WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
SOLID AND HAZARDOUS WASTE DIVISION

SOLID WASTE GUIDELINE #22

"Performance Based Design Demonstrations"

1.0 Introduction

Chapter 2, Section 4(j) of the Wyoming Solid Waste Rules and Regulations (SWRR) requires that permit applications for new units and lateral expansions at municipal solid waste landfills must contain either a composite liner and leachate collection system, or a performance based design (PBD). An approved PBD must ensure that pollutant concentrations will not exceed maximum contaminant levels (MCLs) in the uppermost aquifer at the relevant point of compliance. A composite liner is a system consisting of two components; the upper component must consist of a minimum 30-mil flexible membrane liner (FML) and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. For purposes of the guideline this is referred to as an engineered containment system (ECS).

The primary purpose of this document is to identify the processes which the Wyoming Department of Environmental Quality, Solid and Hazardous Waste Division (Department) has determined are appropriate for evaluating the performance of PBDs. The PBD demonstration process consists of four basic parts:

1. Adequately characterize site conditions.
2. Predict leachate generation using the Hydrologic Evaluation of Landfill Performance (HELP) model, or alternate approach acceptable to the Department.
3. Conduct contaminant fate and transport modeling.
4. Assess the effects of other factors such as landfill gas, waste types and facility operating practices.

The information needed to support a PBD must be submitted as supporting documentation in permit applications for new units or lateral expansions at MSW landfills. This process may also be useful as a screening tool to evaluate alternative landfill designs at perspective sites before permit applications are prepared and submitted.

The information in this document should not be interpreted by applicants or Department staff as mandatory. Proposals for alternate approaches will be considered by the Department on a case-by-case basis. While focused on MSW landfills due to regulatory requirements, the concepts presented in this guideline may also be applicable to industrial and construction demolition landfills.

2.0 Background

The requirement for a PBD or a composite liner with leachate collection was contained in Senate File 0121 (Enrolled Act 71, 2011 General Session) and subsequently incorporated into SW Chapter 2 Section 4(j).

To allow for consideration of alternative approaches, site-specific conditions, and changing technologies, the SWRR do not contain prescriptive information regarding how an operator must demonstrate that MCLs will not be exceeded at the relevant point of compliance.

Guidelines have been prepared to outline an approach that consists of:

- Evaluating site specific geologic and hydrogeologic information;
- Evaluating leachate generation rates using the HELP model and local climate data; and
- Using contaminant fate and transport modeling to evaluate migration of contaminants to groundwater.

The objective of landfill design, construction and operation is environmental protection. A facility constructed with an ECS provides significantly more protection and significantly less risk of environmental contamination that a facility without an ECS. Information cited by Rooker (2000) and EPA (2002) indicates that a well constructed composite liner can achieve efficiencies greater than 90%, and as high as 99%. Based on the regulatory requirements and the information summarized above, the Department considers an ECS to be the preferred landfill design option and the "point of departure" for decisions on landfill design.

The Department recognizes and acknowledges that generation of leachate in and of itself may not be an accurate predictor of a long-term potential for groundwater impacts. However, data shows that the annual generation of even a relatively small amount of leachate will result in groundwater impacts over the long-term unless the depth to groundwater is great, the underlying formations are unfractured and have low permeability, and the groundwater flow rate is high. Therefore, the Department has prepared this and other guidance documents to describe the type of technical and scientific information that is needed to show that a landfill constructed without an ECS will effectively protect groundwater from contamination.

3.0 Performance based design demonstration process

As noted above, the Department has identified a three step process appropriate for developing a PBD. The three general steps are described below, as well as other factors that should be considered.

3.1 Characterization of site geology and hydrology

Thorough site characterization is critical to any PBD demonstration submitted. Data must be collected to meet a number of performance objectives and must consider the input requirements of any models that will be used to predict the performance of the PBD. Commonly accepted standards for determining site characteristics such as the depth to groundwater, groundwater flow direction and rate, soil types, and the presence or absence of subsurface fractures must be followed. Appropriate quality assurance/quality control (QA/QC) procedures

must be followed to ensure the accuracy and validity of the data. To ensure that acceptable site characterization standards are followed applicants should refer to Department guidance on site characterization. Operators should note that a more rigorous and costly site characterization may be needed, depending on the type of alternate landfill design being proposed.

The definition of aquifer that was contained in the SWRR was revised and placed in statute in 2011 (see Senate Enrolled Act 58) and subsequently incorporated into SW Chapter 1 Section 1(e). This change, coupled with the PBD requirement to demonstrate that MCLs will not be exceeded in the uppermost aquifer may affect the approach an applicant chooses for site characterization. One of the most significant changes in the definition of aquifer was inclusion of a 0.5 gallon per minute quantity of water that must be able to be produced to be considered an aquifer. The Department has identified two approaches applicants may follow to evaluate this; there may be others. First, applicants may choose to identify and characterize the unsaturated zone, shallow water bearing zones that do not meet the aquifer definition, and the uppermost aquifer. Modeling would then be performed to confirm that MCLs will not be exceeded in the uppermost aquifer. The second approach, which is more conservative, would be to characterize a site to the uppermost water bearing zone, and assume this water bearing zone is an aquifer. Modeling would then be done to evaluate potential impacts to this water bearing zone. The subject of uppermost aquifer is discussed in more detail in SW Guideline # 23 Site Characterization for Landfill Siting and Design.

