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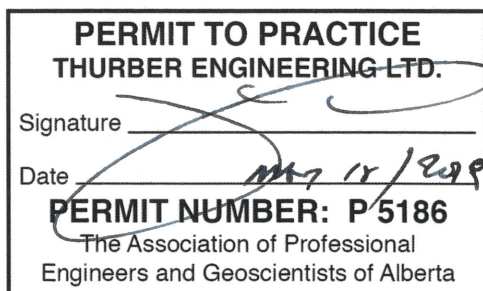
**REVIEW OF AMENDMENT TO EPEA APPROVAL
10348-03-00 FOR CLEAN HARBORS PROPOSED
LANDFILL EXPANSION, RYLEY, ALBERTA**

Report
to
Village of Ryley



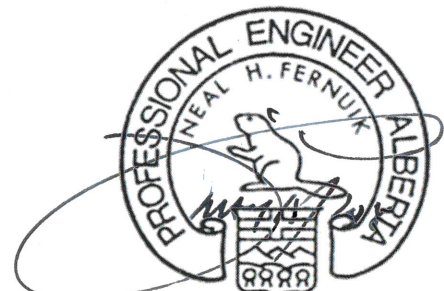
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STATEMENT OF LIMITATIONS AND CONDITIONS



1. INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by the Village of Ryley (Ryley) to conduct a review on Clean Harbours report titled *Application for Amendment of App of Approval No.: 10348-03-00 as amended Lateral Expansion of the Ryley Hazardous Waste Landfill and Transfer Facility* September 2017 prepared by TetraTech.

Authorization to undertake the review was provided by Mr. Michael Simpson, Chief Administrative Office of Ryley.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SCOPE OF WORK

The scope of work was outlined in Thurber's March 28, 2018 proposal and can be generally summarized as outlined below:

- Regulatory Approval Requirements
- Geological and Hydrogeological properties
- Geotechnical and Landfill Design
- Third party monitoring costs.

Review of the Regulatory Approval Requirements was provided by Ms. Lynn Maslen, M.Sc., P.Biol. of Spencer Environmental Management Services Ltd.

3. ASSESSMENT

The application for amendment of the current Approval for lateral expansion of the Ryley Facility is to include NE ¼ 09-050-17 W4M and to construct and operate a new landfill cell (Cell 5) and associated infrastructure. Existing landfill consists of Cell 1, Cell 2, Cell 3A, Cell 3B, and Cell 3C and facilities at SE ¼ 09-050-17 W4M. The current Approval for construction, operation and reclamation of the existing Ryley Industrial Waste Management Facility is effective from March 31, 2017 and expire at March 31, 2027. The application for an amendment had been prepared following the *Guide to Content for Industrial Application Part 3: Amendments* as regulated by the Approvals and Registrations Procedure Regulations under the Environmental



and Enhancement Act issued by the Alberta Environment and Sustainable Resource Development.

3.1 Regulatory Approvals Requirement

The *Guide to Content for Industrial Application Part 3, section 19 Project Background subsections 19.1-19.5*, requires the applicant to update plans, public interest decisions, and regulatory authorizations (Leases, Licences, Approvals and Permits) in relation to the proposed changes. That request is addressed in the application for approval amendment (Application Report) Chapter 4 “Project Background”, subsections 4.1 to 4.4.

The *Guide to Content for Industrial Application Part 3, section 20* requires the applicant to update applicable elements of the current setting and its environmental conditions. That request is addressed in the Application Report in Chapter 5 “Setting and Environmental Conditions and pre-disturbance biological resources conditions of the proposed expansion area (NE ¼ 09-050-17 W4M including Cell 5) are specifically described in subsection 5.1.2.

Application Report subsections 4.1 to 4.4 and 5.12 present information not presented in other Appendices, including Appendix C Detailed Technical Investigation Program Report (Report). Therefore, the Application Report subsections are reviewed here, cross-referenced to the *Guide to Content for Industrial Application Part 3, (the Guide) as the applicant has done in Table 1 of the Application Report*.

The Guide requirements:

19.1. Regional Initiatives or Plans

Identify all government approved regional initiatives or plans that pertain to the area with requirements that relate to environment and resource management for the proposed changes to the activity, such as Land Use Framework Regional Plans and Management Frameworks, Integrated Resource Plans, Water Management Plans, or Municipal Development Plans.

Subsection 4.1 accurately notes that the project is situated within the North Saskatchewan River Planning Region, but that a Regional Plan has not yet been developed. We add that, likewise, there is no applicable Integrated Resource Management Plan.

The subsection does not note that Ryley is situated in the North Saskatchewan River Watershed, Beaverhill sub-watershed. The North Saskatchewan Watershed Alliance has



generated an “Integrated Watershed Management Plan for the North Saskatchewan River in Alberta”, a non-statutory document. A Beaverhill sub-watershed report has not yet been prepared. Note: Unlike Land Use Framework regional plans, watershed management plans are non-statutory. This may be why the watershed management plan was not referenced in the application.

Subsection 4.1 notes that Clean Harbours will obtain all necessary permits pursuant to the Village of Ryley existing planning documents prior to construction.

Subsection 4.2 provides an account of the history of consultation and accommodation between Clean Harbours and the Village of Ryley and Beaver County with respect to the Village LUB, the County MDP and the County and Village planning documents. The report describes the resultant improved environmental management practices at the Clean Harbours facility and improved community engagement and Clean Harbours facility compliance with existing MDPs.

As required.

19.2. Results or Decisions that Modify Environmental Requirements

Related to the proposed changes identified in this application, identify any Hearing results or decisions which set or modify the environmental requirements by:

- the Alberta Energy Regulator (AER);
- the Alberta Utilities Commission (AUC);
- the Natural Resources Conservation Board (NRCB);
- the local Regional Authority or Municipality; or
- the Canadian Environmental Assessment Agency (CEAA)

and identify and reference any of these terms, conditions or commitments for this project that relate to the environment.

19.3. Environmental Impact Assessment

Specify the date an Environmental Impact Assessment (EIA) report was accepted by the Director for the purposes of a Hearing identified in 19.2.

Combined, subsections 4.4 and 4.3 address the requirements of 19.2 and 19.3. The Application Report indicates that no authorizations, approvals or reviews are required by



the Alberta Energy Regulator (AER); the Alberta Utilities Commission (AUC); or the Natural Resources Conservation Board (NRCB).

Subsection 4.3 notes that Alberta Environment and Sustainable Resources reviewed a Project Summary Table and according to their protocol found that an Environmental Impact Assessment, pursuant to Environmental Protection and Enhancement Act (EPEA), was not required.

Canadian Environmental Assessment Agency (CEAA) reviewed a project description and according to their protocol found that an Environmental Impact Statement, pursuant to Canadian Environmental Assessment Act (CEAAAct), was not required.

Historical Resources Act Clearance was obtained.

As required.

