4.2-1

FINAL

KENT HIGHLANDS LANDFILL

WASHINGTON STATE
Department of Ecology
TOXICS CLEANUP PROGRAM
Northwest Regional Office
Bellevue, Washington 98008

CLEANUP ACTION PLAN

APRIL 1992

SIT 4.2

DECLARATIVE STATEMENT

Consistent with Chapter 70.150D RCW, "Model Toxics Control Act", as implemented by Chapter 173-340 WAC, "Model Toxics Control Act Cleanup Regulation", it is determined by Ecology that the selected cleanup actions are protective of human health and the environment, attain Federal and State requirements which are applicable or relevant and appropriate, comply with cleanup actions and provide for compliance monitoring. The cleanup actions satisfy the preference expressed in WAC 173-340-360 for the use of permanent solutions within a reasonable time-frame, and consider public concerns raised during public comment on the draft Cleanup Action Plan.

Furthermore, it is Ecology's opinion that the selected cleanup actions are consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300) and that they meet the CERCLA preference for a remedy that reduces toxicity, mobility and volume. Final authority regarding the consistency of the selected cleanup actions with the National Oil and Hazardous Substances Pollution Contingency Plan rests with the US Environmental Protection Agency.

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April 30, 1993
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TABLE OF CONTENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or relevant and appropriate requirements
ASIL	Acceptable source impact levels
BACT	Best available control technology
BMPs	Best management practices
BOD	Biochemical oxygen demand
Btu	British thermal unit
CAP	Cleanup Action Plan
CAR	Closure Action Report
CERCLA	Comprehensive Environmental Response, Compensation,and Liability Act
cfs	Cubic feet per second
COD	Chemical oxygen demand
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FR	Federal Register
GRMA	Green River Management Agreement
HELP	Hydrologic Evaluation of Landfill Performance
HPA	Hydraulic Project Approval
KCSWR	King County Solid Waste Regulations
MCL	Maximum contaminant level
METRO	Municipality of Metropolitan Seattle
MFS	Minimal Functional Standards for Solid Waste Handling

µg/l	Micrograms per liter
MSW	Municipal solid waste
MTCA	Washington Model Toxics Control Act
NAAQs	National Ambient Air Quality Standards
NCP	National Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGVD	National geodetic vertical datum
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
POTWs	Public-owned treatment works
PSAPCA	Puget Sound Air Pollution Control Agency
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SCFM	Standard cubic feet per minute
SR	State Route
TBC	Standard To Be Considered
TCLP	Toxicity characteristic leaching procedure
TSS	Total Suspended Solids
VOC	Volatile organic compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

I. INTRODUCTION

Chapter 1
Introduction

1.1 Cleanup Action Plan

Purpose

This document presents the Final Cleanup Action Plan (CAP) for the Kent Highlands Landfill, Kent, Washington. This documentation is required by the site cleanup process established by the Washington Department of Ecology (Ecology) under Chapter 173-340 WAC, "Model Toxics Control Act--Cleanup Regulation," and meets requirements specified in WAC 173-340-360(10), Draft Cleanup Action Plan.

It is also Ecology's opinion that this documentation will satisfy the site remediation process specified in the Superfund Memorandum of Agreement between Ecology and EPA for Ecology lead sites which are on the National Priorities List.

The purpose of the CAP is to:

- Summarize the alternative cleanup and closure actions evaluated in the Closure Action Report (CAR)
- Describe the selected cleanup and closure actions from the alternative cleanup and closure actions and the rationale used to select the actions, and
- Provide a document through which public comment may be solicited regarding the selected cleanup and closure actions.

Scope

The CAP presents the site description and history, then summarizes the results of the remedial investigation. These results are described in detail in "Remedial Investigation Report, Kent Highlands Landfill, Closure and RI/FS, Kent, Washington" (CH2M-Hill, 1991a). They are summarized herein to provide background information pertinent to the remainder of the document.

The CAP also presents the alternative actions evaluated for the cleanup and closure of the landfill. These alternative actions are described in detail in the "Closure Action Report, Kent-Highlands Landfill, Kent, Washington" (CH2M-Hill, 1992a).

The rationale and evaluation criteria for the proposed actions are presented for the selected cleanup and closure actions.

Applicability

This Cleanup Action Plan is applicable only to the Kent Highlands Landfill site. The cleanup and closure actions have been developed as an overall remediation process conducted with Ecology participation.

The Cap and the Cleanup Process

The CAP is one in a series of documents used by Ecology to monitor progress of site investigation and cleanup.

The RI and CAR documents present the results of investigations into the nature and extent of contamination at the landfill, assesses the risk posed by that contamination, and evaluate the feasibility of alternative methods of cleaning up the landfill. The investigations, assessments, and evaluations were performed according to Ecology approved work plans which were incorporated into a Consent Order signed in May 1987 under the authority of RCW 90.48 the Water Pollution Act. The Consent Order requires that all activities conducted pursuant to its terms be consistent with the NCP. The Consent Order was entered in Superior Court after a public review and comment period.

The City of Seattle has completed the landfill investigations, assessments, and evaluations and submitted them in Remedial Investigation (RI) and CAR documents which have been reviewed and approved by Ecology .

The CAP sets forth functional requirements for cleanup and closure of the landfill for the affected environmental media (soil, ground water, surface water, , and air).

Other documents to be developed for the cleanup and landfill closure are:

- Engineering Design Reports, Construction Plans and Specifications to provide the necessary technical drawings and specifications to allow a contractor to implement the cleanup and construct the closure actions for the landfill.

- As-built drawings and documentation of any changes or modifications that were necessary during the course of constructing the closure actions.

- The Operation and Maintenance Plans to present technical guidance and regulatory requirements to assure effective operations under both normal and emergency conditions.

- Compliance Monitoring Reports include results of protection monitoring to confirm that human health and the environment are adequately protected during the construction and the operation and maintenance period of the closure action; performance monitoring, to confirm that cleanup and closure action have attained performance standards; and conformational monitoring, to confirm that long-term effectiveness of the cleanup and closure action.

1.2 Site Description and History

The site is located in the City of Kent, approximately 14 miles south of the City of Seattle (Figure 1-1). The site encompasses about 100 acres, of which approximately 60 are filled with refuse. The site is bounded on the east by Frager Road, which parallels the Green River, on the south by State Route (SR) 516, on the west by commercial business property and vacant land along Military Road, and on the north by vacant land that was formerly the site of a sand and gravel pit operation and that has been acquired by the City. Residential neighborhoods are located south of SR 516 (see Figure 1-2).

The landfill lies within what once was a deep ravine that sloped downward, generally west to east, toward the Green River. The floor of the ravine was poorly drained and swampy with a thick cover of brush and trees. A stream also flowed through the ravine. It was fed by springs along the foot of the northern slope and by runoff that drained into the ravine from the higher ground to the west. The stream flowed out of the ravine into Midway Creek, which then flowed into the Green River.

As the ravine was filled, offsite surface water from the south, north, and west was diverted in ditches and pipes around the site to the east. Onsite stormwater now drains to ditches along the north and south sides to the detention ponds located on the lower eastern part of the site, and ultimately to the Green River.

Waste disposal at the site began in 1968. Solid waste was placed in lifts and covered with soil taken from a borrow area north of the landfill. Landfilling started at the bottom of the ravine at the east end of the site and continued to fill the entire ravine, leaving a terraced slope at the east end of the site. Landfilling stopped in December of 1986.

Piping was installed along the walls of the ravine to intercept groundwater springs. Piping was also installed to collect leachate. This piping was eventually covered by waste and now drains leachate into a pretreatment aeration pond at the east end of the site. The pretreated leachate is discharged via a force main to the Metro sewage system.

