
31 March 2020

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Annual Summary Report - 2020
Hounsfeld Heights – Briar Hill Community
Calgary, Alberta

File CG2430.1 E48

1.0 Introduction

Clifton Associates Ltd. (Clifton) was retained by Sears Canada Inc. (Sears) to manage the on-going remediation and monitoring program at the site, which includes the Mall Area north of 14th Avenue NW, and the Hounsfeld Heights Area to the south. In Environmental Protection Order No. EPO-2018/01-SSR dated 28 February 2018, Alberta Environment and Parks (AEP) requested Sears provide an Annual Report on 31 March 2019, and each subsequent year, documenting communication between Sears and the affected stakeholders, as well as a summary of the environmental work completed in the previous year. The first Annual Report under this requirement was provided to AEP, as well as the stakeholders, on 04 April 2019.

Since the date of the original EPO, amendments naming additional responsible parties as well as an Environmental Appeals Board (EAB) Hearing have occurred. Following the hearing, the EAB provided a report and its recommendations to the Minister of Environment and Parks. On 05 February 2020, Ministerial Order (MO) 09/2020 was released. The MO confirmed the decision of the Director to name Suncor Energy Inc. (Suncor Energy) as a party to the EPO.

The MO also confirmed the requirement of providing an Annual Report to all stakeholders which is to include the original reporting requirements set forth within the EPO, in addition to also addressing the following items:

- Outline all attempts made by the Parties to gain access to the properties in Hounsfeld Heights for effective delineation and remediation, excluding personal information;
- Include a detailed summary of the work done in Hounsfeld Heights during the previous year, including the results and plan for future work in the following calendar year; and
- Make the Annual Report available to the community, including the residents of the Hounsfeld Heights neighbourhood.

This Annual Report follows the same outline as presented in 2019 with a few amendments to adjust for the new requirements set forth in the MO.

2.0 Communication

Sears and their consultant, Clifton, have utilized a variety of avenues to communicate findings to the pertinent stakeholders of the project. All communication is tailored to its specific audience and has been conducted in accordance with the communications plan proposed as part of the Updated Site Management Plan (SMP) (Clifton, 2014).

In 2019, communication was as follows:

- Clifton, on behalf of Sears, circulated a quarterly summary of work to residents and stakeholders. The summary was provided to the Hounsfeld Heights – Briar Hill Community Association. The quarterly communication was posted in the community newsletter, on the community website as well as on the Sears communications website.
- Sears continued to use its communication website accessible to all members of the community, specifically designed to allow easy access to all publicly available reports and communications related to the project.
- Clifton, on behalf of Sears, was in contact with select residents to obtain approval and access to perform indoor air quality assessments associated with the semi-annual soil vapour sampling program and the soil vapour monitoring program contingency plan.
- Clifton, on behalf of Sears, was in contact with one resident pertaining to access to their property for the proposed liquid petroleum hydrocarbon (LPH) delineation program.
- Additional communication with residents in the Hounsfeld Heights – Briar Hill Community as well as the private property owners of the Mall Area was through email, phone, or in-person communication. This was completed on an as needed, basis. If specified, Clifton contacted residents using their communication method of choice.
- Additional communication with stakeholders such as AEP and the City of Calgary was through email, phone, or in-person communication.

All communication in 2019 was related to the communication of results from work being completed on-site or as a means of requesting access to specific portions of the site which required additional consent, either verbally or through an access agreement.

Concerns expressed during communication were specific to each stakeholder and how they are being impacted. During the EAB hearing, additional concerns raised from the Hounsfeld Heights Landowners Group included, but was not limited to, uncertainty surrounding the remediation, not understanding technical reports, and issues associated with the current communication methods/strategy.

As per the MO, changes to the communication strategy moving forward are to include:

- Identifying a Key Communication Contact for all stakeholders;
- Responding to inquiries from the community within 5 business days, in writing;

- Developing an effective two-way communication strategy with consultation from the residents; and
- Continuing the use of the communications website to provide regular status updates, copies of all finalized, stamped reports and a summary of the results from all finalized reports.

Mr. Stephen d'Abadie of Clifton has currently been identified as the Key Communication Contact for all stakeholders. Mr. d'Abadie's contact information is presented below:

Name: Stephen d'Abadie, MEng, PBIOL

Email Address: Stephen_dabadie@clifton.ca

Phone Number: (403) 263-2556 ext. 4139

Mailing Address: 2222 – 30th Avenue NE, Calgary, AB, T2E 7K9

Moving forward, Clifton will use its best efforts to respond to all inquires from the community within 5 business days, in writing. It is also anticipated that the development of an effective two-way communication strategy with consultation from the community will also be completed in 2020. Lastly, the communications website will continue to be used to provide easy access to the community of all regular status updates and copies of all pertinent reports. The use of this website may change following the development of the communication strategy.

3.0 Environmental Work

In 2019, Clifton completed the following activities associated with the site:

- Mall Area Additional Characterization;
- Groundwater Monitoring and Sampling – Spring and Fall;
- Soil Vapour Sampling – Winter and Summer;
- Dual Phase Vapour Extraction (DPVE) system Retrofit and Continued Operation;
- Preparation of the Revised Remediation Plan; and
- Permeable Reactive Barrier (Plumestop) Remediation Program.

