December 11, 2017 Reference No. 11149336

Maureen Bilawchuk
Senior Policy Specialist
Ministry of Environment and Climate Change Strategy
Environmental Standards Branch
325, 1011 Fourth Avenue
Prince George, BC V2L 3H9

Dear Ms. Bilawchuk:

Re: Final Report following Completion of the 2017 Minor Works Landfill Closure Activities at Cobble Hill Holdings 460 Stebbings Rd Near Shawnigan Lake, British Columbia

The purpose of this letter is to provide the Ministry of Environment and Climate Change Strategy (Ministry) with GHD's final report related to the landfill closure activities being conducted at the Cobble Hill Holdings (CHH) site located at 460 Stebbings Rd near Shawnigan Lake, BC (Site) pursuant to the June 29, 2017 Spill Prevention Order MO1701 (SPO), the August 11 and September 18, 2017 letters from the Ministry to the Named Parties, and associated correspondence.

As requested by the Ministry, this letter provides the following information:

1. Summary of the status of the work completed at the Site by the Named Parties in relation to the SPO and 2017 minor works identified in the July 21, 2017 Updated Final Closure Plan.
2. Discussion on the adequacy of the current state of the landfill (aka the Permanent Encapsulation Area, or PEA) as of the completion of construction of the 2017 minor works (i.e., prior to implementing final closure works) in preventing the spill or release of environmental contaminants, including a summary of the potential/outstanding environmental risks at the Site
3. Provision of high-level comments on the July 21, 2017 Updated Final Closure Plan
4. Conclusions and recommendations with regard to the adequacy of the Site and works

The intent of this letter is to provide discussion and comments for use by the Ministry and is not an exhaustive list of all requirements or deviations to the design provided in the July 21, 2017 Updated Final Closure Plan. This letter does present a summary of fundamental comments on the design, construction, and monitoring and identifies deviations that GHD noted during the on-Site inspections of the works and considers significant.

1. Summary of the Work Completed

As identified in Section 4.8 of the Updated Final Closure Plan, "*the following are considered minor construction works that were initiated and completed during the 2017 construction season:*

- *Install of new leachate and leak detection tanks into secondary lined lock block facility*
- *Install new twin piping to leachate and leak detection storage tanks*
- *Pump out, remove sludge, and backfill containment pond*
- *Install three Seepage Blanket Monitoring wells*
- *Weld patches on existing linter*
- *Stockpile and Cover Soil in Soil Management Area with 6 mil Poly tarps and sandbags*
- *Excavate Run-on ditching*"

In addition, as identified in the SPO, the following (paraphrased) additional conditions were required to be met pursuant to a letter from the Ministry dated August 11, 2017:

- Commence the 2017 minor works by August 28, 2017 and complete by no later than October 31, 2017
- Have a Qualified Professional (QP) continuously present on Site to supervise the 2017 minor works
- Complete one test pit at the northern toe of the PEA (based on a subsequent letter from the Ministry dated September 18, 2017)
- Implement monthly environmental monitoring by August 31, 2017 consisting of groundwater, surface water and leachate sampling (and including the new seepage blanket monitoring wells by October 31, 2017)
- Install and commission a high-level alarm in the Leachate Storage and Detection Facility by October 31, 2017
- Submit additional reporting to the Ministry including a detailed construction work plan and schedule and semi-monthly status reports with information including deviations to the work plan and schedule, planned activities, and water quality results.

The Named Parties also performed the following additional activity during the 2017 minor works to mitigate against potential damage to the PEA liner during high winds:

- PEA crest ditch ballasting

Summary of the 2017 Minor Works

Consistent with the Ministry's August 11, 2017 letter, a 2017 Minor Construction Works Detailed Construction Plan was prepared by Sperling Hansen Associates (SHA) (the document was originally dated September 10, 2017, but it was revised with several missing figures and re-submitted and re-dated

September 13, 2017). This Detailed Construction Plan incorporated the 2017 minor works as listed above in addition to the additional tasks outlined in the Ministry's August 11, 2017 letter.

The work summarized below was discussed in the two monthly reports prepared by GHD, dated October 23, 2017 (for work conducted in August and September 2017) and November 8, 2017 (for work conducted in October 2017). The minor works were completed by Allterra Construction Ltd (Allterra).

1. In conjunction with the 2017 minor works, two on-Site meetings were held. On September 12, 2017, Cobble Hill Holdings (CHH) representatives provided a tour of the facility for GHD's representative prior to the commencement of the 2017 minor works. A Ministry representative was on Site on September 27, 2017 to tour the Site with Allterra, SHA and GHD and inspect items related to the SPO.
2. Monthly Sampling
   - Results for the September and October 2017 sampling events were provided to the Ministry and are discussed in Section 4 of this letter.
3. On-Site QP
   - A QP was not continuously present on Site to supervise all minor construction works, as required by the SPO, from September 18 to 26, 2017, inclusive; however, as of the September 27, 2017 on-Site meeting with Ministry personnel, a QP was present continuously during the remaining minor construction works from September 27 to 29 and on October 5, 2017, inclusive, based on GHD's observations.
4. Test Pits
   - The test pitting to investigate the secondary clay liner below the PEA was completed as discussed in the October 23, 2017 monthly report.
   - The results of the clay liner assessment are provided under separate cover and discussed in Section 4 below.
5. Leachate Storage and Leak Detection Facility
   - This work was completed as discussed in the two GHD monthly reports.
6. Leachate Conveyance Piping
   - This work was completed as discussed in the two GHD monthly reports.
7. Leachate Storage Tank High Level Alarm
   - This work was completed as discussed in the two GHD monthly reports.
   - The alarm system is battery powered; the battery is charged by a solar cell secured to the outside of the facility. To confirm proper operation, the alarm was manually triggered by raising the floats to approximately 0.3 m below the shoulder (top of the wall) of the tanks. During on-Site testing when triggered, the alarm sent an email to the on-Site Islander Engineering and

Allterra representatives. Based on GHD's observations during this testing, the high-level alarm appeared to be operational.

8. Decommission Contact Water Containment Pond
   - This work was completed as discussed in the two GHD monthly reports.
9. Stockpile and Cover Soil Management Area (SMA) Soil
   - This work was completed as discussed in the two GHD monthly reports
10. Install Shallow Seepage Blanket Monitoring Wells
   - This work was completed as discussed in the two GHD monthly reports
11. PEA Liner Repairs
   - This work was completed as discussed in the two GHD monthly reports
12. PEA Crest Ditch Ballasting
   - This work was completed as discussed in the two GHD monthly reports
13. Run-On Ditching
   - This work was completed as discussed in the two GHD monthly reports

As-built drawings were provided in the October 15, 2017 progress report submitted by the QP and included with GHD's November 8, 2017 monthly report.

Schedule of work

The following bullets provide a summary of the actual timing of the 2017 minor works compared to the schedule identified in the SPO and the Ministry's August 11, 2017 letter:

1. Construction Activities commenced by August 28, 2017
   - Information has not been provided to GHD to conclude whether the planning for the work began by August 28, 2017.
2. One test pit along the PEA toe completed by September 30, 2017
   - Four test pits along the toe were completed by September 29, 2017.
3. Construction Activities completed by October 31, 2017
   - Based on GHD's observations, the 2017 minor construction work appeared to be completed as of October 5, 2017.
4. Install high water level alarm by October 31, 2017
   - The high water level alarm was installed and operational on October 5, 2017.

5. Monthly sampling (surface & groundwater locations by August 31 and seepage blanket wells by October 31)

   - Information has not been provided to GHD to conclude whether or not sampling event(s) were completed in August 2017.
   - The September and October 2017 sampling events were conducted and results were submitted to the Ministry.

6. Leachate volumes collected, stored, and transported submitted by the 15th & 30th (or the following business day)

   - Semi-monthly reports were received as scheduled between July 31 and November 15, 2017.

7. Semi-Monthly Status Reports by the 15th & 30th (or the following business day) commencing when closure activities commence

   - Progress reports were received on time on September 30, October 16, October 30, and November 15, 2017.
   - The reports addressed SPO requirements other than addressing the QP's part-time presence on Site at the outset of the on-Site work.

8. Sample Leak Detection Tank monthly when liquid is present

   - No liquid has been present to sample.

9. Sample Leachate Tanks during leachate removal

   - Leachate was sampled at the receiving facility following its removal in September 2017 and on Site during the October 2017 monitoring event.

Quality of work

In general, GHD does not have concerns with respect to the overall quality of work completed by Allterra that was observed by GHD.

The materials used during the 2017 minor works appeared to meet the specifications identified in the Updated Final Closure Plan and Detailed Construction Plan with the exceptions noted below. GHD's scope did not include specifically evaluating the materials against their intended use; however, no overall concerns were noted.

With the exception of the deviations listed below, GHD did not observe significant discrepancies between the Updated Final Closure Plan, Detailed Construction Plan (together referenced below as the Plans) and the SPO compared to the work completed at the Site.

1. As mentioned above, a QP was not present on Site full time at the outset of the on-Site work.

   i) Based on GHD's observations during the work, prior to the full-time presence of the QP, GHD did not observe potential concerns.

2. Non-woven geotextile was not placed between the lock block walls of the leachate storage and leak detection facility and the liner; however, it was placed on the base of the facility consistent with the Plans and no damage to the liner within the facility was observed by GHD.

    i) Although not ideal, this omission should not affect the integrity of the secondary liner system. The inspections of the facility should include reporting of the liner condition following the removal of leachate to document that the liner was not and has not been damaged.

3. The seepage blanket monitoring wells SB-1 through SB-3 were installed several metres farther north than indicated in the Plans, and the leachate storage and detection facility was constructed approximately 20 metres farther to the north. The eastern seepage layer monitoring well SB-3 was installed nearer to the northeast corner of the PEA, and the central seepage layer monitoring well SB-2 was not located near the leachate conveyance pipes per Section 9.6 of the Updated Closure Plan, which stated, "*SB-2 has been placed strategically to monitor any potential leakage from the conveyance piping to the proposed new leachate and leak detection storage works*."

    i) Based on GHD's observations, the installed location of the leachate storage and leak detection facility as compared to the proposed location does not appear to adversely affect the performance of the leachate collection, storage and detection system.

    ii) The Ministry may want to consider evaluating whether the installed locations of the seepage monitoring wells are appropriate in consideration of their intended purpose. Refer also to the comment regarding SB-1 under the Environmental Monitoring Data subsection in Section 4.0.

