltd., Preliminary Environmental Site Assessment and Geotechnical Investigation, Pier 8, Hamilton Harbour, Hamilton, Ontario, June, 2000
4) Terraprobe Inc., Subsurface Investigation, Pier 8 – Discovery Centre, Hamilton, Ontario, December, 2001
5) Ecoplans Limited, Contaminant Investigation, Guise Street and Harbour Patrol Access Road, Hamilton, Ontario, November, 2002
6) Thurber Engineering Ltd., Geotechnical Investigation, Proposed Watermain and Sewer Installation, Harbour Patrol Access (Pier 8) Road, Hamilton, Ontario, November, 2002
7) XCG Consultants Limited, Revised Final Site-Specific Risk Assessment, Pier 8, Hamilton Harbour, Hamilton, Ontario, February 2003
8) Geotechnical Investigation, West Harbour Pumping Station and Associated Works, Hamilton, Ontario, Draft Report, Terraprobe, 2016

Data from each report was evaluated to determine the suitability for inclusion into the P2ESA, based on appropriateness of sampling methodologies, and QA/QC protocols followed (where such information is provided).

Soil and groundwater results for testing locations that fall within the P2ESA Property are presented in Table 4.1 and Table 4.2 for soils, and Table 5.1 and Table 5.2 for groundwater (Appendix B.3, Pier 8 Risk Assessment), and the results compared to the current applicable Table 1 SCS. Testing Locations are shown in Figure 3 (Appendix B.2, Pier 8 Risk Assessment Report). Digital copies of these reports are provided in the CD accompanying the Pier 8 Risk Assessment Report.

### 2.2.1 Peto MacCallum Ltd., Pier **8**, Baseline Environmental Assessment, Hamilton, Ontario, May **1993**

Peto MacCallum Ltd., (Peto) was retained by the Hamilton Harbour Commission to undertake environmental testing work near Shed 6 and Shed 7 as a baseline soil environmental quality assessment. Two soil samples were obtained from depths <1.8 mbgs at two boreholes (BH5 and BH9). Soil samples were submitted to TSL Environmental Laboratories and tested for metals, EC and SAR. It is noted that samples were also submitted for Total Petroleum Hydrocarbons (TPH); however, this data was not used in the P2ESA, as there is no MOECC SCSs for TPH, and sampling methodologies for hydrocarbons parameters in soil has changed since the date of the investigation.

Dillon reviewed the report, and determined that select data (metals, SAR, EC) can be used as input into the P2ESA, as sampling methodologies are considered generally consistent with current MOECC protocols, and the risk of bias is low. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identified similar soil quality conditions.

A review of the soil quality data indicates that all tested parameters met the current applicable Table 1 SCS; however, antimony and chromium (hexavalent) detection limits were above the Table 1 SCS values.

### 2.2.2 Peto MacCallum Ltd., Geo-Environmental Investigation, Pier 8, Baseline Environmental Assessment, Hamilton, Ontario, July, 1995

Peto MacCallum Ltd., (Peto) was retained by the Hamilton Harbour Commission to undertake environmental testing work near Shed 6 and Shed 7 as a follow-up to a baseline assessment conducted in 1993. Four soil samples were obtained from depths <2 mbgs at four boreholes (BH1A, BH2A, BH3A, BH4A). Soil samples were submitted to Fine Analysis Laboratory and tested for metals, EC and SAR. It is noted that samples were also submitted for Total Petroleum Hydrocarbons (TPH); however, this data was not used in the P2ESA, as there is no MOECC SCSs for TPH, and sampling methodologies for hydrocarbons parameters in soil has changed since the date of the investigation.

Dillon reviewed the report, and determined that select data (metals, SAR, EC) can be used as input into the P2ESA, as sampling methodologies are considered generally consistent with current MOECC protocols, and the risk of bias is low. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identifies similar soil quality conditions.

A review of soil quality data indicates that antimony and zinc were detected at concentrations exceeding Table 1 SCS in select samples.

### 2.2.3 Golder Associates Ltd., Preliminary Environmental Site Assessment and Geotechnical Investigation, Pier 8, Hamilton Harbour, Hamilton, Ontario, June, 2000

Golder Associates Ltd. (Golder) was retained by Public Works and Government Services Canada (PWGSC) to conduct environmental and geotechnical investigations in the northwestern portion of Pier 8. As part of this investigation, two boreholes (BH2, BH3) and three test holes (TH1, TH7, TH8) were constructed in an area that extends within the P2ESA Property. The boreholes were advanced using hollow stem augers, while test holes were advanced using Pionjar equipment, with soil samples obtained using split spoon soil samplers. Monitoring wells were installed in boreholes BH2 and BH3. Test holes extended to depths between 1.98 and 2.31 mbgs. Boreholes extended to depths of 27.46 mbgs (BH-2) and 4.88 mbgs (BH-3).

Select soil samples were submitted to PSC Philip Services analytical laboratories for metal, TPH/BTEX and PAH analyses.

Dillon reviewed the investigation methodologies, and determined that select data can be used as input into the P2ESA. The sampling methodologies for metal analyses are considered consistent with current MOECC protocols, and the risk of bias is low. Therefore, the data is considered appropriate for use in the P2ESA assessment. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identifies similar soil quality conditions. TPH/BTEX and PAH soil quality data was used for qualitative comparison purposes only, as sampling methodologies used in the investigation are not consistent with current requirements.

A review of soil quality data indicates that lead, mercury and zinc were detected at concentrations exceeding Table 1 SCS in select samples.

### 2.2.4 Terraprobe Inc., Subsurface Investigation, Pier 8 – Discovery Centre, Hamilton, Ontario, December, 2001

Terraprobe Inc. (Terraprobe) was retained by the City of Hamilton to conduct a geotechnical investigation along an alignment of a proposed sewer within Discovery Drive, extending from Guise Street intersection to west of Shed 4. Investigations included the drilling of four boreholes using a truck mounted powered auger, with soil samples collected using split spoon soil samplers. A total of 8 soil samples collected from either the fill or underlying native silt and silty sand layer were tested for metals, EC, and SAR.