A summary of each of these items is presented in the following sections.

3.1 Mall Area Additional Characterization

As part of the EPO, one of the requirements set forth by AEP was preparing a Remediation Plan that would address all media, across all areas of the site. Following submission of the Remediation Plan in December 2018, Sears received feedback from AEP requesting, among other items, additional characterization of the Mall Area property, particularly the former excavation area.

Based on a request made by AEP in a letter dated 31 May 2019, Clifton completed a Supplemental Phase II Environmental Site Assessment to address the following objectives:

- Confirm the geological units within the Mall Area;
- Characterize and delineate the residual soil petroleum hydrocarbons (PHCs) within the Mall Area;

- Obtain hydrostratigraphic characterization within the Mall Area, particularly within the former excavation footprint; and
- Characterize and delineate the residual groundwater PHCs within the Mall Area.

To meet these objectives, Clifton advanced boreholes in nine locations throughout the south parking lot of the Mall Area bound to the east by Kal-Tire, to south by 14th Avenue NW, to the east by the Renaissance Towers and to the north by the North Hill Shopping Center. Boreholes were advanced to a maximum depth of 18 m bgs. A single monitoring well was advanced at four of the nine locations, with nested wells installed at an additional four locations. A monitoring well was not installed at one of the borehole locations.

During the borehole drilling, the encountered lithology was documented in field logs and samples were obtained for analysis of benzene, toluene, ethylbenzene, and total xylenes (BTEX), PHC fractions F1 to F4 and volatile organic compounds (VOCs). Select soil samples were also submitted for analysis of polyaromatic hydrocarbons (PAHs).

Groundwater monitoring wells were installed and screened at varying depths to capture the vertical extent of the residual PHCs within the groundwater.

Based on the scope of work completed, the following conclusions were drawn:

Previously identified geological units within the Mall Area were further characterized and confirmed. Geological Units 1 (upper silty sand) and 2 (upper clayey silt) reach a maximum depth of 6.5 m bgs with Unit 3 (middle sandy silt) present to the maximum depth of exploration at 18 m bgs. These units are consistent with previous drilling data from the area. The excavation fill material, consisting of a mix of the upper three Units, was classified as its own distinct Unit, Unit 6.

Based on the results of the soil sampling program, residual soil PHCs have been adequately characterized across the site.

Soil results from within the excavation backfill area show that the treated soil (Unit 6) returned to the excavation, and which at that time met the then current 2001 PST Guidelines, may not, in all areas, meet the current 2019 AEP Tier 1 Guidelines. Beyond the extent of the excavation, soil PHCs are generally located within the saturated zone and likely resulted from lateral migration through the groundwater pathway.

Residual soil PHCs are largely delineated and remain below the vapor inhalation pathway guidelines for all parameters assessed. When comparing residual soil PHC concentrations from the current investigation to the 2008 investigation completed following the excavation, parameters do, on average, appear lower, suggesting natural attenuation is occurring.

Obtaining hydrostratigraphic characterization within the Mall Area was limited to geological Unit 3. This geological unit extended to the maximum depth of exploration at 18 m bgs. Screened wells at varying

elevations throughout this unit suggest that the residual PHCs are limited to the upper portion of the unit. Hydrostratigraphic information from within the excavation footprint was limited to areas beneath the base of the excavation within the underlying soil as the majority of the excavation was limited in depth by the presence of the water table. As a result, screening wells within the excavation fill material would have likely resulted in dry wells.

Residual groundwater PHCs have also been adequately characterized across the site. Residual PHCs exist within, and beyond, the former excavation footprint. With that being said, the residual PHCs are generally delineated with a few exceptions to the south and southwest. Where wells were nested, the deeper well, in all cases, met the applicable guidelines for all parameters suggesting impacts within geological Unit 3 are limited to the upper portion of this unit within the Mall Area. Lastly, when comparing residual groundwater PHCs from the most recent investigation to the 2008 investigation completed right after the excavation, groundwater PHC concentrations do appear, on average to be lower, suggesting natural attenuation is occurring.

A copy of the report titled *Supplemental Phase II Environmental Site Assessment, North Hill Mall -1616 14th Avenue NW, Calgary, Alberta* (18 December 2019) can be found on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link titled *Clifton Associates - Phase 2 ESA, North Hill Mall (2019-12-18) (pdf)*.

3.2 Groundwater Monitoring and Sampling

In 2019, Clifton initiated two groundwater sampling events (semi-annually). The first event was completed in Spring 2019, while the second event started in late Fall and finished at the end of January 2020. A report was released to the stakeholders documenting the Spring 2019 sampling event. A report has not yet been generated for the second event. It is anticipated that a report documenting this event will be made available to all stakeholders by 30 April 2020.

The purpose of the on-going groundwater monitoring and sampling program is to assess whether the PHC plume is expanding, declining or remaining stable, and whether the concentrations of the contaminants of potential concern (CoPC) are below the appropriate guidelines at the lateral extents of the plume. A further objective of the groundwater monitoring and sampling program is to obtain additional data to determine if there is evidence to support the processes of natural attenuation in certain areas of the plume. Sampling for select geochemical parameters in twenty monitoring wells was completed in January 2020 and this information will be presented in the report associated with that event.

