

Section 5: Conceptual Design of Landfill Facilities

5.1 Introduction

Conceptual design phase The Site Development Plan provides the framework for establishing overall goals for facility design, construction, operation, and environmental monitoring. This section describes the methods and procedures for establishing appropriate design criteria and selecting technologies that will satisfy regulatory requirements and performance objectives.

How to respond Prepare a comprehensive Site Development Plan that presents the conceptual design of landfill facilities and environmental control systems and documents the analysis used to select the proposed technologies. The plan should be prepared by or under the direct supervision of a professional engineer with current Oregon registration.

Plan content The Site Development Plan should describe the elements in this subsection. The plan should be stamped by the professional engineer responsible for its preparation. Following the organizational format of this guidance will expedite Department review of the plan.

In this section This section describes the elements of a Site Development Plan, including:

- facility operation
- conceptual design of landfill facilities
- leachate management
- surface water management
- landfill gas management
- environmental monitoring
- closure and end use
- supporting information

5.2 Facility Operation

Facility operation	Describe the existing and proposed facilities, anticipated waste stream characteristics, and operational procedures, including the items in this subsection.
Capacity and projected life	Specify the proposed capacity and projected life of the site.
Population to be served	Identify and list the communities expected to be served by the facility, and estimate their corresponding current populations. Describe how the listing was compiled. Cite all sources used to estimate population.
Industry to be served	Identify and list major industries to be served by the landfill, and describe how the listing was compiled.
Rate of waste disposal	Estimate the future flow of waste to the facility from communities and industries served and from any other projected sources. Include estimates for maximum daily, maximum monthly and average annual volume and weight of waste to be received. Cite all sources used to calculate volume and weight estimates.
Overall description of operation	Describe the operation including on-site equipment on site (i.e., compactors, dozers, grinders or chippers), anticipated hours of operation, and mode of delivery of solid waste to the site.
Site economic viability	Provide key assumptions used to calculate the economic viability of the proposed facility.
Site screening	Describe how the active landfill area(s) will be screened from public view. <u>Reference:</u> OAR 340-94-040(11)(f)

Planned future use	Describe the planned future use of the disposal site after closure.
Waste stream types	<p>List and estimate the quantity of each type of waste stream projected to be disposed of at the facility.</p> <p><u>Examples:</u> domestic wastes, commercial and institutional wastes, industrial wastes, construction and demolition wastes, agricultural wastes, sewage sludge and grit, contaminated cleanup materials, other wastes requiring special handling [see OAR 340-94-040(11)(b)(J)]</p>
Acceptance of industrial waste	<p>If proposing to accept industrial wastes for disposal, report the major industrial waste stream(s). For each weight or volume calculation, treat as one waste stream all industrial waste generated from industries identified by the same first three digits in their Standard Industrial Classification (SIC) code.</p> <p><u>Example:</u> Spent casting sand from an aluminum foundry and spent casting sand from a nonferrous foundry should be treated as one waste stream since they are generated from industries having the same first three digits in their SIC code.</p> <p><u>Definition:</u> a "major" industrial waste stream comprises greater than one-quarter percent, by weight or volume, of the total estimated waste flow.</p>
Regional facility	<p>If the facility is a regional disposal site, discuss the following:</p> <ul style="list-style-type: none"> • plans from the local board of county commissioners for establishing a local citizens advisory committee • how the information necessary for the Department to review and approve a Waste Reduction Program for any person who will send more than 75,000 tons of solid waste a year to the site will be submitted, and • how the county, state and country of origin of the waste will be tracked

5.3 Phased Development of Landfill Facilities

Phased development Describe the phased development of the landfill. Establish a systematic blueprint of the construction, operation, and closure of each major phase of development.

Contents Address the following elements in the design:

- design criteria used to determine the landfill's size, configuration, capacity, location, and environmental protection features
- design, construction, and operation considerations for initial cell development
- individual cell construction and the fill sequence
- slope stability in relation to construction, fill sequence, and side-slope liner design
- facility development drawings
- utility requirements including electrical power, water supply, and wastewater treatment and disposal
- earthwork materials for site construction and development, and
- environmental control technologies

Design criteria Define the basis and any assumptions used to establish the landfill's footprint boundaries, overall configuration, capacity, and location considering at least the following factors:

- regulatory standards for location, design, and operation
- waste stream characteristics
- waste processing (e.g., incineration, composting, shredding)
- buffer zone requirements
- surface drainage patterns and physical characteristics of the site
- slope limitations on the landfill base and final cover profile
- land use and zoning restrictions
- location of utilities and support facilities
- transportation and access patterns
- environmentally sensitive areas
- geotechnical and hydrogeologic constraints, and
- end use alternatives

Facility development drawings Prepare a series of scaled drawings showing the phased development of the site. Show each phase of landfill cell(s) development and site status when new cells are ready to be placed into service. The drawings should include at least one scaled plan-view and two perpendicular cross-sectional drawings of the excavation plan, fill sequence plan, and final grading plan.

