

# **STANDARDS FOR LANDFILLS IN ALBERTA**

Alberta Environment  
Environmental Assurance  
Science and Standards Branch

May 2004



## FOREWORD

Alberta Environment is updating its waste management regulatory requirements. It is anticipated that the new regulatory requirements will be in place for all landfills by 2007. The *Standards for Landfills in Alberta (Standards)* is one initiative in upgrading waste management regulatory requirements. The *Standards* outline the minimum requirements for development, operation, monitoring, closure and the post-closure care of a Class I, Class II, and Class III landfill.

Until the updated regulatory revisions are legislated, the *Standards* will only apply to landfills or lateral expansions as required by the Director issuing landfill approvals or reviewing applications for registration. It is expected that those responsible for landfills, including consultants, will use the *Standards* to prepare approval and registration applications and improve landfill design, operation, and closure measures.

Existing landfills operating under an approval or registration shall follow the conditions of their approval or registration. However, landfill owners and operators should begin updating their operations plan, monitoring plans, and other requirements of the *Standards* in preparation for legislation changes.

The use of the standards does not absolve a landfill owner from Alberta Environment or other ministries regulatory requirements. The landfill owner should consult agencies such as the local development authority, the Energy and Utilities Board if accepting oilfield wastes, and Federal Ministries such as Environment Canada to determine other applicable regulatory requirements.

Any comments or concerns with the content of the *Standards* should be submitted in writing to:

Landfill Specialist, Science and Standards Branch  
Alberta Environment  
4th Floor Oxbridge Place  
9820-106 Street  
Edmonton, Alberta T5K 2J6

**ACKNOWLEDGEMENTS**

Alberta Environment acknowledges, with gratitude, the guidance and direction provided by the participants in developing this document. The members willingly participated in the process by volunteering their time to attend meetings and review documents. The participants and Alberta Environment staff members included the following.

**Steering Committee**

Steve Johnson, M.Eng., P.Eng.	-	Alberta Environment
Karu Chinniah, M.Sc., P.Eng.	-	Alberta Environment
Pat Lang, B.Sc. P.Eng.	-	Alberta Environment
Alison Walker, M.Sc.	-	Hazco Environmental Services
Bob Chandler, Ph. D., P.Eng.	-	Alberta Environment
Susan Halla, A.Sc.T.	-	Alberta Energy and Utilities Board
Bruce Taylor, Ph.D., P.Ag.	-	Solid Waste Association of North America
Pat Sliworsky, Landfill Manager	-	Town of Whitecourt
Jim Lapp, Civil Tech.	-	Solid Waste Association of North America
John Deagle, CET	-	Canadian Waste Services
Norm Richards, P.Eng.	-	NLR Consulting Ltd.
Paul Ruffell, P.Eng.	-	EBA Engineering Consultants
Pete Marshall, B.Sc.	-	AMEC Earth and Environmental
Rick Valdarchi, P.Eng.	-	City of Calgary

**Siting and Monitoring Subcommittee**

Bob Chandler, Ph.D., P.Eng.	-	Alberta Environment
Jasna Hundal, M.Sc., P.Eng.	-	City of Calgary
Brenda Austin, P.Geol.	-	Alberta Energy and Utilities Board
Sue Gordon, Ph.D., P.Geol.	-	Alberta Research Council
Mark Trudell, Ph.D., P.Geol.	-	Komex International Ltd.
Pete Marshall, B.Sc.	-	AMEC Earth and Environmental
Steve Johnson, M.Eng., P.Eng.	-	Alberta Environment
Jim Lapp, Civil Tech.	-	Solid Waste Association of North America

**Engineering and Closure Subcommittee**

Steve Johnson, M.Eng., P.Eng.	-	Alberta Environment
George Neurohr, M.Eng., P.Eng.	-	Alberta Environment
Paul Ruffell, P.Eng.	-	EBA Engineering Consultants
Norm Richards, P.Eng.	-	NLR Consulting Ltd.
Rick Valdarchi, P.Eng.	-	City of Calgary
Jim Lapp, Civil Tech.	-	Solid Waste Association of North America
Pete Dimmell, M.Sc., P.Eng.	-	Seacorp

**Operations and Record Keeping Subcommittee**

Steve Johnson, M.Eng., P.Eng.	-	Alberta Environment
Karu Chinniah, M.Sc., P.Eng.	-	Alberta Environment
John Shaw, P.Eng.	-	Alberta Environment
J. Francis Hugo, P.Eng.	-	Entara Consulting Services Ltd
John Deagle, CET	-	Canadian Waste Services
Susan Halla, A.Sc.T.	-	Alberta Energy and Utilities Board
Alison Walker, M.Sc.	-	Hazco Environmental Services
Don White, P.Chem. QEP	-	Clean Harbors Canada Inc.
Pat Sliworsky, Landfill Manager	-	Town of Whitecourt

Bruce Taylor, Ph.D., P.Ag. - Solid Waste Association of North America  
Jim Lapp, Civil Tech. - Solid Waste Association of North America

<b>DEFINITIONS .....</b>	<b>1</b>
<b>SECTION 1: REGULATORY DISCLOSURE PROCESS FOR A NEW OR LATERALLY EXPANDING LANDFILL .....</b>	<b>7</b>
1.1 <i>Disclosure Plan.....</i>	7
1.2 <i>Submission of the Disclosure Plan .....</i>	7
<b>SECTION 2: LANDFILL DEVELOPMENT AND SITING STANDARDS .....</b>	<b>8</b>
2.1 <i>Natural Environment Separation.....</i>	8
2.2 <i>Requirements for a Hydrogeological Investigation Program .....</i>	9
2.3 <i>Groundwater Monitoring Wells.....</i>	10
2.4 <i>Hydrogeological Investigation Program Reporting.....</i>	10
<b>SECTION 3: DESIGN AND CONSTRUCTION.....</b>	<b>12</b>
3.1 <i>Design Plan and Specifications .....</i>	12
3.2 <i>Design of a Class I Landfill .....</i>	13
3.3 <i>Design of a Class II Landfill.....</i>	13
3.4 <i>Design of a Class III Landfill.....</i>	14
3.5 <i>Construction.....</i>	14
<b>SECTION 4: LANDFILL OPERATION.....</b>	<b>16</b>
4.1 <i>Operator Certification .....</i>	16
4.2 <i>Topsoil and Subsoil Salvaging and Storage .....</i>	16
4.3 <i>Operations Plan.....</i>	16
4.4 <i>Waste Acceptance Policies and Procedures.....</i>	17
4.5 <i>Nuisance Management.....</i>	17
4.6 <i>Liquid Waste Restriction.....</i>	17
4.7 <i>Signage.....</i>	18
4.8 <i>Leachate Management.....</i>	18
<b>SECTION 5: MONITORING, ANALYSIS AND CORRECTIVE ACTION.....</b>	<b>19</b>
5.1 <i>Landfill Monitoring Plan .....</i>	19
5.2 <i>Groundwater Monitoring Program .....</i>	19
5.3 <i>Points of Compliance.....</i>	22
5.4 <i>Groundwater Monitoring Wells.....</i>	22

5.5	<i>Implementation of Groundwater Contingency Plan</i> .....	22
5.6	<i>Surface Water Monitoring Program</i> .....	24
5.7	<i>Implementation of the Surface Water Contingency Plan</i> .....	24
5.8	<i>Subsurface Landfill Gas Monitoring Program</i> .....	24
5.9	<i>Implementation of the Subsurface Landfill Gas Contingency Plan</i> .....	25
5.10	<i>Class I Landfill Ambient Air Monitoring Program</i> .....	25
5.11	<i>Leachate Monitoring Program</i> .....	25
5.12	<i>Methods for Water, Leachate and Solid Waste Analysis</i> .....	26
<b>SECTION 6: FINAL CLOSURE AND POST-CLOSURE CARE .....</b>		<b>28</b>
6.1	<i>Detailed Final Closure Plan</i> .....	28
6.2	<i>Post-Closure Care Plan</i> .....	28
6.3	<i>Post-closure Care Period</i> .....	29
<b>SECTION 7: RECORD KEEPING AND REPORTING .....</b>		<b>30</b>
7.1	<i>Reporting of Contraventions</i> .....	30
7.2	<i>Report Requested by Inspector or Director</i> .....	31
7.3	<i>Operating Record</i> .....	31
7.4	<i>Annual Report</i> .....	31
7.5	<i>Final Closure Report</i> .....	32
7.6	<i>Post-Closure Care Annual Report</i> .....	33
7.7	<i>End of the Post-Closure Care Period Report</i> .....	33

**DEFINITIONS**

All definitions as stated in the Act and regulations shall apply to these Standards.