3.2 Hydrologic Evaluation of Landfill Performance (HELP) modeling

The HELP model has long been used to estimate leachate generation and the potential for leachate to migrate to groundwater. Operators should refer to the HELP model users' guide (EPA, 1994a) and engineering documentation (EPA, 1994b), and the Department's HELP model guideline to ensure that HELP modeling used to support an alternate design demonstration has been properly performed.

3.3 Contaminant fate and transport modeling

Operators also need to evaluate the potential for contaminants to reach groundwater and the possibility that natural processes may prevent groundwater impacts. The Department has developed additional guidance on fate and transport modeling to ensure that fate and transport modeling used to support an alternate design demonstration has been properly performed.

3.4 Other factors

The discussions above focus on modeled or predicted long term performance of a facility constructed with a PBD. However, predicting facility performance decades into the future is extremely difficult. All models used to predict long term performance have limitations. For example, very few models, if any, effectively estimate migration through fractured or heterogeneous formations. In addition, the decades of data needed to verify the accuracy of long-term predictions do not exist. Therefore, the Department believes that it is also appropriate to

consider other factors which may or may not support the design and construction of a landfill with a PBD. In addition to the characteristics of the site and the performance models described above, PBDs should include an evaluation of any other site specific factors which may or may not support the design and construction of a landfill with a PBD. Some of these would include but not be limited to the type and quantity of waste to be disposed at the facility, operational practices, design factors, landfill gas, and the facility's record of compliance.

4.0 Monitoring

MSW landfills must have a groundwater monitoring system that is capable of detecting a release to the uppermost aquifer that may be affected by leakage from the facility. Early detection of a release is critical to minimize environmental impacts and ensure that appropriate corrections are made as soon as possible. The Department will assess landfill and monitoring system designs to ensure that these objectives are achieved. Facilities and monitoring systems must be designed to ensure that a release can be detected early in the life of the facility. In general, this means that disposal should begin in the hydraulically downgradient portion of the site.

Additional monitoring may be needed to assess the performance of a landfill and the validity of assumptions and modeled predictions. For example, it may be necessary to measure precipitation, runoff volumes, performance of the landfill's final cover system, and other factors which could affect leachate generation and migration of leachate to groundwater. Landfill gas is also known to contribute to groundwater contamination; therefore a landfill constructed with a PBD may need a more extensive gas monitoring system.

5.0 Reassessment

If monitoring data or new information varies from the data and assumptions used in the initial PBD demonstration; the operator will need to reassess and resubmit all or part of the demonstration. If a release from a disposal unit with a PBD is detected in a well, the operator will need to investigate the cause of the release. Disposal in that unit may need to cease as soon as practical and operators may need to construct an ECS in future units. It may be necessary to evaluate the need for changes to other design and operating procedures, confirm that the facility's monitoring well network and monitoring plan are adequate, and increase the frequency and number of constituents analyzed in the monitoring wells. The operator will generally be required to isolate the unit(s) with a PBD from other disposal units and create a buffer zone around it.

6.0 Professional Geologist Certification

Geological services or work must be stamped, signed, and dated by a professional geologist (see W.S. § 33-41-115).

7.0 Further Information

Further information can be obtained from the following Solid and Hazardous Waste Division offices. Comments and suggestions for improvements are always appreciated.

Casper:	(307) 473-3450
Cheyenne:	(307) 777-7752
Lander:	(307) 332-6924

8.0 References

Rooker, A. P., 2000, A Critical Evaluation of Factors Required to Terminate the Post-Closure Monitoring Period at Solid Waste Landfills, M.S. Thesis, Department of Civil Engineering, North Carolina State University.

U.S. EPA, 1994a, The Hydrologic Evaluation of Landfill Performance (HELP) Model, User's Guide for Version 3, EPA/600/R-94/168a.

U.S. EPA, 1994b, The Hydrologic Evaluation of Landfill Performance (HELP) Model, Engineering Documentation for Version 3, EPA/600/R-94/168b.

U.S. EPA, 1995, Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide, EPA/540/F-95//009.

U.S.EPA, 2002, Assessment and Recommendations for Improving the Performance of Waste Containment Systems, EPA/600/R-02/099.

Zeiss, C., Major, W., 1993, Moisture Flow Through Municipal Solid Waste: Pattern and Characteristics, Journal of Environmental Systems, v. 22, no. 3.

8.0 Guideline Approval

I have reviewed and approved the policies and procedures described in this guidance document.

Signed

Alan Edwards December 18, 2013

Alan Edwards — Date
Acting Administrator
Solid and Hazardous Waste Division
Department of Environmental Quality

Guideline History

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