Content of drawings Identify the following information on the drawings:

- environmental monitoring components including groundwater monitoring wells, and gas monitoring probes, and surface water monitoring stations
- layout of landfill components including support facilities (e.g., public receiving and recycling areas)
- entrance and on-site roads, gates and fencing
- site drainage and surface water control structures (e.g., berms, dikes, ditches, culverts)
- surface impoundments
- soil stockpiles (i.e., the extent, available volume, and intended use of each soil, sub-soil, or rock unit identified as a borrow source)
- leachate collection, storage, treatment and disposal facilities
- special waste management areas (e.g., tires, bulky wastes, asbestos)
- planned total landfill footprint including buffer zones, landscaping, and site screening features
- planned excavations and base grades for each major phase of site development, relationship to hydrogeologic features (e.g., watertable profile, water bearing formations)
- configuration of the completed landfill and final grading plan
- the final landfill surface profile and its internal components, existing topography, and underlying geology/hydrogeology (in landfill cross-section views)
- existing landfill cells, including their operational status and configuration (e.g., exposed waste, intermediate cover, final cover, leachate drainage layer), and
- gas control system components

Earthwork materials for construction and development Inventory on-site borrow materials and characterize their intended use as follows:

- analyze the results of the Phase I and Phase II geotechnical investigations and identify the intended uses of borrow materials
- quantify the available borrow materials
- describe the management and storage of soils and other construction materials

5.4 Leachate Management

Leachate management	Describe the proposed leachate management strategies for the landfill's active operation, closure and post-closure stages.
Strategies	<p>The leachate management strategy should be based on a systematic analysis of design, construction, and operation techniques, and the following objectives:</p> <ul style="list-style-type: none">• accurately predict leachate quality and quantity• select leachate control methods that are technically and economically sound• maximize leachate containment and collection efficiencies (through liner system and collection and removal system design)• maximize the reliability of leachate containment systems• monitor the effectiveness of leachate control systems• treat and dispose of leachate in an environmentally sound manner, and• minimize leachate generation
Leachate management analysis	<p>Perform a conceptual design analysis to evaluate background data, establish a rational basis for design, and to evaluate the performance and cost effectiveness of alternative technologies. This analysis should complete the following tasks:</p> <ul style="list-style-type: none">• Evaluate leachate quantity and quality using methods described in Section 6• Identify key assumptions and design criteria• Evaluate alternative leachate control technologies• Prepare conceptual design drawings of major components
Liner system: leachate containment	<p>Prepare conceptual design drawings showing typical cross-sections of the proposed liner system including layer types and thicknesses, minimum slopes, and hydraulic conductivities of each soil layer. Describe the liner system components, including the soil and geosynthetic materials, potential sources of these materials, and the overall design basis.</p>

Standard liner design	<p>The standard composite-liner design incorporates the following components:</p> <ul style="list-style-type: none"> • a two-foot thick soil layer with a maximum permeability of 1×10^{-7} cm/sec • a geomembrane layer with a minimum thickness of 60 mil for HDPE or 30 mil for other materials
	<p>The Department may require an enhanced liner design if site specific conditions suggest a significant potential for adverse groundwater quality impacts (see OAR 340-94-060(6)).</p>
Alternative liner design demonstration	<p>If an alternative liner system design is proposed, a demonstration must be made to the Director of the Department that the proposed design will:</p> <ul style="list-style-type: none"> • meet the performance standard in 40 CFR 258.40(a)(1), "the design must ensure that the concentration values listed in Table 1 ... will not be exceeded in the uppermost aquifer at the relevant point of compliance", and • comply with the policies and specific performance requirements of Oregon's Groundwater Quality Protection Rules (i.e., prevent a leachate release exceeding the statistical background concentrations at the relevant point of compliance)
Workplan for alternative design	<p>To facilitate Department review and approval of such a demonstration, submit a workplan describing methods to predict potential water quality impacts. The workplan must specify how the permittee intends to:</p> <ul style="list-style-type: none"> • characterize leachate quality and estimate leachate quantity • estimate liner leakage using a hydrologic model such as the latest version of EPA's HELP model, and • evaluate groundwater quality impacts due to forecasted leakage, using an appropriate groundwater flow and solute transport model, which demonstrates that the alternative liner design would adequately protect groundwater and surface water quality
Leachate collection and removal system	<p>Describe the basis for the design, including key assumptions and design criteria on how the Leachate Collection and Removal System (LCRS) will maintain leachate depths of less than 30 cm. Prepare a conceptual design of the LCRS that includes drawings showing typical cross-sections and a plan-view of system layout, manholes, cleanouts, sumps.</p>