In these Standards,

- (a) “Act” means the *Environmental Protection and Enhancement Act, R.S.A 2000, c. E-12*, as amended;
- (b) “active landfill area” means the areas of the landfill that has received or is receiving waste and that has not been closed, and that is being used for disposal, storage, processing, transport or handling of waste materials;
- (c) “active life” means the period of operation, beginning with the initial receipt of waste and ending with the start of final closure activities;
- (d) “adjacent” means lands that are contiguous to the landfill or would be contiguous if not for a river, stream, railway, road, or utility right of way;
- (e) “APEGGA” means the Association of Professional Engineers, Geologists and Geophysicists of Alberta;
- (f) “aquifer” means an aquifer as defined in the *Water Act*;
- (g) “baseline level monitoring” means a sampling and analysis program that establishes water quality prior to the start of landfill operations;
- (h) “bulk liquid” means a liquid transported in a vehicle tank or body that is not contained in barrels or other such containers;
- (i) “clay liner” means a liner meeting the specifications in Section 3.5(b);
- (j) “clayey deposit” means an unconsolidated geological unit that is capable of achieving the specifications in 3.3(b)(i);
- (k) “cell” means a designed or designated area of a landfill comprised of an excavation or earthen structure in which waste is enclosed by a cover;
- (l) “certified operator” means a person who holds a valid Certificate of Qualification of the appropriate class under *Part 3, Section 25* of the *Waste Control Regulation (A.R. 192.96)*, or as amended;
- (m) “composite liner” means a geomembrane placed directly on the surface of a clay liner;
- (n) “construction quality assurance” means an integrated system of management activities involving planning, implementation, documentation, assessment, reporting and quality improvement to identify the level to which the construction is in compliance with the specifications;

- (o) “construction quality control” means the overall system of technical activities that measures the attributes and performance of construction to verify that the construction meets the specifications;
- (p) “coulee” means a dry or intermittent stream valley or wash, especially a long steep-walled gorge representing a Pleistocene overflow channel that carried meltwater from an ice sheet;
- (q) “day” means any period of 24 consecutive hours unless otherwise specified;
- (r) “detection level monitoring” means a monitoring program that is undertaken during the active life, the final closure and the post-closure period for the purpose of detecting the migration of a contaminant constituent to the surrounding environment;
- (s) “equivalent vertical hydraulic conductivity” means and is obtained from the following calculation:

$$K = d / \sum (d_i / K_i), \text{ where:}$$

K = equivalent vertical hydraulic conductivity

d = thickness of natural geologic material between the bottom of a landfill and the top of an exceptional underlying aquifer

$d_i$  = thickness of each distinctly different geologic layer within the thickness of d

$K_i$  = the vertical hydraulic conductivity of geologic layer  $d_i$

$\Sigma$  = means the summation of all  $d_i / K_i$  values for the distinctly different geologic layers

- (t) “exceptional underlying aquifer” means a hydrostratigraphic unit with a transmissivity of greater than  $2.5 \times 10^{-3} \text{ m}^2/\text{sec}$  yielding water with a total dissolved solids (TDS) concentration not exceeding 4000 mg/L;
- (u) “final closure” means the period of time when waste will no longer be placed in the defined portion of a landfill and activities are undertaken to complete the final cover system and decommission components and facilities that are no longer required, and includes the construction of any additional components or monitoring systems that are necessary for post-closure care;
- (v) “final cover” means soils and other material used on the surface of a landfill that is completed to its maximum designed waste elevation;
- (w) “fractured non-porous bedrock” means a fractured bedrock with a primary porosity of less than 5 percent as measured by a helium porosimeter;
- (x) “geologic materials” means one or more geologic formations;
- (y) “geomembrane” means a sheet of manufactured synthetic material designed to control migration of liquid and gas;
- (z) “groundwater” means groundwater as defined in the Water Act;



- (aa) “gully” means a small channel with steep sides caused by erosion and cut by concentrated but intermittent flow of water usually during and immediately following heavy rains or after ice or snow melt;
- (bb) “hydraulic conductivity” means the ease with which a fluid can be transported through a material;
- (cc) “hydrogeology” means the study of the relationship between water and geology with particular emphasis on the movement and chemistry of water;
- (dd) “hydrogeologist” means a person who is registered with APEGGA with a specialization in hydrogeology;
- (ee) “hydrostratigraphic unit” means the geological formation, or part of a geological formation, or a group of geological formations, in which the hydraulic properties are similar and allow for grouping into aquifers or aquitards;
- (ff) “inert waste” means a solid waste that when disposed of in a landfill or re-used, is not reasonably expected to undergo physical, chemical or biological changes to such an extent as to produce substances that may cause an adverse affect and includes without limitation, demolition debris, concrete, asphalt, glass, ceramic materials, scrap metal and dry timber or wood that has not been chemically treated;
- (gg) “industrial solid waste” means solid waste resulting from or incidental to any process of industry;
- (hh) “landfill gas” means a mixture of gases generated by the microbial decomposition of and chemical reactions between wastes in a landfill;
- (ii) “laterally expanding landfill” means a landfill that is being expanded beyond the previously approved waste footprint;
- (jj) “leachate” means a liquid that has been in contact with waste in the landfill cell and has undergone chemical or physical changes;
- (kk) “leachate collection system” means a system that gathers leachate so that it may be removed from a landfill and which could include a permeable drainage layer, a network of perforated piping, and sumps or manholes from where leachate can be removed;
- (ll) “LEL” means the lower explosive limit that is the lowest percentage by volume of an explosive vapour or gas in air that will propagate a flame of 25<sup>o</sup> Celsius at atmospheric pressure;
- (mm) “liner” means a continuous layer placed beneath and at the sides of a landfill cell to restrict the migration of leachate, or landfill gas or both;
- (nn) “maximum acceptable leachate head” means the head of leachate above the lowest part of a liner, not including the sumps or leachate pipe trenches and is either:

- (i) 300 mm above a 1.0 metre thick clay liner that has a hydraulic conductivity of  $1 \times 10^{-9}$  metres/second; or
  - (ii) an alternate design head based on the calculated advective performance rate being one order of magnitude better (lower) than the equivalent advective performance of (i);
- (oo) “monitoring system” means all equipment used for sampling, analyzing or recording data in respect of any parameter;
- (pp) “monitoring well” means a well drilled at a site to measure groundwater levels and collect groundwater samples for the purpose of physical, chemical, or biological analysis to determine the concentration of groundwater constituents;
- (qq) “municipal solid waste” means solid waste resulting from or incidental to municipal, community, commercial, institutional and recreational activities, and includes garbage, rubbish, ashes, street cleanings, abandoned automobiles, and all other solid wastes except hazardous waste, industrial solid waste, oilfield waste and biomedical wastes;
- (rr) “pH” means a measure of acidity or alkalinity as an expression on a scale of 1 to 14 of the extent of acidity or alkalinity of a substance: substances with a pH of 7 are neutral and those with a pH above 7 are caustic and those with a pH below 7 are acidic;
- (ss) “points of compliance” means the location or locations where measurements of groundwater quality for regulatory purposes are taken to assess a landfill’s performance;
- (tt) “post-closure care period” means the period of time after completion of the final closure of a landfill until the conditions in 6.3(a) and (b) are achieved;
- (uu) “primary liner” means the uppermost liner or composite liner;
- (vv) “primary porosity” means the pore space in the rock matrix excluding pore space created by processes such as dissolution or fracturing;
- (ww) “prohibited waste” means a waste that may not be accepted for disposal at a landfill because of the classification of the landfill as defined in the *Waste Control Regulation*, as amended, or that is otherwise prohibited by the Province of Alberta;
- (xx) “ravine” means a small stream channel, narrow, steep-sided, and commonly V-shaped in cross-section, and larger than a gully;
- (yy) “recycling” means the process by which materials that would otherwise become waste are collected, separated, processed and returned to use in the form of a reusable material or new product;
- (zz) “response level monitoring” means a monitoring program that is undertaken following detection of contaminant constituents above specified limits and is