4. Pipe bedding material was sourced from on Site and did not meet the specifications of the design; however, the QP approved the use of the material as being adequate for the intended use.

    i) Based on on-Site observations and GHD's experience, this substitution is reasonable.

5. Cleanouts proposed in the Updated Final Closure Plan were not installed based on the QP's opinion that access is available at the connection to the leachate and leak detection storage tanks.

    i) Based on on-Site observations, this change is reasonable.

6. The QP approved not washing the lock block walls of the SMA. The QP's rationale was to avoid the reintroduction of water into the stockpiled soils. GHD notes that the Updated Final Closure Plan and Detailed Construction Plan identified that the concrete floor was proposed to be washed.

    i) This is further discussed in Section 4.

7. The QP approved the use of 75 mm clear drain rock around the screens of the seepage layer monitoring wells instead of 25-50 mm drain rock.

    i) Based on on-Site observations and GHD's experience, this substitution is reasonable.

8. Instead of coarse gravel and sand bags being used as liner ballast, the QP approved the use of rubber tires due to availability and to minimize foot traffic on the PEA liner.

    i) Based on on-Site observations and GHD's experience, this substitution is reasonable.

9. A soil berm was placed over new twin leachate conveyance piping installed between the PEA and the leachate storage and leak detection facility to provide for additional cover over the piping.

    i) Based on on-Site observations, this change is reasonable.

10. A plywood door on hinges was installed and secured with a padlock on the north side of the leachate storage and detection facility to enable access to the inside of the facility. As of GHD's October 5, 2017 site inspection, there was no signage observed on the door.

    i) The QP should consider installing 'confined space' signage on the door.

Outstanding work

There is no on-Site work still pending in conjunction with the 2017 minor works.

Based on documentation made available to GHD by the Ministry, it appears that the August 2017 environmental monitoring results deliverable has not yet been received by the Ministry; however, data for the following months have been received.

Conclusions and Recommendations

The 2017 minor works were generally completed consistent with the Plans and SPO, with the deviations noted above. It is GHD's option that the performance of the 2017 minor works has not been significantly adversely affected due to these deviations with the exception of an increased risk of a potential release of contaminants to the environment from the SMA due to not washing the SMA concrete floor as discussed in Section 4 below.

A summary of the recommendations mentioned above for consideration by the Ministry are as follows:

- The inspections of the leachate detection and storage facility should include reporting of the condition of the secondary liner following the removal of leachate to document that the liner was not damaged.
- The Ministry may want to consider evaluating whether the installed locations of the seepage monitoring wells are appropriate in consideration of their intended purpose.
- The QP should consider installing 'confined space' signage on the door of the leachate detection and storage facility.

2. Adequacy of the Current State of the PEA

This section provides a discussion on the adequacy of the current state of the PEA as of the completion of construction of the 2017 minor works in preventing the spill or release of environmental contaminants pending the proposed final closure works, including a summary of the potential/outstanding environmental risks at the Site. A review of the adequacy of the Site, including environmental monitoring data, is provided in Section 4.

- Holes identified in the PEA cover liner were repaired in August 2017, as reported by Allterra representatives and as observed by GHD based on written markings on the liner, and in

September 2017 as observed by GHD. Quality Control (QC) data, which indicated that the repairs were completed successfully, were received for the September 2017 repair work. The August 2017 repairs were completed prior to the Ministry's August 2017 letter requiring that QC data be submitted; this QC data has not been received by the Ministry as understood by GHD. Regardless, although GHD's scope did not include a full detailed inspection of the cover liner system and the repairs, the repairs that were observed visually appeared adequate and holes in the liner system were not observed by GHD following the liner repair works.

- Regarding the PEA clay basal liner investigation, as discussed by GHD in a separate letter to the Ministry dated December 11, 2017:
  - GHD's observations of the secondary clay basal liner in four locations along the northern toe of the PEA in all three landfill cells as well as along the southern PEA perimeter and the results of the ground penetrating radar (GPR) study support the conclusion that the secondary clay basal liner is present beneath the PEA as indicated in the as-built drawings provided in the July 21, 2017 Updated Final Closure Plan. The dual liner system meets the objectives of the Site's Waste Discharge Permit PR-105809, which required "*primary and secondary containment detection and inspection sumps*".
  - Based on two sample results, the clay quality met the permeability requirements of the 1993 Landfill Criteria, which was in effect at the time. Although not all of the clay layer thickness observed met the default 1-m requirement identified in the 1993 Landfill Criteria, the presence of the dual LLDPE and clay layer system is likely justifiable as an alternate liner system of equivalent environmental protection, which was allowable under the 1993 Landfill Criteria. Although the permit and 1993 Landfill Criteria establish the benchmark for evaluating the existing basal liner under the PEA, it was also evaluated against the more stringent 2016 Landfill Criteria. The dual liner system and the clay quality generally satisfied the requirements of the 2016 Landfill Criteria (detailed discussion is provided in the separate GHD letter). Mineralogy testing identified that the smectite content of the basal clay liner was high enough to indicate that the clay could undergo swelling/shrinkage and/or a potential increase in permeability when exposed to the PEA's leachate. Regardless, this testing was not required by the Permit or 1993 Landfill Criteria in effect when the PEA was designed and constructed. Furthermore, the PEA's leak detection system is intended to identify significant leaks of the primary liner prior to release into the environment.
- During the test pitting activities at the toe of the PEA, GHD observed that the cover liner was welded to the basal liner and that the leachate collection piping was present. In addition, neither visual nor olfactory indications of the potential presence of leachate (e.g., hydrocarbon staining or odour) were noted by GHD on the upper surface of, or within, the clay basal liner. These observations supported GHD's observations that leachate was being contained within the PEA liner system and had not been released into the environment.
- GHD observed that the PEA crest ditch was ballasted to "ensure the open lines crest ditches on the PEA do not 'trampoline' over the winter months" (as mentioned in Section 2.9 of the Detailed Construction Plan). Comment was not provided in the Plans as to the adequacy of not providing

ballasting over the remaining area of the PEA liner to mitigate against being 'whipped' or caught by a strong wind.

- No leachate was observed by the QP and GHD in the leachate leak detection tank prior to when it was removed during the 2017 minor works. Based on the semi-monthly status reports provided to the Ministry by the QP between July 31 and November 15, 2017, inclusive, no leachate has been observed in the former and new leachate leak detection tanks. These observations support the conclusion that leachate has not leaked through the basal primary liner of the PEA.

Conclusions and Recommendations

- Based on the above discussion, GHD has not identified significant potential risks with respect to the current state of the PEA in relation to potential releases of contaminants to the environment pending the implementation of the final closure activities as discussed in the Updated Final Closure Plan.
- The Ministry may want to consider whether obtaining additional technical justification is warranted regarding the adequacy of the basal liner that was installed based on the Waste Discharge Permit and 1993 Landfill Criteria. Field data, such as the cell 1C clay basal liner thickness, could be obtained during the next phase of construction.
- The Ministry may want to consider whether the existing ballasting of the PEA cover liner being only located within the crest ditch and not the remaining areas of the PEA is adequate to prevent potential wind damage to the cover liner.

3. Comments on the Updated Final Closure Plan

GHD conducted a cursory review of the Updated Final Closure Plan in conjunction with the letter prepared by Hemmera Envirochem Inc. dated June 22, 2017 titled *Independent Review of Final Closure Plan for the Shawnigan Lake Landfill, 460 Stebbings Road* and the June 29, 2017 SPO.[1]

Hemmera's conclusions stated, in part:

> *"Based on the information provided and reviewed, the Landfill Closure Plan appears to be a comprehensive document that substantially addresses the requirements of Section 4 of the SPO as well as input from Ministry of Environment staff contained in letters dated March 17, April 13, and May 18, 2017. The Closure Report appears to provide sufficient technical justification to demonstrate that proposed site-specific alternatives provide an equivalent or better level of environmental protection relative to [Landfill Criteria for Municipal Solid Waste], including for worst case conditions, such as, 200-year design storm event(s), plus snowmelt and multi-day precipitation events.*

[1] GHD's review did not incorporate a detailed comparison against the requirements of the 2016 2nd Edition Landfill Criteria for Municipal Solid Waste, SPO, or other requirements.

While many aspects of the Landfill Closure exceed minimum criteria requirements, some details require further clarification to ensure the facility is designed, constructed and operated to minimize any risks to the environment."

The Hemmera letter provided several recommendations. The SPO appears to have considered these recommendations and required that the previously submitted version of the closure plan be revised.

The Updated Final Closure Plan states in Section 1.1 that "*Updates have been addressed as per the second amended SPO…*". The SPO's additional requirements are summarized therein.

Based on GHD's review, the Updated Final Closure Plan appears to have addressed these additional requirements. Insofar as these additional requirements were applicable to the 2017 minor works (e.g., QP being present during the works, revised monitoring and reporting, submitting as-built drawings of the new works), they were generally addressed as discussed in Section 1 of this letter.

Based on GHD's cursory review of the Updated Final Closure Plan, GHD did not identify fundamental concerns related to the Plan's compliance with the 2016 Landfill Criteria and the SPO. Regardless, GHD offers the following comments for consideration by the Ministry's during its review of the Updated Final Closure Plan:

- The methodology could clarify how the new clay layer is to be placed and compacted against the existing clay layer such that a competent seal is established (e.g., bentonite, keying).
- Discussion could include technical justification to support leaving the smooth 40-mil LLDPE liner in place on the crest of the PEA (per Section 3.1) in light of it being exposed to the environment from the time of its installation in the fall of 2016 (per Section 2.2) to the implementation of the final closure works. GHD acknowledges that the Updated Final Closure Plan already considers improving (i.e., decreasing) the permeability of the cover liner system as it states that an additional minimum 500-mm thick layer of low permeability soil ($\leq 1x10^{-6}$ cm/s) will be placed on top of the LLDPE liner.
- Identification of the proposed post-closure land use for the Site could be identified as required per Section 7.1 of the 2016 Landfill Criteria. The proposed land use is not mentioned specifically in the Updated Final Closure Plan.
- A revision to the Updated Final Closure Plan could be submitted based on the completion of the 2017 minor works, the deviations to the works as approved by the QP during the 2017 minor works as discussed in Section 1 of this letter, the Ministry's August 11, 2017 letter and other correspondence, and the current conditions of the Site. For example, the Updated Final Closure Plan references that the SMA concrete pad will be decontaminated following relocation of the soil from the SMA to the PEA and that the wash water will be directed to the former contact water pond for storage prior to transport. This may need to be amended since the contact water pond was decommissioned during the 2017 minor works.