Landfill gas is collected by vent pipes installed in the landfill during filling. Most of these pipes are now connected to a forced exhaust system that discharges the gas to flares at two locations near the western and northern edges of the site. Gas migration west of the site was detected in 1984 and was brought under control with a series of perimeter gas extraction wells installed in native soils along the site perimeter. This system has been extended along the north and south sides of the landfill. No gas migration has been detected to the east of the site or south of SR 516.

In 1984 potential hazardous waste site preliminary assessment was performed by the U.S. Environmental Protection Agency (EPA) under its hazard ranking system. In April 1987, Seattle completed an initial plan and Environmental Impact Statement (EIS) for the closure of the landfill.

In 1990, after a subsequent evaluation, the site was placed on the national priorities list (NPL) for cleanup because of the presence of an unknown quantity of hazardous waste at the site. Recognizing their responsibility to conduct the investigations necessary to close the landfill, the City entered into a consent order with Ecology on May 26, 1987, that called for the city to conduct a remedial response program, consistent with the National Contingency Plan (NCP), beginning with a remedial investigation (RI).

1.3 Conclusions of Studies Conducted at the Site

The evaluations conducted in preparation for the Closure Action Report are based on information obtained from a series of studies, the major one being the RI completed in June 1991(CH2M-Hill, 1991a). The conclusions of these studies are summarized briefly below.

The vast majority of waste delivered to the site was municipal waste. Less than 0.5 percent of the total waste delivered to the site was industrial-type waste, and probably only very small quantities of hazardous waste were ever delivered to the site.

Leachate is present within perched zones in the landfill. A site water balance based on its hydrologic and hydrogeologic characteristics suggests that some of the leachate generated within the landfill is not collected in the leachate collection system and migrates into the groundwater. Leachate analyses showed typical concentrations of chemical oxygen demand (COD), metal salts, volatile organic compounds (VOCs), and other parameters for municipal landfills. Leachate contamination of the groundwater downgradient of the refuse fill is very slight. No indications were found in groundwater of leachate contamination (concentrations above primary drinking water standards) migrating offsite.

No effects of the landfill on water quality in samples collected from the Green River were observed. Water quality in Midway Creek, which flows through the extreme eastern end of the site, appears to be degraded by contaminants originating from urban runoff upstream of the landfill. Concentrations of some metals in Midway Creek increased downstream of the site, but the concentrations were within surface water quality standards and toxicity criteria. Similar conclusions were drawn with regard to sediment samples taken from the Green River and Midway Creek. A biological investigation revealed that fish and other aquatic life on the site in Midway Creek do not show any abnormalities; Midway Creek provides a rearing habitat for juvenile salmonids and other species.

Subsurface offsite gas migration has occurred, primarily on the north and west sides of the landfill. Gas migration has not occurred to any significant extent east of the site or south of SR 516 because of subsurface hydrogeologic conditions that prevent gas migration. Gas migration to the west of the site has been controlled. North of the site, landfill gas has migrated onto vacant land owned by the City of Seattle. Air dispersion modeling of gas venting from the surface of the landfill indicates that estimated concentrations of trace gas compounds at the landfill boundaries do not exceed acceptable source impact levels set by the state.

A human health and environmental risk assessment based on the Remedial Investigation results indicated that exposure scenarios developed would result in estimated excess lifetime cancer risk for existing site conditions that are within the range that EPA and Ecology consider to be protective of human health. Future condition scenarios are not anticipated to present any greater risks than existing conditions. The environmental assessment indicated that natural ecosystems do not appear to be adversely affected by the landfill.

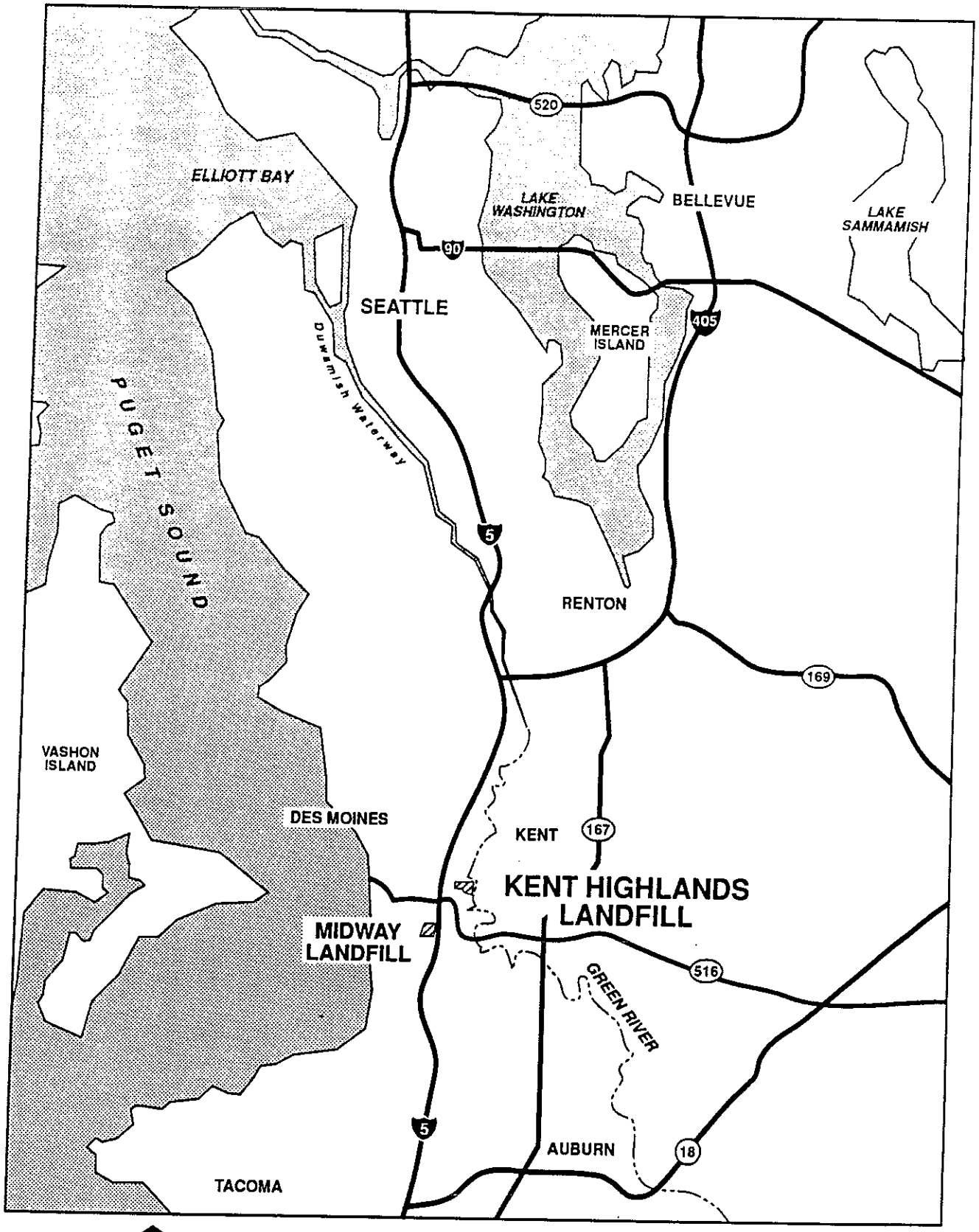
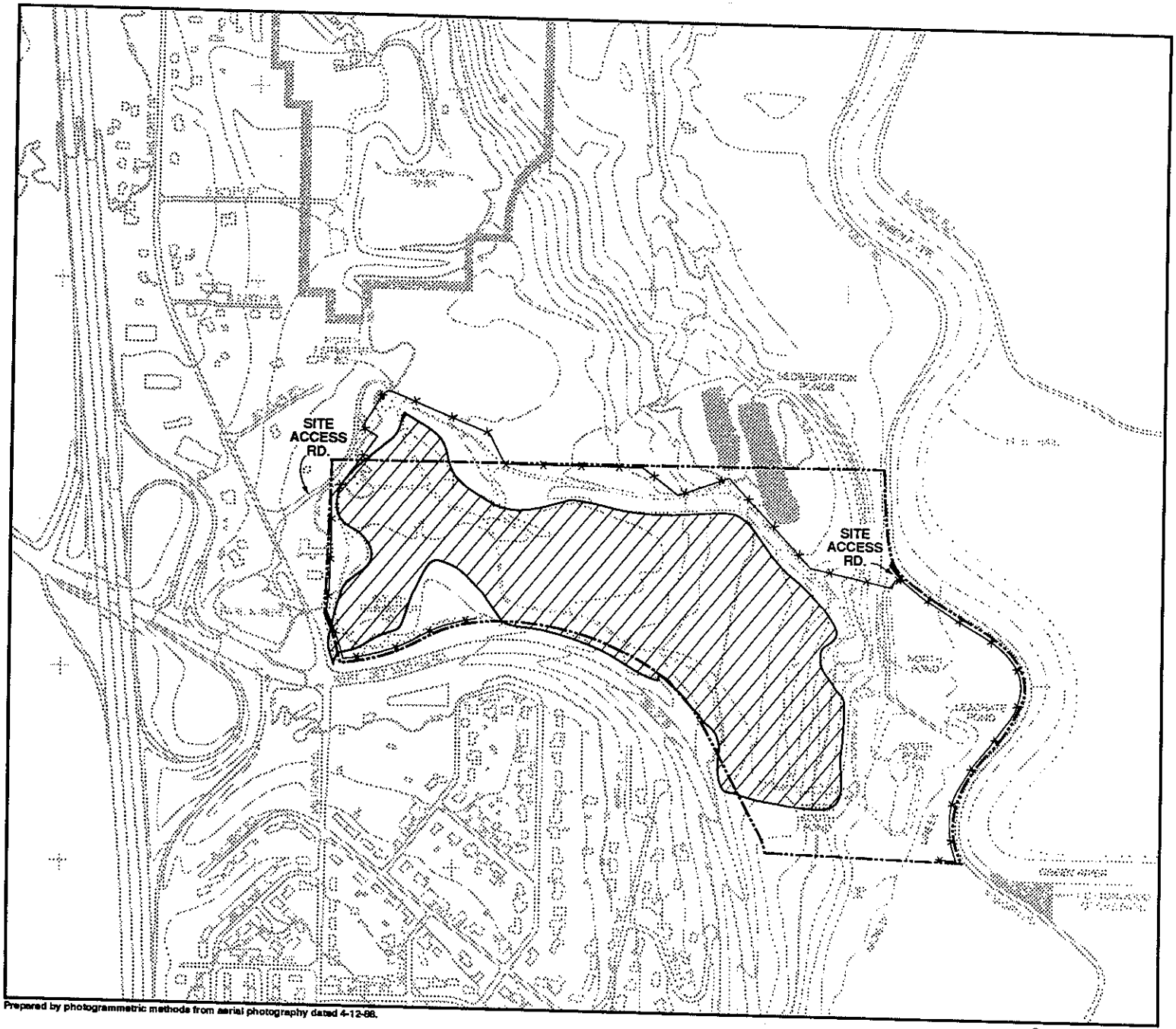