Dillon reviewed the investigation methodologies, and determined that select data can be used as input into the P2ESA. The sampling methodologies are considered consistent with current MOECC protocols, and the risk of bias is low. Therefore, the data is considered appropriate for use in the P2ESA assessment. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identifies similar soil quality conditions.

A review of soil quality data indicates that antimony, cadmium, lead, mercury, molybdenum, selenium, silver, SAR and zinc were detected at concentrations exceeding Table 1 SCS in select samples.

### 2.2.5 Ecoplans Limited, Contaminant Investigation, Guise Street and Harbour Patrol Access Road, Hamilton, Ontario, November, 2002

Ecoplans Limited was retained by McCormick Rankin Corporation to undertake environmental testing along Guise Street for a proposed watermain installation and road reconstruction project. The portion of the study area that falls within the P2ESA Property included BH12 and BH13 along the Harbour Patrol Access Road (now Discovery Drive). A total of four soil samples were obtained from the fill at depths between 0 and 1.3 mbgs, and tested for metals, EC, SAR and PAH. It is noted that samples were also submitted for BTEX and Total Petroleum Hydrocarbons (TPH); however, this data was not used in the P2ESA as sampling methodologies for hydrocarbons parameters in soil has changed since the date of the investigation.

Dillon reviewed the report, and determined that select data (metals, SAR, EC) can be used as input into the P2ESA, as sampling methodologies are considered generally consistent with current MOECC protocols, and the risk of bias is low. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identifies similar soil quality conditions.

A review of soil quality data indicates that barium, molybdenum and selenium were detected at concentrations exceeding Table 1 SCS in select samples.

### 2.2.6 Thurber Engineering Ltd., Geotechnical Investigation, Proposed Watermain and Sewer Installation, Harbour Patrol Access (Pier 8) Road, Hamilton, Ontario, November, 2002

Thurber Engineering Ltd. (Thurber) was retained by the City of Hamilton to conduct a geotechnical investigation along an alignment for a proposed watermain and sewer installation along the Harbour Patrol Access Road (know Discovery Drive). The work involved the construction of one borehole (Borehole 02-10) to a depth of 9.75 m. One soil sample from a the fill collected at a sample depth of approximately 3 m was submitted for analytical testing to PSC Analytical Laboratories and tested for metals, SAR, EC and free cyanide.

Dillon reviewed the investigation methodologies, and determined that select data can be used as input into the P2ESA. The sampling methodologies are considered consistent with current MOECC protocols, and the risk of bias is low. Therefore, the data is considered appropriate for use in the P2ESA assessment. This conclusion is supported by soil quality data collected in the same general area during Dillon P2ESA investigations which identifies similar soil quality conditions.

A review of soil quality data indicates that molybdenum and zinc were detected at concentrations exceeding Table 1 SCS in select samples.

### 2.2.7 XCG Consultants Limited, Site-Specific Risk Assessment, Pier 8, Hamilton, Harbour, Hamilton, Ontario, February, 2003

XCG Consultants Limited (XCG) was retained by Public Works and Government Services Canada (PWGSC) on behalf of Parks Canada to conduct a Site Specific Risk Assessment of lands in the northwest portion of Pier 8 that were owned at that time by the federal government. A portion of the study area included the northwest corner of the P2ESA Property, but also included lands further to the west beyond the P2ESA Property that are currently occupied by the HWT Centre, Williams Café, HWT offices and ice rink. The work was conducted as part of the planning at the time to develop the Canada Discovery Centre on Marine Conservation facility.

The SSRA references data that was collected as part of a 2002 Phase II ESA study. Investigations that were conducted on the portion of the Phase II ESA study area, that fall on the P2ESA Property included drilling of four boreholes (BH2, BH3, BH5, and MW1) the installation of one monitoring well (MW1). In addition, two surface soil samples were obtained (Boat 1, Boat 2) within the former boat storage area.

Select soil samples were analyzed for metals, BTEX/TPH, and PAH. One groundwater sample from MW1 was tested for metals and PAH.

Dillon reviewed the report methodologies and QA/QC protocols, and determined that select data can be used as input into the P2ESA. Comments on the suitability of the data for inclusion into the P2ESA include:

- Metals for soil and groundwater – sampling methodologies are consistent with current MOECC protocols, and risk of bias is low, therefore data is considered appropriate for use in the P2ESA assessment.
- TPH/BTEX/PAH for soil – sampling protocols are not consistent with MOECC sampling protocols. Furthermore, MOECC site condition standards do not exist for TPH. This data has not been used as quantitative information in the P2ESA, but has been used qualitatively to aid delineation of areas of potential impacts, where supported by recent soil data from nearby sampling locations.
- PAH/BTEX for groundwater – Sampling methods did not use low flow sampling techniques, and therefore there is a potential for bias (high) chemical analyses results as a result of entrained sediment in the sample; however, it is also possible for bias (low) for volatile parameters. Therefore, this data has not be used as quantitative information in the P2ESA, but has been used qualitatively to aid delineation of areas of potential impacts, where supported by recent groundwater data.

Table 1 SCS were exceeded in soil in one or more locations for cadmium, copper, lead and silver. Table 1 SCS were exceeded in groundwater at MW1 for copper, lead, molybdenum, nickel, silver and vanadium.