- continued until corrective measures have mitigated the contaminant constituents to below the specified limits;
- (aaa) “run-off” means any rainwater or meltwater that drains as surface flow from an active landfill area;
  - (bbb) “run-on” means any rainwater or meltwater that drains as surface flow onto the active landfill area;
  - (ccc) “secondary leachate collection system” means a system that gathers liquids between a primary liner and a secondary liner system;
  - (ddd) “secondary liner” means the lowermost liner or composite liner;
  - (eee) “site specific conditions” means all conditions related to the landfill site that may influence its design or operation including climate and quantity and nature of the waste received or proposed to be received at the landfill;
  - (fff) “siting” means the process of identifying, investigating, evaluating and selecting locations for solid waste management and disposal facilities;
  - (ggg) “Small Class II Landfill” means a landfill that only receives municipal solid waste or inert waste and that has a waste footprint that is less than 5 hectares in total area;
  - (hhh) “soil” means mineral or organic earthen materials that can, have, or are being altered by weathering, biological processes or human activity;
  - (iii) “structural components” means liners, leachate collection systems, final cover systems, run-on and run-off systems and any other landfill components that are necessary for the protection of human health and the environment;
  - (jjj) “subsoil” means the layer of soil directly below the topsoil, to a maximum depth of 1.2 metres below the topsoil surface, that consists of the B and C horizons as defined in *The System of Soil Classification for Canada, Agriculture and Agri-Food Canada, 1998, Publication 1643, 3<sup>rd</sup> Edition*, as amended or replaced from time to time;
  - (kkk) “topsoil” means the uppermost layers of soil that consist of the L, F, H, O, and A horizons as defined in *The System of Soil Classification for Canada, Agriculture and Agri-Food Canada, 1998, Publication 1643, 3<sup>rd</sup> Edition*, as amended or replaced from time to time;
  - (III) “unstable area” means land which may be subject to differential settling due to soil conditions, geologic and geomorphic features or man-made features;
  - (mmm) “uppermost formation” means a continuous water-saturated geological stratum or strata, including but not limited to sand lenses and aquifers, that is projected to be the most probable pathway or pathways for lateral transport of leachate;

- (nnn) “waste footprint” means the areas within a landfill where waste has been disposed of and is proposed to be disposed of, but does not include those areas used for purposes other than disposal such as surface water storage, recycling facilities, buffer zones and buildings;
- (ooo) “wellhead protection zone” means the surface and subsurface area surrounding a water well or well field supplying a public water system, which contributes to the water well, and through which contaminants are reasonably likely to move towards and reach the water well or well field;
- (ppp) “year” means calendar year, unless otherwise specified;

**SECTION 1: REGULATORY DISCLOSURE PROCESS FOR A NEW OR  
LATERALLY EXPANDING LANDFILL**

**1.1 Disclosure Plan**

- (a) Prior to submitting an application for a landfill approval or registration, the person responsible for a proposed new or laterally expanding landfill shall submit a written Disclosure Plan to the Director.
- (b) The Disclosure Plan shall include, at a minimum, the following:
  - (i) the need for the new or laterally expanding landfill development;
  - (ii) the proposed process for public consultation; and
  - (iii) the proposed process for technical investigation of the site.

**1.2 Submission of the Disclosure Plan**

- (a) The person responsible for a proposed new or laterally expanding landfill shall implement the Disclosure Plan as authorized in writing by the Director.
- (b) The person responsible for a proposed new or laterally expanding landfill shall provide documentation that demonstrates conformance with the Disclosure Plan with the application for a landfill approval or registration.

**SECTION 2: LANDFILL DEVELOPMENT AND SITING STANDARDS****2.1 Natural Environment Separation**

- (a) The person responsible for a new landfill shall comply with setbacks as set out under legislation by the Province of Alberta as referenced in Table 2.1.

**Table 2.1  
Standards for Separation**

<b>Setting</b>	<b>Legislation</b>	<b>Section Reference</b>
Land subject to slope failure	<i>Waste Control Regulation (AR 192/96), as amended</i>	<i>Part 6 General – Sec. 37 (a)</i>
A natural area that permanently contains water such as a lake, river or creeks	<i>Waste Control Regulation (AR 192/96), as amended</i>	<i>Part 6 General – Sec. 37 (c)(i)</i>
A man-made surface feature that permanently contains water such as an irrigation canal, drainage ditch, but not a road-side ditch, dugout, or reservoir	<i>Waste Control Regulation (AR 192/96), as amended</i>	<i>Part 6 General - Sec 37 (c)(ii)</i>
Municipal and community water supply wells	<i>Waste Control Regulation (AR 192/96), as amended</i>	<i>Part 6: General - Sec 37 (b)</i>

- (b) The person responsible for a laterally expanding landfill shall comply with setbacks as set out under legislation by the Province of Alberta as referenced in Table 2.1 unless
- (i) the landfill existed prior to implementation of natural environmental setbacks in Table 2.1;
  - (ii) the person responsible provides evidence in writing to the Director that surface water will not be impacted for a landfill that does not comply with the Waste Control Regulation Section 37(c) as amended; and
  - (iii) the person responsible provides evidence in writing to the Director that groundwater will not be impacted for a landfill that does not comply with the Waste Control Regulation Section 37(b) as amended;

- (c) A new Class I or Class II landfill shall not be situated at a location where there exists one or more of the following conditions:
  - (i) there is less than 30 metres of geologic materials between the base of the landfill and an exceptional underlying aquifer where the geologic material has an equivalent vertical hydraulic conductivity greater than  $1 \times 10^{-8}$  metres/second; or
  - (ii) the geologic materials within 10 metres below the base of the landfill include fractured non-porous bedrock or karst features; or
  - (iii) there is less than a 10 metre thick layer of a clayey deposit having an equivalent vertical hydraulic conductivity less than  $1 \times 10^{-8}$  metres/second beneath all waste deposited at or below the original grade unless the person responsible provides evidence in writing to the Director that the groundwater quality will not exceed performance standards at the points of compliance.
- (d) A new landfill shall not be situated within a ravine, coulee or gully.
- (e) Unless the person responsible provides evidence in writing to the Director that the groundwater quality will not exceed the performance standards at the points of compliance, the new waste footprint of a laterally expanding Class I or Class II landfill shall not be situated where there exists one or more of the following conditions:
  - (i) there is less than 30 metres of geologic materials between the base of the landfill and an exceptional underlying aquifer where the geologic material has an equivalent vertical hydraulic conductivity greater than  $1 \times 10^{-8}$  metres/second; or
  - (ii) the geologic materials within 10 metres below the base of the landfill include fractured non-porous bedrock or karst features; or
  - (iii) the area of the laterally expanding landfill is situated within a ravine, coulee or gully; or
  - (iv) there is less than a 10 metre thick layer of a clayey deposit having an equivalent vertical hydraulic conductivity less than  $1 \times 10^{-8}$  metres/second beneath all wastes deposited at or below the original grade.

## 2.2 Requirements for a Hydrogeological Investigation Program

- (a) Prior to the design of a new or laterally expanding landfill, the person responsible shall complete a Hydrogeological Investigation Program specific to the landfill site and its surrounding area.
- (b) The Hydrogeological Investigation Program shall be designed by a hydrogeologist.
- (c) The Hydrogeological Investigation Program shall characterize the hydrologic and hydrogeologic settings expressed on regional and local scales.

