F I N A L

Community Based Risk Assessment Port Lands, Toronto

Prepared for

Waterfront Toronto

Last Updated: December 2020

CH2M HILL Canada Limited
245 Consumers Road
Suite 400
Toronto, ON M2J 1R3

Executive Summary

Introduction

CH2M Hill Canada Ltd. (CH2M) was retained by Waterfront Toronto to complete a Community-Based Risk Assessment (CBRA) for the Port Lands Flood Protection Project (the Project). The Project was initiated to flood-protect and revitalize the Toronto Port Lands, a 356-hectare (880-acre) area bound by the Keating Channel/Don River and Lake Shore Boulevard to the north, the Toronto Inner Harbour to the west, Leslie Street to the east, and Lake Ontario and Tommy Thompson Park to the south. The scope of the Project includes construction of a river valley through the CBRA Project Area to flood protect the greater Port Lands area; and development of parklands adjacent to the new river valley, Lake Ontario, and the Keating Channel. Currently, five subareas within the CBRA Project Area have been identified:

1. Villiers Island: Existing land that will ultimately form an island once the river valley is constructed.
2. Polson Island: Existing land that will ultimately form the southern side of the river valley and green spillway once the river valley is constructed.
3. Mainland Area: Existing land east of the renaturalized Don River and north of the Keating Channel that will form a flood protection valley wall and sediment management area.
4. Essroc Quay Infill Area: The land to be created around Essroc Quay via infilling.
5. The Water Lot: The area created by the construction of the new river valley, extending from top of bank to top of bank.

Due to the unique nature of the project – creating a river through a brownfield site – and the need to manage the contaminants present throughout the construction site, Waterfront Toronto is voluntarily undertaking a process outlined by the Ministry of the Environment and Climate Change (Ministry) called a Community-Based Risk Assessment. The CBRA enables the evaluation of multiple properties across the Port Lands that will be impacted by the flood protection construction work in order to identify potential health concerns for people and ecological systems (wildlife and aquatic habitat) associated with existing contamination, and to outline soil and groundwater management plans to provide long term protection. The CBRA will also facilitate the identification and design of risk management measures (RMMs), including soil and groundwater management plans, to protect people and ecological receptors in the CBRA Project Area over the long term.

The Project Team is composed of Waterfront Toronto, the Toronto and Region Conservation Authority (TRCA), the Toronto Port Lands Corporation (TPLC), and the City of Toronto (City). Multiple land owners are present within the CBRA Project Area, as well as other parts of the Toronto Port Lands; however, the bulk of the CBRA Project Area is owned by the Toronto Port Lands Company (TPLC) via a number of lease arrangements. WT owns two parcels of land within the CBRA Project Area, covering the addresses of 13 Munitions Street, and 54 and 130 Commissioners Street. Some properties are currently under private ownership, including 309 Cherry Street, and 10 and 16 Munitions Street. Private properties are not included within the CBRA risk evaluation, as these areas are excluded from the flood protection construction work that will be completed as part of the Project.

Objectives

The CBRA is being completed based on the anticipated condition of the CBRA Project Area following the construction works necessary to achieve flood protection. The objectives of the CBRA was as follows:

- Based on the concentrations of contaminants of concern (COCs) expected to be managed in place, assess the risk from potential exposure to soil and groundwater COCs by possible future human receptors who may use the CBRA Project Area following the flood-protection construction works.
- Assess risk to terrestrial and aquatic ecological receptors from potential exposure to soil and groundwater COCs in CBRA Project Area following the flood-protection construction works.
- Develop risk-based concentrations and intervention values (IVs) for COCs in soil, groundwater, and sediment in the CBRA Project Area to guide soil management and the need for RMMs.
- Develop a risk management plan (RMP) to mitigate or minimize unacceptable risks.
- Prepare an adaptive soil management plan and groundwater management plan to set out approaches for managing and reusing soil and groundwater

Parkland areas to be developed as part of the Project represent a regulatory change to a more sensitive land use; therefore, these lands will require a Record of Site Condition (RSC) to be filed according to Ontario Regulation (O. Reg.) 153/04. The CBRA approach does not include the efforts to meet the requirements for an RSC. Consequently, the parklands (and any applicable community land use) will undergo a separate RSC process per O. Reg. 153/04 (Ministry, 2011a).

In addition to parkland or specific community areas to be developed as part of the Project, other portions of the CBRA Project Area may be redeveloped to more sensitive land uses in the future, including residential land use. Since the development of residential land is not part of the Project, it is not addressed by the CBRA approach. Lands redeveloped for residential use will also require the filing of an RSC, and that process will occur as needed in the future, separate from the CBRA effort.