### 2.2.8 Terraprobe Ltd., Geotechnical Investigation, West Harbour Pumping Station and Associated Works, Hamilton, Ontario, Draft Report, 2016

Terraprobe Inc. (Terraprobe) was retained by the City of Hamilton to conduct a geotechnical investigation for the design of new underground services proposed for the West Harbour/Pier 8 area. The work included the construction of 27 boreholes, of which 15 were within the P2ESA Property, to depths varying between 6.6 and 24.8 mbgs. Boreholes drilled within the P2ESA Property included BH4 thru BH6, and BH8 thru BH19. Drilling was conducted using hollow-stem auger drilling equipment, with soil samples obtained using split-spoon soil samplers in accordance with ASTM Standard D1586. Bedrock was investigated in one of the boreholes using conventional diamond drilling techniques and NQ sized coring equipment. Monitoring wells were installed in select boreholes for later sampling and submission for analysis by Dillon.

Select soil samples were submitted by Terraprobe under chain of custody to AGAT laboratories for soil quality analysis of select parameters including metals and inorganics, PAH, PCB, PHC and VOCs. Samples were stored in dedicated containers provided by the laboratory. Grain size analyses were also performed on samples from four boreholes (BH5, BH10, BH12, BH24).

No groundwater samples were obtained by Terraprobe. Sampling and analytical testing results of groundwater performed by Dillon are presented separately in the P2ESA Addendum Report (Appendix B, Pier 8 Risk Assessment).

Observed soil conditions consisted of fill overlying deposits of loose silt, silty sand and sandy silt, below which is a silty clay strata. Beneath the overburden is bedrock of the Queenston Formation.
Boreholes that are within the P2ESA Property, where soil quality data was obtained included the following:

| Borehole[1] | Parameters (number of samples) | | | | |
|---|---|---|---|---|---|
| | Metals and Inorganics | PHC/BTEX | PAH | VOC | PCB |
| BH4 | 2 | 2 | 2 | 2 | 2 |
| BH5 | 1 | 1 | 1 | 1 | 1 |
| BH6 | 1 | 1 | 1 | 1 | 1 |
| BH8 | 2 | 2 | 2 | 2 | 2 |
| BH9 | 1 | 1 | 1 | 1 | 1 |
| BH10 | 2 | 2 | 2 | 2 | 2 |
| BH11 | 2 | 2 | 2 | 2 | 2 |
| BH12 | 1 | 1 | 1 | 1 | 1 |
| BH13 | 1 | 1 | 1 | 1 | 1 |
| BH14 | 1 | 1 | 1 | 1 | 1 |
| BH16 | 1 | 1 | 1 | 1 | 1 |
| BH17 | 2 | 2 | 2 | 2 | 2 |
| BH18 | 1 | 1 | 1 | 1 | 1 |
| BH19 | 1 | 1 | 1 | 1 | 1 |

Note 1: Borehole locations are shown on Figure 3 (Appendix B, Pier 8 Risk Assessment). Borehole designation is shown as "TP-BHx".

The analytical testing results have been incorporated into the Dillon P2CSM report and supporting figures, tables and appendices.

Quality Assurance/Quality Control program followed by Terraprobe included the submission of 2 duplicate samples.

The results of the chemical analyses were compared to the Table 1 and Table 3 of the MOECC Standards (MOECC, 2011). Analyses results indicated that several samples of the fill exceeded the MOECC Table 1 standards for the parameters electrical conductivity, SAR, antimony, lead, mercury, zinc, benzene, xylenes, F2-F4 PHCs, and PAHs.

Dillon has reviewed the study and field investigation methodologies, investigation results and quality assurance/quality program implemented during the Terraprobe, 2016 investigation, and considers the provided data acceptable for input into the assessment of the P2ESA Property.

## 2.3 Summary of Sampling and Analysis Plan

The sampling and analysis plan providing details on the P2ESA Property investigation locations and contaminants of concern are presented in the following table. New investigation boreholes and/or monitoring wells are highlighted in italics. Sampling locations are shown in Figure 3 (Appendix B.2, Pier 8 Risk Assessment Report).

Table 2
Investigated Areas of Potential Environmental Concern

| APEC | Contaminated Source Description | Investigation Boreholes/Monitoring Wells | Contaminants of Concern |
|---|---|---|---|
| APEC 20a, 20b, 20c | Entire Pier 8 Area - Port Activities; Impacted Fill; Marine Vehicle Maintenance | All boreholes/monitoring wells<br><br>*New (MW215, MW216, MW217, TP-BH5/MW, TP-BH6/MW, TP-BH10/MW, TP-BH11/MW, TP-BH19/MW)* | Metals, inorganics, PHC/BTEX, PAH, VOC, PCB |
| APEC 21 | NW Corner of Pier 8, Former Fertilizer Storage | MW16, MW131,MW132, MW180<br><br>*New (MW217, TP-BH10/MW, TP-BH11/MW)* | Inorganics |
| APEC 22 | Transformer Area West of Shed 6 | MW115, BH116, BH117 | Metals, PHC, PAH, PCB |
| APEC 23 | Shed 6 Heating oil UST South side (UST #6) | MW25, BH106, BH108, MW110 through MW114, MW138 through MW151 (d&s), BH156 through BH165, MW 175, MW176, BH200 through BH210 | PHC/BTEX, PAH |
| APEC 24 | Shed 6 Boat (Tug Boat) Maintenance | MW30, MW99 | PHC/BTEX, VOC |