19.4. Other Regulatory Authorizations

Identify any authorizations related to the proposed changes identified in this application and their date of issuance, such as Leases, Permits or Approvals and their amendments by:

- the Alberta Energy Regulator (AER);
- the Alberta Utilities Commission (AUC);
- the Natural Resources Conservation Board (NRCB);
- the local Regional Authority or Municipality; or
- Alberta Environment and Sustainable Resource Development (ESRD) for authorizations under the Environmental Protection and Enhancement Act (including on-site potable water treatment and use and stormwater runoff), the Water Act, the Climate Change and Emissions Management Act, the Public Lands Act, and the Forests Act;

and identify and reference any terms, conditions or commitments for this project that relate to the environment. Staff may request the submission of this information if it cannot be sourced from public records.

Subsection 4.4 discusses the above statutes and reports that provincial authorizations, approvals etc. for construction and operation are limited to a need to apply for Water Act approval to remove some temporary and seasonal (non-crown) claimed wetlands and to



divert surface water flows that would otherwise enter the Project Footprint. The report acknowledges the need to obtain these approvals and comply with all approval conditions.

A Development Permit must be obtained from the Village of Ryley.

Subsection 4.4 indicates a commitment to construct and operate to minimize mortality to wildlife. To clarify, proactively minimizing risk of mortality to wildlife is required to comply with the Wildlife Act, Species At Risk Act and Migratory Birds Convention Act. In this case, there is no applicable mechanism for authorization to affect wildlife during construction preparation under these statutes. The applicant's commitment demonstrates awareness of the need to proactively comply.

As required.

20.0. Setting and Environmental Conditions

20.1 and 20.2. Predisturbance Setting and Conditions

Identify which aspects of the setting or environmental conditions require updating based on the proposed changes to the activity (for example, new substance of concern, or nature of release).

Describe the current setting and current environmental conditions for these aspects.

Subsection 5.1.2 contributes to updating conditions at NE ¼ 09-050-17 W4M and describes the biological resources present. Vegetation and wildlife resources are well-described using regional existing datasets data and newly-generated site-specific data. Biological sampling/survey methods and timing meet industry standards. Survey methods and efforts are commensurate with the setting and proposed project as set out in the project description. Fish resources are adequately described. The setting and associated risks of loss of species of concern are well described.

Note: Fieldwork and analysis was done in 2016. References cited to identify Vegetation Elements of Conservation Concern (VECC) date to 2015 and for Status of Wild Species 2010 and 2011. Newer, adjusted references are available for both. All lists should be updated for future approval/permit applications.

As required.

20.3. and 20.4. Regional Initiatives or Plans



For all government regional initiatives or plans identified in 19.1, approved or under development, identify and comment on changes over the last approval period to any terms, conditions or commitments that relate to the environment.

For all government regional initiatives or plans identified in 19.1, approved or under development, describe and highlight any changes to the plant or facility's obligations, potential obligations or opportunities.

Subsection 5.2 notes no applicable changes.

Not Numbered Application Report Summary Section

Subsection 5.3 "Site Suitability", provides a clear summary of site suitability criteria met and notes no anticipated constraints, other than the need to obtain Water Act approval to remove wetlands.

We note one possible other minor constraint: presence of Swainson's hawk nest.

Subsection 5.1.2.2 notes that a Swainson's hawk nest, a species noted in that section as of management concern, was observed on site. Other raptor nests may be present at time of clearing.

Subsection 5.1.2.4 summarizes pre-construction measures but fails to indicate an awareness of the additional considerations associated with raptor nests. Best Management Practices include consulting with AEP, in the year of clearing, regarding the treatment of Swainson's hawk as a Sensitive Raptor to ensure understanding of the current definition of active nest and the associated disturbance avoidance period.

Not Numbered Assessment of Proposed Construction Considerations

What environmental risks or objectives must be addressed solely during project's construction phase? How will they be addressed or achieved? How will reclamation materials be conserved and stored for future reclamation of the site?

Subsection 6.9 provides a thorough list of Environmental Protection Measures that will be applied during construction within the Project Footprint.

Note: There is a possibility that the presence of active and inactive raptor nests may affect clearing. See Swainson's hawk note above.



As required.

22. Amended or Final Reclamation Plan

When, how, and to what extent is the site going to be returned to equivalent land capability? What environmental risks or objectives must be addressed solely during the project's reclamation phase? How will they be addressed or achieved?

Subsection 7.1 indicates that the landfill cells cannot be reclaimed for future development or agricultural use and notes the primary goal of its conceptual reclamation plan is to ensure safe and secure containment of closed landfill cells while minimizing aesthetic impact on the landscape. The concept includes steps to minimize wildlife interaction within the reclaimed, fenced area. The proposed fence is described as industry standard chain-link fencing to a height of up to 2.5 m above grade, topped with three overhanging strands of barbed wire. We assume overhanging means angled out from vertical. While such a fence is appropriate to successfully exclude deer, we note that canids (e.g. coyote and fox) would be capable of digging under an unprotected fence bottom.

3.1.1 Conclusions

The Application Report is prepared strictly according to the Guide to Content for Industrial Approval Applications. The content with respect to environmental assessment, regulations, approvals and biological resources is generally thorough and commensurate with the local and regional setting. The report is well written, clear and easy to follow. The conclusions are well-substantiated. A few very minor information deficiencies that do not affect the conclusions have been identified by this review. With respect to biological resources, the report focuses on the resources present on site that would be removed with construction. The report suggests there is little potential for off-site biological resources, and on-site resources remaining during phasing to be affected by facility operations, given a suitably designed and operated facility. Potential for sensitive, potential receptor off-site biological resources to be affected appears to have been indirectly addressed by the Detailed Technical Investigation Program and Report which suitably focussed on physical features and geological, hydrogeological and hydrological studies and prevention of on and off-site impacts.

3.2 Geology and Hydrogeological Properties

The geological and hydrogeological conditions of the proposed expansion area (NE ¼ 09-050-17 W4M including Cell 5) in the application for amendment report are summarised from the "Detailed



Technical Investigation Program Report NE ¼ Section 09-050-17 W4M, Clean Harbors Ryley Facility Proposed Expansion” prepared by Tetra-Tech at February 2017.

The Standards requirements:

2.1 Natural Environmental Separation;

- (b) Setback for new landfills (100m from land subject to slope failure; 300m from a natural area that permanently contains water such as a lake, river or creek)

The Report answers at all questions listed in table 2.1 in sections 3.1 and 6.1 and shows that the setback conditions are satisfactory for a landfill site.

As required.

- (c) A new landfill or the new waste footprint of a laterally expanding landfill shall not be situated at a location where there exists one or more of the following conditions:

- (i) the area is situated within ravine, coulee or gully;

The Report presented answers in sections 3.1 and 6.1. There are no ravine, coulee or gully at the proposed landfill site.

As required.