Site Characterization

The geology of the CBRA Project Area consists of unconsolidated overburden overlying bedrock. The overburden geology consists of five main stratigraphic units (GHD, 2015): heterogenous fill; a thick poorly graded native sand unit; discontinuous organic layers (peat); discontinuous native silt, clayey silt to clay till; and, Georgian Bay Formation shale bedrock. One main hydrostratigraphic unit was found at the CBRA Project Area: an unconfined fill and native sand aquifer with a potential hydraulic connection to the weathered upper Georgian Bay Formation shale bedrock. The hydraulic properties of the fill and native sand layers was expected to be similar, given their predominantly coarse, granular materials. Based on this understanding and the apparent direct hydraulic connection between the fill and native sand layers, groundwater will tend to flow horizontally and vertically within the fill and native sand layers, with the two layers acting as a single aquifer unit. The fill and native sand aquifer extends across the entire CBRA Project Area. No aquitard separating the native sand and weathered shale bedrock units was identified, which means there may be a direct hydraulic connection between the fill and native sand and the underlying weathered shale bedrock formation.

Lands in the CBRA Project Area were primarily used for heavy-industrialized activities dating back to the early 1900s. Some of the land use included petroleum refining and storage, equipment manufacturing, steel foundries, liquid and solid waste management, vehicle maintenance and repair operations, and municipal services (that is, incineration and sewage treatment) (SLR, 2009). Environmental investigations and studies conducted within the CBRA Project Area since the 1990s have identified widespread soil or groundwater contamination, resulting from extensive historical industrial activities.

Soil quality at the CBRA Project Area was evaluated based on approximately 1,689 soil samples collected from over 500 locations between 1991 and 2018. In general, widespread soil impacts were observed across the CBRA Project Area for various COCs, likely originating from the many former industrial operations and land uses at the Port Lands. Petroleum hydrocarbons (PHCs) were identified as the primary COCs, exhibiting elevated soil concentrations in many sample locations. PHC impacts appear to be associated with the observed NAPL at some locations in the project area. The greatest volume of PHC-impacted soils appears to be centralized over the lands commonly referred to as the "former Imperial Oil Lands," which had been occupied by a number of petroleum manufacturing and distribution facilities since 1925. High concentrations of polycyclic aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and xylene (BTEX) were found at many of the PHC-impacted locations, likely associated with the same land use or activities.

Groundwater quality was assessed using approximately 439 groundwater samples collected from over 300 locations. Similar to soil, widespread groundwater impacts were also observed at the CBRA Project Area, likely sourcing from the former industrial operations on the Port Lands. PHC and VOC impacts were consistently observed within the former Imperial Oil Lands, the Villiers Street properties, and north of the Keating Channel.

One hundred and sixteen monitoring wells were gauged at the site and up to 6 locations contained measurable light nonaqueous phase liquid (LNAPL). Petroleum sheen was also observed in a monitoring well north of the Keating Channel in 2018 (Evans, 2018, per. comm.). However, the most heavily impacted NAPL areas identified to date were primarily located within or adjacent to the former Imperial Oil Lands of the CBRA Project Area. The RA exposure and toxicity assessments are typically based on the assumption that NAPL is not present. Therefore, NAPL requires separate consideration. A 3D environmental visualization software model has been developed using laser-induced fluorescence (LIF) data, soil sample data, and dissolved phase monitoring data set. The objective in the model development is to provide a 3D representation of NAPL extents in proximity to the new river valley. Using the model, NAPL-impacted soil within the river valley excavation area, and NAPL that may remain in place beyond the envelope of excavation was quantitatively evaluated. The NAPL extent was defined based on consideration of the LIF results and soil sample analytical data indicating concentrations of total PHCs exceeding 1,500 micrograms per gram (µg/g).

Preliminary test results from LNAPL mobility testing performed on wells containing LNAPL in 2016 indicate that LNAPL mobility at the testing area is very low. Based on this understanding, it is likely that a majority of the PHCs found in soil represents residual LNAPL. However, the presence of NAPL even at residual saturation adjacent to a surface water interface, as planned via the construction of the river valley, can lead to changes in pore geometry (soil disturbance) and the potential transport of NAPL to surface water via ebullition. As such, the development of the NAPL Conceptual Site Model (CSM) is important to understanding potential risks related to NAPL remaining in place in the CBRA Project Area and the relevant risk management measures (RMMs) that may be required. A more comprehensive NAPL mobility assessment (focussed on areas immediately adjacent to or below the construction grade of the Water Lot) is currently ongoing.

Additional details regarding site characterization activities within the CBRA Project Area are presented in Section 3 of the CBRA.