3.2.1 Spring 2019 Monitoring and Sampling Event

In the Spring of 2019, Clifton completed a groundwater monitoring and sampling event which consisted of collecting samples from 87 monitoring wells throughout the Hounsfeld Heights and North Hill Mall areas. Prior to the sampling, all wells were monitored for depth to the groundwater and the total depth of the well in addition to measuring the organic vapour concentration of the well and determining if LPH was present. Sampling of the wells was completed using either a dedicated disposable bailer or a HYDRASleeve and in some cases both methods were used on a single well for comparative purposes.

Samples were submitted for analysis of BTEX, PHC fractions F1 to F2, PAHs (select wells) and VOCs.

Upon receiving the groundwater results, they were compared to the AEP 2019 Tier 1 and 2 Guidelines for either commercial land use or residential/parkland land use for coarse and fine-grained soil, depending on the sampling location.

3.2.1.1 Results and Discussion

The monitoring results from the Spring 2019 event show the following interpreted groundwater flow directions for each Unit:

- Unit 1: South and West
- Unit 2: South
- Unit 3: Southeast
- Unit 4: South
- Unit 5: Southeast

The interpreted groundwater flow directions were generally consistent with previous investigations.

One-hundred and four samples were submitted for laboratory analysis of BTEX and PHC fractions F1 and F2. Of the BTEX and PHC fractions F1 and F2, benzene was the most frequently detected and was the parameter which most commonly exceeded the AEP 2019 Tier 1 Guidelines. Also, with few exceptions, the remainder of the BTEX and PHC F1 and F2 compounds detected were associated with a detection or exceedance of benzene in the same sample. For these reasons, benzene is considered representative of the BTEX and PHC fractions F1 and F2 throughout this discussion. For the BTEX and PHC F1 and F2 constituents, the plume margin is defined by the AEP 2019 Tier 1 Guideline for benzene, 0.005 mg/L.

Benzene has been detected in concentrations in excess of the AEP 2019 Tier 1 Guidelines in Units 1, 2, 3, and 4. Concentrations of benzene ranged from below detection (<0.00040 mg/L) to a maximum of 3.7 mg/L in BH1982 (Unit 3).

Monitoring wells BH1954, BH1981, BH2003, BH1944, BH1982, BH1929, BH1964, BH1980, BH2002, BH1937 and BH1939 are all located in the southern portions of Unit 3 and 4 and have been used to perform a Mann-Kendall Plume Stability Analysis. Based on the Mann-Kendall Plume Stability Analysis of the available data for these wells the following trends were observed:

- Stable: BH1954, BH1982
- Declining: BH1981, BH1929, BH1937, BH1939 and BH2002
- Expanding: BH1944
- Not completed as all data has been below the detection limit: BH2003, BH1964 and BH1980

It should be noted that the Site-Specific Tier 2 Guidelines which are in place for the protection of human health through the vapour inhalation pathway are only exceeded for one parameter, benzene, in one well, BH1982. The concentration of benzene in this monitoring well is 3.7 mg/L while the Site-Specific Tier 2 Guideline value is 3.2 mg/L.

Sixty-three samples were submitted for laboratory analysis of PAHs. Naphthalene was the most frequently detected PAH; however, no exceedances were observed. Also, with few exceptions the remainder of the PAH compounds detected were associated with a detection of naphthalene within the same sample.

The sampling plan for PAHs has been re-evaluated throughout the project as more data has been collected and reviewed. Only 17 monitoring wells have been sampled for PAHs in nine sampling events. Since removal of the freshwater aquatic life pathway, an exceedance of the PAH guidelines has only occurred once, in one well, BH1905, in 2015.

Naphthalene has historically been detected in the three uppermost stratigraphic units: Units 1, 2, and 3. In the 2018 monitoring and sampling event, naphthalene was only detected in Unit 1 and Unit 3. Naphthalene is most widespread in Unit 3 and appears to have been laterally delineated. All monitoring wells installed in Unit 4 and Unit 5 had reported concentrations of naphthalene below the laboratory detection limit.

One hundred and seven samples were submitted for laboratory analysis of VOCs. 1,2 -DCA was the most frequently detected VOC, and most commonly exceeded the AEP 2019 Tier 1 Guidelines. Also, with few exceptions, the remainder of the VOC compounds detected were associated with a detection or exceedance of 1,2-DCA within the same sample. For these reasons, 1,2-DCA is considered representative of the VOCs throughout this discussion. The plume margin is defined as the AEP 2019 Tier 1 Guideline for 1,2-DCA of 0.005 mg/L.

1,2-DCA has been detected at concentrations greater than the AEP 2019 Tier 1 Guidelines in Units 1, 2, 3, and 4. Concentrations were below the analytical detection limits in Unit 5 except for BH2001, which had a detectable concentration of 0.0018 mg/L. Concentrations of 1,2-DCA on-site ranged from below detection (<0.001 mg/L) to 0.33 mg/L (BH1928).