- (ii) there is less than 30 metres of geologic materials with an equivalent hydraulic conductivity greater than 1×10^{-8} m/sec between the bottom of the liner and an exceptional underlying aquifer;

The Report sections 6.2.2.2. shows that within 41 m of investigation depth the exceptional aquifer is not present.

As required

- (iii) the geologic material within 10 metres below the bottom of the liner include fractured non-porous bedrock or karst features.

The Report in section 6.2.2.3 discuss that “fractured non-porous bedrock” in the site area is not present because the bedrock formations are with porosity in range from 19.6% to 24.6% and therefore classified as porous.



The Report in section 6.2.2.3 states that the karst features are not encountered during the detail investigation or during studding background regional review to a depth of 250m.

The Report shows that the requirement is satisfied.

- (d) Presence of 8m thickness of suitable material (equivalent hydraulic conductivity less than 1×10^{-8} m/sec) immediately beneath the lowest part of the liner;

The Report in sections 6.3.2.1 based on total 36 hydraulic response testing in surficial deposits and bedrock and six laboratory testing for vertical hydraulic conductivity shows that the requirement is met.

- (e) Existence of material with hydraulic conductivity greater than 1×10^{-6} m/sec within 8m of the clayey deposits
 - (i) the accumulated thickness of the layers is less than 0.5m; and
 - (ii) any such layers do not extend beyond the compliance boundary

The Report in sections 5.1 and 6.3 shows that both requirements (i and ii) are met.

- (f) The thickness of the clayey deposits required in 2.1(d) attained by compacted earthen material to an equivalent hydraulic conductivity less than 1×10^{-8} m/sec.

The Report shows that there is no compacted earthen material in the site area.

As required.

- (g) Exemptions from 2.1(c) and 2.1(d) if the Director accepts written evidence that the groundwater quality will not exceed groundwater performance standards as per section 5.3.

Not discussed in the Report.

Nor required.

- (h) Section 2.1(g) only applies to landfills which were in existence prior to January 1, 2010.



Not discussed in the Report.

Nor required.

2.2 Requirements for a Technical Investigation Program;

- (a) Prior to the design of a new or laterally expanding landfill, the person responsible shall complete a Technical Investigation Program specific to the landfill and its surrounding area.

The Report is a report of the Technical Investigation Program.

As required.

- (b) The person responsible shall ensure that the components of the Technical Investigation Program are prepared by APEGA registered professionals with expertise in the subject area.

The Report is signed by APEGA members geologists and engineers.

As required.

- (c) The Technical Investigation Program shall include characterization of the geologic, hydrologic, hydrogeologic and geotechnical settings express on regional and local scales.

The Report presents the characterizations and settings on regional and local scales.

As required.

- (d) The Technical Investigation Program shall identify the geologic, hydrologic, hydrogeologic and geotechnical characteristics of the site including, at a minimum, all of the following:
 - (i) the groundwater and surface water regimes associated with the new or laterally expanded landfill;

The Report in section 3.4 describes local and regional hydrology with dugouts and water well use within 5km of the proposed landfill extension. The local surface waters are not a restraint for the landfill expansion.

The Report in sections 5.2 describe groundwater regime and groundwater flow. The report concluded that groundwater table is shallower than 5m and that groundwater management would be required during cells construction and during the landfill use.

As required.

- (ii) the potential contaminant flow paths from the landfill into the receiving environmental;

The Report in section 6.4 discuss that site conditions and engineering solutions and measures prevented contamination of surrounding environment by existing landfill, and therefore they expect the same results in the extended landfill. The Report did not specifically discuss the potential contaminant flow path, but the contaminant flow could be understood based on other explanations, figures and data.

- (iii) for a laterally expanding landfill, the potential impact on groundwater and surface water regimes relative to the existing landfill;

The Report section 6.4 discuss how to protect groundwater and concluded that that the potential impact on groundwater by leakages will be managed by natural geology and engineering solutions.

The Report concluded that the potential impact on surface waters will be minimized by management of surface waters with collecting ponds and other engineering solutions.

As required.

- (iv) characterization of the variability, depth, and engineering properties of onsite soils; and

The Report in section 5.1 discuss in detail the properties of surficial soils and bedrock.

As required.

- (v) a site stability assessment.

The Report in section 6.1.2.1 discuss the slope stability and concluded that there is no evidence of slope failure at the siting area.

As required.

- (e) The boreholes completed for the Technical Investigation Program shall be distributed at:

- (i) an evenly distributed spacing of not more than 200m;

The Report in section 4.0 shows that the detailed drilling program between February 23, 2016 and March 19, 2016 composed of 28 boreholes located on approximately 200m grid across the study area with drilling depth between 12.2m and 41.2m.

As required.

- (f) The minimum depth of the hydrogeologic characterization component of the Technical Investigation Program shall be deeper than 30m bellow the proposed base of the new or laterally expanding landfill.

The Report shows that the depth of the hydrogeological characterization was to 41.2m.

As required.

- (g) The Director may require additional boreholes for hydrogeologic characterization required in 2.2(e) and 2.2(f) to adequately delineate geologic formations.

- (h) A topographic survey shall be conducted for the area of the new or laterally expanding landfill as part of the Technical Investigation Program.

The Report in section 4 shows that the topographic survey of all boreholes was completed.

As required.

2.3 Groundwater Monitoring Wells

- (a) The drilling, construction, maintenance and reclamation of boreholes and monitoring wells for the purpose of conducting the Technical Investigation Program shall be done in accordance with all applicable requirements described in Part 7 of the Water (Ministerial) Regulation (AR 205/98), as amended.

The Report in section 4.0 shows that the drilling program was completed in accordance with requirements of the Water Regulation.

As required.

2.4 Detail Technical Investigation Program Report

- (a) The person responsible for a new or lateral expanding landfill shall ensure that APEGA registered professionals with expertise in the subject area prepares components of the Detailed Technical Investigation Program Report.

The Report in section 8.0 shows the Report was signed by APEGA registered professionals.

As required.

- (b) The Detailed Technical Investigation Program Report shall include, at a minimum, all of the following information:
- (i) a description of the topography, surface drainage patterns, geology, hydrogeology, existing and surrounding land use within 800m of the proposed site;

The Report in section 3.0 describes physical setting, geology and hydrogeology as required.

As required.

- (ii) a drawing showing the proposed site in relation to:
- a. Adjacent development and infrastructure;

The Report section 3.1, Figure 1 and 2.

As required.

- b. Natural and constructed physical features such as streams, rivers, water bodies, canals, and drainage controls;

The Report section 3.1, Figure 3 and 4.

As required.

- c. Domestic, municipal and other licensed water well locations within 5km of the proposed site; and

The Report section 3.4, Figure 6b.

As required.

- d. Municipal wellhead protection zones;

The Report section 3.4.

As required.

- (iii) a detailed site plan showing:

- a. Surface topography; and
- b. Locations and surface elevations of all boreholes and monitoring wells;

The Report Figure 6.