| Table 2<br>Investigated Areas of Potential Environmental Concern | | | |
|---|---|---|---|
| APEC | Contaminated Source Description | Investigation Boreholes/Monitoring Wells | Contaminants of Concern |
| APEC 25 | Shed 6 Heating oil UST NE Corner (UST #7) | MW30, OTE (5 wall/floor samples from tank removal excavation), MW99<br><br>*New (MW215)* | PHC/BTEX, PAH |
| APEC 26 | Shed 6 Bulk Storage of Oil Drums | | PHC/BTEX, PAH |
| APEC 27 | Former Fuel Storage UST at NW corner of Shed 7 (UST #8) | MW124, MW126, MW177, Shed 7 (test pit samples) | PHC/BTEX, PAH |
| APEC 28 | Shed 7 and Surrounding Area | MW124, MW125, MW126, MW177 | Metals, inorganics, PHC/BTEX, VOC |
| APEC 29 | Bermingham Foundations Outdoor Equipment Storage | MW18, BH105, MW176, MW118, MW119, MW120, MW121 | Metals, inorganics, PHC/BTEX, VOC |
| APEC 30 | Former Trucking Terminal Yard Area | MW15, BH85, MW86, MW87, BH88, BH90, MW174, MW189<br><br>*New (MW216)* | Metals, inorganics, PHC/BTEX, VOC |
| APEC 31 | Former Trucking Terminal Maintenance Garage | MW89, BH91, BH92, BH93, BH94, BH95, BH96, MW97, MW98 | PHC/BTEX, VOC |
| APEC 32 | Former Canadian Coast Guard Building/Marine Garage | MW13d, MW13s, MW174 | PHC/BTEX, VOC |
| APEC 33 | Former Fuel Storage (USTs #1-4) near Brewers Marine | BH31, MW72, MW73, MW74, MW62, TP1, TP2, TP3<br><br>*New (MW216, TP-BH5/MW)* | PHC/BTEX, PAH |
| APEC 34 | Former Hangar Area West of Brewers Marine | | Metals, Inorganics, PHC/BTEX, VOC |
| APEC 35a, 35b | Former Trucking Terminal and current use of building as a distribution warehouse (Brewers Marine) | MW11, MW12, MW67, BH31,MW68, BH69, BH70, BH71, MW72, MW73, MW74, MW81, MW187, TP5, TP17, TP20<br><br>New (MW211, MW212, MW213, MW214) | Metals, inorganics, PHC/BTEX, PAH, VOC, PCB |

| Table 2<br>Investigated Areas of Potential Environmental Concern | | | |
|---|---|---|---|
| APEC | Contaminated Source Description | Investigation Boreholes/Monitoring Wells | Contaminants of Concern |
| APEC 36 | Navy League General Area, Impacted Fill, thickness from 0 to 2m | MW19, MW20, BH127, BH128, BH129, MW130, BH179<br><br>*New (TP-BH19/MW)* | Metals, inorganics, PHC/BTEX, PAH, VOC, PCB |
| APEC 37 | Former Heating Oil AST south of Navy League Building (AST #2) | MW19 | PHC/BTEX, PAH |
| APEC 38 | Navy League Workshop | MW20, BH129 | PHC/BTEX, VOC |
| APEC 39 | Former Federal Lands NW Corner of Pier 8 (additional fill placed during construction of parking lot) | MW131, MW132, MW133, MW134, MW135, MW136, MW137, MW180 | Metals, inorganics, PHC/BTEX, PAH, VOC, PCB |
| APEC 40 | Oil Pipeline | MW62, MW72, MW78, BH80, MW81, MW82, MW84, MW187 | PHC/BTEX, PAH |
| APEC 41 | Off-site (Former Federal Lands – fill of unknown quality, west side of Pier 8) | MW131, MW134, MW137, MW180, MW181 | Metals, Inorganics, PHC/BTEX, VOC |
| APEC 42 | Off-site Pier 7 (Impacted Fill, Port Activities, Garages and Maintenance of Marine Vehicles, and associated fuel UST (UST #5)) | MW68, MW75d, MW75s, MW169, MW173d, MW173s, MW184, MW190 | Metals, inorganics, PHC/BTEX, VOC |
| APEC 43, 44 | Off-site (Impacted fill along Guise Street, and former machine shop on Brock Street) | MW68, BH69, MW169, MW173d, MW173s | Metals, inorganics, PHC/BTEX, VOC |
| APEC 45 | Off-site (Former Waste Disposal Landfill; Navy base, imported fill under Guise Street) | MW84, MW130<br><br>*New (TP-BH19/MW)* | Metals, inorganics, PHC/BTEX, PAH, VOC |

## 2.4 Summary of P2ESA Results

The P2ESA identified metals/inorganics, PHC/BTEX impacts and PAH in the soil and groundwater at concentrations above Table 1 SCS over the majority of the P2ESA Property; however, PHC/BTEX impacts in groundwater are less extensive in the south and east. VOC impacts in soil and groundwater are more sporadic, and are elevated in the subsurface above Table 1 SCS in the west, north and east. PCB impacts were detected in the soil in isolated locations near the center of the Pier. PCBs were not detected in groundwater; however, the detection limits were raised above Table 1 SCS as a result of analytical

limitations for some of the samples. In general, the portion of the Pier 8 property that was constructed post-1960s has poorer soil and groundwater quality than the older portions of the Site in the south and the area west of Catherine Street.

The source of the elevated parameter exceedances is attributed largely to the contaminated fill (APEC 20a) used to construct Pier 8; however, several other smaller impact sources were identified. These sources included petroleum fuel underground storage tanks (USTs) associated with the former truck terminal near Brewers Marine Supply yard; historical surface fuel/oil spillage in Shed 4 and former heating oil USTs at Shed 6, Shed 7 and former above ground storage tank (AST) associated with the Navy League building. While the majority of impacts are within the fill, impacts do extend into the underlying native material in some locations. The maximum depth of impacts was determined based on analysis of soil and groundwater samples collected from below the impacted zone that met the Table 1 SCS. However, for conservativeness and vertical delineation purposes of the regulation, the maximum depth of soil and groundwater impacts was considered the top of the underlying silt and clay unit, which in all cases was either at the same elevation, or lower elevation, than the deepest tested sample that met Table 1 SCS. Although the fill material was not found to be impacted in all locations within the area delineated as impacted, exceedances were common. Furthermore, due to the nature of filling operations and unknown quality of fill materials, impacts were interpreted to potentially occur anywhere within this area. Similarly, impacts may extend into the shallower portions of the underlying native materials due to leaching or due to harbour related contamination predating the filling operations. Impacts were not interpreted to extend into the silt and clay unit as this unit is a regional aquitard that is deemed to be a physical barrier for vertical migration of groundwater and soil contamination.