LCRS design criteria	<p>The Department's recommended design criteria are as follows:</p> <ul style="list-style-type: none"> • Drainage layer slopes should be at least 2% (after settlement) • Collection pipes should: <ul style="list-style-type: none"> • have slopes of at least 1% • meet the recommendations of (not minimums) of OAR 340-52-030, and • have enough slope to maintain scouring velocity • Manhole spacings should not exceed the capabilities of available cleanout equipment and should meet recommendations (not minimums) of OAR 340-52-030 for sewer pipelines. At a minimum, cleanouts should be provided at both ends of all leachate collection pipes with sweep ends used to allow smooth access to cleanout equipment • Leachate pipe should have a minimum diameter of 6 inches and should be schedule 80 or equivalent strength pipe • Granular drainage layers should consist of competent, non-angular rock or rounded gravel and have a minimum in-place hydraulic conductivity of at least 1×10^{-2} cm/sec
<u>Secondary LCRS:</u> Under certain circumstances (see OAR 340-94-060(6)), the Department may require a secondary leachate collection system. Suggested design criteria for the secondary LCRS and other pertinent design-related information are provided in Section 7 (Detailed Design).	
Leachate storage	<p>Prepare a conceptual design of the storage system including cross-section and plan-view drawings and describe the design basis. Leachate storage impoundments should be located, designed, constructed, and monitored to at least the same standards as landfills. Leachate storage impoundments should be equipped with a leak detection system beneath the entire liner system, creating a double liner system to protect against the high hydraulic head typically impinging on the liner system.</p>
Leachate treatment and disposal	<p>Perform a leachate treatment feasibility study as outlined in Section 6 of this guidance. The results of this study should be used to develop conceptual design drawings and preliminary equipment specifications for the proposed treatment and disposal methods. The Department recommends treatment methods that reduce leachate contaminants, not methods that transfer the environmental problem to another medium.</p>

**Leachate
minimization**

Describe the design, construction, and operation techniques that will be used to minimize leachate production during the landfill's active and post-closure periods.

The leachate minimization program should include the following elements:

- phased development and closure to minimize the active area footprint
 - temporary geosynthetic covers to minimize infiltration in active cells
 - run-on and runoff control systems for active and closed areas
 - subsurface drainage systems to control groundwater seepage
 - low permeability final cover systems to minimize infiltration during post-closure, and
 - cell construction techniques that promote surface runoff rather than infiltration
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5.5 Surface Water Management

Surface water	Describe the proposed methods for managing surface water run-on and runoff during the landfill's active operation and post-closure stages.
Surface water control during active landfill operations	Describe the surface water control measures and facilities that will be implemented and maintained during active landfill operations and how the system will <ul style="list-style-type: none">• intercept and divert run-on away from active and closed landfill cells (subareas)• promote runoff from landfill areas capped with interim or final cover• minimize site erosion• temporarily store excess peak runoff flow until it can be discharged at a lower controlled rate• control sediment transport by removing suspended solids from surface water runoff as necessary to comply with the facility's NPDES stormwater discharge permit, and• collect and contain leachate-contaminated stormwater that accumulates in active landfill areas
Surface water control after final facility closure	Describe the surface water control measures and facilities that will be implemented and maintained after final closure of the facility and how the system will <ul style="list-style-type: none">• protect the integrity and effectiveness of the landfill cover system, and• minimize long-term maintenance requirements after closure
Conceptual design	Prepare conceptual design drawings showing the complete surface water control systems that will be in place during active landfill operations and after cell closure.

5.6 Landfill Gas Management

Landfill gas	Describe the methods and technologies that will be used to control landfill gas.
Content	Evaluate the following design and construction considerations: <ul style="list-style-type: none">• site characteristics including topography, soils, geology, hydrogeology, climate• fluctuations in groundwater levels, soil moisture, barometric pressure, and other environmental parameters• locations of on-site structures, utilities, etc.• adjacent land use and development• size and age of the landfill and quantity of in-place refuse• regulatory standards including federal air emission standards for landfills• the landfill's operational history• landfill gas monitoring results• permitting requirements for flare units and other air emission sources• operational status of the landfill unit (closed/full, active/partially full, new/empty, etc.)• site development sequence• suitable space for mechanical equipment (motor blowers, flares, electrical panels, etc.)• moisture conditions within the landfill (saturated zones can impede gas flow)• landfill gas quality (chemistry) and potential effects on leachate and groundwater quality• design of existing and future landfill cells and potential influences on landfill gas flow paths• current and future landfill gas production rates• depth of in-place refuse below grade (interface between refuse and subsurface strata)• available options for containing and managing landfill gas condensate• capital costs and operation and maintenance costs of alternative designs
Types of control systems	There are two general types of landfill gas control systems: active systems and passive systems. Active control systems are recommended by the Department for most applications because of their superior flexibility and performance. However, active systems are usually substantially more expensive to construct and operate.