As required.

- (iv) the profile and depths of the topsoil and subsoil;

The Report section 5.1, Appendix A.

As required.

- (v) detail borehole records showing the geologic and hydrogeologic conditions encountered and the depth of all major stratigraphic features;



The Report section 5.1, Appendix A.

As required.

- (vi) site stability;

The Report section 6.1.2.

As required.

- (vii) cross-sections showing:

- a. An interpretation of the geologic stratigraphy to the depth of the hydrogeologic characterization component;

The Report Figure 8a-8f.

As required.

- b. Direction of groundwater flow; and hydraulic conductivities of the geologic strata that influence or control groundwater movement;

The Report Figure 8a-9d.

As required.

- (viii) a detailed written interpretation of the hydrologic, hydrogeologic, and geotechnical conditions on a regional and local scale;

The Report sections 3.0 and 5.0.

As required.

- (ix) a statement that the site is suitable for landfill development in accordance with applicable regulatory requirements in Alberta; and

The Report sections 7.1 and 7.2

As required.

- (x) recommendations for:

- a. The area suitable for landfilling;
- b. The landfill design based on the hydrologic and hydrogeologic conditions; and
- c. Dealing with the implications of the conditions in section 2.4(b)(viii) on possible landfill development.

The Report sections 7.1 and 7.2

As required.

3.2.1 Conclusion

The Program and the Report are conducted strictly according to the Standards. The Investigation program is well balanced between requirements of the Alberta regulations and natural conditions. The Report is well prepared with clear conclusions and logical recommendations.

3.3 Proposed Groundwater Monitoring Program (PGWMP)

Section numbers starting with 4.1.6 are from Terms and Conditions Attached to Approval 10348-03-00. The Terms and conditions from approval are followed by our comments in blue italics.

4.1.6 In addition to 4.1.5, the approval holder shall:

(b) maintain the integrity of

(vi) the groundwater monitoring wells,

The PGWMP: in section 1.1 says that "All wells will be protected from damage and will be locked, except when being sampled."

As required.

4.6.34 The Landfill Operation Plan shall include, at a minimum, all of the following:

(p) a Remediation Plan to deal with groundwater quality deterioration;

4.6.58 The Annual Landfill Operation Report required in TABLE 4.6-D shall include, at a minimum, all of the following:

(k) any groundwater remedial action taken pursuant to 4.6.34(p).

The PGWMP in section 1.4. presents the Groundwater Contingency Plan and Flow Chart detailing remedial actions.



As required.

SECTION 4.9: GROUNDWATER MONITORING

- 4.9.1** The approval holder shall continue to implement the existing Groundwater Monitoring Program as authorized in writing by the Director, unless and until otherwise authorized on writing by the Director pursuant to 4.9.4.

PGWMP section 1.0 includes a period of baseline monitoring prior to the site operation, followed by monitoring during the site's operation phase. It is assumed the monitoring wells shared by existing monitoring programs will be reset to baseline monitoring frequency.

As required.

- 4.9.2** The approval holder shall submit a revised Groundwater Monitoring Program to the Director on or September 30, 2017, unless otherwise authorized in writing by the Director.

The PGWMP is submitted to the Director as part of the Application for Approval Amendment at September 2017.

As required.

- 4.9.3** If the revised Groundwater Monitoring Program submitted pursuant to 4.9.2 is found deficient by the Director, the approval holder shall correct all deficiencies as outlined in writing by the Director within timeline specified in writing by the Director.

Director's revision is not available.

- 4.9.4** The approval holder shall implement the revised Groundwater Monitoring Program submitted pursuant to 4.9.2 as authorised in written by the Director within timeline specified in written by the Director.

The revised PGWMP is not approved yet.

- 4.9.5** The approval holder shall:

- (a) collect a representative groundwater sample from each of the groundwater monitor wells specified in the Groundwater Monitoring Program, including the groundwater monitoring wells designated as points of compliance; and

PGWMP in section 1.1 Groundwater Monitoring Well Network propose 15 groundwater monitoring wells located at NE 9-50-17 W4M and within compliance boundary.

The PGWMP agrees with Standards and hydrogeological conditions.

- (b) analyse each sample for the parameters listed in TABLE 4-9-A. (Table 4-9-A. Parameters: pH, Electrical conductivity, COD, DOC, TDS, Metals, Major ions, Nutrients, BTEX, Petroleum Hydrocarbons Fractions F1 and F2).

PGWMP in section 121 Water Quality Parameters present proposed parameters for analysing according to the Standards for Landfill in Alberta published at February 2010 (Standards).

The proposed parameters include all by the Approval.

4.9.6 The monitoring required in 4.9.5 shall be conducted at the following frequencies, unless otherwise authorized in writing by the Director:

- (a) a minimum of once per year during each of the active landfill life, landfill cell closure, final landfill closure, and post-closure periods: and
In section 1.3. the PGWMP proposes Detection level monitoring frequency at once/year when baseline monitoring is not (typo?) being undertaken.

AEP February 2010 “Standards for Landfills in Alberta” for landfills with a liner and leachate collection system specifies detection level monitoring frequency is twice/year and once per year when background parameters are being sampled. If this is a proposed change for the Application for Amendment, introduce it as such with reference to the original regulation.

- (b) a minimum of four times per year following detection of leachate constituents in groundwater at level above those specified in 4.9.7, and until the levels specified in 4.9.7 have been met.

PGWMP in section 1.4 Groundwater Contingency Plan in details and with Groundwater Contingency Plan Flow Chart explain activity in case of identifying water quality changes that are related to landfill operations

Background and Detection level monitoring are not explained or referenced in the Flow Chart.

4.9.7 The groundwater quality in the monitoring wells, designated as points of compliance in the Groundwater Monitoring Program, shall not exceed the higher of:

- (a) the objectives established in the water quality objectives in the Canadian Environmental Quality Guidelines (CEQG) for drinking water published by the Canadian Council of Ministers of the Environment (CCME) as amended; or
- (b) background groundwater chemistry as determined performance standard.
PGWMP in section 1.4 Groundwater Contingency Plan in details explain activity in case of identifying water quality changes that are related to landfill operations.

CEQG are specified in the Approval 10348-02-01. Alberta Tier 1 Soil and Groundwater Remediation Guidelines are specified in Approval 10348-03-00. Flow chart does not reference specific governing guidelines. The ability to optimize monitoring frequency or invoke site-specific guidelines with respect to background levels depends on governing guidelines.

4.9.8 The approval holder shall implement the Remediation Plan as specified in the Landfill Operation Plan, when groundwater quality exceeds the groundwater performance criteria in 4.9.7.

The PGWMP in section 1.4 Groundwater Contingency Plan say that the groundwater contingency plan will be implemented, and AEP notified if the monitoring identifies water quality changes that are related to landfill operations.

As required.

4.9.9 The samples extracted from the groundwater monitoring wells shall be collected using scientifically acceptable purging, sampling and preservation procedures so that a representative groundwater sample is obtained.