LNAPL (light non-aqueous phase liquid) product was identified in the fill unit below the floor of Shed 6 (APEC 23 and 26). The LNAPL was identified as a weathered diesel fuel that is attributed to the former heating oil UST that was once located along the south side of the building. The maximum measured product thickness was 46 cm in a monitoring well. Thicknesses of <5 cm were measured in two other monitoring wells. The estimated LNAPL area below the building is approximately 1,400 $m^2$.

Investigations confirmed that all fuel storage tanks had been previously removed from the Study Area, with the exception of a 1,890 L heating fuel UST located at the NE corner of Shed 6. This tank was removed during the investigations; and soil samples taken along the sides and floor of the excavation to assess worst case contamination conditions. Since the surrounding fill (APEC 23, 26) was impacted with the same Contaminants of Concern (COC) (i.e., PHC/BTEX and PAH) as the tank area, the maximum extent of impacts associated with this APEC was within the delineation area of fill impacts, and therefore, differentiation between maximum extent of impacts from these two APECs could not be performed.

## 2.5 Summary of Maximum COC Concentrations

A summary of the maximum detected concentrations of the COC where concentrations exceed Table 1 SCS are presented in the following tables, for soil and groundwater, respectively. Values in italics are the maximized quantified detection concentration for parameters where the maximum reported concentration was non-detect and the Reporting Detection Limits (RDLs) were elevated above SCS.

| Soil Contaminants of Concern | | | |
|---|---|---|---|
| Soil COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| *METALS AND INORGANICS* | | | |
| Electrical Conductivity | 3.52 mS/cm | MW84 0.66 to 1.01 | APEC 20a |
| Sodium Adsorption Ratio | 68.9 | MW84 1.52 to 1.82 | APEC 20a |
| Antimony | 8.5 ug/g | MW132 3.05 to 3.33 | APEC 20a, 39 |
| Arsenic | 36.4 ug/g | SHED 7 TANK AREA 1.25 to 1.45 | APEC 27 |
| Barium | 361 ug/g | MW118 1.75 to 2.18 | APEC 20a, 29 |
| Beryllium | 6.08 ug/g | MW100 0.76 to 1.37 | APEC 20a |
| Boron | 92.2 ug/g | MW100 0.76 to 1.37 | APEC 20a |
| Cadmium | 13.2 ug/g | BH5 SS2* .75 to 1.4 | APEC 20a |
| Chromium (VI) | 0.74 ug/g | MW120 0.6 to 0.9 | APEC 20a, 29 |
| Chromium (total) | 164 ug/g | BH95 1.83 to 2.03 | APEC 30, 31, 20a |
| Cobalt | 32.5 ug/g | BH129 0.53 to 1.02 | APEC 20a |
| Copper | 1140 ug/g | MW98 4.57 to 5.03 | APEC 30, 31, 20a |
| Lead | 2480 ug/g | Shed 7 Tank Area 1.25 to 1.45 | APEC 27 |
| Mercury | 4.08 ug/g | MW133 0.76 to 1.01 | APEC 20a, 39 |
| Molybdenum | 12 ug/g | MW18 0.86 to 0.99 | APEC 20a, 29 |
| Phosphorus | 898 ug/g | SHED 7 TANK AREA 1.25 to 1.45 | APEC 27 |
| Potassium | 3540 ug/g | MW109 0.58 – 0.88 | APEC 21 |

| Soil Contaminants of Concern | | | |
|---|---|---|---|
| Soil COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| Selenium | 2.2 ug/g | BHG2* 1.51 to 2.1 | APEC 20a |
| Silver | 30.7 ug/g | MW110 1.52 to 1.98 | APEC 20a, 23 |
| Zinc | 3640 ug/g | Shed 7 Tank Area 1.25 to 1.45 | APEC 27 |
| *BTEX AND PETROLEUM HYDROCARBONS* | | | |
| Benzene | 1.43 ug/g | TP2 2.0 to 2.3 | APEC 33 |
| Toluene | 1.4 ug/g | MW12 2.29 to 2.49 | APEC 35a, 33 |
| Ethyl benzene | 13.1 ug/g | MW143 1.68 to 2.08 | APEC 20a, 23 |
| Total Xylenes | 39.6 ug/g | MW143 1.68 to 2.08 | APEC 20a, 23 |
| PHC(F1) | 637 ug/g | MW143 1.68 to 2.08 | APEC 23 |
| PHC(F2) | 19,700 ug/g | MW143 1.68 to 2.08 | APEC 23 |
| PHC(F3) | 13,700 ug/g | MW143 1.68 to 2.08 | APEC 23 |
| PHC(F4) | 44,100 ug/g | MW144 1.98 to 2.26 | APEC 23 |
| *POLYCYCLIC AROMATIC HYDROCARBONS* | | | |
| Acenaphthene | 16.9 ug/g | MW143 1.68 to 2.08 | APEC 23 |
| Acenaphthylene | 3.69 ug/g | MW143 1.68 to 2.08 | APEC 23 |
| Anthracene | 8.18 ug/g | MW119 1.12 to 1.42 | APEC 20a, 29 |
| Benzo(a)anthracene | 25.7 ug/g | MW119 1.12 to 1.42 | APEC 20a 29 |
| Benzo(a)pyrene | 17.5 ug/g | MW119 1.12 to 1.42 | APEC 20a 29 |
| Benzo(b)fluoranthene | 24.8 ug/g | MW119 1.12 to 1.42 | APEC 20a 29 |
| Benzo(g,h,i)pyrene | 8.3 ug/g | MW18 0.86 to 0.99 | APEC 20a 29 |
| Benzo(k)fluoranthene | 8.06 ug/g | MW119 1.12 to 1.42 | APEC 20a 29 |
| Chrysene | 25.2 ug/g | MW119 1.12 to 1.42 | APEC 20a 29 |

