SOLID WASTE PERMITTING
SUBMISSION INSTRUCTION NO. 7

LEACHATE MANAGEMENT PLAN
FOR SOLID WASTE MANAGEMENT FACILITIES

Developed by:

Virginia Department of Environmental Quality
Office of Waste Permitting and Compliance
629 East Main Street
Richmond, Virginia 23219

V. 01/2012

TABLE OF CONTENTS

LEACHATE MANAGEMENT PLAN

The Leachate Management Plan should be submitted with the Part B Application or Part B Modification Application as Attachment VIII to DEQ Form SW PTB. [9 VAC 20-81-130.L., 140.A.6., and 210]

Format The format used for the Leachate Management Plan should encourage clear analysis and presentation of the proposed leachate management activities relating to collection, removal, treatment, and disposal. The Leachate Management Plan should start with a title page and table of contents followed by the following sections and discussions. The title page should identify the facility name and permit number, the permit applicant, document date, and document preparer information. In addition, the header or footer of each page should include the facility name, permit number, document title, revision date, and page number.

Leachate collection systems for solid waste disposal facilities are typically designed to include one or more drainage layers, a series of perforated leachate collection pipes, and a protective filter layer. Collected leachate is then removed through sumps or gravity drain carrier pipes to one or more tanks or surface impoundments/lagoons, before being disposed. Information on the proposed leachate management system to be installed and operated at the proposed solid waste disposal facility should be presented in this plan.

Leachate collection systems for solid waste management facilities may or may not be required depending on the design and operation of the proposed management facility. If the proposed solid waste management facility will collect, store, treat, and dispose of its leachate, information on the proposed leachate management system to be installed and operated at the proposed solid waste management facility should be presented in this plan, as applicable.

Operational details to include the frequency of inspections, monitoring, and maintenance activities relating to the leachate collection system, the frequency of leachate discharge or disposal, and the facility's response to leachate seeps as required under § 9 VAC 20-81-210 should be addressed in the Operations Manual.

A. Leachate Estimate

Estimate the quality and quantity of leachate to be generated annually by each unit, based on generally accepted methods for projection of leachate flow.[1] The estimate shall include the 30-day volume and average flow rate for each month of the year. At a minimum, annual leachate production shall be estimated at 5-year intervals for 20 years or until closure, whichever is greater. For existing facilities, include the current leachate generation rate. Indicate any flow meters or other equipment installed to quantify leachate generated. Describe assumptions, data sources, and methods used to perform the modeling and calculations. Provide copies of model results and calculations in an attachment to this plan. [9 VAC 20-81-210.A.1.]

[1] The Hydraulic Evaluation of Landfill Performance (HELP) Model

B. Leachate Collection

In the following sections, provide information on the design of the proposed leachate collection system (LCS). Reference the appropriate Design Plans (PTB Attachment III) and Technical Specifications (PTB Attachment VII) as necessary. [9 VAC 20-81-210.A.]

1. **Drainage Layer Design**

Describe the materials to be used in the leachate collection system drainage layer. [9 VAC 20-81-210.A.3.]

a. Soil Drainage Layer

i. *Bearing Strength*.
Demonstrate that the drainage layer will have sufficient bearing strength to support expected loads.

ii. *Slope Stability*.
If the landfill is designed on moderately to steeply (greater than 15%) sloping grades, include calculations demonstrating that the selected granular drainage materials will be stable on the most critical (e.g., usually the steepest) slope in the design. The calculations and assumptions shall be shown, especially the friction angles between all material interfaces, and supported by laboratory and/or field testing.

b. Geosynthetic Drainage Layers

Geosynthetic drainage nets (geonets and geocomposites) may be substituted for the granular layers of the leachate collection system. A granular protection layer may also be used to protect the underlying geosynthetics (geomembrane and geosynthetics drainage layer). A geonet can be considered for bottom drainage use in CDD and industrial landfills. Filter materials are sometimes used above geosynthetic drainage layer. These materials can experience problems with creep, intrusion, biological clogging etc.

i. *Transmissivity*
If a geonet is used in place of a granular drainage layer, it must provide the same level of performance (maintaining less than 12 inches of leachate head above the liner). Keep in mind that McEnroe's equations, which are used in the HELP model to estimate the maximum head, implicitly assumes the estimated head is within the thickness of the drainage medium. Therefore, if the estimated head is greater than the thickness of the geosynthetic drainage layer, the estimated head become inaccurate because the assumption was not met.