The PGWMP in section 1.2.2 explain sampling protocol which complies with 4.9.9 requirements.



As required.

4.9.10 The approval holder shall:

- (a) protect from damage; and
 - (b) keep locked except when being sampled
- all groundwater monitoring wells unless otherwise authorized in writing by the Director.

The PGWMP in section 1.1 say that “all wells will be protected from damage and will be locked, except when being sampled”.

As required.

4.9.11 If a representative groundwater sample cannot be collected because the groundwater monitoring well is damaged or is no longer capable of producing a representative groundwater sample, the approval holder shall:

- (a) clean, repair or replace the groundwater well; and
- (b) collect and analyse a representative groundwater sample prior to the next scheduled sampling event;

Unless otherwise authorized in writing by the Director.

The PGWMP in section 1.1 say that “If a groundwater sample cannot be collected because the monitoring well is damaged or is no longer capable of producing a representative sample, the well will be cleaned, repaired or replaced”.

As required.

4.9.12 In addition to the sampling information recorded in 2.2.1, the approval holder shall record the following sampling information for all groundwater samples collected:

- (a) a description of purging and sampling procedures;
- (b) the static elevation above sea level, and depth below ground surface of fluid phases in the groundwater monitoring well prior to purging;
- (c) the temperature of each sample at the time of sampling; and
- (d) the pH of each sample at the time of sampling; and
- (e) the specific conductance of each sample at the time of sampling.

The PGWMP in section 1.2.2 Sampling Methods explained that purging and sampling will be done under the direct supervision of a qualified member of APEGA. Also, the PGWMP in the section 1.2.2 Sampling

Methods explained sampling protocol and collecting data in which all required data are included.

4.9.13 The approval holder shall carry out remediation of the groundwater in accordance with the following:

- (a) Alberta Tier 1 Soil and Groundwater Remediation Guidelines, Alberta Environment, February 2009, as amended; and
- (b) Alberta Tier 2 Soil and Groundwater Remediation Guidelines, Alberta Environment, February 2009, as amended.

The PGWMP in section 1.4 Groundwater Contingency Plan and subsection Groundwater Contingency Plan explained that “the groundwater contingency plan is built around a key element, the outlier, as defined by Sara and Gibbons (1991)”. The groundwater contingency plan text is supported by a groundwater contingency plan flow chart.

The flow chart does not reference the governing guidelines.

REPORTING

4.9.14 The approval holder shall compile an Annual Groundwater Monitoring Program Report which shall include, at minimum, all of the following information:

- (a) a completed Record of Site Condition Form, Alberta Environment 2009, as amended;
- (b) a legal land description of the facility and a map illustrating the facility boundaries;
- (c) a topographic map of the facility;
- (d) a description of the industrial activity and processes;
- (e) a map showing the location of all surface and groundwater users, and a listing describing surface water and water well use details, within at least a 1.6 kilometre radius of the facility;
- (f) a general hydrogeological characterization of the region within a five kilometre radius of the facility;
- (g) a detailed hydrogeological characterization of the facility, including an interpretation of groundwater flow patterns;
- (h) cross-sections showing depth to water table, patterns of groundwater movements and hydraulic gradients at the facility;
- (i) borehole logs and completion details for groundwater monitoring wells;

- (j) a map showing locations of all known buried channels within at least five kilometre of the facility;
- (k) a map of surface drainage within the facility and surrounding area to include nearby water bodies;
- (l) a map of groundwater monitoring well locations and a table summarizing the existing groundwater monitoring program for the facility;
- (m) a summary of any changes of the groundwater monitoring program made since the last groundwater monitoring report;
- (n) analytical data recorded as required in 4.9.5 and 4.9.11(b);
- (o) a summary of fluid elevation recorded as required in 4.9.12(b) and an interpretation of changes in fluid elevations;
- (p) an interpretation of QA/QC program results;
- (q) an interpretation of all data in this report, including the following
 - (i) diagrams indicating the location and extent of any contamination,
 - (ii) a description of probable sources of contamination, and
 - (iii) a site map showing the location and type of current and historical potential sources of groundwater contamination;
- (r) a summary and interpretation of the data collected since the groundwater monitoring program began including:
 - (i) control charts which indicate trends in concentrations of parameters, and
 - (ii) the migration of contaminants;
- (s) a description of the following:
 - (i) contaminated groundwater remediation techniques employed,
 - (ii) source elimination measures employed,
 - (iii) risk assessment studies undertaken, and
 - (iv) risk management studies undertaken;
- (t) a proposed sampling schedule for the following year(s);
- (u) a description of any contaminant remediation, risk assessment or risk management action conducted at the facility; and
- (v) recommendation for:
 - (i) changes to the groundwater monitoring program to make it more effective, and
 - (ii) remediation, risk assessment and risk management of contamination identified.

The PGWMP explains the protocol and the procedure of the program.



The 2016-year Groundwater Monitoring Program Report included with the application met extension of Approval 10348-02-01 requirements into 2017. We assume that Approval 10348-03-00 was met with 2017-year Groundwater Monitoring Program Report.

4.9.15 The approval holder shall submit the Annual Groundwater Monitoring Program Report to the Director.

The PGWMP in section 1.0 say that “The site development timeline will be determined by ongoing operations at the existing Ryley Facility, therefore, the timing of baseline and operational monitoring is not yet established”.

The PGWMP doesn’t discuss the 2017-year Annual Groundwater Monitoring Program Report results.

4.9.16 If the Annual Groundwater Program Report is found deficient by the Director, the approval holder shall correct all deficiencies identified in writing by the Director, within timeline specified in writing by the Director.

The 2016-year Groundwater Monitoring Program Report included with the application met extension of Approval 10348-02-01 requirements for CEQG compliance into 2017.

We assume that Approval 10348-03-00 requirements for Alberta Tier 1 Soil and Groundwater Remediation Guidelines compliance were met with 2017-year Groundwater Monitoring Program Report.

3.3.1 Conclusions on the PGWMP

A clarifying reference is desired for what’s driving the work. Please reference the AEP request for the changes in this Amendment to the Approval 10348-03-00; state the specific changes to PGWMP in Section 1.0 of Appendix K; or provide them as an attached list to Appendix K.

The Application and PGWMP flow chart would benefit from a clear statement or reference of what guidelines will govern the work going forward. It is not immediately clear that there is a gap whereby supporting documents in the Application for Amendment are governed by a one-year extension of Approval 10348-02-00 to March 2017 which complies to Canadian Environmental Quality Guidelines (CEQG) for drinking water; while Approval 10348-03-00 complies to February



2016 “Alberta Tier 1 or 2 Soil and Groundwater Remediation Guidelines”. We recognize that background levels are pending assessment and will govern guidelines, nevertheless it would help to have a separate section clarifying the current status and proposed guidelines moving forward.