Figure 1-1
Regional Vicinity Map

Source: CH2M HILL, 1992a



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

LEGEND

- Approximate site boundary
- Approximate refuse limits
- Fence line
- Dirt roads

N

0 100 200 500
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

Figure 1-2
Local Site Map

II. PROPOSED CLEANUP AND CLOSURE ACTION

Chapter 2
Proposed Cleanup and Closure Action

2.1 Refuse

Access Controls

A site fence, consisting of a 6-foot-high chain link fence with locking gates, will form the primary access control. Additional control is provided by natural impediments. Signs will be posted at the two site entrances in accordance with Minimum Functional Standards (MFS) requirements. Additional fencing will be installed within the site around the permanent flare facility. Fencing exists around the leachate treatment area at the east end of the site.

Refuse Outside Property Boundary

Based on cost-effectiveness and the cover's ability to meet all other criteria, waste that extends beyond the property boundary in Areas 2 and 3 (Figure 2-1) may either be covered in place, using the same final cover concept as selected for onsite waste, or may be excavated and disposed of onsite within the area where additional fill is needed for final grading. Covering the waste in place is more cost-effective than excavation. Cost of easements for covering in place have not yet been determined and may affect the relative cost-effectiveness of covering in place versus excavating the waste. No Action is proposed for handling the off-site refuse in Area 1 since the material is inert construction debris.

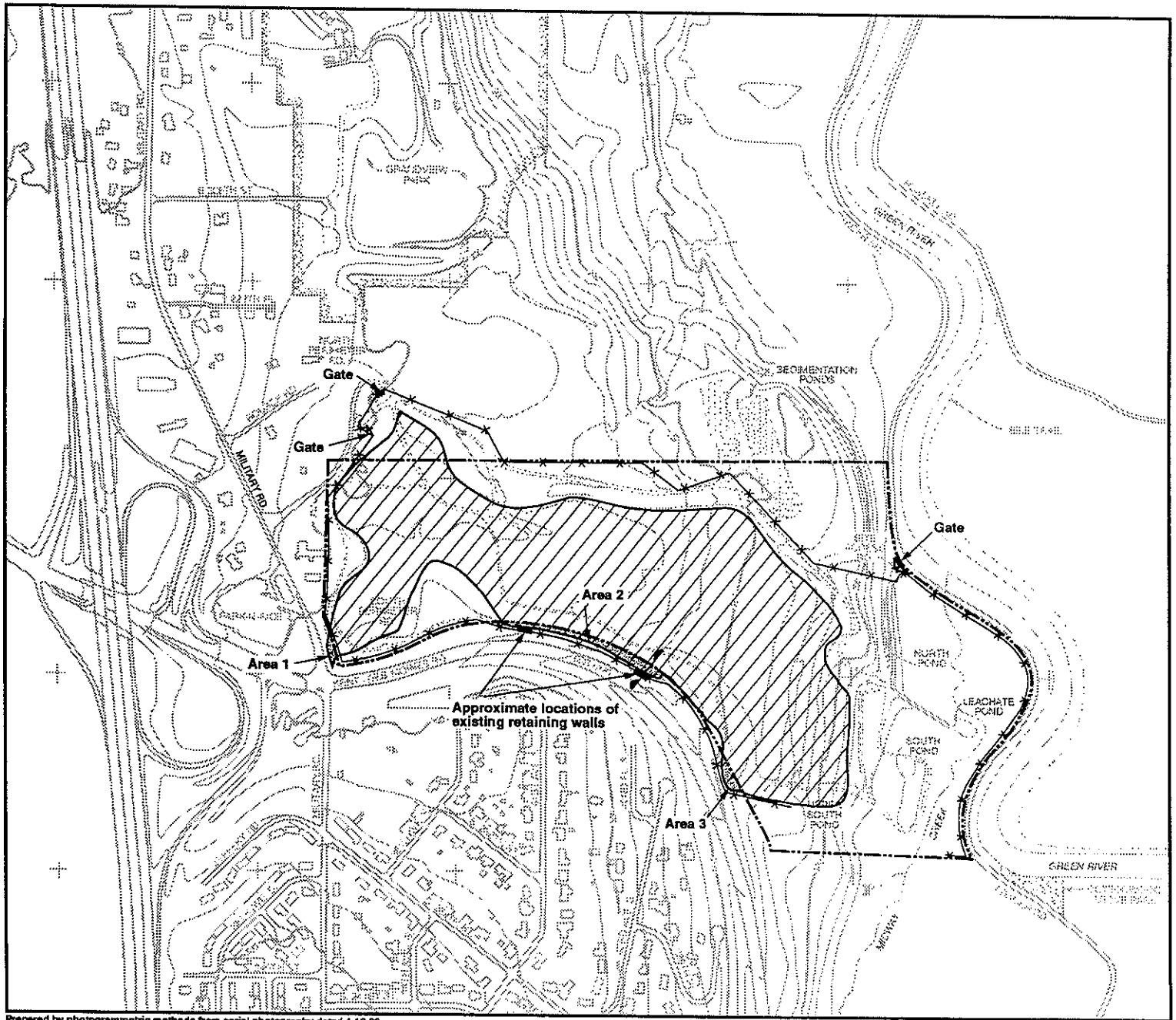
Site Grading

The site grading concept shown in Figure 2-2 will be constructed prior to placement of final cover in order to achieve adequate drainage slopes. Grading will require approximately 250,000 cubic yards of fill material. Some of this material will be obtained from the stockpile on City-owned property north of the site. The balance of the fill material will be imported. The North Pond and Upper South Pond will be filled as part of final site grading.