Monitoring wells BH1928, BH1954, BH1981, BH2003, BH1929, BH1937 and BH1939 are all located in the southern portions of Unit 3 and 4 and have been used to perform a Mann-Kendall Plume Stability Analysis. Based on the Mann-Kendall Plume Stability Analysis of the available data for these wells the following trends were observed:

- Stable: BH1928, BH1981
- Declining: BH1929, BH1939, BH1937
- Expanding: BH1954 (but below the AEP Tier 1 Guidelines)
- Not completed as all data has been below the detection limit: BH2003

It should be noted that the Site-Specific Tier 2 Guidelines which are in place for the protection of human health through the vapour inhalation pathway are only exceeded for one parameter, 1,2-DCA, in one well, BH1928. The concentration of 1,2-DCA in this monitoring well is 0.33 mg/L while the Site-Specific Tier 2 Guideline value is 0.29 mg/L.

3.2.1.2 Conclusions

The data collected during this sampling event is generally consistent with previous sampling events. This groundwater monitoring and sampling program is part of the risk management component of the site as well as the long-term remediation monitoring of the site.

From a risk management perspective, out of the 116 monitoring wells located throughout the site, only two wells have parameters, one in each well, which exceed the Tier 2 Site-Specific Guidelines for the protection of human health.

While groundwater sampling is one method of assessing potential risks to the site, the soil vapour sampling program provides a more representative assessment as to whether or not the residual PHCs within the soil and groundwater pose a risk to human health through the vapour inhalation pathway. To date, the soil vapour sampling program has revealed no risk to human health.

The soil vapour sampling program and the groundwater monitoring and sampling program will continue to be used as tools to assess risk throughout the long-term remediation of the site.

The statistical analysis completed on wells across the site will be used to determine trends within the results as they become available. Currently, the dataset is small and does not take into account seasonality. Seasonal fluctuations within the data will be assessed at the end of the 2020 as more data is available. It should also be noted that the terms “increasing, decreasing and stable” do not take into account whether exceedances of the AEP 2019 Tier 1 Guidelines are present. It is recommended that any conclusions drawn from the statistical analysis be done so with the understanding of the inherent data biases due to a lack of seasonal interpretation and the AEP 2019 Tier 1 Guidelines.

3.2.1.3 Recommendations

Based on the work conducted at the site during the Spring 2019 sampling event, Clifton recommended the following:

- The semi-annual groundwater monitoring and sampling program be continued as part of the risk management component of the site as well as the long-term remediation monitoring of the site.
- PAHs analysis should be removed from the groundwater program based on the removal of the freshwater aquatic life pathway due to the distance to the nearest surface water bodies and no exceedances being observed in the past four years.
- Historically dry wells with non-detectable well vapour concentrations (BH1909, BH1920, BH1931, BH1932, BH1938, BH1960, BH1968, BH1969, BH1970, BH1986, BH1987, and BH1988) should be decommissioned at the time site closure is obtained.
- BH1943 and BH1979 were found to be damaged, and should be properly abandoned and replaced, given their key location at the downgradient edge of the plume.
- The following wells have never had detectable concentrations of BTEX, PHC F1 to F2 and VOCs ranging between six and 11 sampling events over a four to five year time-frame: BH912, BH1901 to BH1903, BH1913, BH1914, BH1916 to BH1919, BH1926, BH1934, BH1935, BH1941, BH1942, BH1945 to BH1948, BH1951 to BH1953, BH1955, BH1957, BH1959, BH1961 to BH1964, BH1966, BH1968, BH1972, BH1978, BH1980, BH1983, BH2003, BH2004, BH2007 to BH2009, BH1102, BH1701. These

wells should be sampled once more on an annual basis for one additional year. If the results are still not detectable select monitoring wells should be removed from the program based on their location with respect to the plume extent and proximity to adjacent monitoring wells which provide a similar data set.

A full presentation of all the data from the Spring 2019 program can be found in the report titled *2019 Spring Monitoring and Sampling Event, Hounsfield Heights and Mall Areas, Calgary, Alberta* (19 September 2019) which is located on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link titled *Clifton Associates - Groundwater Monitoring and Sampling Report - Q1 2019 (2019-09-19) (pdf)*.

3.3 Soil Vapour Sampling Program

In 2019, Clifton completed two Soil Vapour Monitoring Program events. The first event was completed in Winter 2019, while the second event was completed in Summer 2019. Both reports have been released to the stakeholders. In addition to the semi-annual soil vapour monitoring program, the contingency sampling plan was triggered following an exceedance which occurred during the Winter 2019 sampling event. A summary of the Winter, Contingency Plan and Summer sampling programs are presented in the following sections.

3.3.1 General Methodology

A bottom-up approach to soil vapour characterization was selected by Clifton for the site. Deep, near-source vapour sampling was completed first to assess the need for sub-slab vapour and potentially indoor sampling. High spatial and temporal variability in soil vapour concentrations were anticipated as part of the design of the soil vapour monitoring program.

In addition to assessment of possible soil vapour intrusion in the Mall Area around Kal-Tire, soil vapour characterization was focused in the Hounsfield Heights Area south of 11th Avenue NW, based on the following reasons:

- Intermittent, thin, or missing clay stratum;
- Imperfectly understood soil stratigraphy;
- Shallow water table; and
- High number of underground utility corridors.

The proposed sampling frequency for collection of soil vapour samples was semi-annually. The semi-annual sampling program should capture temporal fluctuations as a result of seasonal changes in the water table, as well as changing temperatures and saturation of the soil and groundwater.

The indoor air quality of structures on-site was predicted using measured soil vapour concentrations and a vapour attenuation factor specific to the soil type, land use, depth to contamination, and contamination source. Indoor air concentration criteria were developed based on key receptors and expected exposure times.