| Soil Contaminants of Concern | | | |
|---|---|---|---|
| Soil COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| Dibenzo(a,h)anthracene | 3.16 ug/g | MW119<br>1.12 to 1.42 | APEC 20a, 29 |
| Fluoranthene | 48.2 ug/g | MW119<br>1.12 to 1.42 | APEC 20a, 29 |
| Fluorene | 25.2 ug/g | MW143<br>1.68 to 2.08 | APEC 23 |
| Indeno(1,2,3-c,d)pyrene | 9.44 ug/g | MW119<br>1.12 to 1.42 | APEC 20a, 29 |
| Methylnaphthalene, 2-(1-) | 440 ug/g | MW143<br>1.68 to 2.08 | APEC 23 |
| Naphthalene | 73.1 ug/g | MW143<br>1.68 to 2.08 | APEC 23 |
| Phenanthrene | 64.7 ug/g | MW143<br>1.68 to 2.08 | APEC 23 |
| Pyrene | 35.1 ug/g | MW119<br>1.12 to 1.42 | APEC 20a, 29 |
| *VOLATILE ORGANIC COMPOUNDS* | | | |
| 1,1-dichloroethane | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.064 ug/g* | *BH107*<br>*2.13 to 2.44* | *APEC 20a* |
| 1,1-dichloroethene | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| 1,2-dichlorobenzene | <0.8 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.333 ug/g* | *MW82*<br>*0.18 to 0.48* | *APEC 30, 20a* |
| 1,2-dichloroethane | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| 1,4-dichlorobenzene | <0.8 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.237 ug/g* | *BH105*<br>*5.26 to 5.56* | *APEC 20a, 29* |
| 4-methyl-2-pentanone (methyl isobutyl ketone) | <2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *1.37 ug/g* | *MW82*<br>*0.18 to 0.48* | *APEC 20a* |
| Acetone | <2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |

| Soil Contaminants of Concern | | | |
|---|---|---|---|
| Soil COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| Bromoform | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.052 ug/g* | *MW137*<br>*12.19 to 12.8* | *APEC 20a* |
| Chloroform | <0.4 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| cis-1,2,dichloroethene | <0.2 ug/g | BH139<br>3.05 to 3.66<br>MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.094* ug/g | *BH105*<br>*5.26 to 5.56* | *APEC 20a* |
| Dichloromethane | <9 ug/g | BH105<br>5.26 to 5.56 | APEC 20a |
| | *0.274 ug/g* | *BH96*<br>*0.56 to 0.69* | *APEC 31* |
| Hexane | <3 ug/g | BH105<br>5.26 to 5.56 | APEC 20a |
| | *1.46 ug/g* | *MW143*<br>*1.68 to 2.08* | *APEC 20a* |
| Styrene | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| Trichloroethene | 0.135 ug/g | MW72<br>1.52 to 2.08 | APEC 35a, 20a |
| Tetrachloroethene | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.138 ug/g* | *BH105*<br>*5.26 to 5.56* | *APEC 20a, 29* |
| trans-1,2-dichloroethene | <0.2 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.054 ug/g* | *MW72*<br>*1.52 to 2.08* | *APEC 35a* |
| Vinyl Chloride | <0.08 ug/g | MW143<br>1.68 to 2.08 | APEC 20a |
| | *0.079* ug/g | *BH108*<br>*4.97 to 5.56* | *APEC 20a* |
| *PCBs* | | | |
| PCBs(total) | 3.95 ug/g | MW137<br>0.76 to 1.09 | APEC 20a, 39 |

* Historical sample

| Groundwater Contaminants of Concern | | | |
|---|---|---|---|
| Groundwater COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| *METALS AND INORGANICS* | | | |
| Chloride | 1740 mg/L | MW84 0.76 to 3.81 | APEC 20a |
| Antimony | 6.37 ug/L | MW131 0.91 to 3.96 | APEC 20a |
| Arsenic | 44 ug/L | MW125 0.76 to 3.81 | APEC 20a |
| Barium | 991 ug/L | MW89 1.83 to 4.88 | APEC 20a |
| Boron | 1980 ug/L | MW137 0.91 to 3.96 | APEC 20a |
| Cobalt | 4.9 ug/L | MW62D 6.1 to 7.62 | APEC 20a |
| Copper | 11 ug/L* | MW1 (Golder) Interval unknown | APEC 20a |
| Lead | 6 ug/L* | MW1 (Golder) Interval unknown | MW20a |
| Molybdenum | 192 ug/L | MW136 0.91 to 3.96 | APEC 20a |
| Nickel | 21.5 ug/L | MW110 1.22 to 4.27 | APEC 20a |
| Phosphorus | 425 ug/L | MW180 15.24 to 18.29 | APEC 21 |
| Potassium | 56700 ug/L | MW131 0.91 to 3.96 | APEC 21 |
| Selenium | 13.8 ug/L | MW114 0.91 to 3.96 | APEC 20a |
| Sodium | 2290 ug/L | MW84 0.76 to 3.81 | APEC 20a |
| Vanadium | 89.8 ug/L | MW131 0.91 to 3.96 | APEC 20a |
| *BTEX AND PETROLEUM HYDROCARBONS* | | | |
| Benzene | 301 ug/L | MW145 0.91 to 3.96 | APEC 20a, 23 |
| Toluene | 8.69 ug/L | MW110 1.22 to 4.27 | APEC 20a |
| Ethyl benzene | 19 ug/L | MW145 0.91 to 3.96 | APEC 20a, 23 |
| PHC(F2) | 12 ug/L | MW25 1.52 to 5.18 | APEC 23 |
| PHC(F3) | 11.4 ug/L | MW114 0.91 to 3.96 | APEC 23 |