The detection level monitoring frequency in the PGWMP may have a typo in that it is specified as once/year when baseline monitoring is not being undertaken. The AEP February 2010 “Standards for Landfills in Alberta” for landfills with a liner and leachate collection system specifies detection level monitoring frequency is twice/year and once per year when background parameters are being sampled. If this is the proposed change to groundwater monitoring, please introduce it as such with reference to the original requirement.

The February 2010 Standards for Landfills in Alberta state that groundwater monitoring interpretation is required under direct supervision of a qualified member of APEGA, not necessarily purging and sampling.

3.4 Geotechnical and Landfill Design

3.4.1 Available Information

The documents provided for our review are more focused to addressing Section 2: Landfill Development and Siting of the February 2010 Standards for Landfills in Alberta (the Standards).

Section 3 “Design and Construction” of the Standards require that an engineering design report and engineering design maps and plans be prepared to describe the Landfill Design and specifications. These documents were not included in the package of information provided to Thurber for review. Hence, our comments regarding geotechnical and landfill design will be more general based on the preliminary information provided in the Application for Amendment of Approval No.: 10348-03-00, As Amended (the Application) and the Detailed Technical Investigation Program Report.

Our review will also compare the available design data to the requirements outlined in the Approval 10348-03-00, dated March 31, 2017 (the Approval). This approval appears to supersede a previous approval 10348-02-00, dated February 29, 2008 that was attached to the 2016 Dugout Sampling Program Class 1 Waste Management Facility Rley, Alberta, prepared by Tetra Tech, February 8, 2017, included in Appendix I of the Report.



3.4.2 Subsurface Conditions

As required by the Standards, the Detailed Technical Investigation Program Report provides a detailed written interpretation of the geotechnical conditions on a regional and local scale. Based on the information provided, the stratigraphy below the lateral expansion site consists of, in descending order:

- Surficial deposits:
 - Glacial till, glaciolacustrine and glaciofluvial sediments (2.5 m to 5 m thick)
- Bedrock:
 - Horseshoe Canyon Formation: Fluvial clayey sandstone, siltstone, and shale (not found by Tetra Tech but noted in area by others)
 - Bearpaw Formation: Marine shale, siltstone, and minor sandstone
 - Upper Bedrock, weathered interbedded clayey sandstone and shale = 0.9 m to 10.2m thick
 - Middle Bedrock, shale with fine bentonite seams = 20 m to 25 m thick
 - Belly River Group (Lower Bedrock) at 31.5 m to greater than 41.1 m below existing ground:
 - Old Man River Formation - Sandstone, siltstone, shale, and coal deposits
 - Continental Foremost Formation - Shale with minor amounts of sandstone
 - Marine Foremost Formation - Sandstone and shale

Detailed bore hole logs and simplified stratigraphic cross-sections are also provided in the report.

3.4.3 Site Suitability

The Standards require that a statement is made in the Report that the site is suitable for landfill development in accordance with applicable regulatory requirements in Alberta.

Section 7.2 of the Report makes this statement but qualifies it saying that “due to the variable nature of the underlying stratigraphy, most notably the upper bedrock unit, the depths of development will vary with landfill design”. The Report further states that “The stratigraphy



encountered beneath the site will affect development on an area by area basis. Specifically, the upper bedrock unit will need to be evaluated on an aerial basis as the cells are developed to confirm that the requirements of the Standards are met in terms of the suitability of hydraulic properties. Where materials are suspect or borderline, the landfill cells will need to be deeper, installed into the top of the middle bedrock unit (clay shale). The landfill design may need to account for, and manage, potential inflow of shallow groundwater in particular considering the potential for deeper cells. Such management measures may include drains”.

The Application elaborates on the comment about variable stratigraphy above as follows; “If landfilling is to occur in any areas of the site where subgrade materials do not meet the hydraulic property requirements, the subgrade materials will need to be compacted to achieve a hydraulic conductivity of 10-8 m/s and thereby meet the criteria. Laboratory testing demonstrates that this value for the hydraulic conductivity can be achieved with standard landfill construction practices”.

In conclusion, Tetra Tech say that the site is suitable for the landfill development but that some special subgrade preparation might be required in some locations of variable subgrade conditions and drains might be required to handle groundwater.

3.4.4 Site Layout and Development

Apparently, the site layout and development were (or will be) described in a separate report which was not included for our review. However, the Application notes that the proposed development will consist of:

- a new Class I Landfill Cell (Cell 5) - 508,670 m³
- associated staging areas, scale and access roads;
- waste receiving and stabilization area; and
- surface water management infrastructure

The proposed Landfill Cell 5 will be constructed with:

- A primary perimeter berm;
- Intermediate perimeter berms (contiguous with future Landfill cell boundaries);
- Composite cell liner; and



- Leachate collection system.

Apparently six additional cells are contemplated that will be construct over period of 40 years extending to 2057, however a separate application will be made for these cells at some point in the future.

3.4.5 Slope Stability

The Detailed Technical Investigation Program Report states that the terrain within the Project Footprint is level to gently undulating; there is no evidence that the Project Footprint is located on lands subject to slope failure.

During the detailed design phase of work, it is typical practice to carry out a detailed slope stability assessment to confirm that the design landfill cell, berm, waste and final cover (cap) slopes will remain stable at various phases of waste filling to avoid future instabilities that could affect the functionality of the landfill. A check should be made that this was (or will be) carried out as part of the detailed design and that the results confirm adequate factor of safety for the various slope inclinations shown on the current design drawings.

3.4.6 Waste Setback from the Landfill Property Line

The Standards require a minimum 30 m separation between the waste footprint and the landfill property line. Figure 3 of the Application shows how Clean Harbours will comply with this requirement.

3.4.7 Design Considerations

Section 3.1 of the Terms and Conditions of the Approval require that each new Class 1 cell shall consist of certain components. The Standards also have certain minimum requirements. The following sections discuss these requirements and how the current application addresses them.

Protective Layer

The approval requires a minimum 0.45 m thick cover of clean sand or soil to be placed over top of the uppermost drainage layer.

Figures 8C, 8D and 8E of the Application indicate that this is to be provided.

Liners



The Approval requires a composite liner that consists of, at a minimum:

- (i) A GCL liner placed in direct contact with an underlying 80 mil HDPE geomembrane as a primary liner;
- (ii) A GCL liner placed in direct contact with an underlying 80 mil HDPE geomembrane as a secondary liner; and
- (iii) A GCL liner placed in direct contact with an underlying clay liner that has:
 - a. A minimum thickness of 1.0 metre at all points, measured perpendicular to the slope, and has
 - b. Been compacted to achieve an insitu hydraulic conductivity of 1×10^{-9} m/s or less;

Figures 8D and 8E of the Application indicate that all of the above noted liners will be provided under the leachate collection sump, collection and clean-out pipe trenches. However, Figure 8C shows that the general area- liner system will not include the GCL liners noted in (i) or (ii). Tetra Tech should be consulted to confirm that this modification will still meet the intent of the Approval and the ultimate decision will lie with the Regulator who reviews the Application.