4. Adequacy of the Site and Works

This section summarizes GHD's conclusions and recommendations with regard to the adequacy of the Site and the 2017 minor works based on GHD's observations, the progress reports provided by the QP, the clay layer evaluation, environmental monitoring data made available to GHD, an evaluation of the new monitoring well MW-6, and quality assurance/quality control (QA/QC) provided by the QP. Additional comments with regards to 'best management practices', specifically in relation to storm water management, are also provided.

- As discussed below, GHD does not have any fundamental concerns regarding the adequacy of the works and the current status of the Site in relation to the protection of human health and the environment.
- The August 11, 2017 letter from the Ministry required a high water level alarm be installed and remain operational in the leachate collection tank to minimize the risk of an unforeseen overflow of leachate. The Detailed Construction Plan provided the details on the proposed system, which stated, "*The solar powered alarm system will provide audible signal through a cell phone based set up triggered by floats within the leachate storage tanks*." This system was observed by GHD during the 2017 minor works to meet the SPO and was consistent with the Plan. Although there is no on-Site audible or visual indication of a high water alarm, GHD expects that the mobile phone-based notification system in conjunction with the ongoing inspections and leachate level monitoring events should provide an adequate level of protection against a leachate release event assuming that the system remains operational.
    - Regarding the high-level alarm, the Ministry may want to consider obtaining confirmation of continued operation in the reporting from the Names Parties to the Ministry.
- The original design in the Updated Final Closure Plan included the installation of one 10,000-gallon leachate storage tank, which was estimated by the QP to be able to contain approximately 80 days of leachate generation. Since two 10,000-gallon tanks were installed during the 2017 minor works, this capacity was doubled. It should be noted that the originally specified 2,500-gallon leak detection tank was also increased in capacity to 10,000 gallons. The tanks are contained within a lined containment facility and supplemented by a high level alarm triggered approximately 0.3 metres from the top shoulder of the storage tanks (according to Allterra), which equates to over 1,000 gallons of storage capacity after the alarm is triggered. As mentioned in Section 5.8 of the Updated Final Closure Plan, GHD supports the recommendation that the facility be also inspected immediately after a high intensity rain event and snowmelt event. The monitoring should include reference to whether any accumulation of liquid within the secondary containment is observed. Note that the QP is also currently monitoring the levels in each of the tanks twice monthly and reporting the data to the Ministry. Assuming that these actions mentioned above continue, GHD believes that it is very unlikely for leachate from the leachate storage and leak detection facility to be released into the environment.
- Further to the bullet above, based on the last three semi-monthly leachate quantity reports provided to the Ministry, 11.5, 9.5, and 8.8 m^3 of leachate has been collected in the first and second halves of

October and the first half of November 2017, respectively. Based on an average of 10 m^3 collected every 15 days (approximately 650 L per day), the 20,000-gallon capacity of the leachate storage system is enough to store leachate generated over 3.8 months. This does not account for what appears to be a decreasing trend of leachate generation. The approximate 650-L/day average generation rate is similar to the 500 L/day rate identified as the current amount being collected in Section 3.4 of the Updated Final Closure Plan.

- Section 9.3 of the Updated Final Closure Plan states "*As per Hemmera's recommendations, leachate and leak detection tank quantity will be recorded during each leachate removal and/or leachate tank monitoring event (monthly). This will be correlated to precipitation data to assess and confirm cover integrity and demonstrate there is no correlation between rainfall events and leachate production due to cover liner leaks.*" Based on the information provided to date, the correlation has not been included with the reporting, although it may be data provided in the annual report.
  - This Ministry may want to keep this in mind when reviewing future submittals.
- As discussed in Section 1 of this letter, GHD observed that the southern run-on ditch was extended to direct surface water flows away from the PEA, thereby further minimizing potential generation of leachate. The successful operation of this ditch during rainfall has been documented in subsequent progress reports submitted by the QP. GHD also observed the replacement of the leachate storage and leak detection facility, its hookup to the existing PEA leachate collection pipes, and the installation and operation of the high level alarm system in the leachate storage tanks. Overall, GHD has not identified concerns regarding these components of the 2017 minor works.
- The SMA concrete floor was swept both manually and with a Bobcat with a broom attachment; soil was also removed from between the joints in the lock block wall manually. Based on GHD's cursory observations, residual soil was not observed on the floor and lock blocks. As discussed with the Ministry on September 27, 2017, the concrete floor or lock blocks of the SMA were not washed to prevent water from flowing beneath the soil pile creating leachate. Recent Site inspection photographs provided in the November 15, 2017 progress report show that the concrete floor and lock blocks are wet.
  - The Ministry may want to consider evaluating how precipitation entering the SMA through the open ends of the SMA or through the spaces between the lock blocks will avoid contacting the soil or, if avoidance is not possible, how potentially contaminated storm water accumulated in the SMA will be managed with no available leachate collection system since the containment pond was decommissioned during the 2017 minor works.

Quality Assurance/Quality Control

- Based on GHD's on-Site observations during construction of the 2017 minor works, nothing came to GHD's attention that would indicate that the QA/QC measures were not principally followed.
- A Quality Management Plan (QMP) for the 2017 minor works was included with the Detailed Construction Plan. The QMP identified QA (e.g., schedule and design reviews) and QC (e.g., observations and inspections) measures. Specifically, the QC requirements were listed for the

secondary clay liner investigation, the leachate storage and leak detection facility construction, the twin leachate conveyance piping installation, the seepage layer monitoring well installation, and the PEA liner repairs. Nothing came to the attention of GHD that would indicate that the QA/QC measures were not principally followed.

- The liner QC test results for the September 2017 liner repairs indicate passing tests.
- Granular material used around the twin leachate conveyance piping did not meet the specifications of the 2017 Minor Construction Works Detailed Construction Plan; however, the QP approved the use of the material as being adequate for the intended use. Based on on-Site observations, GHD believes that this substitution is reasonable.
- Figure 3-1 of the Updated Final Closure Plan identified that the tie-in location for the new twin leachate conveyance piping would be "*pressure and hydraulically tested*." Based on information provided to GHD, this testing has not yet been completed. GHD did not observe any concerns regarding the pipe connections.

Environmental Monitoring Data

- Based on GHD's cursory review of analytical data from two monitoring events as discussed below, nothing came to GHD's attention that would indicate that the environment has been adversely impacted. Although several hydrocarbon parameters were detected at low concentrations in one of the new seepage layer monitoring wells, it is more likely that the constituents are a by-product of well installation (which should decrease over time) rather than from the PEA as the parameters were not detected in PEA leachate.
- The groundwater, surface water, and leachate samples were analyzed for general water quality parameters and anions, dissolved and total metals, hydrocarbons and polycyclic aromatic hydrocarbons. This meets the list of parameters identified in the Updated Final Closure Plan, which include total/dissolved metals, hydrocarbons, physical parameters and nutrients.
- As a preliminary evaluation to assess potential impacts to the environmental, groundwater analytical data was compared to the new BC Contaminated Sites Regulation (CSR) standards protective of drinking water and freshwater aquatic life that became effective on November 1, 2017. Surface water analytical data was compared to BC Approved Water Quality Guidelines (WQGs) for drinking water and freshwater aquatic life.
- GHD reviewed the September and October 2017 monitoring event data.
- Groundwater data:
    - Monitoring wells MW-2, MW-3S/D and MW-6 were sampled during both events. The new seepage layer monitoring wells SB-1 and SB-2 were sampled during the October 2017 sampling event. The eastern seepage layer monitoring well SB-3 was reported as being dry during the October 2017 sampling event. GHD notes that the elevation of the bottom of the well (328.2 metres) is approximately 2 metres higher than for SB-1 and SB-2 (326.3 metres) as identified in Table 1 of the October 15, 2017 progress report.

- The Ministry may want to consider whether the SB-1 location is suitable in light of the intent of the seepage layer monitoring program and as this monitoring well was installed east of its proposed location in the Updated Final Closure Plan. Refer to item 3 under Quality of Work in Section 1 above.

- Based on the two rounds of groundwater data from September and October 2017 reviewed by GHD, dissolved manganese was detected at a concentration greater than the new CSR drinking water standard (1.5 mg/L) in MW-6[2]. Based on GHD's understanding of the Site layout, this location is located upgradient of Site operations. Furthermore, Based on GHD's understanding of historical Site operations, the manganese drinking water standard is not applicable based on the Stage 8 Amendments to the CSR (January 25, 2013), which clarify that manganese water standards are applicable to sites with specific industrial activities that used manganese. Consequently, GHD believes that comparison to the new CSR standard is irrelevant.
- Based on the two rounds of groundwater data from September and October 2017 reviewed by GHD, no hydrocarbons were detected in the upgradient and downgradient monitoring wells. No hydrocarbons were detected in the central seepage layer monitoring well SB-2. Low concentrations of benz(a)anthracene, benzo(a)pyrene and pyrene were detected in the western seepage layer monitoring well SB-1 with benzo(a)pyrene being detected at a concentration greater than the CSR drinking water standard. However, based on the parameters not being detected in the actual PEA leachate samples reviewed by GHD, it is more likely that the constituents are a by-product of well installation (which should decrease over time) rather than from the PEA. This supposition can be supported following the collection and evaluation of additional groundwater data.
    - The Ministry may want to consider reviewing additional monitoring event data prior to evaluating whether a potential impact to the environmental has occurred. As discussed above, the collection and evaluation of additional data is warranted.
- GHD notes that chloride, nitrate, and sulfate concentrations are elevated in the two seepage layer monitoring wells as compared to the groundwater quality exhibited in the background monitoring well MW-6; however, the concentrations are less than CSR water standards and do not appear elevated at the downgradient monitoring well.
    - The Ministry may want to closely monitor these parameters in the seepage layer monitoring wells to determine if the concentrations are persistent or increasing.