| Groundwater Contaminants of Concern | | | |
|---|---|---|---|
| Groundwater COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| PHC(F4) | 1.7 ug/L | MW25 1.52 to 5.18 | APEC 23 |
| *POLYCYCLIC AROMATIC HYDROCARBONS* | | | |
| Acenaphthene | 146 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Acenaphthylene | 31.9 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Anthracene | 3.8 ug/L | MW25 1.52 to 5.18 | APEC 23 |
| Benzo(a)anthracene | 73.5 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Benzo(a)pyrene | 52.2 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Benzo(b)fluoranthene | 70.1 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Benzo(g,h,i)pyrene | 25 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Benzo(k)fluoranthene | 29.7 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Chrysene | 64.6 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Dibenzo(a,h)anthracene | 6.82 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Fluoranthene | 182 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Fluorene | 229 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Indeno(1,2,3-c,d)pyrene | 29.8 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Methylnapthalene, 2-(1-) | 3070 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Naphthalene | 319 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Phenanthrene | 449 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| Pyrene | 204 ug/L | MW114 0.91 to 3.96 | APEC 23 |
| *VOLATILE ORGANIC COMPOUNDS* | | | |
| 1,1-dichloroethane | 0.66 ug/L | MW15 1.52 to 4.57 | APEC 20a, 30 |
| 1,2-dichloroethane | 0.53 ug/L | MW74 2.13 to 5.18 | APEC 35 |

| Groundwater Contaminants of Concern | | | |
|---|---|---|---|
| Groundwater COC | Maximum Concentration | Location/Screen Interval (mbgs) | APEC |
| Chloroform | <2.3 ug/L | MW74<br>2.13 to 5.18 | APEC 35 |
| | *2.2 ug/L* | *MW134*<br>*0.76 to 3.81* | *APEC 20a* |
| Styrene | 1.67 ug/L | MW137<br>0.91 to 3.96 | APEC 20a |
| Trichloroethene | 1.73 ug/L | MW16<br>3.65 to 6.7 | APEC 20a |
| Vinyl Chloride | 1.03 ug/L | MW108<br>0.91 to 3.96 | APEC 20a |
| *PCBs* | | | |
| PCBs(total) | <0.5 ug/L | MW100<br>1.52 to 4.57 | APEC 20a |

* Historical data

Further to the P2ESA, 19 of the 29 APECs identified in the P1ESA were closed, because either no contaminants were detected above the Table 1 SCS, or the observed contamination was deemed to be associated with another overlapping APEC. The remaining 10 APECs that remain open, and information on the associated impacted media (i.e., soil or groundwater), are presented in the following table.

| APEC | | Media Impacted & Identified Contaminants |
|---|---|---|
| 20a | Pier 8 Impacted Fill and Port Activities | Soil – metals/inorganics, PHC/BTEX, PAH, VOC, PCB<br>Groundwater – metals/inorganics, PHC/BTEX, PAH, VOC, PCB |
| 23 | Shed 6 Former Heating Oil UST South Side | Soil – PHC/BTEX, PAH<br>Groundwater – PHC/BTEX, PAH |
| 25 | Shed 6 Former Heating Oil UST NE Corner | Soil – PHC/BTEX, PAH, VOC<br>Groundwater – PHC/BTEX, PAH |
| 26 | Shed 6 Former Bulk Storage of Oil Drums | Soil – PHC/BTEX, PAH<br>Groundwater – PHC/BTEX, PAH |

| APEC | | Media Impacted & Identified Contaminants |
|---|---|---|
| 27 | Shed 7 Former Petroleum Fuel UST | Soil – PHC/BTEX, PAH<br>Groundwater – PHC/BTEX |
| 31 | Shed 4 Building | Soil – PHC/BTEX, VOC<br>Groundwater – PHC/BTEX |
| 32 | Former Canadian Coast Guard Building and Yard | Soil – PHC/BTEX, VOC<br>Groundwater – PHC/BTEX, PAH, VOC |
| 33 | Former Truck Terminal USTs and Associated Fuelling Infrastructure | Soil – PHC/BTEX, PAH<br>Groundwater – PHC/BTEX |
| 35a | Brewer Marine - Former operation of a truck maintenance garage | Soil – Inorganics, PHC/BTEX, VOC<br>Groundwater – Inorganics, PHC/BTEX |
| 38 | Navy League Building Former Heating Oil AST | Soil – PHC/BTEX, VOC |

# 3.0 Quality Assurance and Quality Control (QA/QC) Procedures

DQOs were established consistent with industry guidance (e.g., MOE 1996 Field Sampling Guidance Document) during the planning of the sampling and analysis aspects of the investigation. The DQOs required the information collected to have a level of quality suitable for the intended purpose(s). More specifically, the DQOs required the contaminants of concerns at the Site to be identified, delineated and the concentration quantified for the purposes of conducting the P2ESA and the risk assessment.

Dillon (2011b) described the investigation methodology used at the Site. The use of qualified and experienced personnel that follow standardized industry-consensus practices and use of CALA-accredited laboratories are generally considered to comprise the Quality Assurance portion of QA/QC programs. Incorporated into the QA procedures are QC checks of the quality of the data being collected by performing repeat measurements and applying data acceptance criteria.

QC procedures for fieldwork included such things as checking that the combustible gas indicator or photoionization detector was calibrated and held its calibration during use, re-calibrating the instrument if it strayed by more than about 2% outside the calibration range. Duplicate measurements of water

levels were used to check that the water levels represented a static condition, in addition to not performing measurements during or right after periods of rainfall. QA/QC for soil vapour sampling included helium leak tests and stop tests (QA measures) and analysis of field duplicates and trip blanks (QC measures).