- (d) The Hydrogeological Investigation Program shall identify the hydrologic and hydrogeologic characteristics of the site including, at a minimum, the following:
  - (i) the groundwater and surface water regimes associated with the new or laterally expanding landfills;
  - (ii) the potential contaminant flow paths from the landfill into the receiving environment; and
  - (iii) for a laterally expanding landfill, the potential impacts on groundwater regimes relative to the existing landfill.
- (e) The boreholes completed for the Hydrogeological Investigation Program shall be distributed at:
  - (i) an evenly distributed spacing of not more than 200 metres; or
  - (ii) a minimum of five evenly distributed locations for landfills with a waste footprint smaller than 5 hectares.
- (f) The minimum depth of the hydrogeologic characterization component of the Hydrogeological Investigation Program shall be 35 metres below the proposed base of the new or laterally expanding landfill.
- (g) A topographic survey shall be conducted for the area of the new or laterally expanding landfill as part of the Hydrogeological Investigation Program.

### 2.3 Groundwater Monitoring Wells

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

### 2.4 Hydrogeological Investigation Program Reporting

- (a) After the Hydrogeological Investigation Program is completed and prior to construction of a new or laterally expanding landfill, the person responsible shall submit a detailed technical report to the Director.
- (b) The person responsible shall ensure a professional registered with APEGGA is responsible for the detailed technical report, unless otherwise authorized in writing by the Director.
- (c) The detailed technical 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 800 metres of the proposed site;
  - (ii) a drawing showing the proposed site in relation to:
    - a. adjacent development and infrastructure;
    - b. natural and constructed physical features such as streams, rivers, water bodies, canals and drainage controls;



- c. domestic, municipal and other licensed water well locations within 5 km of the proposed site; and
    - d. municipal wellhead protection zones;
  - (iii) a detailed site plan showing:
    - a. surface topography; and
    - b. locations and surface elevations of all boreholes and monitoring wells;
  - (iv) the profile and depths of the topsoil and subsoil;
  - (v) detailed borehole records showing the geologic and hydrogeologic conditions encountered and depth of all major stratigraphic features;
  - (vi) cross-sections showing:
    - a. an interpretation of the geologic stratigraphy;
    - b. directions of groundwater flow; and
    - c. hydraulic conductivities of the geologic strata that influence or control groundwater movement;
  - (vii) a detailed text interpretation of the hydrologic and hydrogeologic conditions on a regional and local scale;
  - (viii) a recommendation for landfill development on the proposed site; and
  - (ix) if the recommendations is to proceed with the landfill development, 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 (c)(vii) on possible landfill development.

**SECTION 3: DESIGN AND CONSTRUCTION****3.1 Design Plan and Specifications**

- (a) Prior to construction of a new or laterally expanding landfill, the person responsible shall submit financial security or environmental reserve fund documentation for closure and post-closure care activities to the Director.
- (b) Prior to construction of a new or laterally expanding landfill, the person responsible shall submit a Landfill Design Plan and Specifications to the Director.
- (c) The person responsible shall ensure that a professional registered with APEGGA prepares the Landfill Design Plan and Specifications for a new or laterally expanding landfill.
- (d) The Design Plan and Specifications shall include, at a minimum, all of the following information:
  - (i) an engineering design report that provides:
    - a. a description of the type and quantity of waste that are anticipated to be accepted at the landfill;
    - b. a description of the design intent and a summary of the components included in the design to achieve the design intent;
    - c. an assessment of the long-term integrity of the liner and leachate collection system where the landfill is proposed to be located in an unstable area;
    - d. an evaluation of the potential for leachate generation and leachate composition based on site specific conditions;
    - e. an evaluation of the potential for landfill gas generation and gas composition based on the type of waste accepted, climate, the landfill design, or other site specific conditions;
    - f. a description of monitoring systems;
    - g. a preliminary closure plan that includes at a minimum;
      - i a staging plan for closure of the landfill or portions of the landfill;
      - ii a plan to manage surface water infiltration or moisture additions according to the design intent of the landfill cells; and
      - iii a plan for final cover and re-vegetation of completed areas of the landfill and the potential end-use of the landfill after closure; and
  - (ii) engineering design maps and plans that provide:
    - a. topographic maps showing the overall proposed site development and setbacks;
    - b. a site plan that shows the proposed landfill footprint and the location of the points of compliance;
    - c. a minimum 30 metre separation between the waste footprint and the landfill property line;
    - d. cross-sections showing the proposed surface elevations, base elevations and grades for the landfill development;

- e. detailed drawings for structural components of the landfill including, but not limited to, liner systems and leachate collection and removal systems;
  - f. a run-on control system to prevent flow onto the active landfill area for events up to at least the peak discharge from a 1 in 25 year – 24 hour duration rainfall event;
  - g. a run-off control system for the active landfill area to collect and control at least the run-off water volume resulting from a 1 in 25 year – 24 hour duration rainfall event; and
  - h. a groundwater monitoring system.
- (e) If a new or laterally expanding landfill accepts segregated material for the purpose of waste minimization, sorting, recovery, processing, or storage then the Design Plan and Specifications shall include specific areas to be used for these activities.

### 3.2 Design of a Class I Landfill

- (a) In addition to the requirements in Section 3.1, the Landfill Design Plan and Specifications for construction of a new or laterally expanding Class I Landfill shall include, at a minimum, all of the following:
- (i) two liners of which at least one is a composite liner;
  - (ii) a leachate collection system capable of maintaining the maximum acceptable leachate head; and
  - (iii) a secondary leachate collection system.

### 3.3 Design of a Class II Landfill

- (a) In addition to the requirements in Section 3.1, the Design Plan and Specifications for construction of a new or laterally expanding Class II Landfill shall include, at a minimum, the following:
- (i) a liner that provides for containment of the waste constituents; and
  - (ii) a leachate collection system capable of maintaining the maximum acceptable leachate head.
- (b) Notwithstanding the requirements in Section 3.3(a), the Design Plan and Specifications for the construction of a new or laterally expanding Small Class II Landfill may include an alternate feature to that in Section 3.3(a), if the following hydrogeological conditions are met:
- (i) there is a 5 metre thick layer of clayey deposit having a hydraulic conductivity less than  $1 \times 10^{-8}$  metres/second immediately beneath all waste disposed at or below the original grade; and
  - (ii) the geologic materials beneath the clayey deposit:
    - a. have a hydraulic conductivity of less than  $1 \times 10^{-8}$  metres/second to a depth of at least 5 metres beneath the clayey deposit; or
    - b. has a maximum seepage rate that is equivalent to that of a compacted clay liner that:
      - i. is under a 0.3 metre head of water;

- ii. has a hydraulic conductivity of  $1 \times 10^{-8}$  metres/second; and
  - iii. is 5.0 metres in thickness; or
- (iii) the person responsible provides evidence in writing to the Director that the groundwater quality will not exceed the groundwater performance standards at the points of compliance as set out in Table 5.3.

### 3.4 Design of a Class III Landfill

- (a) In addition to the requirements set out in Section 3.1, the Landfill Design Plan and Specifications for construction of a new or laterally expanding Class III landfill shall provide for the containment of inert wastes.