- Surface water data
    - Surface water samples were only collected from SHA-SW1 since SHA-SW2 was dry during both sampling events. Based on GHD's review of the September and October 2017 surface water data, the surface water quality meets the BC WQGs for drinking water and freshwater aquatic life with

[2] GHD incorrectly mentioned in the October 2017 monthly report dated November 8, 2017 that the manganese concentration was identified in tables submitted by the QP to the MOE as being greater than BC Water Quality Guidelines (WQG), whereas it was actually identified as being greater than CSR standards.

the exception of pH during the October 2017 event, which was identified to be slightly below the minimum range. Note that no hydrocarbon parameters were detected during either event. The pH as recorded in one event slightly below WQGs may not in itself be an indicator of an adverse effect to the environment, especially in light of the other constituents meeting WQGs during both events. The Ministry may want to consider past and future surface water data to assess surface water quality.

- Leachate data from the leachate storage tank
  - A comparison of the leachate quality to BC WQGs was provided in the reports submitted by the QP to the Ministry. No hydrocarbon parameters were detected. Chloride, cobalt and manganese were detected at concentrations greater than the WQGs. This is worth consideration when evaluating groundwater and surface water data, especially the hydrocarbons that were detected in the groundwater as discussed above.
- Leachate testing data for soil collected from within the PEA
  - At the request of the Ministry, GHD collected a soil sample from beneath the PEA liner during repairs to the liner at the PEA toe. Based on the limited access to the PEA soils, the soil that was exposed and available to sample was around the toe drain and may have been bedding sand; GHD cannot confirm the representativeness of this sample compared to that of the overall PEA soil quality. The soil sample was submitted for toxicity characteristic leaching procedure (TCLP) testing, specifically for metals, polycyclic aromatic hydrocarbons (PAHs), and benzene, toluene, ethylbenzene and xylenes (BTEX). The results are included in Attachment A.
  - Neither visual nor olfactory indications of contamination were noted by GHD during the soil sampling.
  - The leachate concentrations were identified to be less than CSR standards and WQGs for drinking water and freshwater aquatic life. It should be noted that the detection limits for several parameters were greater than these standards/guidelines since the test followed the TCLP method. Similar to the results of the leachate testing, no hydrocarbons (PAHs or BTEX) were detected. Of the metals, only calcium and magnesium were detected. These metals were also detected in background groundwater samples and surface water samples at similar concentrations.

Review of Monitoring well MW-6

GHD was asked to provide an opinion with respect to the location of MW-6. On the basis of the limited data provided by the Ministry to facilitate the evaluation, GHD provided the following conclusions in a memorandum dated October 5, 2017 with respect to the specific questions provided by the Ministry:

1. Is MW-6 upstream of the landfill?
   - Although the exact groundwater flow direction cannot be determined from the data provided, the data indicates that MW-6 is located in an area of higher groundwater hydraulic head than the

northwestern portion of the Site. Based on this fact, MW-6 is located in an upgradient position relative to the PEA.

2. Is MW-6 being impacted by the landfill?
    - There is no definitive evidence of landfill-related water quality impairments at MW-6 based on the data provided.
3. Is MW-6 suitable as a control well for the site (landfill, pond and other discharge points)?
    - Based on the data reviewed, the construction details, limited groundwater quality, and hydraulic data suggest that MW-6 is a suitable location for representing background groundwater quality at the Site.

Conclusions

This section summarizes GHD's conclusions with regard to the adequacy of the Site and the 2017 minor works.

- GHD does not have any fundamental concerns regarding the adequacy of the works and the current status of the Site in relation to the protection of human health and the environment.
- GHD believes that it is very unlikely that leachate from the leachate storage and leak detection facility will be released into the environment assuming the inspections and monitoring in accordance with the SPO are completed.
- GHD has not identified significant potential risks with respect to the current state of the PEA in relation to potential releases of contaminants to the environment pending the implementation of the final closure works as discussed in the Updated Final Closure Plan.
- Based on GHD's on-Site observations during construction of the 2017 minor works, nothing came to GHD's attention that would indicate that the QA/QC measures were not principally followed.
- Constituents in surface water samples were detected at concentrations less than BC WQG. Constituents in groundwater samples were detected at concentrations less than BC CSR water standards at the upgradient and downgradient sampling locations. Low concentrations of hydrocarbon parameters were detected in one of the new seepage layer monitoring wells installed at the toe of the PEA; however, based on the parameters not being detected in the actual PEA leachate samples reviewed by GHD, it is more likely that the constituent was a by-product of well installation (which should decrease over time) rather than from the PEA. This supposition can be supported following the collection and evaluation of additional groundwater data.

Recommendations

The following bullets summarize the considerations noted in Section 4 of this letter. Additional considerations are included at the end of Sections 1, 2 and 3 of this letter. These considerations are presented as opportunities for improvement.

- QP could include confirmation of continued operation of the leachate storage tank high-level alarm in the reporting to the Ministry.
- QP could include reference in the reporting to the Ministry as to whether any accumulation of liquid within the secondary containment is and/or has been observed.
- Based on the information reviewed by GHD to date, the correlation between rainfall events and leachate production due to cover liner leaks has not been included with the reporting as was identified in the Updated Final Closure Plan.
- The Ministry may want to consider obtaining an evaluation of how precipitation entering the SMA through the open ends of the SMA or through the spaces between the lock blocks will avoid contacting the soil or, if avoidance is not possible, how potentially contaminated storm water accumulated in the SMA will be managed with no available leachate collection system since the containment pond was decommissioned during the 2017 minor works.
- The Ministry may want to consider obtaining an evaluation of whether the installed locations of the seepage monitoring wells are appropriate in consideration of their intended purpose.
- The Ministry may want to closely monitor the parameters detected in the seepage layer monitoring wells to determine if the concentrations are persistent, increasing, or decreasing.

Best Management Practices – Storm Water Management

- The final storm water management ditches identified in the Updated Final Closure Plan were not planned to be constructed in conjunction with the 2017 minor works; notably the PEA toe ditch and conveyance ditch that will direct storm water from the PEA storm water ditches to the settling pond prior to discharge from the Site. Figure 2-2 of the Updated Final Closure Plan indicates that the storm water currently discharges to the north of the PEA onto the quarry floor. This was consistent with GHD's on-Site observations. Based on ground surface contours illustrated on the figure and the presence of a riprap ditch that conveys storm water from the run-on ditch and settling pond, the storm water from the PEA ditches is expected to either infiltrate into the quarry floor or be directed overland eventually to the settling pond. Based on this temporary scenario, GHD has not identified a concern assuming that the settling pond discharge quality meets applicable standards.
- The extension to the run-on ditch was constructed during the 2017 minor works without the installation of erosion protection. This is consistent with the Detailed Construction Plan (prepared to provide detail related to the 2017 minor works) but not the Updated Final Closure Plan. The migration of suspended sediment from the run-on ditch extension during a precipitation event may occur; however, as noted above, this ditch directs flow to the settling pond before discharging west of the Site.

- With respect to the run-on ditch, it should be noted that (as explained to GHD by an Allterra representative) it was re-aligned by Allterra prior to the 2017 minor works at the direction of the Ministry such that the run-on storm water from south of the PEA was directed instead to the settling pond. This will help mitigate potential migration of suspended sediment to the environment assuming that the settling pond discharge quality meets applicable standards.
- With respect to the overall Site conditions and potential erosion, GHD observed that a portion of the clay stock pile located on Site east of the PEA remained uncovered as of October 5, 2017. Based on the potential for a precipitation event to result in the mobilization of clay from this stockpile, the Ministry may want to consider the implementation of sedimentation and erosion controls for this stockpile, if warranted and not already completed.
- Assuming the settling pond functions appropriately in light of the current Site configuration (GHD is not aware of an evaluation of the settling pond's effectiveness), GHD has no overall concerns regarding the current state of the storm water management. The Ministry may want to consider whether inspections are warranted during rainfall events to document that storm water being discharged from the Site meets applicable requirements.

5. External Monitor Qualifications

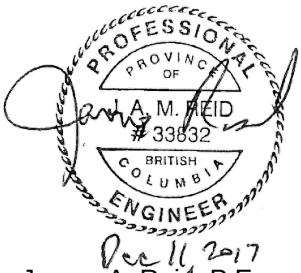
Attachment B provides curricula vitae of the authors of this letter as External Monitors.

6. Closing

Should you have any questions regarding this letter, please do not hesitate to contact the undersigned.

Sincerely,

GHD



James A. Reid, P.Eng.

Reinhard Trautmann, AScT

JAR/sz/05

Encl.