Landfill Cover

Four of the five cover concepts evaluated comply with MFS final cover requirements. These cover concepts are presented in Chapter 4.

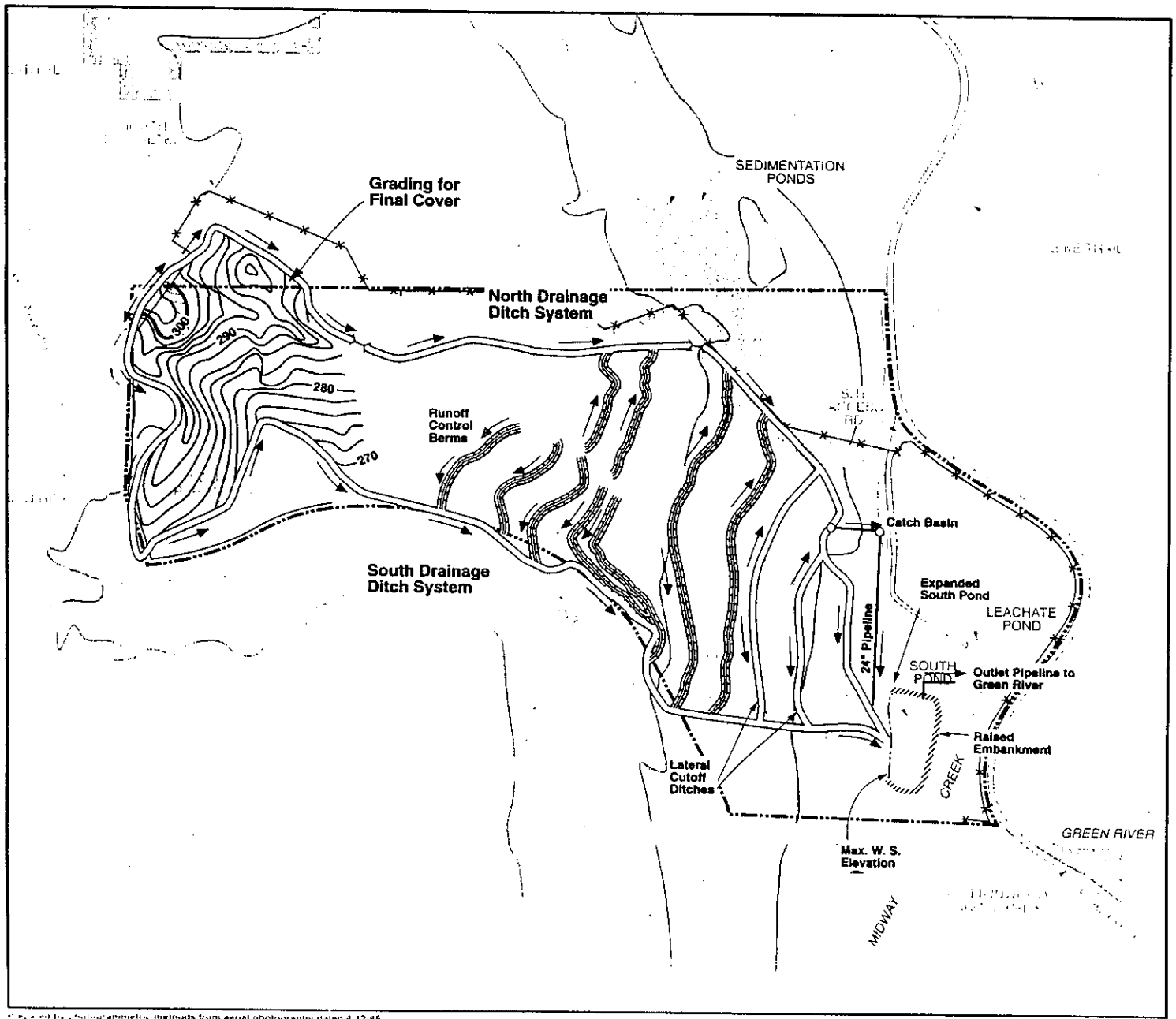
Concept 5 (geomembrane cover with drainage layer) and Concept 4 (low-permeability soil cover with geomembrane and drainage layer) are both expected to perform very well with hydrologic efficiencies of greater than 99 percent. Concept 5 is preferred since it costs less, is easier to construct and maintain, will probably incur fewer maintenance costs, and is estimated to protect groundwater sufficiently at the point of compliance.



Prepared by photogrammetric methods from aerial photography dated 4-12-96.

Source: CH2M HILL, 1992a

Figure 2-1
Refuse Limits



LEGEND

- Approximate site boundary
- Fence line
- Rocked roads
- Ditch
- Runoff control berm
- Flow direction

Note: Actual location of ditches may be revised depending on the technology option(s) selected for offsite refuse areas.

N

0 100 200 500
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

* Prepared by photogrammetric methods from aerial photography dated 4-12-88

Source: CH2M HILL, 1992a

Figure 2-2
Final Cover Grading and Drainage System

Concept 3 (low-permeability soil cover with drainage layer) meets MFS requirements and has a drainage layer, but it achieves a 86 percent efficiency, lower than either concept 4 or 5, and a cost-sensitivity analysis shows that Concept 3 will not be less expensive than Concept 5 unless the low-permeability soil layer can be constructed for less than $9.00 per cubic yard. This is unlikely given typical costs of the required low-permeability materials in the Puget Sound area.

Concept 2 (Minimum Functional Standards Soil Cover) achieves an 88 percent efficiency and meets the minimum requirements of MFS for final cover. However it does not include a drainage layer. This would result in severe erosion of the topsoil layer during high-volume runoff events, which makes this option unacceptable.

Concept 1 (Final Site Grading Only) does not meets the minimum requirements of MFS for final cover, and therefore is not a preferred alternative.

Based on the evaluations described above, installing a final cover system based on the geomembrane and drainage layer concept described above as Concept 5 is the optimal final cover concept for this site. Concept 5 is the recommended final cover concept. Concept 5 has proven to be an effective, low-maintenance final cover system at other Municipal Solid Waste (MSW) landfill sites.

Within the topsoil layer, compost and possibly biosolids (sludge) from METRO will be used as a topsoil amendment. Compliance with technical specifications and availability will be evaluated during final design.

2.2 Surface Water Controls

Surface Water Conveyance System

The proposed surface water conveyance system consists of a perimeter ditch system that conveys runoff from the final cover to the South Pond at the eastern end of the site. The site grading plan was designed to allow creation of a single continuous perimeter ditch with a divide at the west end of the site. Based on the final cover concept selection discussed above, the surface water conveyance system will be the system sized for a cover with a drainage layer.

Runoff control berms and ditches will be constructed to intercept sheet flow runoff and divert it to the perimeter system in order to prevent erosion that would otherwise result from sheet flow on the steep slope, and large areas.