3.3.2 Winter 2019

Clifton completed the first event in 2019 between the dates of 15 January 2019 and 04 February 2019. Clifton personnel collected samples of subsurface soil vapour from a total of 47 soil vapour probes. All samples were submitted for analysis of BTEX, PHC fractions F1 and F2, naphthalene, and 1,2-DCA. Selected samples were also submitted for fixed gases (oxygen, nitrogen, carbon dioxide, and methane), which can provide an indication as to the degree of biodegradation taking place in the subsurface.

The results from the soil vapour sampling program were compared to the Soil Vapour Quality Guidelines (SVQG) generated for the protection of indoor air. All samples were below the site specific SVQG with one exception, the sample obtained from soil vapour probe SV-32. The sample from this probe exceeded the SVQG for the following parameters:

- PHC Aliphatic Sub-Fraction C6 to C8;
- Naphthalene; and
- 1,2 – Dichloroethane.

This exceedance was the first exceedance seen in any soil vapour probe since the implementation of the program. As part of the Soil Vapour Monitoring Program approved by AEP, a contingency plan was put in place to address any exceedances which may occur. The exceedance observed in SV-32 triggered the implementation of the contingency plan which is documented in Section 3.3.3 of this report.

A trend analysis was performed on all the results from the Winter 2019 soil vapour sampling event for select parameters. The analysis indicated generally stable trends for naphthalene and 1,2-DCA and a decreasing trend for BTEX compounds for a majority of the vapour probes.

A full presentation of all the data from the Winter 2019 program can be found in the report titled *Soil Vapour Monitoring Report, Winter 2019, Hounsfeld Heights and North Hill Mall, Calgary, Alberta* (15 April 2019) which is located on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link titled Clifton Associates - Soil Vapour Monitoring Report - Winter 2019 (2019-04-15) (pdf).

3.3.3 Contingency Plan Sampling

As mentioned in Section 3.3.2, during the Winter 2019 Soil Vapour Sampling event an exceedance of the site-specific SVQG for the following parameters in Soil Vapour probe SV-32 was observed:

- PHC Aliphatic Sub-Fraction C6 to C8;
- Naphthalene; and
- 1,2 – Dichloroethane.

As a result of this exceedance, the contingency plan as presented in the approved *Revised Soil Vapour Monitoring Program (Update Fall 2016), Hounsfeld Heights and North Hill Mall, Calgary, Alberta* (20 October 2016) was implemented.

The Contingency Plan includes the following protocols:

- Increase sampling frequency of the soil vapour probe which contained the exceedance to quarterly events;
- Contact all residents within a 15 m radius of the observed exceedance and request access to their property for additional investigation which may include one of the following options:
 1. Installation of a sub-slab soil vapour monitoring point, followed by concurrent sampling of indoor air.
 2. Installation of at least one, ideally two, external monitoring points between their structure and the location of the exceedance.
 3. Complete stand-alone indoor air quality sampling.
- If sampling is approved on private residences, provide a letter reporting the results to the homeowner.
- Continue the Contingency Plan sampling until five consecutive events of results have concentrations below the site-specific SVQG.

Additional measures related to the contingency plan are presented in the Revised Soil Vapour Monitoring Program (October, 2016).

3.3.3.1 SV-32 Sampling Results

Since the original exceedance, soil vapour probe SV-32 has been sampled an additional five times. The dates of the sampling events and whether exceedances were observed are provided below:

- 20 March 2019: exceedance
- 16 May 2019: non-exceedance
- 22 August 2019: non-exceedance
- 12 November 2019: non-exceedance
- 29 January 2020: non-exceedance

There have now been four sampling events conducted as part of the contingency program where exceedances of SV-32 have no longer been detected. Five consecutive non-exceedance events are required as part of the contingency plan to return to semi-annual soil vapour sampling of the probe which showed the original exceedance. The next sampling event is scheduled for May 2020. If this event shows a non-exceedance for SV-32 the contingency plan will be discontinued. The sampling of additional probes installed on private properties as discussed in the following section will be completed at the same frequency of SV-32.

3.3.3.2 Supplemental Soil Vapour Point Installation and Sampling

Following the implementation of the Contingency Plan, six residences were contacted to discuss potential access to their property for additional soil vapour investigation.

Clifton received a response from four homeowners, one of which owns two of the homes within the 15 m contingency plan radius. Based on initial communications, two of the homeowners agreed to having supplemental investigation completed on their property. The other two homeowners chose to wait until the supplemental sampling of SV-32 was completed and would make their decision on the basis of those results.

Of the two residences which agreed to additional investigation, one agreed to the installation of two soil vapour probes on their property while the other agreed to the installation of one soil vapour probe on their property. Initial sampling was conducted immediately following the installations and was to be completed quarterly until the contingency plan is discontinued. Once the contingency plan is completed, these points will be sampled semi-annually upon approval from the homeowners. All results in 2019 and early 2020 came back below the site-specific SVQG for the additional soil vapour probes which were installed on private properties.

Individual reports were provided to the homeowners presenting the results of the sampling program completed on their property.