### 3.5 Construction

- (a) The person responsible shall construct a new or laterally expanding landfill according to the Landfill Design Plan and Specifications authorized in writing by the Director.
- (b) If the new or laterally expanding landfill is to be constructed with a clay liner, the clay liner shall be constructed by compacting clay material to a thickness of not less than 1 metre measured perpendicular to the slope, and that achieves a hydraulic conductivity of less than  $1 \times 10^{-9}$  metres/second, or that is constructed with a greater thickness and that achieves an equivalent advective flow performance to a 1.0 metre compacted clay liner with a hydraulic conductivity of  $1 \times 10^{-9}$  metres/second where the hydraulic conductivity is greater than  $1 \times 10^{-9}$  metres/second.
- (c) If the new or laterally expanding landfill is to be constructed with a composite liner, the composite liner shall be constructed with a geomembrane placed directly on the surface of a clay liner that is constructed by compacting clay materials to a thickness of not less than 0.6 metre measured perpendicular to the slope, and that achieves a hydraulic conductivity of less than  $1 \times 10^{-9}$  metres/second, or that is constructed with a greater thickness that achieves an equivalent advective flow performance where the hydraulic conductivity is greater than  $1 \times 10^{-9}$  metres/second.
- (d) Prior to the construction of a new or laterally expanding landfill, the person responsible shall submit to the Director a Construction Quality Assurance Plan and a Construction Quality Control Plan.
- (e) The person responsible shall construct a new or laterally expanding landfill according to the Construction Quality Assurance Plan and a Construction Quality Control Plan as authorized in writing by the Director.
- (f) Any deviations to the Construction Quality Assurance and Construction Quality Control Plan, or the Design Plan and Specifications, must be authorized in writing by the Director prior to implementation.

- (g) Section 3.5 (f) does not apply to deviations where:
  - (i) the deviation results in a minor adjustment to the Design Plan and Specifications to suit field conditions encountered; and
  - (ii) the deviation will not result in a change in the design performance of the landfill.
- (h) Prior to commencing operations of a new or laterally expanding landfill, the person responsible shall submit a report detailing the Construction Quality Assurance results to the Director confirming that the landfill has been constructed according to the Construction Quality Assurance Plan and the Design Plan and Specifications.
- (i) If the construction of the new or laterally expanding landfill has not been according to some or all of the Construction Quality Assurance and Construction Quality Control Plan or the Design Plan and Specifications, the person responsible shall provide a report to the Director that justifies the deviation that includes a description of any potential impacts that may result from the deviation.

**SECTION 4: LANDFILL OPERATION****4.1 Operator Certification**

- (a) The day-to-day operation of a Class II or Class III landfill shall be directly supervised by a Certified Operator in accordance with the *Waste Control Regulation*, as amended, and the latest edition of the *Municipal Waste Management Facility Operator Certification Guidelines*.
- (b) The day-to-day operation of a Class I landfill shall be directly supervised by a person with qualifications as specified in writing by the Director.

**4.2 Topsoil and Subsoil Salvaging and Storage**

- (a) During the construction and operation of a landfill, the person responsible shall separately recover and stockpile all topsoil and subsoil such that all topsoil and subsoil stockpiles:
  - (i) shall be constructed in a manner that allows for maximum recovery of the topsoil and subsoil; and
  - (ii) shall be contoured, stabilized and seeded to prevent soil loss by erosion; and
  - (iii) shall only be used for reclamation at the landfill site.

**4.3 Operations Plan**

- (a) The person responsible shall
  - (i) develop;
  - (ii) maintain; and
  - (iii) implementan Operations Plan that is consistent with the Landfill Design Plan and Specifications.
- (b) The Operations Plan shall include, at a minimum, the following information:
  - (i) waste acceptance policies and procedures as per Section 4.4;
  - (ii) policies and procedures for wastes requiring special handling, if accepted;
  - (iii) operating procedures for nuisance management as per Section 4.5;
  - (iv) procedures for covering the waste including a description of proposed materials and the frequency of cover applications;
  - (v) a plan for the protection of liners;
  - (vi) an emergency response plan;
  - (vii) a site safety plan;
  - (viii) a plan for the management of subsurface landfill gas;
  - (ix) a plan for the management of leachate including its collection, removal, treatment and disposal;
  - (x) a plan for the management of surface water run-off and run-on control systems;

- (xi) the Landfill Monitoring Plan in accordance with Section 5.1; and
- (xii) a plan for other operations where they are included at the landfill site such as the storage, processing, recycling or composting of segregated waste or feedstocks.

#### **4.4 Waste Acceptance Policies and Procedures**

- (a) The waste acceptance policies and procedures in the Operations Plan shall be consistent with the requirements set out in the Waste Control Regulation (AR 192/96), as amended, and as specified in writing by the Director.
- (b) The waste acceptance policies and procedures shall include a program to detect a prohibited waste so that it is prevented from being disposed of in a landfill cell.

#### **4.5 Nuisance Management**

- (a) The person responsible for a landfill shall take all necessary measures to control nuisances such as litter, fires, disease vectors, odours and dust, including but not limited to:
  - (i) erecting artificial barriers, utilizing natural barriers, or other effective measures to control access to the site to prevent the uncontrolled disposal of wastes;
  - (ii) covering solid waste that is disposed in the landfill with soil or other alternative cover material at a frequency specified in the Operating Plan;
  - (iii) maintaining areas for storage, processing or recycling of segregated waste in a clean and orderly manner;
  - (iv) establishing and maintaining litter controls to minimize the escape of waste from the landfill site;
  - (v) retrieval of litter that accumulates on the landfill site; and
  - (vi) retrieval of litter that is washed, blown, or transported onto adjacent properties, provided the consent of the owner of the adjacent property is first obtained.

#### **4.6 Liquid Waste Restriction**

- (a) No liquid waste shall be disposed in a Class III landfill cell.
- (b) No oilfield waste that is liquid shall be disposed in any landfill cell.
- (c) No hazardous waste that is liquid shall be disposed in any landfill cell.
- (d) A containerized liquid, that is waste, greater than 5 litres shall not be disposed in any landfill cell.
- (e) A bulk liquid, that is waste, greater than 5 litres shall not be disposed in a Class II landfill cell unless the landfill cell is designed with a liner and leachate collection system and acceptable liquid addition limits are set out

in the Design and Specifications Plan and authorized in writing by the Director.

#### **4.7 Signage**

- (a) The person responsible shall erect and maintain signs at the landfill entrance providing, at a minimum, the following information:
  - (i) the name of the person responsible;
  - (ii) the landfill class;
  - (iii) any waste restrictions, and
  - (iv) the telephone numbers for:
    - a. the person responsible;
    - b. the local fire department; and
    - c. Alberta Environment (1-800-222-6514).

#### **4.8 Leachate Management**

- (a) Leachate accumulating in any cell shall not exceed the maximum acceptable leachate head authorized in writing by the Director.
- (b) The person responsible shall remove leachate from the cell at a frequency that maintains the level of leachate at or below the maximum acceptable leachate head authorized in writing by the Director.



**SECTION 5: MONITORING, ANALYSIS AND CORRECTIVE ACTION****5.1 Landfill Monitoring Plan**

- (a) The person responsible for a landfill shall develop a Landfill Monitoring Plan which shall include, at a minimum, the following:
  - (i) a Groundwater Monitoring Program; and
  - (ii) a Surface Water Monitoring Program.
- (b) In addition to the requirements in Section 5.1(a), the person responsible for a landfill that accepts organic waste that is reasonably expected to undergo microbial decomposition shall develop a Subsurface Landfill Gas Monitoring Program as part of the Landfill Monitoring Plan.
- (c) In addition to the requirements in Section 5.1(a) the person responsible for a landfill that is designed and constructed with a leachate collection system shall develop a Leachate Monitoring Program as part of the Landfill Monitoring Plan.
- (d) In addition to the requirements in Section 5.1(a), the person responsible for a Class I landfill shall develop an Ambient Air Quality Monitoring Program as part of the Landfill Monitoring Plan.
- (e) The Landfill Monitoring Plan as set out in Sections 5.1 (a), (b), (c), and (d) shall be prepared by a professional registered with APEGGA unless otherwise authorized in writing by the Director.
- (f) The person responsible shall submit a Landfill Monitoring Plan to the Director:
  - (i) as part of the application for an Approval or Registration for a new or laterally expanding landfill; or
  - (ii) within a time period specified in writing by the Director for an operating landfill.
- (g) If the Director finds the Landfill Monitoring Plan to be deficient, the person responsible shall correct all deficiencies as outlined by the Director in writing within 120 calendar days of receiving the deficiency letter.
- (h) The person responsible shall implement the Landfill Monitoring Plan as authorized in writing by the Director.
- (i) The person responsible shall implement the Landfill Monitoring Plan until the end of the post-closure period, unless otherwise authorized in writing by the Director.