Surface Water Detention Facility

In compliance with the substantive requirements of the Green River Management Agreement (GRMA), as well as detention requirements of the City of Kent and the Washington Department of Fisheries, the following recommendations are made as the basis for design of the South Pond stormwater detention improvements for final landfill cover conditions (CH2M HILL, 1992b and 1992c):

1. Expand the existing South Pond to provide a minimum of 5.7 acre-feet of active detention storage volume by raising and extending the existing embankments.

2. Provide an emergency spillway with capacity to pass at minimum the 100-year, 24-hour design storm overflow over the raised east embankment of the South Pond. The spillway crest elevation corresponding to the recommended minimum detention storage requirement is approximately 35.6 feet NGVD. Provide a minimum of one foot of embankment freeboard above the spillway water surface elevation corresponding to the spillway design storm flow (minimum embankment elevation of approximately 37.5 NGVD).

3. Enlarge the outfall pipeline to 24-inch-diameter for the existing 12-inch- diameter section (approximately 320 feet in length). Verify the condition/ improvement needs of the existing 24-inch section. Provide improved surface withdrawal outlet controls at the South Pond outlet for connection to the replacement pipeline.

4. Install a flap gate on the improved outfall pipeline (in the existing manhole) to prevent Green River backflow to the South Pond during high river stages. Install a slide gate at the pond outlet to provide positive shutoff of flows from the South Pond to the Green River at river stages corresponding to flows in excess of 9,000 cfs.

The expanded detention facility would provide detention for the recommended cover alternative without discharge through the emergency spillway for Green River flow conditions. The recommended storage volume would provide 4.2 acre-feet of additional storage, which is the incremental increase in runoff volume from 1988 (pre-existing) to final cover conditions for the recommended cover alternative.

The preferred alternative for expansion of the south pond requires placement of fill in an area that may be designated as wetland. The extent of wetlands west of the existing pond is approximately 15,150 square feet. The approximate area within the wetlands requiring fill for the expansion of the pond is 1,200 square feet (CH2M-Hill, 1993). The potential impact is minimal and there is no practicable alternative to expansion of the south pond which is necessary to meet flood control requirements. Therefore, no mitigation is proposed. However, measures to protect wetland areas will be implemented during construction.

Water Quality

Vegetated ditches in the surface water conveyance system and the sedimentation control function of the South Pond will provide water quality control for surface water discharges.

2.3 Leachate Collection System

Collection System

The existing leachate collection system properly protects human health and the environment. System inspection, maintenance and repair actions are recommended. Accomplishing these work items would maintain the system at its current efficiency. These items are properly categorized as maintenance activities. There would not be any enhancement or expansion of the collection piping network, except for connection of the seep collection system.

The subcover seep collection system would be constructed as part of the final cover system design. A seep collection system may be required in the North Pond area.

Treatment and Discharge System

Two treatment and discharge system options have been presented;

- Continued pretreatment of the combined toe buttress, south leachate, and spring drain flows from the landfill and discharging it to the Metro sanitary sewer

- Construction of a new treatment facility to treat the spring drain flow only and discharge it to the Green River. This would also require continued operation and maintenance of the existing pretreatment and discharge system for the reduced flow collected from the toe buttress and south leachate collection sub-systems

Construction of a separate spring drain treatment and discharge system was not seen to be cost-effective. The use of the existing pretreatment system with discharge to Metro is recommended.

2.4 Landfill Gas

The proposed landfill gas control system consists of an interior gas collection system designed to extract gas directly from the landfill and a perimeter ring of extraction wells in native soils designed to capture gas migrating away from the sides of the landfill and to prevent further migration with a vacuum "barrier".

The interior collection system will be a combination of the existing system of riser pipes protruding from buried piping and trenches in the landfill, new deep gas extraction wells (average depth 115 feet), and gas extraction trenches in the shallow parts of the landfill on the west end of the site. Approximately 50 perimeter extraction wells (including 39 existing perimeter wells), 30 new deep interior wells, 1,000 feet of new gas extraction trench, and the approximately 100 existing interior extraction risers are proposed to be included in this system.

The interior gas collectors will be connected by manifold piping that will be placed within the final cover layers but above any geomembrane. The perimeter wells will be connected by a similar but separate manifold pipe so that perimeter flows and interior flows can be kept separate, for potential gas utilization.

Gas disposal will be accomplished by thermal incineration using enclosed flares that will be constructed at the toe of the east slope of the landfill. Mechanical exhausters will draw gas through the collection system manifold piping and discharge it to the flares.

Landfill gas present in the soil north of the site that has migrated beyond the range of the perimeter gas control system will be extracted using a system of wells separate from the on-site system. Gas disposal will be accomplished by activated carbon adsorption.

Gas utilization by either sale to a local customer via a dedicated pipeline or on-site generation of electric power is potentially economically feasible according to a preliminary analysis performed by the City. The City has solicited interest from private parties who may be interested in investing in an energy conversion project. If a gas utilization project proceeds, the flare facility will be maintained in order to handle gas during any times when the energy recovery facilities are not operating.

III. COMPLIANCE AND MONITORING REQUIREMENTS

Chapter 3
Compliance Monitoring Requirements

Compliance monitoring requirements have been identified based on ARARs and the closure action requirements presented in Chapters 9 and 11. These requirements address the quality of onsite media, integrity of physical controls, reporting requirements, and procedures for response when monitoring results are outside allowable limits. Compliance monitoring requirements have been identified for the following media:

- Groundwater
- Surface water
- Landfill gas (subsurface and flare emissions)
- Leachate

The current regulatory requirements, existing monitoring program, and proposed monitoring program are addressed for each of these media. Contingency procedures that address reporting, documentation, emergency monitoring, and triggers for corrective action, are presented as appropriate.

3.1 Groundwater

Regulatory Requirements

The Washington State Minimum Functional Standards for Solid Waste Handling (MFS), Chapter 173-340 of the Washington Administrative Code (WAC 173-304), and the King County Solid Waste Regulations (KCSWR) (also known as the Code of the King County Board of Health Title 10) specify the requirements for groundwater monitoring and corrective action.

Proposed Monitoring Program

A draft Groundwater Monitoring Program (CH2M Hill, 1991c) was developed by the City of Seattle Solid Waste Utility based upon the hydrogeologic conditions as defined by the Remedial Investigation (CH2M Hill, 1991a) and regulatory requirements for groundwater monitoring specified by MFS and KCSWR. This program was submitted to Ecology and the Seattle-King County Department of Public Health in December 1991. The Seattle-King County Department of Public Health and Ecology responded to the draft Groundwater Monitoring Program in letters to the Seattle Solid Waste Utility dated July 12, 1992, and March 4, 1993, respectively.

The final groundwater monitoring program will be developed after discussions with the Seattle Solid Waste Utility. The final program will be based upon the requirements of MFS and KCSWR.

3.2 Surface Water

Regulatory Requirements

The National Pollutant Discharge Elimination System (NPDES) requires that any point source discharge of stormwater attain effluent limitations that are established for the site. The federal program is implemented by the state through the NPDES Permit Program (WAC 173-220).

Existing Monitoring Program

No surface water monitoring program is currently in place because no determination has been made by Ecology on the compliance monitoring requirements applicable to the site. The surface water control system onsite includes a point source discharge from the South Pond to the Green River. The discharge structure at the South Pond allows discharge to the Green River when the water surface elevation of the pond is at elevation 30.4 NGVD or above. Sampling locations are accessible at the outlet from the South Pond Monitoring of this stormwater discharge may be required as part of the NPDES program.

Proposed Monitoring Program

A surface water monitoring program will be developed in accordance with the implementation of the Ecology NPDES Baseline General Permit for storm water associated with industrial activities.