Show the calculation used to compute the capacity of a geonet and filter system. The transmissivity of a geonet can be reduced entirely by intrusion of the fine textured materials. Show the results of the laboratory transmissivity tests performed under loads, and configurations that closely replicate the actual field conditions. It is important that the transmissivity value used in the leachate

collection system design calculations be selected based upon those loaded conditions.[2]

Specify minimum transmissivity under expected operating (dynamic) and completion (static) loads. The specifications for thickness and type of materials shall be identified on the drawings and shall be consistent with the design calculations.

ii. *Side Slopes*
Show the friction factors against sliding for geotextiles, geonets, and geomembranes. Manufacturers' data may be used, but shall be supported by the results of actual tests using site materials. Show all sliding stability calculations.

2. **Filter Layer and Pipe Protection Design**

The openings in drainage materials, whether holes in pipes, voids in gravel, or apertures in geonets, are sometimes protected against clogging due to accumulation of fine (silt-sized) materials. An intermediate material, between the waste and drainage layer, having smaller openings than those of the drainage material, can be used as a filter. Sand or geotextiles may be used as filter material. The soil filter layer may be the uppermost layer of the LCRS; however, optionally, a buffer layer may be included to protect the filter layer from damage due to traffic. This buffer layer may be general fill, as long as it is no finer than the soil used in the filter layer. If leachate recirculation is to be included, care must be taken to ensure that the permeability of the buffer is sufficiently high. If geotextiles are used on a slope, they should be secured in an anchor trench similar to those for geomembranes or geonets. Demonstrate that the use of graded material or filter fabric system design will prevent physical clogging (sedimentation) throughout the active life of the landfill and the post-closure care period. To prevent chemical and biological clogging, show the design of a cleaning system to include:

- A minimum of six-inch diameter pipes to facilitate cleaning;
- A slope sufficient for self-cleaning;[3]
- Access located at major pipe intersections or bends to allow for inspections and cleaning; and
- Valves, ports, or other appurtenances to introduce biocides and/or cleaning solutions.

a. <u>Soil Filter Layer</u>
Show how the design and material specifications of the filter layer will allow adequate flow of liquids through it, will provide adequate retention of fines, and evaluate the possibility of long-term clogging of the filter. Include estimates of particle size distribution of the drainage system and of the invading materials. Describe the

[2] Use ASTM D-4716 to evaluate the transmissivity of the geonets.

[3] Generally, flow velocities should be in the vicinity of two feet per second.

thickness of the filter layer, the method of placement, and the dimensions of any envelope around the piping system.

b. Geotextile Filter Layer
Geotextile filter design parallels sand filter design with some modifications. The most important specifications are those of hydraulic conductivity and retention. In practice, it should be noted that the use of geotextiles as filter material has resulted in problems with clogging due to biological growth on the geotextile.

3. **Leachate Collection Pipe**

The design of perforated collection pipes should consider the following factors:

- The required flow using peak daily lateral drainage and percolation rates determined from running the HELP Model (assuming no run-off) and pipe spacing;
- Pipe size using the design leachate flow; and
- The structural strength of the pipe.

a. Sizing
Demonstrate that pipe and pipe perforation sizes are sufficient to allow free leachate access to the drainage system yet avoid clogging of the perforations and pipes by the drainage media. Show all calculations.

b. Piping Strength
The component that is most vulnerable to strength failure is the drainage layer piping. Demonstrate that any piping used will have sufficient strength to prevent collapse from anticipated static and dynamic loads. Pipe strength calculations should include resistance to wall crushing, pipe deflection, and critical buckling pressure.