Land-Based Subareas Risk Assessment

The land-based subareas risk assessment (RA) evaluates potential health concerns for people and ecological systems (wildlife and aquatic habitat) associated with future use of Essroc Quay, Villiers Island, Polson Island, and the Mainland Area. The CBRA Project Area's most recent land use has been industrial/commercial/community; however, Villiers Island, Polson Island, and the Mainland Area are

planned to be developed as mixed parkland, industrial, commercial, and community use, while the Essroc Quay is planned to be developed as parkland and road.

Based on the projected construction plans and future grades, the risk evaluation in the CBRA is completed on the assumption that some of the existing soil and groundwater with COCs will be left in place in each subarea and managed as required per the associated RMP included in Appendix H. If warranted, soils from specified areas may be removed from the CBRA Project Area, at which time they will be managed according to the RMP, tested, and disposed of as required by applicable legislation.

In Villiers Island, 55 chemicals in soil and 34 chemicals in groundwater were retained as COCs. In Polson Island, 43 chemicals in soil and 28 chemicals in groundwater were retained as COCs. For the Mainland Area, 64 chemicals in soil and 22 chemicals in groundwater were retained as COCs. These chemicals were carried through for further consideration in the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA).

Human Health Risk Assessment

The following onsite human health receptor types have been identified: Recreational Site Visitors, Indoor Workers, Outdoor Workers, Construction Workers, and Utility Workers. Potential offsite receptors include: Surface Receptors and Construction/Utility Workers. The onsite Recreational Site Visitor, Indoor Worker, and Outdoor Worker receptors could potentially be exposed to surface soil. The onsite Construction and Utility Worker receptors could potentially be exposed to surface and subsurface soil. Offsite receptors could be exposed to COCs through COC migration offsite through soil particulate or groundwater.

The HHRA considered the following exposure pathways: direct contact with soil and groundwater; inhalation of indoor air, outdoor air (volatiles), and fugitive dust; ingestion of garden produce; and, dermal contact with vapours. Those exposure pathways that were considered to be complete and retained for quantitative evaluation were modelled for the “maximally exposed” receptor/pathway scenarios. Exposure estimates were calculated in accordance with Health Canada (2010), J&E (1991), Ministry (2011c), Sanders and Stern (1994), and USEPA (1989; 2004; 2009). Potential risk to those receptor/pathways not specifically modelled will be evaluated qualitatively from the maximally exposure quantitative results.

The toxicity reference values (TRVs) were obtained from regulatory agencies including the Ministry and the USEPA (IRIS). Other TRVs cited in the Ministry Rationale Document (Ministry, 2011c)—such as those developed by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (CalEPA OEHHA), the Agency for Toxic Substances and Disease Registry (ATSDR), the Netherlands National Institute of Public Health and Environmental Protection (RIVM), or the World Health Organization (WHO)—were also considered. There is high confidence that the TRVs selected to be used in this CBRA were relevant and protective of human health. Reference doses (RfDs) and reference concentrations (RfCs) used in this CBRA were considered to be protective of the human population (including sensitive subgroups) at continuous exposure levels (that is, 24 hours per day, 7 days per week). The human receptors identified in the problem formulation were likely to have exposure that is less that continuous (that is, 40-hour work week), and therefore the CBRA provides another layer of conservatism. Similarly, inhalation unit risks (URs) and oral slope factors (SFs) used herein were derived by their respective agencies to account for continuous exposure.

Ecological Risk Assessment

The planned future uses of Villiers Island, Polson Island, and the Mainland include habitat suitable for soil organisms, plants, birds, and mammals. Based on the CBRA Property’s characteristics, the purpose of this assessment, and the types of flora and fauna currently present and expected to use the area in the future, the ERA involved the quantitative assessment of soil organisms, terrestrial plants, birds, and mammals in

relation to COCs in soil; and the quantitative assessment of terrestrial plants in relation to COCs in groundwater at the CBRA land-based subareas. The dietary exposure of birds and mammals to COCs in the land-based subareas as a result of the ingestion of vegetation or prey in the land-based subareas were also considered.

Generally, Villiers Island, Polson Island, and the Mainland Area are each expected to have a depth to groundwater of at least 1 m below ground surface (mbgs), with most portions of these land-based subareas having a depth to groundwater at least 2 mbgs under the post-Project conditions. Groundwater data was treated as one unit, as opposed to two segregated units. NAPL was found in subareas of the CBRA Property and was assumed to be at a minimum depth of 2 mbgs post-construction of the river valley. As such, ecological receptors were not expected to have contact with NAPL in the land-based subareas since it will be below the rooting depths of plants expected to be present post-construction. Given that most portions of the land-based subareas are expected to have a depth to groundwater greater than 1.5 mbgs under the post-Project conditions, the potential for vegetation – including deep rooted vegetation (such as trees) – to contact groundwater is very limited; however, for completeness, consideration is given to this exposure pathway herein. Dermal contact with groundwater for soil organisms, birds, and mammals was considered a minor exposure route.