3.3 Landfill Gas

Regulatory Requirements

Compliance monitoring requirements have been identified for subsurface landfill gas migration and emission of landfill gas into the ambient air. Federal regulations, Solid Waste Disposal Facility Criteria (40 CFR 258.23), specify that a routine methane monitoring program must be implemented to ensure the following:

- The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit (i.e., at the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure) for methane in facility structures (excluding gas control or recovery system components)

- The concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary

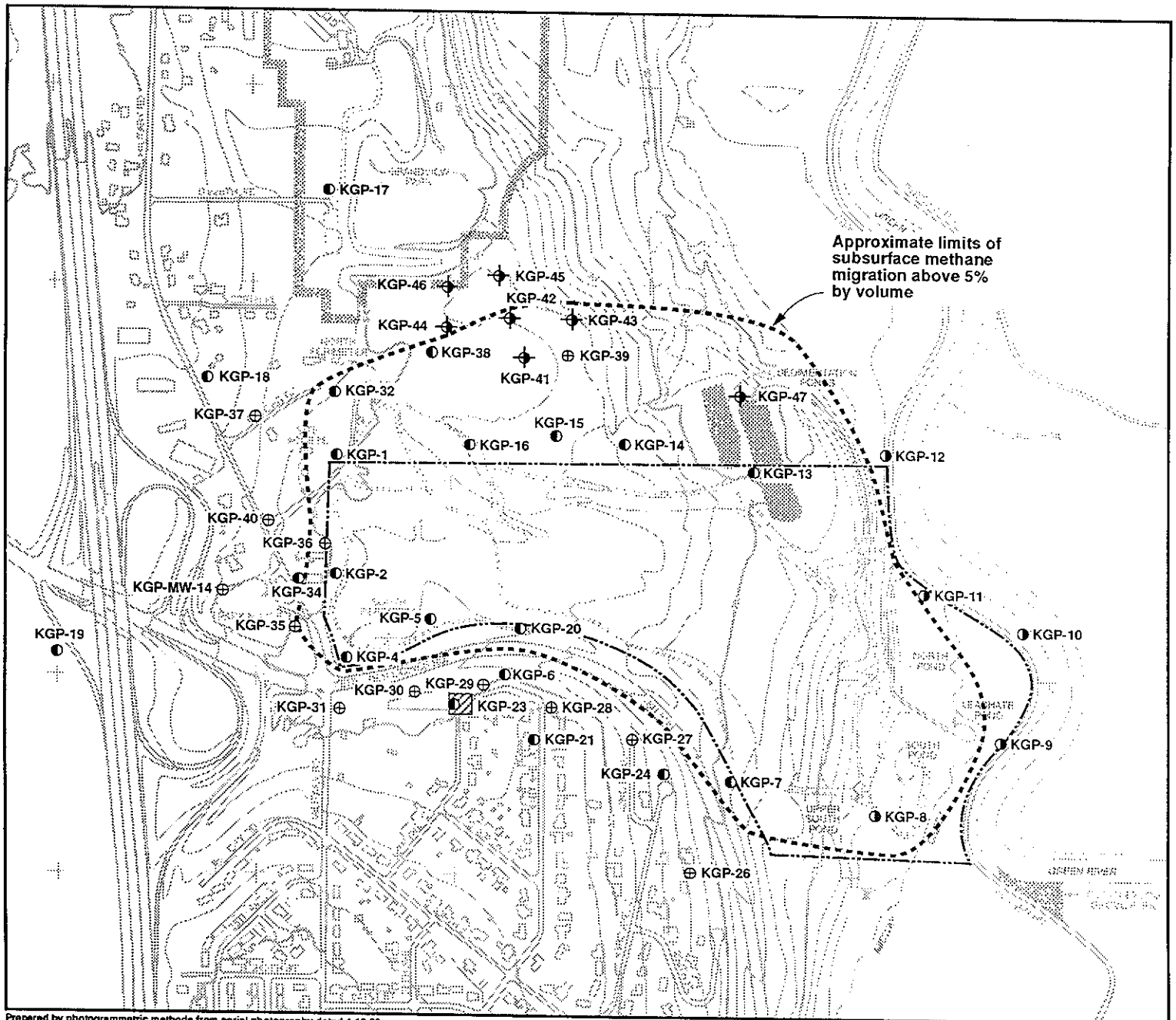
The type and frequency of monitoring must be determined based on site specific conditions although a minimum of quarterly monitoring is required. The site specific conditions are soil, hydrogeologic, hydraulic, and location of the facility structures and property boundaries. MFS does not require a monitoring program although it does require that the explosive gas performance standards are met.

In addition to the two performance standards listed above, MFS specifies that the concentration of hydrocarbons (expressed as methane) shall not exceed one hundred parts per million by volume in offsite structures. King County Solid Waste Regulations (KCSWR) requires development and implementation of a sampling and testing program to monitor gas production and migration, in accordance with the performance standards. The local health officer must approve the program. Reporting the results of the monitoring program is not required under the KCSWR regulation.

RCRA (Subtitle D), MFS, and KCSWR specify that the gas collection and disposal system must not cause an exceedence of any air quality criteria, including criteria pollutants regulated under the Clean Air Act, as amended. The Puget Sound Air Pollution Control Agency (PSAPCA) is a regional body authorized by Ecology to implement the Washington Clean Air Act. For new emission sources constructed onsite or modifications of existing sources, air monitoring is required to demonstrate that the acceptable source impact levels (ASILs) and ambient air quality standards are being met. The regulations do not specify explicit monitoring and reporting requirements.

Existing Monitoring Program

The migration of subsurface landfill gas is monitored by testing approximately 48 subsurface gas probes, located around the perimeter of the site, on a regular basis. The locations of these gas probes are shown in Figure 3-1.



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

LEGEND

- Approximate site boundary
- Pre-existing gas probe cluster
- Pre-existing shallow gas probe
- Gas probe cluster installed for RI
- Area in which KGP-23 probe array (13 probes) is located
- Gas probe cluster installed after RI

Note: All locations shown are approximate.

N

0 100 200 500
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

Figure 3-1

Gas Probe Locations and Extent of Gas Migration

Eleven of these probes are shallow, single level gas probes 37 are multiple level (double or triple) probes designed to allow sampling gas from the soils at different discrete depths. The probes are tested for combustible gas concentration and pressure in the soil pore space. Portable combustible gas meters with internal pumps are used to extract samples of subsurface gas from the probes and measure combustible gas concentrations. Portable pressure gauges are used to measure pressures in the probes.

Probes that have shown combustible gas concentrations consistently below the lower explosive limit are monitored on a monthly basis. Those probes that have shown combustible gas concentrations above the lower explosive limit within the past year are tested on a weekly basis. The testing results are evaluated for determining changes in the quality and quantity of subsurface gas migration. Modifications to the program are made if dictated by the testing results. The Seattle Solid Waste Utility retains copies of all testing results.

If combustible gas is detected above the lower explosive limit in subsurface gas probes near a structure, then monitoring offsite structures is triggered. Decisions to monitor offsite structures are made on a case-by-case basis, in accordance with the procedures specified in the Combustible Gas Monitoring Program (CH2M-Hill, 1992a, Appendix D), adopted by the City of Seattle Solid Waste Utility in 1989. Structure monitoring is done using an instrument which can measure combustible gas concentrations down as low as 1 ppm by volume. The program specifies action levels and contingency procedures.

Proposed Monitoring Program

The existing program exceeds the compliance monitoring requirements and will be maintained during final design and construction of closure facilities. Upon completion of closure facilities and with continued stabilization of the landfill, the monitoring program will be revised to reflect the changing conditions. The program revisions will be submitted to Ecology and Seattle-King County Department of Health for approval. The anticipated revisions are discussed below.