Attachment A
PEA Soil TCLP Test Results

Results Summary L2001029

Job Reference	SHAWNIGAN SIA LOT 23 TEST PIT 1 (SPO MO1701)
Report To	Maureen Bilawchuck, BC MINISTRY OF ENVIRONMENT - Southern Interior - Penticton
Date Received	3-Oct-2017 8:45
Report Date	27-Oct-2017 10:38
Report Version	1

Client Sample ID			E309766_REG
Date Sampled			28-Sep-2017
Time Sampled			10:30
ALS Sample ID			L2001029-1
Parameter	Lowest Detection Limit	Units	Soil
Physical Tests (Soil)			
Moisture	0.25	%	14.6
Saturated Paste Extractables (Soil)			
Chloride (Cl)	12	mg/kg	48
% Saturation	1.0	%	29.5
Sodium (Na)	1.0	mg/kg	52.5
TCLP Extractables (Soil)			
1st Preliminary pH	0.10	pH	6.84
2nd Preliminary pH	0.10	pH	1.69
Final pH	0.10	pH	4.89
Extraction Solution Initial pH	0.10	pH	4.89
Acenaphthene	0.000050	mg/L	<0.000050
Acenaphthylene	0.000050	mg/L	<0.000050
Acridine	0.000050	mg/L	<0.000050
Anthracene	0.000050	mg/L	<0.000050
Benz(a)anthracene	0.000050	mg/L	<0.000050
Benzo(a)pyrene	0.000050	mg/L	<0.000050
Benzo(b&j)fluoranthene	0.000050	mg/L	<0.000050
Benzo(g,h,i)perylene	0.000050	mg/L	<0.000050
Benzo(k)fluoranthene	0.000050	mg/L	<0.000050
Chrysene	0.000050	mg/L	<0.000050
Dibenz(a,h)anthracene	0.000050	mg/L	<0.000050
Fluoranthene	0.000050	mg/L	<0.000050
Fluorene	0.000050	mg/L	<0.000050
Indeno(1,2,3-c,d)pyrene	0.000050	mg/L	<0.000050
Naphthalene	0.000050	mg/L	<0.000050
Phenanthrene	0.000050	mg/L	<0.000050
Pyrene	0.000050	mg/L	<0.000050
TCLP Metals (Soil)			
1st Preliminary pH	0.10	pH	6.84
2nd Preliminary pH	0.10	pH	1.69
Final pH	0.10	pH	4.88
Extraction Solution Initial pH	0.10	pH	4.89
Antimony (Sb)-Leachable	1.0	mg/L	<1.0
Arsenic (As)-Leachable	1.0	mg/L	<1.0
Barium (Ba)-Leachable	2.5	mg/L	<2.5
Beryllium (Be)-Leachable	0.025	mg/L	<0.025
Boron (B)-Leachable	0.50	mg/L	<0.50
Cadmium (Cd)-Leachable	0.050	mg/L	<0.050
Calcium (Ca)-Leachable	2.0	mg/L	**126**
Chromium (Cr)-Leachable	0.25	mg/L	<0.25
Cobalt (Co)-Leachable	0.050	mg/L	<0.050
Copper (Cu)-Leachable	0.050	mg/L	<0.050

Results Summary L2001029

Job Reference	SHAWNIGAN SIA LOT 23 TEST PIT 1 (SPO MO1701)
Report To	Maureen Bilawchuck, BC MINISTRY OF ENVIRONMENT - Southern Interior - Penticton
Date Received	3-Oct-2017 8:45
Report Date	27-Oct-2017 10:38
Report Version	1

Client Sample ID			E309766_REG
Date Sampled			28-Sep-2017
Time Sampled			10:30
ALS Sample ID			L2001029-1
Parameter	Lowest Detection Limit	Units	Soil
Iron (Fe)-Leachable	5.0	mg/L	<5.0
Lead (Pb)-Leachable	0.25	mg/L	<0.25
Magnesium (Mg)-Leachable	0.50	mg/L	**3.37**
Mercury (Hg)-Leachable	0.0010	mg/L	<0.0010
Nickel (Ni)-Leachable	0.25	mg/L	<0.25
Selenium (Se)-Leachable	1.0	mg/L	<1.0
Silver (Ag)-Leachable	0.050	mg/L	<0.050
Thallium (Tl)-Leachable	1.0	mg/L	<1.0
Vanadium (V)-Leachable	0.15	mg/L	<0.15
Zinc (Zn)-Leachable	0.50	mg/L	<0.50
Waste Characterizations (Waste)			
Benzene	0.0050	mg/L	<0.0050
Toluene	0.0050	mg/L	<0.0050
Ethylbenzene	0.0050	mg/L	<0.0050
Xylenes	0.0050	mg/L	<0.0050

Qualifier Legend

VC:RHS	Volatile Analysis Compromised; Samples Received With Headspace

BC MINISTRY OF ENVIRONMENT - Southern Interior - Penticton
ATTN: Maureen Bilawchuck
102 Industrial Place
Penticton BC V2A 7C8

Date Received: 03-OCT-17
Report Date: 27-OCT-17 10:38 (MT)
Version: FINAL

Client Phone: 250-354-6333

Certificate of Analysis

Lab Work Order #: L2001029

Project P.O. #: NOT SUBMITTED
Job Reference: SHAWNIGAN SIA LOT 23 TEST PIT 1 (SPO MO1701)
C of C Numbers:
Legal Site Desc:

Other Information: Client: TQ
EMS ID: E309766

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2001029-1				
	Description					
	Sampled Date	28-SEP-17				
	Sampled Time	10:30				
	Client ID	E309766_REG				
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	14.6				
Saturated Paste Extractables	Chloride (Cl) (mg/kg)	48				
	% Saturation (%)	29.5				
	Sodium (Na) (mg/kg)	52.5				
TCLP Extractables	1st Preliminary pH (pH)	6.84				
	2nd Preliminary pH (pH)	1.69				
	Final pH (pH)	4.89				
	Extraction Solution Initial pH (pH)	4.89				
	Acenaphthene (mg/L)	<0.000050				
	Acenaphthylene (mg/L)	<0.000050				
	Acridine (mg/L)	<0.000050				
	Anthracene (mg/L)	<0.000050				
	Benz(a)anthracene (mg/L)	<0.000050				
	Benzo(a)pyrene (mg/L)	<0.000050				
	Benzo(b&j)fluoranthene (mg/L)	<0.000050				
	Benzo(g,h,i)perylene (mg/L)	<0.000050				
	Benzo(k)fluoranthene (mg/L)	<0.000050				
	Chrysene (mg/L)	<0.000050				
	Dibenz(a,h)anthracene (mg/L)	<0.000050				
	Fluoranthene (mg/L)	<0.000050				
	Fluorene (mg/L)	<0.000050				
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050				
	Naphthalene (mg/L)	<0.000050				
	Phenanthrene (mg/L)	<0.000050				
	Pyrene (mg/L)	<0.000050				
TCLP Metals	1st Preliminary pH (pH)	6.84				
	2nd Preliminary pH (pH)	1.69				
	Final pH (pH)	4.88				
	Extraction Solution Initial pH (pH)	4.89				
	Antimony (Sb)-Leachable (mg/L)	<1.0				
	Arsenic (As)-Leachable (mg/L)	<1.0				
	Barium (Ba)-Leachable (mg/L)	<2.5				
	Beryllium (Be)-Leachable (mg/L)	<0.025				
	Boron (B)-Leachable (mg/L)	<0.50				
	Cadmium (Cd)-Leachable (mg/L)	<0.050				
	Calcium (Ca)-Leachable (mg/L)	126				
	Chromium (Cr)-Leachable (mg/L)	<0.25				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2001029-1				
	Description					
	Sampled Date	28-SEP-17				
	Sampled Time	10:30				
	Client ID	E309766_REG				
Grouping	**Analyte**					
SOIL						
TCLP Metals	Cobalt (Co)-Leachable (mg/L)	<0.050				
	Copper (Cu)-Leachable (mg/L)	<0.050				
	Iron (Fe)-Leachable (mg/L)	<5.0				
	Lead (Pb)-Leachable (mg/L)	<0.25				
	Magnesium (Mg)-Leachable (mg/L)	3.37				
	Mercury (Hg)-Leachable (mg/L)	<0.0010				
	Nickel (Ni)-Leachable (mg/L)	<0.25				
	Selenium (Se)-Leachable (mg/L)	<1.0				
	Silver (Ag)-Leachable (mg/L)	<0.050				
	Thallium (Tl)-Leachable (mg/L)	<1.0				
	Vanadium (V)-Leachable (mg/L)	<0.15				
	Zinc (Zn)-Leachable (mg/L)	<0.50				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2001029-1				
	Description					
	Sampled Date	28-SEP-17				
	Sampled Time	10:30				
	Client ID	E309766_REG				
Grouping	**Analyte**					
WASTE						
Waste Characterizations	Benzene (mg/L)	VC:RHS <0.0050				
	Toluene (mg/L)	VC:RHS <0.0050				
	Ethylbenzene (mg/L)	VC:RHS <0.0050				
	Xylenes (mg/L)	VC:RHS <0.0050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Ethylbenzene	E	L2001029-1
Matrix Spike	Toluene	E	L2001029-1
Matrix Spike	Xylenes	E	L2001029-1
Method Blank	Phenanthrene	MB-LOR	L2001029-1
Matrix Spike	Calcium (Ca)-Leachable	MS-B	L2001029-1
Matrix Spike	Cobalt (Co)-Leachable	MS-B	L2001029-1
Matrix Spike	Zinc (Zn)-Leachable	MS-B	L2001029-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
E	Matrix Spike recovery outside ALS DQO due to heterogeneous analyte background in sample.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
VC:RHS	Volatile Analysis Compromised; Samples Received With Headspace

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BTX-TCLP-CL	Waste	TCLP Leachable BTEX	EPA 1311 (Leach), and EPA 8260C/5021A

A representative sample of waste is extracted, in a Zero Headspace Sampler, with the amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction is set up in a rotator for a minimum of 18 hours. The pH of the fluid used is a function of the alkalinity of the solid phase of the waste. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved.

The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

CL-PASTE-IC-VA	Soil	Chloride in Soil (Paste) by IC	Carter-CSSS / EPA 300.1 (modified)

A soil extract produced by the saturated paste extraction procedure is analyzed for chloride by Ion Chromatography with conductivity detection.

HG-TCLP-CVAFS-VA	Soil	Mercury by CVAFS (TCLP)	EPA 1311/245.7

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA 245.7).

MET-PASTE-ICP-VA	Soil	Metals in Soil (Paste) by ICPOES	Carter-CSSS / EPA 6010B (modified)

A soil extract produced by the saturated paste extraction procedure is analyzed for Sodium, Calcium, and Magnesium by ICPOES as per "Soil Sampling and Methods of Analysis" by M. Carter.