Test data from Tetra Tech indicates that the clay till from the site satisfies the preferred range of clayey soils for construction of compacted clay liners (CCL). The upper bedrock unit consists primarily of clayey materials (clayey sandstone and clay shale) that has also been used for CCL construction but is high plastic, in the marginal category for CCL borrow material. On this basis, it should be possible to construct a clay liner that can meet the hydraulic conductivity parameters outlined in (iii) b above, using clayey materials available on site.

The Approval requires that the composite liner for the landfill shall be constructed on a foundation or base such that there shall be no failure of the liners due to settlement, compression, or uplift. Tetra Tech note that groundwater will likely be encountered in the cell excavations, and that drains might be required, however subdrains are not shown on the conceptual design drawings to deal with potential uplift groundwater pressures that might heave and crack the CCL.



Leachate Collection

The Approval states that the cells require a leachate collection system that:

- (i) Is placed over the primary liner;
- (ii) Is capable of maintaining the maximum acceptable leachate head; and
- (iii) Consists of:
 - a. A geo-composite drainage layer with a transmissivity of at least 10^{-4} m²/s placed over top of the primary liner;
 - b. A network of perforated leachate collection pipes; and
 - c. A leachate collection sump placed over the primary liner.

Figures 8C, 8D and 8E of the Application show a leak detection design that meets these conditions. The project specifications (not available for our review) will need to specify a geo-composite product that can meet the transmissivity requirements.

The Application says that the cells will be sloped to the south or west to aid in the movement of leachate to collection points so the leachate can be measured and removed through access pipes, and disposed of appropriately at an off-site deep injection well.

Leak Detection

The Approval requires that a leak detection system be designed that:

- (i) Is installed over the secondary liner:
- (ii) Is capable of detecting the leakage through the primary liner; and
- (iii) Consists of:
 - a. A geo-composite drainage layer with a transmissivity of at least 1×10^{-4} m²/s placed over top of the secondary liner;
 - b. A network of perforated leak detection liquid collection pipes, and
 - c. A leak detection liquid collection sump placed over the secondary liner.



Figures 8C, 8D and 8E and the text in the Application indicate that a geocomposite leak detection layer will be placed above the secondary liner. It will feed into the sump area and be accessed by a network of perforated pipes.

The project specifications (not available for our review) will need to specify a geo-composite product that can meet the transmissivity requirements.

Final Cover

The Approval requires that a final cover is to be provided:

- (i) That meets the requirements in Section 6.1(c) of the Standards for Landfills in Alberta, as amended; or
- (ii) As specified in the Landfill Cell Closure Plan submitted by the approval holder and authorized in writing by the Director pursuant to 7.1.1 and 7.1.4.

The Application says that when a cell is filled to capacity, the cell will be capped with clay or soil cover and synthetic material, to limit infiltration and the generation of leachate. The cap layers will then be covered with subsoil and topsoil then seeded with grass.

Figure 12 of the Application shows a conceptual view of the closure plan. With Cell 5 and all of the future cells oriented in a capped mound trending from south to north along the west side of the lateral expansion property. Normally a more detailed plan is prepared that shows each stage of development in plan and cross-section view. This might be available under separate cover and should be requested for review.

Run-on Control

The Standards require a run-on control system to prevent flow onto the active landfill area. The Approval requires a run-on control system capable of preventing flow onto the active landfill area from at least the peak discharge from a 1 in 25-year, 24 hour duration storm event at the facility.

The Application says that “for the period of development associated with Cell 5 and associated Project infrastructure in the south half of the Project Footprint, local run-on water from adjacent undeveloped areas could pool against the outside edges of Project infrastructure including pond berms and access roads. Where such ponding of this run-on water persists in areas south of the abandoned railway bed, ponded run-on water will be pumped to the northeast, past the basin divide, adjacent to the abandoned railway bed and Secondary Highway 854, where it will remain



for evaporation. Drainage within the Project Footprint north of the abandoned railway bed will continue as per existing conditions during the period of construction and operation of Cell 5”.

The Application states that the volume of run-on water to be produced during the operation of Cell 5 is expected to be sufficiently small as to not result in impacts to off-site downstream properties where a defined drainage course does not exist.

Run-off Control

The Standards require a run-off control system for the active landfill area to collect and control at least the run-off water. The Approval requires a runoff control system capable of collecting and controlling at least the runoff volume resulting from a 1 in 25-year, 24-hour duration storm event at the facility.

Based on the Application, surface water run-off from developed portions of the Project Footprint will be collected in 3 stormwater retention ponds (Ponds 3 through 5). The stormwater retention ponds will be operated on a batch basis, emptied as soon as practicable after spring melt and storm events so as to restore the available storage capacity prior to a subsequent event. The Application further states that “As per the terms of the Current Approval, Clean Harbors may discharge surface water from existing stormwater ponds to the receiving environment subject to confirmation that the water quality meets the applicable discharge criteria”. There is data in the Application to show that the 1 in 25-year, 24-hour duration storm event should be accommodated by the design.

Groundwater Monitoring System

A groundwater monitoring system is required by the Standards. This is discussed in Section 3.3 of our review.

Cells

In the Application, Clean Harbors is proposing to construct Cell 5 and future landfill cells below the native ground surface, at a base elevation of approximately 681 m asl. The Report says that the planned cells will range in depth between approximately 4 m and 6 m. These depths will place the base of the landfill within the upper bedrock unit.

Figure 8B of the Application shows design inclinations for the inside slopes of the cell of 3H:1V. This design inclination is typical for this application but should be confirmed by a slope stability assessment.



Perimeter Berm

The drawings in the Application show that the perimeter berm for Cell 5 will vary from 2 m to 4 m in height. It will be constructed with outer slopes inclined at 3H:1V and a 5 m wide top. These are relatively common design parameters; however, the berm inclination should be confirmed by a slope stability assessment.

Segregated Materials

The Standards say that if a new or laterally expanding landfill accepts segregated material for the purpose of waste minimization, sorting, recovery, processing, or storage then the Landfill Design Plan and specifications shall include specific areas to be used for these activities.

The Application indicates that a central waste receiving and stabilization area is proposed to stabilize any received waste containing free liquids by addition of sawdust. It will be developed outside the boundary of a Class I Landfill Cell. The waste receiving and stabilization pits will be constructed with an engineered containment consisting of welded steel waste bins encased in concrete (Figure 9). The waste receiving and stabilization area will be elevated above the waste receiving and transfer vehicles to minimize contact of the waste with the vehicles and precipitation falling on the waste receiving and stabilization area will be directed to the proposed Pond 4.

3.4.8 Construction Quality Assurance Plan and a Construction Quality Control Plan

The Standards require that prior to the construction of a new landfill, laterally expanding landfill or landfill cell, the person responsible shall submit to the Director a Construction Quality Assurance Plan and a Construction Quality Control Plan. This was not included in the package provided for our review.