Following completion of the final cover and gas control system and after readings in perimeter and offsite gas probes have stabilized, gas probe monitoring will be reduced to quarterly. If any of the offsite gas probes show combustible gas concentrations above the lower explosive limit, the monitoring frequency will be increased to weekly while corrective actions are undertaken. Some of the offsite gas probes that have never indicated combustible gas concentrations above background may be removed from the monitoring program if approved by Ecology and the Seattle-King County Health Department. Records of monitoring will be kept on file at the City of Seattle Solid Waste Utility. Onsite structures entered by any personnel will be monitored at least weekly for combustible gas concentrations using instruments capable of detecting combustible gases at one ppm or less by volume. The instruments will be swept over all floor slab cracks, any pipe or conduit entry points, and in enclosed spaces within the structures. Records of monitoring will be kept on file at the City of Seattle Solid Waste Utility.

3.4 Leachate

Regulatory Requirements

The Municipality of Metropolitan Seattle (Metro) requires the City to monitor components of the leachate collection and treatment system influent and effluent prior to discharge to its sewer system, in accordance with conditions specified in the City's current Wastewater Discharge Permit.

Influent components to be monitored separately consist of condensate from the landfill gas control system and purge water from groundwater monitoring wells. The landfill gas condensate will be monitored for pH and is required to be neutralized, if necessary, to keep the pH between 5.5 and 12.5 standard units. Purge water from groundwater monitoring wells will be produced quarterly, as a result of the groundwater monitoring program. The purge water currently must be sampled and analyzed both quarterly and annually for various parameters.

Grab samples are collected and the analytical results must demonstrate compliance with permit limitations prior to discharging the purge water into the leachate system.

The monitoring requirements for the effluent from the leachate treatment system currently include continuous flow monitoring and monthly and annual sampling for various parameters.

Grab samples must be taken from the wet well of the leachate collection and treatment system. Samples must be representative of the volume and nature of the reported discharge.

If the results of the monitoring program show an exceedence of an effluent limitation then a written response must be submitted to Metro within 14 days of discovery of the violation or with the monthly report. The written response must include:

- The reasons or causes of the violation(s), if determinable
- The corrective action, as required, to respond to rectification of the violation
- The proposed schedule for preventing a recurrence of the violating condition and for attaining consistent compliance, specifying the plan of action with steps and their completion date

Existing Monitoring Program

The City currently contracts to conduct the required sampling and analysis program. Each month the contractor collects grab samples from the wet well and analyzes these samples for the required parameters. The City submits the contractor's analytical reports and the quantity of wastewater discharged (flow) during that period to Metro.

Proposed Monitoring Program

The existing program will be updated to reflect the additional requirements for disposal of landfill gas condensate and groundwater purge water in accordance with the permit specifications. These requirements were recently issued by METRO in a revised permit (revision date 1/16/92). The compliance monitoring program will be modified to reflect changes in requirements resulting from operational changes and/or from changes resulting from renewal of the Wastewater Discharge Permit in 1994.

3.5 Physical Controls

MFS and KCSWRs require the facility to be regularly inspected to prevent malfunctions and deterioration, operator errors, and discharges that may cause or lead to the release of wastes to the environment or a threat to human health (WAC 173-304-405; WAC 173-304-407; Part V, Section 3). An inspection log that documents the date and time of inspection, observations, nature of repairs or corrective actions, and inspector's signature must be kept onsite and made available to the jurisdictional health department upon request. These requirements will be met by normal operation and maintenance procedures in conjunction with the additional monitoring procedures outlined in this section for physical controls. The physical controls that will be monitored include the landfill cover system, leachate collection system, gas control system, surface water control system, and fencing.

Landfill Cover System

The integrity of the landfill cover system will be monitored by regular visual inspections. Approximately once per week the landfill cover will be visually inspected for the following potential problems:

- Differential settlement
- Erosion
- Exposure of subsurface cover components
- Slope creep
- Dead vegetation

Differential settlement causes depressions in the cover and may damage the cover system by tearing the geomembrane. Records of the inspections and any repairs conducted will be kept on file with the City of Seattle Solid Waste Utility.

Maintenance of the landfill cover system (e.g., reseeding) will be conducted as needed based upon the regular visual inspections.

Surface Water Control System

The conveyance system (e.g., drainage channels) and detention pond will be monitored by regular visual inspections. The surface water control system will be inspected for sediment buildup/blockage and for deterioration. Maintenance (e.g., sediment removal) will be conducted as needed, based on the visual inspections.

Leachate Collection System

A flow monitoring program will be implemented for the purpose of monitoring the performance of the leachate collection system. This program is currently being developed and will include field measurements (e.g., leachate flow and groundwater levels), data analysis procedures, and reporting requirements. The basic monitoring program is summarized in the following paragraphs.

Flow measurements will be taken on a daily basis from the south leachate, spring drain, and toe buttress collection systems. Measurements of the spring drain and south leachate collection system flows will be taken separately at the collection manhole, prior to discharge into the leachate pond. Flow will be measured separately in the toe buttress force main and gravity line.

Groundwater levels will be measured on a monthly basis in the primary aquifers (i.e., Upper Aquifer, Lower Outwash Aquifer) that may discharge to the landfill. Measurements will be taken at approximately 10 to 15 locations to monitor seasonal groundwater gradients.

Local precipitation data will also be either measured onsite or obtained from the nearby weather station at Sea-Tac Airport. Precipitation and groundwater are the primary factors that affect leachate production. Procedures to evaluate the performance of the leachate collection system may include:

- Control charts to distinguish random variability from long-term trends
- Statistics; minimum, maximum, variance, and frequency distribution
- Groundwater quality data to verify changes in collection efficiency

Because leachate production will change as final closure actions are implemented (e.g., cover system), the data evaluation procedures will have to be updated as needed to reflect site conditions.

Gas Control System

The gas control system which consists of collection and disposal components, is currently being constructed in phases and upon completion of the flare facility, an operation and maintenance (O&M) manual will be prepared for the facility. In addition to specific O&M procedures, an overall system monitoring program has been implemented to assess the system performance in controlling the migration of subsurface landfill gas. The existing gas collection system is monitored on a weekly basis by testing the gas extraction points (perimeter wells and interior risers from within the landfill) for gas flow rate, temperature, pressure, and the concentration of combustible gas, carbon dioxide, and oxygen. Adjustments (e.g., flow rate at each extraction point) are made, as needed, to maintain the maximum extraction of gas from the landfill to prevent subsurface landfill gas from migrating beyond the property boundary. The results of the weekly testing and the subsequent system adjustments are kept on file with the City of Seattle Solid Waste Utility.

Monitoring of the completed gas collection system will be conducted in the same manner as it is currently done. Additional perimeter and interior gas extraction wells will be added to the system and these additional wells will be included in the monitoring program. After gas flow rates and the other measured parameters at each gas extraction point have stabilized following installation of final cover, the monitoring frequency will be cut back to an appropriate duration. Installation of a low permeability final cover will make the gas collection system more stable by reducing the likelihood that air will be drawn down through the cover into the collection system. Records of monitoring will be kept on file at the City of Seattle Solid Waste Utility.

The gas disposal system will consist of a permanent flare facility. Operation of the flare facility will include continuous monitoring systems to measure temperature and flame status in each flare, motor vibrations, bearing temperature and voltage overload in each exhauster, flame arrester temperature, and the content of methane and oxygen in the inlet flow gas. Reports of the monitoring and will provide a record of proper system operation.

Emission testing of the flare facility will be done. Inlet and flare exhaust samples will be taken and analyzed in accordance with a plan approved by Ecology and the Puget Sound Air Pollution Control Authority.

Fence

The physical condition of the fence will be monitored by regular inspections. Periodically the fence will be inspected for damage that would compromise the site security. Damage to the fence may occur from fallen trees or vandalism. To maintain site security, the fence will be fixed as needed, based upon the visual inspections.