**5.2 Groundwater Monitoring Program**

- (a) The person responsible for a landfill shall develop the Groundwater Monitoring Program to include, at a minimum, the following:

- (i) a program to establish baseline groundwater quality prior to the start of landfill operations;
  - (ii) a detailed program for groundwater sample collection and analysis, that includes, at a minimum, the following:
    - i. retrieval of representative samples from the groundwater monitoring system at a frequency set out in Table 5.1, or as otherwise authorized in writing by the Director; and
    - ii. laboratory analysis of the samples for parameters as set out in Table 5.2; and
  - (iii) a Groundwater Contingency Plan for response and assessment in the event that the groundwater monitoring program or performance standards in Table 5.3 are not met.
- (b) The parameters in the Groundwater Monitoring Program for a Class II landfill that receives wastes other than municipal solid wastes shall be as specified in writing by the Director and based on site-specific conditions.
- (c) The parameters in the Groundwater Monitoring Program for a Class I Landfill shall be as specified in writing by the Director and based on site-specific conditions.
- (d) The groundwater monitoring data shall be interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine any groundwater quality impacts as a result of the landfill operations.

**Table 5.1**  
**Frequency for Groundwater Sampling and Analysis**

<b>Landfill Class</b>	<b>Baseline Level Monitoring Minimum Frequency</b>	<b>Detection Level Monitoring Minimum Frequency</b>	<b>Response Level Monitoring Minimum Frequency</b>
Class I Landfill	4 x per year	2 x per year	4 x per year
Class II Landfill	2 x per year	2 x per year	2 x per year
Class III Landfill	2 x per year	1 x per year	2 x per year

**Table 5.2**  
**Groundwater Parameters for Baseline, Detection and Response Monitoring Programs**

<b>Landfill Class</b>	<b>Baseline Level Monitoring</b>	<b>Detection Level Monitoring</b>	<b>Response Level Monitoring</b>
Class I Landfill	Site specific based on the type of waste accepted and as specified in writing by the Director	Site specific based on the type of waste accepted and as specified in writing by the Director	As specified in writing by the Director
Class II Landfill accepting municipal solid waste  - And -  Class III Landfills accepting construction, demolition, and renovation wastes	Major Ions [Calcium, Magnesium, Sodium, Potassium, Chloride, Sulphate, Nitrate] Hardness Alkalinity Carbonate Bicarbonate pH Total Dissolved Solids Dissolved Metals [Arsenic, Barium, Beryllium, Boron, Cadmium, Molybdenum, Mercury, Nickel, Total Phosphorous, Silicon, Silver, Strontium, Thallium, Tin, Vanadium, Zinc] Ammonia DOC COD TKN Benzene Toluene Ethylbenzene Xylene	Major Ions [Calcium, Magnesium, Sodium, Potassium, Chloride, Sulphate, Nitrate] Hardness Alkalinity Carbonate Bicarbonate pH Total Dissolved Solids Dissolved Metals [Arsenic, Barium, Beryllium, Boron, Cadmium, Molybdenum, Mercury, Nickel, Total Phosphorous, Silicon, Silver, Strontium, Thallium, Tin, Vanadium, Zinc] Ammonia DOC COD TKN Benzene Toluene Ethylbenzene Xylene	As specified in writing by the Director
Class II Landfills accepting waste other than municipal solid wastes (i.e. pulp mills, industrial	Site specific based on the type of waste accepted and as specified in writing by the Director	Site specific based on the type of waste accepted and as specified in writing by the Director	As specified in writing by the Director

sites)			
--------	--	--	--

### 5.3 Points of Compliance

- (a) The person responsible shall establish points of compliance at locations that are:
- (i) at least 20 metres inside the property boundary of the landfill; and
  - (ii) at least 10 metres, but not more than 60 metres from the waste footprint;

### 5.4 Groundwater Monitoring Wells

- (a) The person responsible for a new or laterally expanding landfill shall construct groundwater monitoring wells that are:
- (i) No more than 200 metres from the next groundwater monitoring well as measured along the points of compliance;
  - (ii) At locations that provide an accurate representation of upgradient and downgradient groundwater quality.
- (b) The person responsible shall ensure that each groundwater monitoring location along the points of compliance includes at least one well designed to allow for collection of groundwater samples from the uppermost formation.
- (c) All groundwater monitoring wells shall be protected from damage and shall be locked, except when being sampled, unless otherwise authorized in writing by the Director.
- (d) If a groundwater sample cannot be collected because the monitoring well is damaged or is no longer capable of producing a representative sample:
- (i) the groundwater monitoring well shall be cleaned, repaired or replaced; and
  - (ii) a representative groundwater sample shall be collected prior to the next scheduled sampling date unless otherwise authorized in writing by the Director.

### 5.5 Implementation of Groundwater Contingency Plan

- (a) Throughout the active life and post-closure period of the landfill, the groundwater quality shall meet the groundwater performance standards listed in Table 5.3 at each of the points of compliance unless otherwise authorized in writing by the Director to meet baseline groundwater quality standards.
- (b) If at any time until the end of the post-closure period, groundwater quality at the landfill fails to meet the groundwater performance standards at the points of compliance, the person responsible shall immediately notify the Director and shall implement the Groundwater Contingency Plan developed in accordance with Section 5.2(a)(iii).

**Table 5.3**  
**Groundwater Performance Standards**

Parameter	Performance Standard
<u>Major Ions</u>	
Calcium	background
Magnesium	background
Sodium	< 200 mg/L
Potassium	background
Chloride	< 250 mg/L
Sulphate	< 500 mg/L
Nitrate	< 45 mg/L
Hardness	background
Alkalinity	background
Carbonate	background
Bicarbonate	background
pH	> 6.5 and < 8.5
Total Dissolved Solids	< 500 mg/L
<u>Dissolved Metals</u>	
Arsenic	< 0.025 mg/L
Barium	< 1.0 mg/L
Beryllium	background
Boron	< 5 mg/L
Cadmium	< 0.005 mg/L
Chromium	< 0.05 mg/L
Copper	< 1.0 mg/L
Iron	< 0.3 mg/L
Lead	< 0.010 mg/L
Manganese	< 0.05 mg/L
Molybdenum	background
Mercury	< 0.01 mg/L
Nickel	background
Total Phosphorous	background
Silicon	background
Silver	background
Strontium	background
Thallium	background
Tin	background
Vanadium	< 5.0 mg/L
Zinc	background
Ammonia	background
DOC	background
COD	background
TKN	background
Benzene	< 0.005 mg/L
Toluene	< 0.024 mg/L
Ethylbenzene	< 0.0024 mg/L
Xylene	< 0.3 mg/L

--	--

## 5.6 Surface Water Monitoring Program

- (a) The Surface Water Monitoring Program shall include, at a minimum, the following:
- (i) a program to establish baseline surface water quality of the receiving stream for run-off from the landfill;
  - (ii) a surface water quality sampling and analytical program during the active life, final closure and post-closure period for the landfill that establishes upstream and downstream surface water quality of any receiving stream for run-off water;
  - (iii) a surface water quality sampling and analytical program for run-off impounded surface water prior to its release
  - (iv) a list of parameters and concentration limits for the impounded run-off surface water based on the discharge area; and
  - (v) a Surface Water Contingency Plan in the event that surface water has been adversely affected as a result of the landfill operations.
- (b) The surface water monitoring data obtained in Section 5.6 (a)(ii) and (iii) shall be interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine any surface water quality impacts as a result of the landfill operation.

## 5.7 Implementation of the Surface Water Contingency Plan

- (a) If at any time until the end of the post-closure care period, the receiving surface water stream is adversely affected by the landfill, the person responsible shall immediately notify the Director and shall implement the Surface Water Contingency Plan developed in accordance with Section 5.6 (a) (v).