MET-TCLP-ICP-VA	Soil	Metals by ICPOES (TCLP)	EPA 1311/6010B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MOISTURE-VA	Soil	Moisture content	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PAH-TCLP-ME-MS-VA	Soil	PAH's IN TCLP LEACHATE	EPA 1311/3511/8270 (MOD)

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

SAT-PCNT-VA	Soil	Saturation Percentage	Carter-CSSS

Saturation Percentage (SP) is the total volume of water present in a saturated paste (in mL) divided by the dry weight of the sample (in grams), expressed as a percentage, as described in "Soil Sampling and Methods of Analysis" by M. Carter.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Additional Information:

Average Cooler Temperature (Deg Celsius): 0.6

Sampling Agency Code: GHD

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: BC MINISTRY OF ENVIRONMENT - Southern Interior - Penticton
102 Industrial Place
Penticton BC V2A 7C8
Contact: Maureen Bilawchuck

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-PASTE-IC-VA	**Soil**							
Batch R3857860								
WG2639390-2 LCS								
Chloride (Cl)			94.1		%		80-120	16-OCT-17
WG2639390-1 MB								
Chloride (Cl)			<1.0		mg/kg		1	16-OCT-17
HG-TCLP-CVAFS-VA	**Soil**							
Batch R3857281								
WG2638237-1 MB								
Mercury (Hg)-Leachable			<0.0010		mg/L		0.001	13-OCT-17
WG2638237-4 MB								
Mercury (Hg)-Leachable			<0.0010		mg/L		0.001	13-OCT-17
MET-PASTE-ICP-VA	**Soil**							
Batch R3857280								
WG2639390-2 LCS								
Sodium (Na)			95.1		%		80-120	16-OCT-17
WG2639390-1 MB								
Sodium (Na)			<0.50		mg/kg		0.5	16-OCT-17
MET-TCLP-ICP-VA	**Soil**							
Batch R3854701								
WG2638237-1 MB								
Antimony (Sb)-Leachable			<1.0		mg/L		1	13-OCT-17
Arsenic (As)-Leachable			<1.0		mg/L		1	13-OCT-17
Barium (Ba)-Leachable			<2.5		mg/L		2.5	13-OCT-17
Beryllium (Be)-Leachable			<0.025		mg/L		0.025	13-OCT-17
Boron (B)-Leachable			<0.50		mg/L		0.5	13-OCT-17
Cadmium (Cd)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Calcium (Ca)-Leachable			<2.0		mg/L		2	13-OCT-17
Chromium (Cr)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Cobalt (Co)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Copper (Cu)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Iron (Fe)-Leachable			<5.0		mg/L		5	13-OCT-17
Lead (Pb)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Magnesium (Mg)-Leachable			<0.50		mg/L		0.5	13-OCT-17
Nickel (Ni)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Selenium (Se)-Leachable			<1.0		mg/L		1	13-OCT-17
Silver (Ag)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Thallium (Tl)-Leachable			<1.0		mg/L		1	13-OCT-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-ICP-VA	**Soil**							
Batch R3854701								
WG2638237-1 MB								
Vanadium (V)-Leachable			<0.15		mg/L		0.15	13-OCT-17
Zinc (Zn)-Leachable			<0.50		mg/L		0.5	13-OCT-17
WG2638237-4 MB								
Antimony (Sb)-Leachable			<1.0		mg/L		1	13-OCT-17
Arsenic (As)-Leachable			<1.0		mg/L		1	13-OCT-17
Barium (Ba)-Leachable			<2.5		mg/L		2.5	13-OCT-17
Beryllium (Be)-Leachable			<0.025		mg/L		0.025	13-OCT-17
Boron (B)-Leachable			<0.50		mg/L		0.5	13-OCT-17
Cadmium (Cd)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Calcium (Ca)-Leachable			<2.0		mg/L		2	13-OCT-17
Chromium (Cr)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Cobalt (Co)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Copper (Cu)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Iron (Fe)-Leachable			<5.0		mg/L		5	13-OCT-17
Lead (Pb)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Magnesium (Mg)-Leachable			<0.50		mg/L		0.5	13-OCT-17
Nickel (Ni)-Leachable			<0.25		mg/L		0.25	13-OCT-17
Selenium (Se)-Leachable			<1.0		mg/L		1	13-OCT-17
Silver (Ag)-Leachable			<0.050		mg/L		0.05	13-OCT-17
Thallium (Tl)-Leachable			<1.0		mg/L		1	13-OCT-17
Vanadium (V)-Leachable			<0.15		mg/L		0.15	13-OCT-17
Zinc (Zn)-Leachable			<0.50		mg/L		0.5	13-OCT-17
MOISTURE-VA	**Soil**							
Batch R3851642								
WG2635889-2 LCS								
Moisture			100.3		%		90-110	10-OCT-17
WG2635889-1 MB								
Moisture			<0.25		%		0.25	10-OCT-17
PAH-TCLP-ME-MS-VA	**Soil**							
Batch R3854145								
WG2638237-1 MB								
Naphthalene			<0.000050		mg/L		0.00005	25-OCT-17
Acenaphthene			<0.000050		mg/L		0.00005	25-OCT-17
Acenaphthylene			<0.000050		mg/L		0.00005	25-OCT-17
Acridine			<0.000050		mg/L		0.00005	25-OCT-17

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-ME-MS-VA	**Soil**							
Batch R3854145								
WG2638237-1 MB								
Anthracene			<0.000050		mg/L		0.00005	25-OCT-17
Benz(a)anthracene			<0.000050		mg/L		0.00005	25-OCT-17
Benzo(a)pyrene			<0.000050		mg/L		0.00005	25-OCT-17
Benzo(b&j)fluoranthene			<0.000050		mg/L		0.00005	25-OCT-17
Benzo(g,h,i)perylene			<0.000050		mg/L		0.00005	25-OCT-17
Benzo(k)fluoranthene			<0.000050		mg/L		0.00005	25-OCT-17
Chrysene			<0.000050		mg/L		0.00005	25-OCT-17
Dibenz(a,h)anthracene			<0.000050		mg/L		0.00005	25-OCT-17
Fluoranthene			<0.000050		mg/L		0.00005	25-OCT-17
Fluorene			<0.000050		mg/L		0.00005	25-OCT-17
Indeno(1,2,3-c,d)pyrene			<0.000050		mg/L		0.00005	25-OCT-17
Phenanthrene			0.000057	MB-LOR	mg/L		0.00005	25-OCT-17
Pyrene			<0.000050		mg/L		0.00005	25-OCT-17
SAT-PCNT-VA	**Soil**							
Batch R3854922								
WG2639390-3 IRM		**VA-ALP-SRS1507**						
% Saturation			103.1		%		80-120	15-OCT-17
BTX-TCLP-CL	**Waste**							
Batch R3856129								
WG2640428-1 MB								
Benzene			<0.0050		mg/L		0.005	16-OCT-17
Toluene			<0.0050		mg/L		0.005	16-OCT-17
Ethylbenzene			<0.0050		mg/L		0.005	16-OCT-17
Xylenes			<0.0050		mg/L		0.005	16-OCT-17

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Waste Characterizations							
TCLP Leachable BTEX							
	1	28-SEP-17 10:30	16-OCT-17	14	18	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2001029 were received on 03-OCT-17 08:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

WATER, GENERAL CHEMISTRY AND BACTERIOLOGICAL REQUISITION

ALS Global

Province Of British Columbia
Ministry of Environment

Req # 50232927

L2001029-COFC

Urgent?		**Csr No.**	
Office	90	**Client**	TQ
Study		**Project**	N/A
Lab	ALS Global		
Ministry Contact	MBILAWCH BILAWCHUK, MAUREEN		
Sampler	Reinhard Trautman		
Signature			
EMS Id	E309766	**Well Plate #**	
Location	SHAWNIGAN SIA LOT 23 TEST PIT 1 (SPO MO1701)		

Sampling Agency

Code GHD	**Name** GHD Limited
Address	10271 Shellbridge Way
	Suite 165
City	Richmond
Postal Code	V6X2W8 **Phone** (604) 214-0510

Number of Containers 2

Instructions To Lab See other tests, [redacted] analysis.
TCLP

State: SO Descriptor: MU Collection Method: GRB

No.	Class	Collection Start YYYY-MM-DD HH:MI	Collection End YYYY-MM-DD HH:MI	Depth Upper	Depth Lower	Tide	Comment
1	REG						This is a sample of solid waste from the landfill.
2		17/09/28	17/09/28				
3							
4		10:30	10:36				
5							
6							

GENERAL (250 mL PLASTIC)

	Acidity pH 8.3
	Alkalinity Titration Curve
	Alkalinity: Total: pH 4.5
	Alkalinity: Phenolphthalein
	(500 mL Plastic) Biochemical Oxygen Demand (BOD)
	Bromide
	(500 mL Plastic) Carb. Biochem. Oxygen Demand (CBOD)
	Carbon: TIC
	Chloride
	Colour: True
	Fluoride
	Nitrogen: Nitrate and Nitrite
	Nitrogen: Nitrate
	Nitrogen: Nitrite
	pH
	Phosphorus: Diss. ortho-phosphate
	(500 mL Plastic) Residue: Filterable (TDS)
	(500 mL Plastic) Residue: Nonfilterable (TSS) -Subsample (3 mg/L LOR)
	(500 mL Plastic) Residue: Nonfilterable, Fixed
	(500 mL Plastic) Residue: Total (TS)
	Specific Conductance
	Turbidity
	Sulphate

GENERAL NUTRIENTS (125 mL AMBER GLASS) - H2SO4

	Carbon: TOC
	Chemical Oxygen Demand (COD)
	Nitrogen: Ammonia
	Nitrogen: Total
	Nitrogen: Total Kjeldahl (Calc)
	Nitrogen: Total Organic
	Phosphorus: Total

GENERAL (125 mL AMBER GLASS) - FIELD FILTER, H2SO4

	Carbon: DIC (Field Filter)
	Carbon: DOC (FF, H2SO4)
	Nitrogen: Dissolved Kjeldahl (Calc) (FF, H2SO4)
	Nitrogen: Total Dissolved (FF, H2SO4)
	Phosphorus : Total Dissolved (FF, H2SO4)

METALS: TOTAL

High	Low	
	[redacted]	Metal Pkg. (ICPMS) - HIGH (60 mL Plastic) - HNO3
[redacted]		Metal Pkg. (ICPMS) - LOW (60 mL Plastic) - HNO3
		Mercury - 40mL Glass, HCl
		Hardness (60 mL Plastic) - HNO3