4. **LCS Design Standard**

Discuss the capability of the LCS to maintain less than 30 cm (12 in) of leachate above the liner system. [9 VAC 20-81-210.A.2.]

C. Leakage Monitoring System

For landfills equipped with double liners, describe the design of the leak detection system and the materials of construction. Describe the layout and spacing of the pipe network. [9 VAC 20-81-210.A.]

1. **Grading**

Demonstrate that the leak detection points are appropriately located. Show that the drainage media in which the leakage monitoring system operates is appropriately graded to assure that leakage at any point in the liner system could be detected.

2. **Pipe Network**

If a pipe network is used to collect leakage, show calculations for the spacing of the pipe network.

3. **Piping Strength**

   Demonstrate that any piping used between the liners will have sufficient strength to prevent collapse from anticipated static and dynamic loadings.

4. **Sizing**

   Demonstrate that pipe and pipe perforation sizes are sufficient to allow free liquid access to the drainage system yet avoid clogging of the perforations and pipes by the drainage media.

5. **Drainage Media**

   Demonstrate sufficient gradation of drainage media and filter materials to allow free liquid access to LMS. Demonstrate that drainage media thickness and hydraulic conductivity will be sufficient to promote drainage.

6. **Monitoring**

   Demonstrate that the LMS will provide timely detection of liquids entering the space between the liners. Indicate flow meters or other equipment that will be used to detect leaks.

D. Leachate Removal System

Describe the components to be used to remove leachate from the landfill, referencing the appropriate Design Plans as necessary. If portable pumps are to be used, specify the schedule to move a pump from one sump to another in the operating plan. If gravity method is used for leachate removal, (1) show pipe penetrations through the geomembrane and liner system and describe the construction of the penetration and (2) provide a mechanism for emergency shut-off of leachate in the gravity pipe.

E. Collection and Storage Units

Describe the design of collection and storage facilities associated with the LCS. The design may include berms, ditches, pumps, sumps, tanks, and surface impoundments. Guidance Memo 04-1993: HELP Model provides a procedure for calculating the minimum storage capacity in accordance with 9 VAC 20-81-210.B. Describe assumptions, data sources and methods used to make the calculations. [9 VAC 20-81-210.A.1., B. and C.]

F. Leachate Treatment or Disposal

Describe the leachate treatment or disposal method that will be used. [9 VAC 20-81-210.D.]

G. Leachate Recirculation

For sanitary landfills proposing to recirculate leachate over a Subtitle D or pre-approved liner system (9 VAC 20-81-130.J.1.a. and J.1.b.), indicate method of leachate recirculation to be used (direct injection, spray application, injection fields, etc.). Provide calculation, design and operational information pertaining to the pipe network and leachate application rates to be used. [9 VAC 20-81-210.D.]

Leachate recirculation over any other liner or recirculation of liquids in addition to leachate or gas condensate from the landfill requires a Research, Development, and Demonstration Plan in accordance with 9 VAC 20-81-600.F.7. Guidance Memo 05-2009: Research, Development, and Demonstration Plans provides information on the RDD Submittal to be included in Part B Attachment XVII.

H. Attachments

1. **Leachate Estimate Modeling Results.**

   Provide copies of the modeling results and any calculations used to determine the maximum quantity of leachate presented in Section A.

2. **Leachate Collection System Calculations**

   Provide copies of calculations substantiating the information provided in Section B.

3. **Leakage Monitoring System Calculations**

   Provide copies of calculations substantiating the information provided in Section C, if applicable.

4. **Leachate Collection Capacity**

   Provide copies of the modeling results and calculations indicating the 7-day storage volume and capacity of the leachate storage system as indicated in Section E.