## 5.8 Subsurface Landfill Gas Monitoring Program

- (a) The Subsurface Landfill Gas Monitoring Program shall include, at a minimum, the following:
- (i) a description of the subsurface landfill gas monitoring sites and their locations;
  - (ii) the methods to be used for measurement and detection of the lateral migration of subsurface landfill gas;
  - (iii) the frequency for measurement of subsurface landfill gas; and
  - (iv) a Subsurface Landfill Gas Contingency Plan for the mitigation of subsurface landfill gas migration.
- (b) The subsurface landfill gas monitoring data shall be interpreted by a professional registered with APEGGA, or other professional authorized in writing by the Director, to determine the potential impacts from the subsurface migration of landfill gas.

## 5.9 Implementation of the Subsurface Landfill Gas Contingency Plan

- (a) Throughout the active life and post-closure care period of the landfill, the subsurface landfill gas shall not exceed the landfill gas explosive limits set out in Table 5.4.
- (b) If at any time until the end of the post-closure care period, the explosive gas limits as set out in Table 5.4 are exceeded, the person responsible shall immediately notify the Director and shall implement the Subsurface Landfill Gas Contingency Plan developed in accordance with Section 5.8 (a) (iv).

**Table 5.4**  
**Subsurface Landfill Gas Explosive Limits**

Sampling Location	Explosive Gas Limits
In the subsurface at the property boundary	50% LEL
In an on-site building or enclosed structure or in the area immediately outside the foundation of the building or structure	20% LEL
In an off-site building or enclosed structure or in the area immediately outside the foundation of the building or structure	1% LEL

## 5.10 Class I Landfill Ambient Air Monitoring Program

- (a) The Class I Landfill Ambient Air Quality Monitoring Program shall include, at a minimum, the following:
  - (i) a description of the type and nature of potential fugitive emissions that reflect the type and nature of the wastes accepted at the landfill;
  - (ii) a description of ambient air monitoring sites and their locations;
  - (iii) the methods to be used for measurement and detection of fugitive air emissions; and
  - (iv) the frequency for monitoring of ambient air.

## 5.11 Leachate Monitoring Program

- (a) The Leachate Monitoring Program shall include, at a minimum, the following:

- (i) a program to measure the leachate head during the active life, final closure and post-closure care period for the landfill;
- (ii) the methods to be used to measure the leachate head;
- (iii) the frequency for measurement of the leachate head;
- (iv) a program to test the leachate quality during the active life, final closure and post-closure care period for the landfill;
- (v) the methods to be used to sample the leachate for quality; and
- (vi) the frequency to test the leachate quality.

## 5.12 Methods for Water, Leachate and Solid Waste Analysis

- (a) With respect to any sample required to be taken by the person responsible for a landfill, the person responsible shall ensure that:
  - (1) collection;
  - (2) preservation;
  - (3) storage;
  - (4) handling; and
  - (5) analysis;

shall be conducted in accordance with the following, or as otherwise specified in writing by the Director:

- (i) For air monitoring:
  - a. The *Methods Manual for Chemical Analysis of Atmospheric Pollutants*, Alberta Environment, as amended; and
  - b. The *Air Monitoring Directive*, Alberta Environment, as amended;
- (ii) For surface water, leachate and groundwater monitoring:
  - a. the *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, American Water Works Association and the Water Environmental Federation, as amended; and
  - b. the *Methods Manual for Chemical Analysis of Water and Wastes*, Alberta Environment Centre, Vegreville, Alberta, October 1987, AEC V96-M1, as amended;
- (iii) For whole effluent toxicity tests:
  - a. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout*, Environment Canada, Environmental Protection Series I/RM/13, July 1990, as amended;
  - b. the *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia Magna*, Environment Canada, Environmental Protection Series, I/RM/14, July 1990, as amended;
  - c. the *Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum**, Environment Canada, Environmental Protection Series, November 1992, as amended;



- d. the *Biological Test Method: Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia*, Environment Canada, Environmental Protection Series 1/RM/21, February 1992, as amended;
  - e. the *Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows*, Environment Canada, Environmental Protection Series 1/RM/22, February 1992, as amended; and,
  - f. the *Biological Test Method: Toxicity Test Using Luminescent Bacteria (Photobacterium phosphoreum)*, Environment Canada, Environmental Protection Series, 1/RM/24, November 1992, as amended;
- (iv) For soil samples:
- a. *Manual on Soil Sampling and Methods Analysis*, Lewis Publishers, 1993, as amended; and,
  - b. *The Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, USEPA, SW-846; September 1986, as amended;
- (v) For waste analysis
- a. the *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods*, USEPA, SW-846, September 1986, as amended; or
  - b. the *Methods Manual for Chemical Analysis of Water and Wastes*, Alberta Environmental Centre, Vegreville, Alberta, 1996, AECV96-M1 as amended; or
  - c. the *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, American Water Works Association, and the Water Environment Federation, as amended, or
  - d. the *Interim Compilation of Test Methods and Methods of Dangerous Goods Regulations*, Environment Canada, as amended; or
  - e. the *Toxicity Characteristic Leaching Procedure (TCLP)*, USEPA Regulation 40 CFR261, Appendix II, Method No. 1311, as amended.
- (b) The person responsible shall ensure that all analytical data for the parameters to be monitored are produced by laboratories accredited for those parameters by the Standards Council of Canada, or by those organizations designated by the Standards Council of Canada to provide such accreditation, unless prior written authorization for exemption from such accreditation is provided by the Director

**SECTION 6: FINAL CLOSURE AND POST-CLOSURE CARE****6.1 Detailed Final Closure Plan**

- (a) The person responsible shall provide a Detailed Final Closure Plan and notify the Director in writing of the intent to close the landfill at least 180 calendar days prior to implementing final closure.
- (b) The Detailed Final Closure Plan shall include, at a minimum, the following:
  - (i) a schedule for completion of the final closure;
  - (ii) a plan for completion of the final cover system;
  - (iii) a drawing that shows the proposed slopes of the final cover;
  - (iv) a plan for replacement of soil;
  - (v) a plan for remediation of areas affected by subsidence and differential settlement;
  - (vi) a plan for erosion control;
  - (vii) a plan for restoration of surface water drainage
  - (viii) plans for changes to the groundwater and landfill gas monitoring systems, including, but not limited to the addition or reclamation of monitoring wells;
  - (ix) plans for changes to the leachate collection and landfill gas control systems, including but not limited to the addition or deletion of components of those systems;
  - (x) plans for decommissioning and removal of buildings, storage areas, processing areas or any other operations or facilities that are on the landfill property that will no longer be required; and
  - (xi) a Post-Closure Care Plan.
- (c) The person responsible shall ensure that the Detailed Final Closure Plan is prepared by a professional registered with APEGGA.
- (d) If the Director finds the Detailed Final Closure Plan to be deficient, the person responsible shall correct the deficiencies as outlined by the Director in writing prior to completion of the closure of the landfill.
- (e) The person responsible shall complete the final closure in accordance with the Detailed Final Closure Plan as authorized in writing by the Director.

**6.2 Post-Closure Care Plan**

- (a) The Post-Closure Care Plan shall include, at a minimum, the following:
  - (i) a plan for maintaining the integrity of the final cover systems;
  - (ii) a plan for maintaining surface water drainage systems; and
  - (iii) a plan for maintaining and operating the following components where they are part of the landfill design:
    - a. groundwater monitoring systems;
    - b. leachate collection and removal systems; and
    - c. landfill gas control systems.

- (b) If the Director finds the Post-closure Care Plan to be deficient, the person responsible shall correct the deficiencies as outlined by the Director in writing within 120 calendar days of the deficiency letter.