3.4.9 Conclusions for Geotechnical and Landfill Design

In conclusion, Tetra Tech say that the site is suitable for the landfill development but that some special subgrade preparation might be required in some locations of variable subgrade conditions and drains might be required to handle groundwater.

3.5 Third Party Monitoring Costs

We have compiled costs (excluding GST) for groundwater monitoring, leachate monitoring, and surface water run-off monitoring.



3.5.1 Groundwater Monitoring Cost

We have estimated a cost of \$26,000 per year for groundwater monitoring and reporting for an extended cost of \$104,000 for the 4-year baseline monitoring period during where no long-term monitoring optimization is possible.

Assumptions for Groundwater Monitoring

- Constituents to be monitored include:
 - Routine water
 - Dissolved metals
 - Ammonia
 - Total Kjeldahl Nitrogen (TKN)
 - Phenols
 - Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX), and F1-F2 petroleum hydrocarbon (PHC) fractions F1-F2
 - Subset of four chlorinated volatile organic compounds (CVOCs; including Methylene Chloride Vinyl Chloride, Trichloroethene, Tetrachloroethene)
- Two monitoring events per year;
- One draft monitoring report to Clean Harbors for review by January 31 of the year following monitoring; and
- One final report pending all client and ultimate client edits by March 1 of the year following monitoring.

3.5.2 Leachate Monitoring Cost

We have estimated a cost of \$2,200 per year for leachate monitoring and reporting per active landfill cell and an extended cost of \$4,700 for five active landfill cells.



Assumptions for Leachate Monitoring

- Constituents to be monitored include:
 - Routine water
 - Dissolved metals
 - Ammonia
 - Total Suspended Solids (TSS)
 - TKN
 - Phenols
 - BTEX, PHC F1-F2
 - Chemical Oxygen Demand (COD)
- One monitoring event per year;
- One draft monitoring report to Clean Harbors for review by January 31 of the year following monitoring; and
- One final report pending all client and ultimate client edits by March 1 of the year following monitoring.

3.5.3 Run-off Monitoring Cost

We have estimated a cost of \$2,300 per release from one run-off retention pond and an extended cost of \$3,500 for one release from each of three run-off retention ponds.

Assumptions for Surface Water Run-off Monitoring

- Constituents to be monitored include:
 - Routine water
 - Ammonia

- TSS
 - COD
 - Oil and grease
- One monitoring event per grouped release from all three run-off retention ponds;
 - One draft monitoring report to Clean Harbors for review six weeks following a monitored release event;
 - One final compilation report pending all client and ultimate client edits by March 1 of the year following monitoring;

4. ADDITIONAL INFORMATION REQUIREMENTS

4.1 Setting and Environmental Conditions

- Fieldwork and analysis was done in 2016. References cited to identify Vegetation Elements of Conservation Concern (VECC) date to 2015 and for Status of Wild Species 2010 and 2011. Newer, adjusted references are available for both. All lists should be updated for future approval/permit applications.
- Subsection 5.1.2.2 notes that a Swainson's hawk nest, a species noted in that section as of management concern, was observed on site. Other raptor nests may be present at time of clearing. There is a possibility that the presence of active and inactive raptor nests may affect clearing
- Subsection 5.1.2.4 summarizes pre-construction measures but fails to indicate an awareness of the additional considerations associated with raptor nests. Best Management Practices include consulting with AEP, in the year of clearing, regarding the treatment of Swainson's hawk as a Sensitive Raptor to ensure understanding of the current definition of active nest and the associated disturbance avoidance period.
- The Final Reclamation Plan concept includes steps to minimize wildlife interaction within the reclaimed, fenced area. The proposed fence is described as industry standard chain-link fencing to a height of up to 2.5 m above grade, topped with three overhanging strands of barbed wire. We assume overhanging means angled out from vertical. While such a fence is appropriate to successfully exclude deer, we note that canids (e.g, coyote and fox) would be capable of digging under an unprotected fence bottom.

4.2 Groundwater Monitoring - Section 4.9 of the Groundwater Monitoring Approval

- The Application and PGWMP flow chart would benefit from a clear statement or reference of what guidelines will govern the work going forward. It is not immediately clear that there is a gap whereby supporting documents in the Application for Amendment are governed by a one-year extension of Approval 10348-02-00 to March 2017 which complies to Canadian Environmental Quality Guidelines (CEQG) for drinking water; while Approval 10348-03-00 complies to February 2016 “Alberta Tier 1 or 2 Soil and Groundwater Remediation Guidelines”. We recognize that background levels are pending assessment and will govern guidelines, nevertheless it would help to have a separate section clarifying the current status and proposed guidelines moving forward.
- The detection level monitoring frequency in the PGWMP may have a typo in that it is specified as once/year when baseline monitoring is not being undertaken. The AEP February 2010 “Standards for Landfills in Alberta” for landfills with a liner and leachate collection system specifies detection level monitoring frequency is twice/year and once per year when background parameters are being sampled. If this is the proposed change to groundwater monitoring, please introduce it as such with reference to the original requirement.
- The February 2010 Standards for Landfills in Alberta state that groundwater monitoring interpretation is required under direct supervision of a qualified member of APEGA, not necessarily purging and sampling.

4.3 Geotechnical and Landfill Design

- During the detailed design phase of work, it is typical practice to carry out a detailed slope stability assessment to confirm that the design landfill cell, berm, waste and final cover (cap) slopes will remain stable at various phases of waste filling to avoid future instabilities that could affect the functionality of the landfill. A check should be made that this was (or will be) carried out as part of the detailed design and that the results confirm adequate factor of safety for the various slope inclinations shown on the current design drawings.
- The Approval requires that the composite liner for the landfill shall be constructed on a foundation or base such that there shall be no failure of the liners due to settlement, compression, or uplift. Tetra Tech note that groundwater will likely be encountered in the cell excavations, and that drains might be required, however subdrains are not shown on



the conceptual design drawings to deal with potential uplift groundwater pressures that might heave and crack the CCL.

- Figure 12 of the Application shows a conceptual view of the closure plan. With Cell 5 and all of the future cells oriented in a capped mound trending from south to north along the west side of the lateral expansion property. Normally a more detailed plan is prepared that shows each stage of development in plan and cross-section view. This might be available under separate cover and should be requested for review.
- Cells - Figure 8B of the Application shows design inclinations for the inside slopes of the cell of 3H:1V. This design inclination is typical for this application but should be confirmed by a slope stability assessment. Similar statement for the Perimeter Berm with a side slope of 3H:1 V.
- The Standards require that prior to the construction of a new landfill, laterally expanding landfill or landfill cell, the person responsible shall submit to the Director a Construction Quality Assurance Plan and a Construction Quality Control Plan. This was not included in the package provided for our review.

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.