Conceptual design plans Prepare preliminary engineering drawings showing the following landfill gas control system features:

- extraction well and/or horizontal collection trench locations and spacings
 - configuration of collection lateral and header piping
 - condensate drains, storage and treatment methods, and
 - mechanical equipment complex (motor-blower, flare, and associated equipment)
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Design criteria The Department's recommended design criteria for landfill gas control systems are as follows:

- The landfill gas control system should be operationally flexible to accommodate changing gas production rates, migration patterns, gas chemistry, and other variables.
 - Active control systems should be designed to provide 100 percent blower standby (backup) capability.
 - The landfill gas control system should be designed for phased construction and expansion potential.
 - Flame arresters should be incorporated into flare systems to prevent accidental ignition in the discharge piping system.
 - Flare units should be equipped with automatic ignition systems and alarms.
 - Header piping systems should have minimum (post-settlement) slopes of 3 percent for condensate drainage and collection.
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Methane limits The concentration of methane gas must not exceed

- 25 percent of the lower explosive limit for methane in facility structures, excluding gas control or recovery system components, or
- the lower explosive limit (LEL) at the facility property boundary

Reference: OAR 340-94-060(4) and 40 CFR Part 258.23(a)

Monitoring Facilities must conduct routine monitoring, with a minimum frequency of once per quarter, to verify compliance with the allowable concentration limits.

5.7 Environmental Monitoring

Establishing monitoring In most instances, detailed environmental monitoring programs will not be established until Phase II site characterization and detailed facilities design are completed.

Conceptual monitoring plan Describe the overall monitoring strategies and objectives for

- groundwater
- surface water
- leachate
- landfill gas
- air (if applicable)

Guidance Guidance for preparing an environmental monitoring plan is provided in Section 10.

5.8 Closure and End Use

Closure and post-closure Describe the general procedures for final facility closure and the end use plan for the facility property. Closure of modern landfills is accomplished in phases when discrete cells or subareas reach final capacity. Closed areas must be maintained and monitored while active operations continue in other cells. For financial assurance purposes, these activities should be considered as interim closures. The 30-year post-closure care period does not officially begin until final facility closure is complete.

Reference: OAR 340-130

Reference Minimum regulatory requirements for final facility closure are prescribed in OAR 340-94-100 and 40 CFR Part 258.1. Detailed closure provisions should be incorporated into the closure plan (see Section 11 for further instructions).

5.9 Supporting Information

Local government endorsement	<p>Submit written recommendations of the local government unit(s) having jurisdiction to establish a new disposal site or to substantially alter, expand, or improve a disposal site or to make a change in the method or type of disposal. Such recommendations should include, but are not limited to, a statement of compatibility with:</p> <ul style="list-style-type: none">• the acknowledged local comprehensive land use plan and zoning requirements or the Land Conservation and Development Commission's Statewide Planning Goals (using the Department's Land Use Compatibility Statement form), and• the adopted local solid waste management plan <p><u>Reference:</u> OAR 340-93-070(3)(b) requires submittal of local government information to document that the proposed new landfill or expansion of an existing landfill has been reviewed and approved by the local host community</p> <hr/>
Compatibility with solid waste plans	<p>Explain how the proposed facility or facility expansion is compatible with all elements of the local solid waste management plan, and the state integrated solid waste management plan.</p> <hr/>
Waste reduction	<p>If any local government or other person will send more than 75,000 tons of solid waste per year to the disposal site, submit a copy of the person's plans for implementing a waste reduction program.</p> <hr/>
Other permits	<p>Identify any local, state, or federal permits, in addition to the Solid Waste Disposal Site Permit, that will be required for the proposed facility or expansion. If the permit has been granted, include a copy of the permit. If the permit has been previously applied for but not yet granted, include a copy of the permit application.</p> <p><u>Examples:</u> Corps of Engineers Section 404 permit; NPDES permit</p> <hr/>

Statement of need	Submit a statement clearly demonstrating the need for the new or expanded facility. For the renewal of a permit for an existing facility, the statement should relate to the continuing need for the facility. The statement of need should address the following criteria: <ul style="list-style-type: none">• the availability and capacity of alternative disposal sites or resource recovery systems and facilities• the relationship of the permit application to current or proposed state and local solid waste management plans for the affected area• the existence of contracts for disposal of waste at the proposed site• the potential costs of shifting to available alternative sites and the proximity of such sites, and• the ability of the proposed site to comply with statutory and regulatory requirements
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5.10 Additional Resources

References	U.S. EPA <u>Solid Waste Disposal Facility Criteria Technical Manual</u> . November 1993
	Washington D.O.E. <u>Solid Waste Landfill Design Manual</u> . June 1987.