METALS: DISSOLVED

High	Low	
	[redacted]	Metal Pkg (ICPMS) - HIGH (60 mL Plastic)-Field Filter, HNO3
[redacted]		Metal Pkg. (ICPMS) - LOW (60 mL Plastic)-Field Filter, HNO3
		Mercury - 40mL Glass, Field Filter, HCl
		Hardness (60 mL Plastic) - Field Filter, HNO3

SPECIFIC Tests

	Obs Well Package
	Cyanide: SAD (60 mL Plastic + NaOH)
	Cyanide: WAD (60 mL Plastic + NaOH)
	Sulphide: Total (125 mL Plastic, ZnAc & NaOH)
	Residue: Nonfilterable (TSS) -Whole Bottle - 1 mg/L LOR (150 mL Plastic)
	Chlorophyll a (250 mL Brown Plastic Bottle or Filter) Vol:
	Phaeophytin (250 mL Brown Plastic Bottle or Filter) Vol:

ORGANICS

	BTEX (2 X 40 mL glass vials, NaHSO4 or Na2S2O3, No headspace)
	VOC Full List (2 X 40 mL glass vials, NaHSO4 or Na2S2O3, No headspace)
	Volatile Hydrocarbons (VH) (2X40 mL glass vials, NaHSO4 or Na2S2O3, No headspace)
	Trihalomethanes (THM) (2 X 40 mL glass vials, NaHSO4 or Na2S2O3, No headspace)
	VPH (2 X 40 mL glass vials, NaHSO4 or Na2S2O3, No headspace)
	EPH (2 X 100 mL Amber Glass, NaHSO4)
	PAH (2 X100 mL Amber Glass, NaHSO4)
	LEPH/HEPH (Calc) (2 X 100 mL Amber Glass, NaHSO4)
	Oil & Grease (2 X 250 mL Amber Glass, 2 mL 1:1 HCl or 1:1 H2SO4)
	Mineral Oil & Grease (2 X 250 mL Amber Glass, 2 mL 1:1 HCl or 1:1 H2SO4)
	Organochlorine Pesticides (OCP) (2 X 500 mL Amber Glass)
	Organophosphorus Pesticides (OPP) (2 X 500 mL Amber Glass)
	Polychlorinated Biphenyls (PCBs) (2 X 500 mL Amber Glass)
	Chlorophenols (Tri, Tetra & Penta) (2 X 500 mL Amber Glass, C6H8O6 & NaHSO4)
	Phenolics, Chlorinated (2 X 500 mL Amber Glass, C6H8O6 & NaHSO4)
	Phenolics, Non-Chlorinated (2 X 500 mL Amber Glass, C6H8O6 & NaHSO4)
	Phenols, Colorimetric (125 mL Amber Glass, H2SO4)
	Acid Extractable Herbicides (2 X 1 L Amber Glass, NaHSO4)
	Resin Acids (2 X 500 mL Amber Glass, C6H8O6 & NaHSO4)
	Fatty Acids (2 X 500 mL Amber Glass, C6H8O6 & NaHSO4)

BACTERIOLOGY

	E. coli - MF
	Enterococci - MF
	Fecal coliform - MF
	Fecal coliform - MPN
	Fecal streptoc - MF
	Total coliform - MF
	Total coliform - MPN

OTHER Tests

	[redacted] analysis
	TCLP

Smpl No.	FIELD TEST Details	Method Results	Units

Paul Oct 3 @ 08:45
0.6°C.

Report ID: EMSR0900

Date: 2017-09-25 10:07

Attachment B
External Monitor CVs

James Reid
Project Manager/Engineer

Qualified: Bachelor of Applied Science with Options in Water Resources and Management Sciences (B.A.Sc.)

Connected: Member, Association of Professional Engineers and Geoscientists of British Columbia (APEGBC); Registered Professional Engineer, Michigan

Professional Summary: James' work history spans over 25 years in environmental and construction related fields. Specifically, James has been involved with landfill design and construction; environmental site assessments, investigations, and remediation; spill responses; and facility hazardous material/decommissioning and demolition assessments. James' involvement in 300+ sites in BC, Michigan and other Provinces and States have ranged in complexity from commercial due diligence and compliance assessments to multi-disciplined large scale environmental, solid waste and demolition projects. Through his work experience, James brings together effective and collaborative project teams and fosters lasting relationships with clients through his dedication, dependability and responsiveness.

Landfills

Project Manager
Mission Landfill Design/Build | District of Mission | Mission, British Columbia

For a GHD design/build construction project, James lead the design, contractor procurement, construction oversight, and reporting for a $4.5 MM design/build project that involved an engineered wetland, upgraded leachate pre-treatment system, infiltration pond, 3-phase power extension, and municipal landfill cell closure. Under James' management, the work was completed on schedule and significantly under budget, and with no lost-time health and safety incidents. James has also managed several projects for the District related to the landfill, including a hydrogeological investigation, completion of the landfill's groundwater monitoring program, preparation of a conceptual design for the landfill expansion, and as a senior technical advisor for the 2016 Design, Operations, and Closure Plan Update.

Project Manager / Design Lead
Bailey Landfill Design/Build | Jacob Bros Construction | Chilliwack, British Columbia

James lead the design and construction oversight for a $6.6MM design/build project that included a municipal landfill cell base liner system, landfill gas collection and treatment/flare system, and leachate pump station.

Project Manager / Design Lead
Squamish Landfill | District of Squamish, British Columbia

James lead the design, specification, and agreement preparation; contractor procurement; project management; and construction oversight for a landfill cell base liner system extension and intermediate capping of an existing municipal landfill.

Project Manager / Design Lead
Metamora Landfill Superfund Site | Lapeer County | Michigan

James was the design lead of a Superfund site landfill capping project, which incorporated contaminated soil relocation, a hazardous waste landfill cap, and passive landfill gas management. James managed the project during construction oversight and the operations, maintenance, and groundwater / LFG monitoring phase. Challenges included addressing agency concerns regarding off-site migration of LFG and groundwater contamination. James designed and implemented improved monitoring networks for both media to address the immediate need for delineation as well as ongoing monitoring.

Project Coordinator / Engineer
Various Landfills | Michigan

James designed and implemented environmental and geotechnical investigations at landfills in Michigan including the Fons Landfill, Old Wayne Landfill and National Airport Site landfill, in conjunction with pre-design studies to prepare for the design of a final remedy. James also prepared remedial action plans, which included the scope and rationale for selecting site-specific landfill cap alternatives.

Project Manager
Monitoring Programs | Various Landfills | British Columbia

James has managed groundwater, leachate, surface water, and landfill gas monitoring programs for various municipal landfills located in the BC Lower Mainland and on Vancouver Island.

Due Diligence/ Investigation/Remediation

Project Manager / Engineer
Phase I and Phase II Environmental Site Assessments | Various Clients | Various Provinces and States

James has completed Phase I Environmental Site Assessments (ESAs) for vacant, commercial, and light and heavy industrial facilities for due diligence, financing, or to address regulatory requirements primarily in BC, Alberta, and Michigan including automotive manufacturing and testing plants, recycling facilities, broadcasting facilities, gas stations, dumps, mineral exploration sites, tree nurseries, chemical manufacturing facilities, a casino, and storage and distribution facilities. Based on results, James has also completed Phase II ESAs at many of these facilities.

Project Manager
Former Asbestos Manufacturing Facility | Confidential | Surrey, British Columbia

James manages the ongoing investigation of a former asbestos and paint manufacturing facility consistent with applicable provincial regulations, guidance and protocols towards obtaining a Certificate of Compliance from the BC Ministry of Environment, including completing a Stage 1 Preliminary Site Investigation that identified over 20 areas of potential environmental concern, and a Stage 2 PSI. James is currently managing the completion of the remediation.

Project Manager
Certificate of Compliance | Jacob Bros Construction | Vancouver, British Columbia

James managed a team that completed supplemental investigative reporting and remedial oversight compliant with the BC Contaminated Sites Regulation resulting in approval of a CoC for the client in time for building occupancy. Challenges included addressing newly applicable groundwater and soil vapour standards, complying with different standards for the Site and adjacent public property, and removing a previously unknown old underground fuel storage tank and associated remediation. James also worked with the City of Vancouver to successfully obtain a wastewater discharge permit for the construction works.

Project Engineer
Stage 1 Preliminary Site Investigation | Service Station | Mission, British Columbia

James completed a Stage 1 Preliminary Site Investigation (PSI) of a service station slated for decommissioning. The PSI was conducted consistent with the BC Ministry of Environment's Technical Guidance, and was reviewed and accepted by the project's Contaminated Sites Approved Professional (who is on the BC MOE's Roster of Approved Professionals).

Project Manager
LNAPL Investigation, Remediation and Monitoring | Confidential | Delta, BC

Following identification of the presence of LNAPL and dissolved phase constituents in groundwater during the removal of three underground storage tanks, GHD was retained to conduct further investigation and determine remedial options. James's team supplemented existing data with additional monitoring wells and boreholes, using Sudan IV as a field screening tool for LNAPL detection. Following delineation of the LNAPL-impacted soil, remedial options were evaluated; excavation and off-site disposal was selected to meet the client's short and long-term objectives. James' team currently conducts semi-annual groundwater and indoor soil vapour monitoring to evaluate remedial effectiveness and dissolved phase plume stability.

Project Coordinator
DNAPL Recovery and WTP O&M | Client Group | Vancouver, British Columbia

Based on Ministry of Environment Remediation Orders, James manages the operations, maintenance and monitoring of a groundwater and dense non-aqueous phase liquid (DNAPL) recovery system. James facilitated a re-design of the water treatment plant, which resulted in a 20% increase in flow, 33% reduction in maintenance events, and increase in WTP treatment efficiency and reliability.

Project Manager
Underground Storage Tank Removal | Confidential | Victoria, British Columbia

In conjunction with the client's removal of their two underground storage tanks, James completed the remediation of soil contamination and confirmed through a groundwater investigation that no further work was warranted. James also managed the related design of a new above-ground storage tank containment area.

Project Coordinator
Nuclear Groundwater Protection Initiative | Exelon Nuclear | Multiple Locations

James was stationed at the headquarters of Exelon Nuclear for five months during which he coordinated simultaneous fast-tracked assessments of tritiated groundwater at eleven nuclear power generating stations. GHD completed the project in accordance with the aggressive schedule established by the client.