For the ERA, measured chemical concentrations in soil and groundwater were used to represent exposure by ecological receptors. Ecological benchmark concentrations (EcoBMCs), threshold effect levels derived to be protective of receptor groups for growth, survival, and reproduction, were used for the assessment of risks to ecological receptors. The EcoBMCs were largely obtained from the Rationale Document (Ministry, 2011c) and include the Ministry Plant and Soil, or Birds and Mammals component values. For COCs for which no Ministry EcoBMCs was available, or if only one Ministry EcoBMC existed (for example, an Ministry soil organism/plant EcoBMC was available, but no Ministry bird/mammal EcoBMC existed), alternate sources of EcoBMCs were reviewed. Canadian Council of Ministers of the Environment (CCME), provincial, USEPA, and other reference sources were searched for relevant EcoBMCs. Based on jurisdictional relevancy and Ministry preference (per Section 5.3 of Ministry, 2011c), CCME EcoBMCs were reviewed and used first, followed by those from provincial, USEPA, and other reference sources, as needed. The CCME, Ministry, and USEPA EcoBMCs were considered appropriate for use in this ERA, as they have been peer-reviewed and were supported by regulators. EcoBMCs to support the assessment of ecological risks related to terrestrial plant exposure to groundwater COCs were not readily available. However, per the Rationale Document (Ministry, 2011c), the GW3 component values were considered protective of terrestrial plant exposure to shallow groundwater. Therefore, the GW3 values were applied as the EcoBMCs for this pathway.

Results and Conclusion

Unacceptable risks are possible in Villiers Island, Polson Island, and the Mainland Area for certain receptors and pathways, and will therefore require risk management. As most portions of the land-based subareas are expected to have a depth to groundwater greater than 1.5 mbgs under the post-Project conditions, the potential for vegetation to contact groundwater is very limited and potential risk to terrestrial plants is expected to be minimal. As such, RMMs are not expected to be required to reduce the potential risks of exposure to groundwater to acceptable levels for ecological receptors in the land-based subareas. Groundwater elevations in areas slated for implementation of deep-rooting vegetation could be reviewed post-construction to confirm the pathway is incomplete. Otherwise, the pathways requiring RMMs are summarized as follows:

Villiers Island

- Human health:
- Direct contact with soil (dermal and ingestion) and NAPL; dermal contact with PAHs in groundwater (unacceptable risks are possible but unlikely); incidental ingestion of groundwater and NAPL; inhalation of fugitive dust; and, inhalation of indoor air (soil, groundwater, and NAPL).
- Inhalation of outdoor air in a trench may result in unacceptable risks. Exceedances are attributable to the presence of naphthalene in limited soil sample locations, PHC F2 in limited soil and groundwater locations, and benzene and PHC F1 in limited soil vapour sample locations. The potential for impacts trench air will likely depend on the proximity of the excavation work to these locations, the size of the trench, and the trench construction method.
- **Ecological:** direct contact exposure of ecological receptors to soil.

Polson Island

- Human health:
- Direct contact with soil (dermal and ingestion) and NAPL; dermal contact with PAHs in groundwater (unacceptable risks are possible but unlikely); incidental ingestion of groundwater and NAPL; inhalation of fugitive dust; and inhalation of indoor air (soil, groundwater, and NAPL).
- Inhalation of outdoor air in a trench may result in unacceptable risks. Exceedances are attributable to the presence of PHC F1 and PHC F2 in limited soil sample locations and PHC F2 in limited groundwater locations. The potential for impacts trench air due to PHC F1 and PHC F2 will likely depend on the proximity of the excavation work to these limited locations, the size of the trench, and the trench construction method.
- **Ecological:** direct contact exposure of ecological receptors to soil.

Mainland Area

- Human health:
- Direct contact with soil (dermal and ingestion) and NAPL; dermal contact with groundwater (unacceptable risks are possible but unlikely); incidental ingestion of groundwater and NAPL; inhalation of fugitive dust; and inhalation of indoor air (soil, groundwater, and NAPL).
- Inhalation of outdoor air at ground surface; unacceptable risks are possible but unlikely. With the exception of a limited number of elevated MDLs for 1,2-dibromoethane results in soil, the risk exceedances are attributable almost entirely to elevated concentrations measured in one soil sample from Terrapex MW101 in 2004; the results from subsequent sampling adjacent to this location were less than the applicable SCS, suggesting that the results are not widespread. In addition, the Terrapex MW101 soil sample was collected from a depth of 3.1-9.1 mbgs, and is therefore understood to be located in the saturated zone, that is below the projected future water table. As the soil impacts are not present in the upper reaches (that is, within the uppermost 30 cm) of the groundwater table, vapour transport to the overlying vadose zone will be impeded due to the slower diffusion of volatile chemicals in water than in soil gas (USEPA, 2015). Based on a review of the locations of the exceedances and the associated analytical data, the potential for volatilization to outdoor air at ground surface is limited and outdoor air inhalation risks above acceptable levels due to the aforementioned COC concentrations in soil are not expected for the Recreational User Outdoor Worker, Construction Worker, Utility Worker, and Indoor Workers in the Mainland Area.
- Inhalation of outdoor air in a trench; unacceptable risks are possible. It is noted that risk exceedances are attributable almost entirely to elevated concentrations measured in one soil sample location, Terrapex MW101, collected in 2004; the results from subsequent sampling in the