The following two Supplemental Soil Vapour Sampling reports document the findings of the contingency plan sampling:

- J *Supplemental Soil Vapour Monitoring Points Installation and Monitoring Report, Hounsfeld Heights and North Hill Mall, Calgary, Alberta* (20 June 2019); and
- J *Supplemental Soil Vapour Monitoring Points Installation and Monitoring Report, Hounsfeld Heights and North Hill Mall, Calgary, Alberta* (13 January 2019).

These reports can be found on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link entitled Clifton Associates - Supplemental Soil Vapour Monitoring Report (2019-06-20) (pdf) and the 2020 tab at the link titled Clifton Associates - Supplemental Soil Vapour Monitoring Report (2020-01-13) (pdf).

3.3.4 Summer 2019

Clifton completed the second soil vapour monitoring and sampling event in Summer 2019 between the dates of 06 August 2019 and 26 August 2019. Clifton personnel collected samples of subsurface soil vapour from a total of 46 soil vapour probes. All samples were submitted for analysis of BTEX, PHC fractions F1 and F2, naphthalene, and 1,2-DCA. Selected samples were also submitted for fixed gases (oxygen, nitrogen, carbon dioxide, and methane), which can provide an indication as to the degree of biodegradation taking place in the subsurface.

The results from the soil vapour sampling program were compared to the site-specific SVQG generated for the protection of indoor air. All samples were below the site-specific SVQG, including SV-32 which had an exceedance of three parameters in the Winter 2019 sampling event.

It was recommended in this report that an assessment of the extent of the SVMP should be completed to determine if the same frequency and number of samples is still required for all vapour probes.

This recommendation needs to be discussed with AEP as the soil vapour sampling program of the Revised Remediation Plan is one of the components required to measuring potential risk to human health through the vapour inhalation pathway.

A full presentation of all the data from the Summer 2019 program can be found in the report titled *Soil Vapour Monitoring Report, Summer 2019, Hounsfeld Heights and North Hill Mall, Calgary, Alberta* (23 October 2019) which is located on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link titled Clifton Associates - Supplemental Soil Vapour Monitoring Report (2019-06-20) (pdf).

3.4 Dual Phase Vapour Extraction System Retrofit and Operation

As part of the Revised Remediation Plan, the continued operation of the DPVE system was recommended as a measure to reduce, to the extent practicable, any residual LPH within the community of Hounsfeld Heights. A secondary objective of continuing to operate the DPVE is to remove contaminated groundwater from the subsurface, reducing the overall mass of residual PHCs within the subsurface.

In February 2019, Sears released a Request for Proposal (RFP) to select vendors to perform a retrofit of the existing the DPVE system housed in Lions Parks, Hounsfeld Heights. The intended purpose of the DPVE retrofit was to address existing issues with specific mechanical components, gauges and sensors and provide a system capable of operating into the future so long as the system is required for remedial purposes. The RFP also included a request for a routine maintenance program to be conducted throughout the duration of operation.

Upon reviewing the received bids in response to the RFP, Sears selected Sequoia Environmental Remediation Inc. to perform the retrofit and routine maintenance of the DPVE system.

In April 2019, following a kick-off meeting between Sequoia, Clifton and Sears the retrofit was initiated. During the next two months, Sequoia completed work on the extraction equipment (vacuum pumps), liquid discharge system, vapour discharge system and components, the horizontal moisture knockout components as well as the overall system controls and instrumentation.

In June 2019, the system was re-initiated with the upgrades which had been completed. Since that time, Sequoia has performed weekly and monthly maintenance on the system to ensure it continues to efficiently operate.

The DPVE continues to operate on two extraction lines connected to four extraction wells (EX-4 to EX-7). Two of these extraction wells EX-4 and EX-5 are located in close proximity to the only well (BH1704) on-site which still shows the presence of LPH. As part of the operations of the DPVE, monthly discharge reports are submitted to the City of Calgary. In 2019, a total of approximately 300,000 L of groundwater was extracted, treated and discharged to the City sanitary sewer system.

During this time, an estimate of LPH removal based on a vapour equivalent was calculated and was presented in the 2019 Spring Groundwater Monitoring and Sampling Report as 985 L between July and August of 2019. It is important to note that these estimates rely on assumptions such as contaminant composition and density and external factors such as ambient pressures as well as data frequency and averaging which will have an impact on estimated volume removal. Furthermore, these estimates assume

all vapours are directly related to LPH when in fact they are also related to the dissolved phase PHCs within the groundwater.

As a result, LPH removal is also gauged by observing the presence of it within the monitoring well network to determine if it is being reduced. In the Spring 2019 event an LPH thickness of 35 mm was observed in monitoring well BH1704 while in the Winter 2019 event, there was no LPH observed. This was the first time since September 2015 where LPH has not been observed in this monitoring well. However, one event is not sufficient to draw a conclusion and further monitoring and sampling events will continue to assess this well for the presence of LPH. In addition, as part of the future work presented in Section 5.0 of this report, additional delineation is planned to be completed to further define the extent of LPH within this area.

3.5 Revised Remediation Plan

The EPO issued in 2018 required the submission of a Remediation Plan for the site. As stated in the EPO the Remediation Plan was to include:

- A proposal outlining the remediation and / or risk management plan for all substances in or under the site and off-site areas, including all soil, subsoil, and groundwater;
- A detailed description of the work that will be undertaken for both the site and off-site areas to meet the SVQG and AEP 2019 Tier 1 Guidelines as applicable for all other media; and
- A schedule to implement the Remediation Plan by March 2019.