Environmental Testing / Auditing

Project Manager/Director | Drinking Water Sampling Program | VIA Rail | Vancouver, British Columba

James was the project manager and is currently the project director of a project involving scheduled and unscheduled drinking water sampling events, underground tank integrity testing and repairs, water

distribution evaluations, and train wash operational trouble-shooting, James worked closely with the VIA representatives to modify the original scope of work to be better suited to addressing their objectives, reviewed site underground piping schematics to help determine sources of potential water impurities, and communicated with the City of Vancouver to discuss the results submitted on behalf of VIA.

Project Manager | Lead Auditor
EHS Compliance Audit | GE Energy | Langley, British Columba

James was the project manager and lead auditor who prepared and implemented a comprehensive audit program for GE Energy for their BC operations. The audit package included questions and guidelines prepared from applicable local bylaws and provincial and federal laws and regulations incorporating environmental, health and safety. Using the audit, James audited their Langley, BC facility and provided evaluation findings and recommendations.

Lead Auditor
EHS Compliance Audits | Confidential (Manufacturing Warehouses) | BC, WA, OR

James completed environmental, health and safety audits for a manufacturing corporation at three of their operational warehouses in BC, Oregon and Washington. For the audits, James's inspections included general housekeeping and facility records, emergency management systems, flammable and combustible liquids storage, hazardous waste management, general material storage facilities, and safety and training programs.

Decommissioning/Demolition

Project Manager
Former Food Processing and Refrigeration Facility | VersaCold | Vancouver, British Columbia

James managed the decommissioning and demolition of a 1940s former food processing and refrigeration facility that was located along the shoreline of the Burrard Inlet on federal property. James and the GHD team completed Phase I and II ESAs, evaluated historical structural plans of the facility, conducted a hazardous materials assessment, prepared a Vancouver Fraser Port Authority (VFPA) Category C permit with environmental management plans and other supporting documentation, and prepared a construction contract with specifications, drawings, and supplemental conditions to CCDC 4. The decommissioning, demolition and site restoration was completed on time and within budget. Supplemental work included the removal and remediation of two previously unknown underground storage tanks. James currently manages ongoing tasks including new vegetation management and ongoing groundwater monitoring.

Project Manager
Residential/Commercial Property | Regional Municipality of Wood Buffalo | RMWB, Alberta

James managed the demolition of two structures for the RMWB, including hazardous materials abatement, demolition, and site restoration. James prepared the contract documents, assisted with procurement, and acted as owners representative during the work.

Project Manager
Hazardous Materials Surveys at Various Sites | Transmission Company | British Columbia

James manages a client portfolio as well as individual projects that involve conducting hazardous materials surveys and Phase I ESAs of buildings in preparation for either demolition or sale.

Project Manager
Hazardous Materials Surveys and Decommissioning Assessments at Various Sites | Michigan

James managed a variety of hazardous materials surveys and facility decommissioning assessments of industrial, commercial and residential buildings in Michigan. The surveys were conducted in preparation for either demolition or sale. Properties included a 93,000 m^2 hospital complex, 130,000 m^2 industrial plant, and various smaller industrial, commercial and residential properties.

Emergency Response

Project Manager
Residential Fuel Oil Release | Confidential Insurance Adjuster | Saanichton, BC

James responded within 30 minutes of the initial call from the client to a residential fuel oil release. James lead a team who retained the remedial contractor and oversaw the successful removal and excavation of contaminated soil and groundwater adjacent to and beneath a house as well as the restoration of the house itself. James actively communicated with the tenant, owner, insurance adjuster, local municipal government, and BC Ministry of Environment throughout the remediation and worked with the tenant to allow them to return to the home while safely completing the remediation.

Project Manager
Diesel Fuel Spill | Confidential Insurance Company | Medicine Lake, Montana

James mobilized a team to the site of a diesel fuel release within a federal wildlife reserve within 4 hours of the initial call from the client. James successfully coordinated and worked with multiple stakeholders, including the Fish and Wildlife Service, Environmental Protection Agency, Montana Department of Environmental Quality, and Department of Transportation, ensuring that the applicable federal and state cleanup regulations were addressed while completing the cleanup in a safe and expedited manner.

Portfolio Manager / Project Manager
Diesel Fuel Spills | Insurance Company and Private Companies | Various Provinces and States | Ongoing

James manages the response and cleanup of diesel fuel releases due to tractor trailer accidents across Canada and the US for an insurance company and various trucking companies. James is dedicated to responding to the initial notifications 24/7 to ensure that potential immediate threats to human health and the environment are addressed. James works with GHD's emergency response team network to identify the qualified team necessary to respond locally, and communicates with the client, regulatory bodies, contractors, and the GHD team to safely and expeditiously control, cleanup, and report on the cleanup activities.

Project Manager
Transformer Spill | Confidential Insurance Adjuster | Surrey, British Columbia

James lead a team to respond to a release of approximately 675 litres of transformer oil released onto parking lot and into an adjacent city stormwater ditch. James mobilized to the site with the remedial contractor immediately following access authorization. James directed the remedial contractor while communicating with the BC Ministry of Environment and City of Surrey representatives to ensure their expectations were met.

Work history

1992 – present	Associate, GHD (formerly Conestoga Rovers & Associates), Vancouver, British Columbia
	Named Associate, 2002

Reinhard Trautmann
Senior Technologist

Qualified: Civil Engineering Technology, Fanshawe College, Ontario, 1975

Connected: Applied Science Technologists & Technicians of British Columbia, Board of Directors - Solid Waste Association of North America

Professional Summary: Reinhard has more than 25 years of experience in solid waste management in addition to the 15 years of experience in municipal water, waste water and roadway operations and design. Reinhard's experience spans both the private and public sector in management roles in Municipal, Territorial and Regional District governments in Ontario, British Columbia, and Yukon. Reinhard's expertise includes the supervision of landfill closures, construction, design, operations, maintenance as well as the construction and operations of waste transfer stations. Reinhard has operated a specialized construction demolition landfill and soil remediation facility. Reinhard is also a member of the teaching staff in the British Columbia chapter of the Solid Waste Association of North America.

Solid Waste

Senior Landfill Operations Technologist
GHD Limited | Victoria, BC | 2013 - present

Reinhard provides operational support and construction supervision to landfills and transfer stations. This has included operational plans for the KM LNG Landfill and operational support to numerous remote first nation waste and recycling transfer systems including construction oversite as per the engineered design.

Manager
Tervita Construction and Demolition (C&D) and Soil Remediation Landfill | Tervita Corporation | Langford & Victoria, BC | 2011 - 2013

Reinhard was responsible for the Soil Remediation Landfill in Victoria, BC. The landfill received C&D material that was site separated for wood, metal and residual waste. Hydro carbon soil was also received for treatment and reuse in the landfill operations. A leachate collection program was also managed on site. Oversee and inspect all construction activities as required for approval of site long term closure plan.

Manager
Regional District of Central Kootenay | Nelson, BC | 1995 - 2008

Reinhard was responsible for operation and maintenance of four landfill, 12 waste transfer stations and a recycling program. The transfer stations and landfills were operated by Regional District staff including the trucking of all transfer station waste and recycling.

Reinhard was also responsible for landfill closures, construction and engineering oversite for all waste management operations including Solid Waste Management Plan development and implementation, Development and implementation of a recycling and education program.

Manager
Town of Kincardine | Kincardine, ON | 1989 - 1995

Reinhard was responsible for the landfill operations and the municipality representative to oversee and review a landfill design, hydrogeological investigations leachate investigations landfill closure and regulatory approval. Development and implementation of a recycling and education program and the introduction of one of the first curbside User Pay programs in Ontario. In addition to the waste component the oversite of all capital and maintenance works programs responsibilities including waste, waste water and roads.

Manager, Community Operations
Government of Yukon | Whitehorse, YK | 1984 - 1989

Reinhard was responsible for advising Yukon Municipalities and First Nations Councils on operations and management of road, sewer, and water systems and landfill sites including:

- Financial management of departmental operations
- Design, estimate, quantity take-off, and stipulation of water, sewer, and road contracts
- Direct management of unincorporated community landfill sites including design and construction
- Advising Municipalities on operation, maintenance and construction of landfill facilities
- Contract management
- Construction supervision and inspection for roadways, sewer and water project

Manager, Public Works
City of Dawson | Dawson, YK | 1983 - 1984

Reinhard was responsible for operation and maintenance of all public works including, water, waste water, roads, parks and waste management.

Technician – Waste and Waste Water
Stanley Associates Engineering | Edmonton, AB & Whitehorse, YK | 1977 - 1983

Reinhard was the onsite construction inspector for a water and waste water replacement program for the City of Dawson, Yukon, including a looped recirculating water system and utilities buried in permafrost, construction of a sewer outfall, lift stations, screening plant, pump-house and reservoir and service connections to all residences and businesses.

Other related areas of interest

Awards

- BC Ministry of Environmental Award, Municipal Landfill Category awarded to the Regional District of Central Kootenay, BC Ministry of Environment, 1994
- Waste Minimization Award, awarded to the Town of Kincardine, Recycling Council of Ontario, 1993

Presentations

- The BC Ministry of Environment on "The Power of Policy: Implementing Local Policies and Regulations to Support Waste Reduction", 1995
- The Recycling Council of Ontario, Annual Conference on "Kincardine's Bag Tag Program, Making Reduction Happen", 1994

Work history

2013 – present	GHD (formerly Conestoga-Rovers & Associates), Waterloo, ON
2011 – 2013	Tervita Corporation, Langford, BC
2008 – 2011	Highest Waste Recyclers Ltd., Highlands, BC
1995 – 2008	Regional District of Central Kootenay, Nelson, BC
1989 – 1995	Town of Kincardine, Kincardine, ON
1984 – 1989	Government of Yukon, Yukon
1983 – 1984	City of Dawson, Yukon
1977 – 1983	Stanley Associates Engineering, Edmonton Alberta, Whitehorse Yukon
1974 – 1977	Associated Engineering Ltd., Edmonton, Alberta