vicinity of this location were generally less than the applicable SCS. When the data from Terrapex MW101 are excluded from consideration, the only remaining risk exceedances are from 1,2-dibromoethane in soil and PHC F2 in soil and groundwater. Based on a review of the locations of the RBC exceedances and the associated analytical data, the potential for volatilization to trench air is limited. The potential for impacts trench air will likely depend on the proximity of the excavation work to the Terrapex MW101 location or the limited locations of PHC F2 exceedances in soil and groundwater, the size of the trench, and the trench construction method.

- **Ecological:** direct contact exposure of ecological receptors to soil

Based on the predicted risk and hazard levels, RMMs are required to minimize and eliminate potential human and ecological health risk. Appendix H provides an RMP for the CBRA Project Area, and details the required RMMs.

The HHRA and ERA have both indicated that potential risks above target levels are present within the land-based subareas due to COCs in soil and groundwater. As such, the development of risk-based soil and groundwater IVs in these areas is required to support the implementation of RMMs, particularly for soil reuse. IVs represent the concentrations above which COCs would present a potential risk to receptors exceeding acceptable levels in the absence of RMMs. IVs are derived from risk-based concentrations (RBCs) back-calculated for different exposure pathways by applying human health TRVs or EcoBMCs and target risk levels. For the soil IVs, the lowest relevant RBC is selected as the applicable IV for one of two soil placement options: as part of soft cap or under hard cap. The soil RBCs are applicable for soil pH ranges of 5 to 9; it is assumed that placed soils will fall within this natural pH range. The soil RBCs, and selection of the soil IVs, are presented as Attachment J-1 to Appendix J, the Soil Management Plan.

Additional details regarding the land-based subareas RA are presented in Section 4 of the CBRA.

Water Lot Risk Assessment

The water lot RA evaluates potential health concerns for people and ecological systems (wildlife and aquatic habitat) who may use the Water Lot following the flood-protection construction works. Following the construction activities associated with the Project, the Water Lot will be composed of a constructed river base overlying (as relevant along the length of the Water Lot) heterogeneous fill, thick poorly graded native sand unit, discontinuous peat and organic layer, discontinuous native silt (clayey silt to clay till), and Georgian Bay Formation shale bedrock. The finished channel bed elevation will intercept the water table within the fill and native sand aquifer, and the mean elevation of Lake Ontario. Soil containing NAPL will remain in place below the new river valley. The maximum depth of these impacts will remain as approximately 9 mbgs with the exception of the area adjacent to the former Imperial Oil Site, where impacts extend down to at least 10 mbgs. The minimum depth to impacts will be the 1.5 to 2 m thickness of the constructed river base.

In soil, a total of 56 chemicals were identified as COCs in the Water Lot soil remaining in place. As these chemicals will be located below the constructed river base, exposure to these chemicals by human or ecological receptors by direct contact is not anticipated post-construction; however, there is a limited potential that COCs identified in the Water Lot soil may become sediment in the future river valley. Thus, a quantitative evaluation was conservatively conducted to determine potential risks to human receptors via direct contact with soil COCs in sediment. It is also acknowledged that some COCs within these soils could leach to groundwater and migrate upwards into the river, thus this pathway was considered potentially complete.

In groundwater, 42 chemicals were identified as COCs in the Water Lot. These chemicals were carried through for consideration in the HHRA and ERA where complete pathways were present. Given that the exposure of human receptors to COCs migrating to surface water will be considerably less than the

exposure of aquatic receptors to surface water, exposure pathway for humans were not considered significant. Thus, a quantitative evaluation was conducted to determine potential risks to human receptors via direct contact with groundwater through migration to surface water. Groundwater COCs from land-based subareas may also migrate and discharge into the Water Lot. As such, exposure of Water Lot receptors to groundwater COCs from the land-based subareas was considered.

Sediment currently located upstream of the new constructed river may migrate downstream and become deposited within the new river channel. Although the quality of this sediment would not be related to impacts currently observed within the CBRA Project Area, a review of the quality of the upstream sediment was completed in order to understand the potential implications for the longer-term health of receptors within the new river channel. Overall, the upstream sediment quality did not appear to pose a detrimental risk to populations of aquatic receptors within the new river valley, should this sediment migrate downstream. As such, upstream sediment quality was not considered further within the Water Lot.