The original Remediation Plan was submitted to AEP in December 2018. Following a review of the Remediation Plan by AEP, clarification and additional requests for information were made and documented in two correspondence letters dated 20 February 2019 and 31 May 2019. Clifton, on behalf of Sears, worked with AEP to provide the responses and additional information they were requesting pursuant to an approval of the Remediation Plan.

The original letter provided by AEP on 20 February 2019 was responded to by Clifton, on behalf of Sears in two separate documents dated 10 April 2019 and 01 May 2019. A summary of AEP correspondence is presented below:

- Provide information related to the current delineation, extent and characterization of residual PHCs within the Mall Area;
- The Remediation Plan is to include a trigger and contingency in case the 1,2-DCA plume shows signs of expansion or is not effectively being managed;
- Adjustments to the Site-Specific groundwater guidelines were required;
- A timeline for achieving the AEP 2019 Tier 1 Guidelines was to be provided for all areas of the site; and
- A description of the active remedial measures which are to be implemented to expedite achieving the AEP 2019 Tier 1 Guidelines across the site. Plume Monitoring.

In addition to these requests, additional comments were provided to Sears surrounding PHC delineation, the Domestic Use Aquifer pathway, access across the site and support of the current SVQG.

Upon providing the two responses to AEP, a second communication dated 31 May 2019 was sent to Sears seeking some additional clarification and characterization requests for the site pursuant to acceptance of the Remediation Plan. A summary of the AEP correspondence dated 31 May 2019 is presented below:

- Additional characterization of the Mall Area was required; and
- Additional information was to be provided presenting the current and historical presence of LPH on-Site.

In addition to the requests above, their letter also provided additional comments surrounding outstanding items from their initial correspondence in February 2019 as well as supporting comments to the previous submissions as having addressed their concerns.

Upon addressing and completing the additional information and work requests from AEP, Clifton submitted a Revised Remediation Plan on 13 August 2019. Upon review of the Revised Remediation Plan by AEP, an acceptance letter was provided on 12 September 2019 with conditions specific to the potential changing site conditions over time and supplemental information being gathered as part of the Revised Remediation Plan.

It is now understood, that following the EAB hearing in December 2019 and the release of the MO in early 2020, a request to submit another revised version of the plan taking into account specific requirements set forth in the MO is to be provided by 05 May 2020. Furthermore, an updated version of the plan shall be submitted each calendar year, or at a frequency determined appropriate by the Director, to reflect the previous years work and data and any changes to the plan.

The current Revised Remediation Plan, prepared in August 2019 and accepted in September 2019, includes the following key components:

- **Source Removal:** Continue to address the presence of LPH on-site through the use of the DPVE system. This may also include an assessment of the current system performance and effectiveness to determine if adjustments are required. This will also include further investigation in the extent of LPH on-site;
- **Plume Expansion Control:** Implement measures to prevent the expansion of the dissolved phase PHC plume in areas of higher potential risk. This includes the full-scale application of a permeable reactive barrier along 11th Avenue NW;
- **Plume Monitoring:** Continue with the semi-annual groundwater monitoring and sampling program. The groundwater program will begin to include an assessment of parameters indicative of natural attenuation. The data from these events will be used as a tool to assess whether the plume is expanding, declining or remaining stable as well as a method of assessing risk to human health throughout the site; and
- **Risk Management:** Continue with the semi-annual soil vapour monitoring and sampling program. The soil vapour monitoring and sampling program will be used as a method of assessing risk to human health in addition to determining trends within the soil vapour plume across the site.

A copy of the report titled *Revised Remediation Plan, Hounsfeld Heights and Mall Areas, Calgary, Alberta* (13 August 2019) can be found on the Sears Communication Website at <http://searscanadaepo.sears.ca> under the 2019 tab at the link titled Clifton Associates - Revised Remediation Plan Pt 1 (pdf), Clifton

Associates - Revised Remediation Plan Pt 2 (pdf), Clifton Associates - Revised Remediation Plan Pt 3 (pdf).

3.6 Permeable Reactive Barrier (PlumeStop™) Program

In response to the Updated SMP (Clifton, 2014), Clifton contacted Regenesis Remediation Services to complete an application of PlumeStop™ along 11th Avenue NW. The initial PlumeStop™ pilot study, which was conducted in 2016, was completed in an area that contained some of the highest PHC concentrations across the entire site. In 2018, Clifton and Regenesis completed a second pilot study in an area along 11th Avenue where concentrations were lower and more representative of the entire groundwater plume.

The first pilot study completed in 2016 also included the injection of an oxygen release compound while the second pilot study only included the use of PlumeStop. The purpose of applying an oxygen release compound is to promote microbial colonization and degradation of the CoPCs at a greater rate. Based on the results of both pilot studies, and as per the Revised Remediation Plan, Clifton recommended the full-scale application of PlumeStop with an oxygen release compound as a permeable reactive barrier along 11th Avenue NW to control plume expansion in an area of higher potential risk.