### 6.3 Post-closure Care Period

- (a) The Post-Closure Care Period shall be a minimum period of 25 years following the final closure of the landfill.
- (b) In addition to 6.3 (a), the Post-Closure Care Period shall continue until the following circumstances occur:
  - (i) groundwater quality performance standards are met at the points of compliance;
  - (ii) subsurface landfill gas concentrations are below explosive limits set out in Table 5.4 at subsurface gas monitoring locations; and
  - (iii) the leachate constituents are lower than the parameter concentrations required by Table 5.3, unless otherwise authorized in writing by the Director to use baseline groundwater quality; or
  - (iv) the accumulated volume of leachate is equal to or less than the previous years accumulated volume of leachate for five consecutive years;
- (c) During the Post-Closure Care Period, the person responsible, at a minimum, shall:
  - (i) protect and maintain the integrity of the final cover system and surface water run-off and run-on systems;
  - (ii) make repairs to the cover system as necessary to correct the effects of settling, subsidence, erosion, leachate break-out or other such events within one year of discovery of any problem; and
  - (iii) protect, maintain, operate and monitor the following components where they are part of the landfill design:
    - a. groundwater monitoring system;
    - b. leachate collection system; and
    - c. landfill gas control system.
- (d) During the Post-Closure Care Period, the person responsible shall inspect the final cover system a minimum of two (2) times per year.

**SECTION 7: RECORD KEEPING AND REPORTING****7.1 Reporting of Contraventions**

- (a) In addition to any other reporting required pursuant to the Act or the regulations, any person carrying out a landfill operation shall immediately report any contravention of these Standards to:
- (i) the Approval holder or the Registration holder; and
  - (ii) the Director:
    - a. by telephone at (780) 422-4505; or
    - b. by any other method authorized in writing by the Director.
- (b) In addition to any other reporting required pursuant to the Act or the regulations, where a contravention is reported under Section 7.1(a), the Approval holder or Registration holder shall provide a report to the Director:
- (i) in writing; or
  - (ii) by any other method authorized in writing by the Director
- within 7 calendar days of the reporting of the contravention, or within any other time period specified in writing by the Director.
- (c) The report required in Section 7.1(b) shall contain, at a minimum, all of the following:
- (i) a description of the contravention;
  - (ii) the date of the contravention;
  - (iii) an explanation as to why the contravention occurred;
  - (iv) a legal land description of the location of the contravention;
  - (v) the name of the registered owner or owners of the parcel of land on which the contravention occurred;
  - (vi) a summary of all preventative measures and actions that were taken prior to the contravention;
  - (vii) a summary of all measures and actions that were taken to mitigate any effects of the contravention;
  - (viii) the measures that will be taken to address any remaining potential effects related to the contravention;
  - (ix) the Approval number or Registration number provided by the Director for the landfill site, and the name of the person who held the Approval or Registration number at the time when the contravention occurred;
  - (x) the names, addresses, telephone numbers and responsibilities of all persons operating the site at the time that the contravention occurred;
  - (xi) the names, addresses and telephone numbers of all persons who had charge, management or control of the site at the time that the contravention occurred;
  - (xii) a summary of proposed measures that will prevent future contraventions including a schedule of implementation for those measures;
  - (xiii) any information that was maintained or recorded under these Standards, as a result of the contravention; and

- (xiv) any other information required by the Director in writing.

## **7.2 Report Requested by Inspector or Director**

- (a) A person who is required to record and maintain any information required by these Standards, shall, within 7 calendar days or any other time period specified in writing by the Director, provide to the Director on request, any information maintained or recorded under these Standards.

## **7.3 Operating Record**

- (a) The person responsible shall establish and maintain an Operating Record for a landfill until the end of the Post-Closure Care Period.
- (b) The person responsible shall provide the Operating Record to the Director upon a request in writing.
- (c) The Operating Record shall contain, at a minimum, the following information:
  - (i) a copy of the Approval or Registration number;
  - (ii) as-built records for the landfill showing the location and development of excavations, fill areas, final grades and structural components;
  - (iii) annual topographic survey records and plans showing the areas where waste has been disposed in the previous year of operation;
  - (iv) the most recent version of the design and operating plan for the landfill;
  - (v) records of handling of any wastes accepted at the landfill including the amounts accepted and the disposal locations within the landfill; and
  - (vi) all Annual Reports for the landfill as set out in Section 7.4.; and
  - (vii) the Final Closure Report as set out in Section 7.5; and
  - (viii) all Post-Closure Care Annual Reports for the landfill as set out in Section 7.6

## **7.4 Annual Report**

- (a) During each year of the active life of the landfill, the person responsible shall prepare an Annual Report for the landfill covering the calendar year reported on.
- (b) The person responsible shall place the Annual Report in the Operating Record by March 31 of the year following the year on which the report is based.
- (c) The Annual Report shall contain, at a minimum, the following information:
  - (i) the types and quantities of wastes disposed at the landfill and the location of wastes requiring special handling;
  - (ii) the following environmental monitoring records and their interpretations;

- a. groundwater monitoring;
  - b. leachate monitoring, if it is applicable;
  - c. landfill gas monitoring, if it is applicable;
  - d. records on the quality and quantity of leachate removed from the landfill cell for treatment or disposal;
  - e. records on the quality and quantity of impounded surface water released to the environment; and
- (iii) a site development plan showing the staging of landfill operations, including but not limited to:
- a. contour mapping;
  - b. the location of active and inactive disposal areas;
  - c. areas where a final cover has been placed; and
  - d. the location of cells constructed; and
- (iv) any remedial action taken;
- (v) any complaints received and the action or actions taken as a result of a complaint; and
- (vi) adjustments to financial security or the environmental reserve fund necessary for closure and post-closure care activities.

## 7.5 Final Closure Report

- (a) The person responsible shall prepare a Final Closure Report and submit a copy of the report to the Director within 60 calendar days of completion of the final closure of the landfill.
- (b) The person responsible shall file a copy of the Final Closure Report in the operating record for the landfill within 60 calendar days of completion of the Final Closure Report.
- (c) The Final Closure Report shall include, at a minimum, the following:
- (i) the date of completion of the final closure;
  - (ii) a statement including supporting evidence that the final closure has been completed in accordance with the final closure plan;
  - (iii) a description of any deviations to the final closure plan and the reasons for the deviations;
  - (iv) a description of the final cover system and the installation methods and procedures used;
  - (v) an estimate of the maximum quantity of waste placed on the site over the active life of the landfill; and
  - (vi) a description of how the following elements have been, or will be dealt with
    - a. the final use of the closed areas;
    - b. drainage restoration;
    - c. soil replacement;
    - d. final cover slopes;
    - e. erosion control;
    - f. re-vegetation and conditioning of the site; and
    - g. subsidence and differential settlement remediation.

## 7.6 Post-Closure Care Annual Report

- (a) During each year of the post-closure care period, the person responsible shall prepare an Annual Report for the landfill covering the calendar year reported on.
- (b) The person responsible shall place the Annual Report in the Operating Record by March 31 of the year following the year on which the report is based.
- (c) During the Post-Closure Care Period, the person responsible shall compile, unless otherwise authorized in writing by the Director, the following information:
  - (i) the annual groundwater monitoring report;
  - (ii) the annual landfill gas monitoring report if required in Section 5.1;
  - (iii) the annual surface water monitoring report;
  - (iv) the leachate monitoring report if required in Section 5.1;
  - (v) a record of maintenance and repairs carried out;
  - (vi) a report on the operation of the leachate collection and removal systems, if required in Section 5.1;
  - (vii) a report on the operation of the landfill gas control systems, if required in Section 5.1; and
  - (viii) a report of any remedial or corrective action taken.

## 7.7 End of the Post-Closure Care Period Report

- (a) The person responsible shall notify the Director of the end of the Post-Closure Care period by submitting an End of the Post-Closure Care Period Report.
- (b) The End of the Post-Closure Care Period Report shall include, at a minimum, the following:
  - (i) a summary of post-closure care period activities;
  - (ii) a summary of post-closure care period monitoring data; and
  - (iii) supporting evidence that the requirements set out in 6.3(b) have been achieved.