Water quality within the Water Lot will likely be influenced by water chemistry from the Don River upstream of the Port Lands CBRA Project Area. In December 2017, LimnoTech (2018) collected five mid-depth water samples from the Don River within and upstream of the CBRA Area. Samples were collected from the Don River between Sunlight Park Road (north) and Lakeshore Boulevard (south). The analytical results of the investigation compared to the Provincial Water Quality Objectives (PWQOs) (Ministry, 1999). Overall, the upstream surface water quality did not appear to pose a detrimental risk to populations of aquatic receptors within the new river valley. As such, upstream surface water quality was not considered further within the Water Lot.

Human Health Risk Assessment

Based on the projected construction plans, the risk evaluation in the CBRA is completed on the assumption that soil and groundwater currently located above the construction elevation will no longer be in place within the Water Lot and thus data representing these media were not considered further. Additionally, based on the project construction plans, it is assumed no receptors will have direct access to the soil or groundwater left in place below the construction elevation, due to the presence of the constructed river base. As such, direct contact to existing soil and groundwater was considered an incomplete pathway and was not considered further.

The following onsite receptor types have been identified: Recreational Users, Outdoor Workers, and Construction Workers. Offsite, potential receptors include: Surface Water Receptors. The onsite Recreational User, Outdoor Worker, and Construction Worker receptors could potentially be exposed to surface water impacted by groundwater migrating into the Water Lot. Within the limited riparian areas towards the edges of the Water Lot, there is also some potential for the onsite receptors to be exposed to outdoor air impacted by volatiles in soil and groundwater migrating upwards in the vadose zone and releasing into outdoor air. It is noted that impacts at depth in saturated soil and groundwater, especially those that will be located beneath surface water in the Water Lot (that is, outside of the riparian area) were not expected to impact outdoor air since vapour transport through water is impeded by the slower diffusion of volatile chemicals in water versus soil gas in the vadose zone (USEPA, 2015). Offsite receptors could be exposed to COCs through COC migration offsite through surface water migration.

It is noted that no enclosed buildings in contact with the ground surface will be constructed within the Water Lot, given its function for flood control. Similarly, no surface accessible utilities are planned to be installed in the Water Lot. As such, Indoor Worker and Utility Worker receptors will not be present within the Water Lot under the future construction scenario.

There is a limited potential that COCs identified in the Water Lot soil may become sediment in the future river valley. Given the anticipated limited exposure of human receptors to COCs within the Water Lot, a quantitative evaluation of risk will only be performed for sediment. Typically, in a risk evaluation, risk calculations were selectively performed for the “maximally exposed” receptor/pathway scenarios

identified. Potential risks to those receptor/pathways not specifically modelled were then evaluated qualitatively from the maximally exposed quantitative results. As aquatic receptors were expected to be the maximally exposed and most sensitive receptors present within the Water Lot, quantitative assessment was completed for these receptors and potential risks to human receptors were evaluated qualitatively.

Similar to the land-based subareas RA, the TRVs were obtained from regulatory agencies including the Ministry and the USEPA (IRIS). Other TRVs cited in the Ministry Rationale Document (Ministry, 2011c) were also considered.

Ecological Risk Assessment

The Water Lot in its future developed condition is aquatic habitat in its entirety that will support aquatic/riparian habitat and ecological receptors. Some soil COCs could leach to groundwater and migrate upwards into the river, and groundwater COCs from within the Water Lot and the land-based areas could additionally migrate into the new river. Thus, ecological receptors in the Water Lot could be exposed to COCs migrating to surface water. Exposure to chemicals in soil and groundwater left in place below the constructed river base by ecological receptors by direct contact is not anticipated post-construction, thus soil and groundwater direct contact evaluations were not required.

The planned future condition of the Water Lot is anticipated to have habitat suitable for benthic invertebrates, pelagic invertebrates, fish, and aquatic/riparian vegetation, birds, and mammals. The media that will be assessed as part of the Water Lot ERA under the future development scenario is surface water impacted by groundwater discharge. Sediment ingestion and absorption of chemicals through the epidermis was not assessed because the construction of the Water Lot will be such that the sediment lining the bottom of the water column will meet specific quality criteria protective of aquatic/riparian organisms, and be separated from potential contaminated soils by a soil barrier.