3.6.1 Technology Description

PlumeStop™ is a colloidal activated carbon reagent. The activated carbon particles in PlumeStop™ have a diameter of 1 – 2 µm, which allows it to suspend in liquid form. Research completed by Regenesis shows that the diameter of soil pore throats varies between 3 and 30 µm, which precludes other activated carbon particles (granular activated carbon and powdered activated carbon) from dispersing completely through the aquifer. PlumeStop™ can theoretically achieve wider distribution through the soil matrix using lower injection pressures.

The activated carbon is suspended in a colloidal biomatrix favorable for microbial colonization and growth. The CoPCs sorb to the activated carbon, and microbes are drawn to the source of nutrition provided by both the CoPCs and the biomatrix. Digestion of CoPC by microbial activity reopens sorption sites on the activated carbon.

The oxygen release compound used at the site is trademarked as ORC Advanced (ORC-A). ORC-A is a white, odorless powder, which consists of a mixture of calcium hydroxide oxide, calcium hydroxide, monopotassium phosphate and dipotassium phosphate. The ORC-A is mixed with water and injected as a slurry to provide a slow controlled release of oxygen into the subsurface for up to 12 months.

3.6.2 Full Scale Application and Performance Monitoring

Following completion of the 2018 pilot study, Clifton worked with Regenesis as well as InSitu Remediation Services Ltd to design a full-scale application along 11th Avenue NW using the performance data obtained from both pilot studies. As part of the design process, passive flux meters were hung in select monitoring wells at different depth intervals to provide an estimate of mass flux of PHCs through the groundwater by depth. This data was used to help determine the quantity of product required as well as the injection zone thickness to ensure the entire PHC plume was being intercepted.

Upon completing the final design and obtaining the necessary City of Calgary permits, the full-scale application along 11th Avenue NW commenced on 05 November 2019 and was completed on 12 December 2019.

During this time, a total of 57 direct-push injection points, using a Geoprobe Model 7822, were used to inject 38,181 kg of PlumeStop and 8,370 kg of ORC-A. The spacing of the injection points was approximately 3.05 m beginning at the intersection of 11th Avenue and 15th Street NW and ending at the corner of 11th Avenue and 16A Street NW. The injection zone thickness ranged from approximately 2 m to 9.5 m depending on the interpreted vertical extent of PHC impacts along 11th Avenue NW.

The injection was completed using a bottom-up approach. Direct push rods were advanced to the maximum depth at each location. The Plumestop was first injected, the rod was then flushed with water and then the ORC was injected. This process was completed in 1.52 m intervals until the entire injection zone was completed.

Prior to injection, the following monitoring wells, located down-gradient of the injection, were identified as performance monitoring wells for the application of the PlumeStop:

- BH1928, BH1929, BH1936, BH1937, BH1939, BH1954 and BH1982.

Four of these monitoring wells were used as performance wells during the previous two pilot studies, including BH1929, BH1937, BH1939 and BH1982. A performance monitoring program was initiated in January 2020 following the outline presented within the Revised Remediation Plan. The results along with a detailed injection report have not yet been prepared and will be presented in 2020.

4.0 Data Gaps

Based on the work completed in 2019, supplemented by the proposed work in the Revised Remediation Plan, there is one primary data gap which has been identified in association with the site. The primary data gap is the extent of LPH within the community of Hounsfeld Heights. Most recently, LPH has only been detected in one monitoring well on-site, BH1704. In the most recent groundwater monitoring and sampling event this well no longer showed the presence of LPH. However, as stated in Section 3.4 this one data point cannot be used to make any conclusions on whether or not the LPH has been completely eliminated. Monitoring well BH1704 is located on 13th Avenue NW, directly south of Lions Park between 15th and 16th street NW. The well is located directly adjacent to residential properties and therefore the LPH extent beyond the well location beneath the properties to the south is currently unknown.

As part of the Revised Remediation Program, and as referenced within the MO, a program to further define and delineate the LPH will be undertaken in 2020.

5.0 Future Work

Based on the current Revised Remediation Plan as well as the requirements within the EPO and the MO, the following work is being proposed for 2020:

- Development of an effective two-way communication strategy between the parties and all stakeholders, particularly the residents of Hounsfield Heights;
- Continued use of the communication website which may be adjusted based on the developed communication strategy;
- Performance and communication assessment of the current DPVE configuration;
- Delineation program for the presence of LPH within Hounsfield Heights;
- Permeable Reactive Barrier performance monitoring and reporting;
- Completion and submission of a PlumeStop/ORC Injection report;
- Completion and submission of the report documenting the second groundwater monitoring and sampling event conducted in 2019;
- Replacement of monitoring wells BH1979 and BH1948;
- On-going groundwater monitoring, sampling and reporting as presented within the Revised Remediation Plan;
- On-going soil vapour monitoring, sampling and reporting as presented within the Revised Remediation Plan; and,
- Submission of an updated Revised Remediation Plan as per the MO.

The above scope of work follows the outlined approach presented within the Revised Remediation Plan as well as the requirements set forth in the EPO and MO. All technical work will be reported and made available to all stakeholders through the communication website.

6.0 Closure

This report was prepared by Clifton Associates Ltd. for the use of Alberta Environment and Parks for the Site defined as the Mall Area and Hounsfield Heights Area in Calgary, Alberta. The material in it reflects Clifton Associates Ltd. best judgment available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Clifton Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this meets your requirements. If you require any additional information, please contact our office at (403) 263-2556.

Yours truly,

Clifton Associates Ltd.



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