For laboratory data, a data review process, often referred to as "data validation", was conducted to assess whether the DQOs were satisfied. Dillon established data validation criteria that required the analytical data to have an acceptable level of precision, accuracy, representativeness, comparability and completeness, which is known in the environmental as the "PARCC" criteria. The data validation process is described below.

## 3.1 Precision

Precision is a measure of how tightly grouped a series of repeat measurements are about one central value. Evaluation of precision using statistical distributions and calculation of parameters, like standard deviation, can be conducted where there are three or more measurements. Relative Percent Difference (RPD) is used to evaluate precision where there are only two measurements.

Data precision was evaluated by calculating the RPD between the investigation sample results and their duplicate or results. The RPDs were calculated as follows:

$$RPD = 2x|C1-C2|/(C1 + C2) \times 100\%$$

Where: C1 = sample concentration
C2 = duplicate or replicate concentration.

RPDs were only calculated where both C1 and C2 were above the analytical reportable detection limits (RDL). Dillon uses a screening-level RPD acceptance criterion of <30% for water samples and <60% for soil samples. Soil vapour sampling is still considered too new an area of study to prescribe an acceptance criterion; Dillon typically uses the criterion for soil samples as a starting value. Where the reported concentrations were less than ten times the RDL, lower precision is expected and the screening-level criterion does not apply. Reported concentrations above ten times the RDL and having a RPD greater than the screening-level acceptance criterion were considered to have failed the screening-level criterion. Regardless of the foregoing, both sample results may still be accepted as suitably precise if both results were considered to be many times above or below the applicable regulatory criterion or guideline value being used (i.e., reduced precision is acceptable if it does not affect the interpretation or conclusion). A sample concentration and its duplicate result would be concluded to have lowered precision if the reported concentrations were near the applicable regulatory criterion or guideline value being used, concentrations were above ten times the RDL, and RPD was above its criterion, such that the interpretation might change depending on the reported concentration used. In this case, the data would be qualified as an estimated value. When comparing the sample results to the regulatory criterion, the

average of the sample results may be used provided this is reasonable and does not inadvertently skew the interpretation.

The data considered to have unacceptable precision were identified in the Dillon tables tabulating the laboratory data.

## 3.2 Accuracy

Accuracy is a measure of how close a measure or group of measures is to the true value. The analytical laboratory assessed the accuracy of the analytical results. Dillon evaluated the reported laboratory surrogate recoveries and spike samples to determine if the results were within the acceptance criteria established by the laboratory as reported on the certificates of analysis. The surrogate recoveries and spike samples consist of known concentrations of chemicals that the laboratory adds to the investigation samples. The laboratory measures the amount detected, and then calculates the Percent Recovery (%R) to confirm the reported value is within reasonable agreement to the known value.

If the laboratory reported a %R outside of the acceptance limits, Dillon assessed whether the occurrence was significant to the determination of contaminants of concern.

## 3.3 Representativeness

The representativeness of the analytical results was assessed by reviewing several factors of a qualitative nature, including the following:

- Field procedures and laboratory methods followed industry-consensus practices including sample collection methods, laboratory analytical methods, sample containers, preservative(s), holding times and chain-of-custody documentation;
- Sampling design was appropriate to characterize the subsurface media and units of interest;
- Sample results were consistent with visual/olfactory observations and previous investigation results at nearby locations if available; and
- The number of samples analyzed and parameters for which analyses were performed were sufficient.

## 3.4 Comparability

Data comparability assesses how well the sample result collected at one location or point in time can be compared to other sample results or criteria. Comparability was assessed qualitatively to confirm that the sample results were suitable for comparison to the MOE Standards. The field methods and laboratory methods were kept consistent throughout the investigation program.

## 3.5 Completeness

Analytical results were confirmed to have been obtained for the samples submitted and the analytical parameters requested, including the supporting laboratory documentation and chain-of-custody documentation. The number of samples collected and analyzed, and the frequency of inclusion of quality control samples collected and analyzed was also confirmed to be adequate for the purpose of the investigation.

# 4.0 Hydrogeological and Geological Interpretations Differing from Generic Assumptions

Geologic and hydrogeologic parameters determined for the site that vary from default values applied by the MOECC in the derivation of the generic SCS are summarized in the table below.

| Geological/ hydrogeological characteristic or parameter | MOECC Default | Site Specific Value | Comment |
|---|---|---|---|
| Foc (g/g) | 0.005 (above capillary fringe)<br>0.0003 (aquifer) | 0.015 (upper 0.5 m)<br>0.007 (above capillary fringe)<br>0.0064 (aquifer) | Values are generally consistent with MOECC default, but slightly higher for aquifer materials and therefore conservative. These values were not applied in any site-specific modeling. |
| Depth to Water Table (m) | 3 | 0.5 – 2.9 | Table 7 SCS applied for screening of volatile COCs in groundwater due to shallow water table. |
| Hydraulic Conductivity (horiz.) (m/s) | $3.0x10^{-5}$ | $2.6x10^{-6}$ | Geometric mean k based on in-situ testing is approximately 12 times lower than default value and is therefore conservative. |
| Hydraulic gradient (horiz.) (m/m) | 0.003 | 0.003 – 0.06 | Gradient is higher in areas with higher elevation further from the lake, but consistent with MOECC default closer to the lake. |

| Geological/ hydrogeological characteristic or parameter | MOECC Default | Site Specific Value | Comment |
|---|---|---|---|
| Distance to surface water receiver (m) | 36.5 | 0 | The site is immediately adjacent to Lake Ontario. |

As the Table 1 SCS were applied for the initial screening of the site, these differences had no effect on the conduct of the Phase Two ESA and the identification of COCs to be addressed in the RA. Secondary screening was completed using the Table 7 SCS and Table 9 SCS, and the RA was conducted in a conservative manner applying the generic component values where appropriate, with consideration of these site-specific values as and if required.