NAPL was found in the Water Lot and is assumed to be at a minimum depth of 2 mbgs post-construction of the river valley (that is, it will be located below the constructed river base). As such, ecological receptors were not expected to have direct contact with NAPL below the Water Lot. A recent evaluation of the spatial distribution of the NAPL indicated NAPL in the CBRA Project Area has a low-mobility; however, once the river is constructed the mobility of NAPL may change. Where NAPL may intercept the new river base, there is a risk of NAPL influencing the river and creating aesthetic concerns, which would not meet the PWQOs for oil and grease. Aesthetic concerns related to NAPL adjacent to the surface water are anticipated and will require RMMs, as outlined in Appendix H. NAPL discharge to surface water cannot be permitted and thus will be blocked via the use of RMMs.

Based on the CBRA Project Area's characteristics, the purpose of this assessment, and the types of flora and fauna currently present and expected to use the area in the future, the ERA involved the quantitative assessment of benthic invertebrates, pelagic invertebrates, fish, and aquatic/riparian vegetation, birds, and mammals, in relation to COCs in surface water in the Water Lot. The aquatic/riparian VECs evaluated in this CBRA included Freshwater clams (*Pisidium sp.*), Aquatic worms (*Oligochaeta sp*.), *Hyalella Azteca*, and Mayflies (*Baetidae sp.*) for benthic invertebrates; water fleas (*Daphnia sp.*) for pelagic invertebrates; northern pike (*Esox lucius*), white sucker (*Castostomus commersoni*), emerald shiner (*Notropis atherinoides*), and gizzard shad (*Dorosoma cepedianum*) for fish; sedges (*Carex sp.*) and Canada waterweed (*Elodea canadiensis*) for vegetation; mallard (*Anas platyrhynchos*) and great blue heron (*Ardea herodias*) for birds; and muskrat (*Ondatra zibethicus*) and mink (*Mustela vison*) for mammals.

The ecological receptors and primary exposure pathways assessed in this ERA includes the groundwater-to-surface-water pathway based on current and future conditions at the CBRA Project Area, as follows:

- Benthic Invertebrates – exposure to sediment pore water; ingestion and absorption through the epidermis during burrowing

- Pelagic invertebrates and fish – exposure to surface water and through the food chain; ingestion and dermal contact with surface water, consumption of contaminated prey or forage items
- Aquatic/riparian vegetation – exposure to surface water; uptake through roots, leaves, stems
- Aquatic/riparian birds and mammals –exposure to surface water; dermal contact and ingestion
- Aquatic/riparian birds and mammals –exposure to through the food chain by consumption of contaminated prey or forage items.

As noted previously, sediment ingestion and absorption of chemicals through the epidermis were not assessed because the construction of the Water Lot will be such that the sediment lining the bottom of the water column will meet specific quality criteria protective of aquatic/riparian organisms, and be separated from potential contaminated soils by a soil barrier.

For this ERA, modelled chemical concentrations in surface water and pore water were used to represent exposure. The Ministry PWQOs (Ministry, 1999) and aquatic protection values (APVs) (Ministry, 2011b), or alternative EcoBMCs were used for the assessment of surface water exposure pathways. The dietary exposure of birds and mammals to COCs as a result of the ingestion of vegetation or prey in the water lot were also considered.

Results and Conclusion

Unacceptable risks are possible in the Water Lot for certain receptors and pathways, and will therefore require risk management. The pathways requiring RMMs are summarized as follows:

- human direct contact with groundwater (dermal and ingestion)
- direct contact exposure of ecological receptors to surface water
- direct contact exposure of ecological receptors to sediment pore water
- NAPL discharge to surface water and aesthetic concerns

Based on the predicted risk and hazard levels, RMMs are required to minimize and eliminate potential human and ecological health risk. Appendix H provides an RMP for the CBRA Project Area, and details the required RMMs. While there may be potential risks to human health from direct contact with COCs in soil that may become sediment, risk management measures (e.g., capping) have already been proposed.

The construction of the river base requires the identification of sediment IVs in order to monitor that materials used to form the river base will not pose risks to Water Lot receptors above acceptable levels. Although it is acknowledged that human receptors may also have some limited direct contact with sediment in the Water Lot (for example, accidental fall into river by Recreational User or Outdoor Worker, Construction Worker conducting activities within Water Lot), the maximally exposed receptors will be the aquatic receptors – specifically benthic receptors – thus concentrations protective of these receptors are considered in the development of the sediment IVs. It is assumed that concentrations protective of benthic populations that are in constant contact with the sediment will be protective of human receptors that will have very limited contact with the sediment. This assumption was assessed in Table 5.5-1, which includes human health and ecological sediment IVs.

Additional details regarding the water lot RA are presented in Section 5 of the CBRA.

Communication Plan

The CBRA Communication Plan is intended to present a meaningful and effective way to foster stakeholder participation in the development of the CBRA. The CBRA Communication Plan falls within the overall Don Mouth Naturalization and Port Lands Flood Protection Project (DMNP) Environmental Assessment (EA) Consultation Plan, the full implementation of which aligns with securement of Project funding.

The principles that guide the CBRA consultation activities are consistent with Waterfront Toronto's Public Consultation and Participation Strategy, as well as the guiding principles described in the *Proposed DMNP EA Consultation Plan Terms of Reference* (WT, 2015; TRCA, 2015). CBRA consultation activities also consider the requirements for a Consultation Plan in the development of a Risk Assessment per Ontario Regulation (O. Reg.) 153/04 (as amended). The identified interested parties and government agencies generally coincide with those identified in the DMNP EA Consultation Plan.

The Communication Plan for the CBRA is a unique subset of the overall communication plan for the DMNP, with the following objectives:

1. Create or increase awareness of the CBRA process.
2. Meet the consultation commitments set forth by the DMNP EA and CBRA Ministry Guidelines.
3. Provide interested parties with opportunities to participate in the consultation process.
4. Determine public expectations for the CBRA and associated Site characterization and RMMs.
5. Provide clear, concise information about the CBRA that is easy for the public to understand.
6. Gain additional knowledge of Site conditions that may not have been previously identified from local participants.
7. Create opportunities for meaningful, two-way exchange of information between the DMNP Project Team (WT, City of Toronto [City], Toronto and Region Conservation Authority [TRCA], and CreateTO), their consultants, stakeholders, government agencies, and consultation participants.
8. Produce an accurate and comprehensive CBRA that reflects feedback and advice.

A variety of consultation mechanisms were used from 2016 to 2018 to collect stakeholder feedback, including preconsultation workshops, small group meetings, and direct consultation with agencies or land owners. Further workshops, meetings, and public information centres are planned for 2018 and beyond. Additional tools, such as public notices, and website updates and postings, were employed and will continue to be employed to gain feedback on the CBRA.

Additional details regarding the communication plan are presented in Section 6 of the CBRA.

References

Evans, Mike/GHD Project Coordinator. 2018. Personal communication (email – data files) with Krista Barfoot/CH2M HILL Canada Limited. January to April.

GHD Limited (GHD). 2015. *Port Lands Environmental, Geotechnical, and Hydrogeological Investigation, Port Lands, Toronto, Ontario. Report No. 2, Draft for Review*. Prepared for Waterfront Toronto. September 15.

Health Canada. 2010. *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0*. Contaminated Sites Division, Safe Environments Directorate, Health Canada, Ottawa. September. Revised 2012.

Johnson, P.C., and R.A. Ettinger (J&E). 1991. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapours into Buildings." *Environmental Science and Technology*. Vol. 25, No. 8. pp. 1,445–1,452.

LimnoTech. 2018. *Don River Sampling Results, December 2017*. Prepared for Waterfront Toronto. January 25.

Ontario Ministry of the Environment and Climate Change (Ministry). 1999. *Policies Guidelines Provincial Water Quality Objectives of the Ministry of Environment and Energy.* July 1994, updated 1999.

Ontario Ministry of the Environment and Climate Change (Ministry). 2011a. *Records of Site Condition — Part XV.1 of the Environmental Protection Act. Ontario Regulation 153/04. Environmental Protection Act. As amended. Last amendment: O. Reg. 333/13*. E-Laws currency date: January 1, 2014.

Ontario Ministry of the Environment and Climate Change (Ministry). 2011b. *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act.* April 15, 2011.

Ontario Ministry of the Environment and Climate Change (Ministry). 2011c. *Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario*, Ontario Ministry of the Environment and Climate Change, April 15.

Ontario Ministry of the Environment and Climate Change (Ministry). 2014. *Guidance for Conducting Community Based Risk Assessments*. DRAFT FOR DISCUSSION. August.

Sanders, P.F., and A.H. Stern. 1994. "Calculation of soil cleanup criteria for carcinogenic volatile organic compounds as controlled by the soil-to-indoor air exposure pathway." *Environmental Toxicology and Chemistry*. Vol. 13, No. 8. pp. 1,367–1,373.

SLR Consulting Canada Ltd. (SLR). 2009. *Subsurface Investigation in Support of the EA for the DMN and Port Lands Flood Protection Project.* Prepared for the Toronto and Region Conservation Authority. October 5.

Toronto and Region Conservation Authority (TRCA). 2016. Open Information and Data, TRCA_WaterQuality_2016. Accessed April 2018: https://trca.ca/about/open/#data.

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002. December.

United States Environmental Protection Agency (USEPA). 2004. "Part E, Supplemental Guidance for Dermal Risk Assessment." *USEPA Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual*. Final. July.

United States Environmental Protection Agency (USEPA). 2009. "Part F, Supplemental Guidance for Inhalation Risk Assessment, Final." *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual*. EPA-540-R-070-002, OSWER 9285.7-82. January.

United States Environmental Protection Agency (USEPA). 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. June.