IV. DEVELOPMENT OF CLOSURE ACTION TECHNOLOGY OPTIONS

Chapter 4
Development of Closure Action Technology Options

This chapter presents a summary of the alternatives and technology options developed for closing the Kent Highlands Landfill in accordance with the closure action requirements presented in Chapter 9. Results of evaluations of these alternatives are presented in the final Closure Action Report (CH2M-Hill, 1992a).

4.1 Refuse

Access Control

Site access control options consist primarily of constructing a site fence with locking gates and signage that provides warning of potential hazards. Approximately 6,540 feet of 6-foot-high chain link fence were constructed around part of the site perimeter in 1989. This fencing includes locking gates. Figure 2-1 shows the location of the planned site perimeter fence. Signs will be posted at the two main site entrances as required by MFS. Fencing with access controlled by a locked gate will also be constructed within the site perimeter around the permanent flare facility. Fencing already exists around the leachate treatment area.

Refuse Outside Property Boundary

Refuse extends beyond the landfill boundary onto City of Kent and Washington State Department of Transportation (WSDOT) property at the southwest corner of the landfill site and at two locations on the south side adjacent to SR 516. These areas are shown in Figure 2-1 and are referred to in this report as Areas 1, 2, and 3, respectively.

The following technology options were evaluated with respect to off-site refuse:

- Excavation of refuse and replacement with soil backfill, with either onsite or offsite disposal of refuse
- Leaving offsite refuse in-place and constructing a final cover over the areas of refuse
- No Action

This technology option consists of excavating the offsite refuse, backfilling the excavation with clean soil to either existing grades or proposed final grades, and disposing the excavated refuse either onsite or offsite. If the refuse were to be disposed onsite, it would reduce the amount of fill material needed to achieve final grades by a volume equal to its re-compacted volume.

Covering Offsite Refuse In Place

This technology option consists of leaving the offsite refuse in place and constructing a final cover over Areas 1, 2, and 3. To implement this technology, permanent easement or right-of-way agreements WSDOT will be required. If the alternative of covering waste is selected, offsite refuse areas would be covered with the same cover system as the landfill site. This cover system consists of a vegetated 8-inch topsoil layer underlaid by an 18-inch drainage layer, a flexible membrane liner, and a 6-inch-thick bedding layer.

No Action

This option consists of leaving the refuse in place with the existing soil cover. No further action would be taken to excavate and dispose of the offsite refuse or to extend the final cover system over the offsite refuse. This option is being considered because the western portion of the site is filled with inert construction debris. This option was evaluated for Area 1 only because Areas 2 and 3 are filled with municipal solid waste.

Four test pits were dug in May 1992 to verify that the Area 1 fill material was inert waste. Visual inspection of the excavated material revealed pieces of concrete bricks, and rocks. In addition, monitoring data from shallow landfill gas probes located in Area 1 show no presence of landfill gas; therefore, waste is not decomposing in this area, and landfill gas is not migrating into this area.

Site Grading

Site Grading for Drainage

The site was evaluated for the need to perform grading to achieve conditions necessary for construction of the final cover and surface water control system. The specific grading criteria are as follows:

1. Excavation should be minimized within the limits of refuse, except for removal of refuse from beyond the property boundary, due to the extra handling measures required and potential short-term impacts.

2. All slopes of the final grade over refuse should be at least 4 percent. This will provide for adequate drainage of the area even with some expected settlement of the refuse. A specific minimum slope criterion of 4 percent over areas filled with refuse was chosen based on experience with other landfill sites. Slopes on refuse-filled areas may decrease over time as the decomposing refuse settles.

3. The desired minimum slope of drainage courses (ditches and pipes) is 2 percent but can be as low as 1 percent in off-refuse areas to provide adequate drainage, especially in areas of potential settlements.

4. The location of existing gas wells, piezometers, access roads, etc., should be maintained. For final cover grading, the gas wells, etc., can be raised if required to meet the other criteria of the grading plan, but this should be minimized to avoid any impacts to these installations.

5. Minimize fill grades extending outside the site boundary to adjacent properties and over vegetated areas to avoid impacts to existing screening.

6. Provide erosion control measures to protect water quality.

The majority of the filling and grading work required to achieve final grade is concentrated in the west end of the site. Detailed descriptions and evaluations of the alternative site grading plans are contained in the *Kent Highlands Landfill Closure Grading and Drainage Plan* (1992c).

The final grading plan, shown in Figure 2-2, conservatively assumes that all offsite refuse will be covered in place. Depending on the offsite refuse alternative selected for each area, modifications to the plan may be required during final design.

Other grading measures proposed for the landfill site includes:

1. Grading to accommodate the new gas flare facility at the toe of the east slope.

2. Filling and grading of the Upper South Pond and North Pond to provide positive drainage offsite or to the drainage system.

3. Miscellaneous grading of the site for required drainage channels, roads, and berms.

4. Miscellaneous grading of the site to produce smooth contours for aesthetics, provide proper drainage, and produce a surface suitable for construction of final cover.

Landfill Slope Stability

In May 1991, a field investigation was conducted to obtain data regarding stability of the steep (up to 2.5 horizontal to 1 vertical) east slope of the landfill. The investigation was undertaken to provide a basis for design of grading and final cover at this part of the landfill.

Five boreholes, ranging in depth from 22 to 119 feet, were drilled through the refuse on the east slope and into native materials below the landfill. Three more boreholes were drilled just east of the toe of the slope. Samples of the materials were retrieved and tested for engineering (moisture content, grain size analysis, Atterberg limits, organic content, and unit weight) and strength properties (consolidation and tri-axial shear strength). Piezometers were installed in the boreholes drilled through refuse, in order to measure the static water level within the landfill, which might affect the stability of the slope.

Water levels in these piezometers were measured monthly for 8 months. The results of the field investigation were used to perform both static and seismic (i.e., response in an earthquake) stability analyses. Both analyses concluded that the slope is structurally stable in its current configuration (CH2M HILL, 1991b).

Landfill Cover

Five concepts were developed for evaluation. These are:

- Concept 1, final site grading only
- Concept 2, minimum functional standards soil cover
- Concept 3, low-permeability soil cover with drainage layer
- Concept 4, composite (low-permeability soil and geomembrane) cover with drainage layer
- Concept 5, geomembrane cover with drainage layer

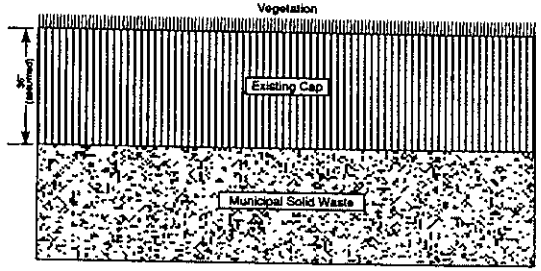
Each of these cover concepts is shown in section view in Figure 4-1 and described briefly as follows. Detailed descriptions are provided in the final Closure Action Report (CH2M-Hill, 1992a). Cover will extend over all municipal solid waste.

Concept 1. Final Site Grading Only

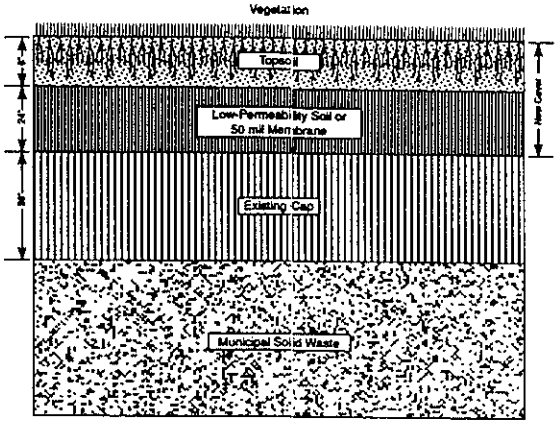
This concept assumes no improvement in preventing infiltration of precipitation compared to existing conditions.

Physically, final grading of the site would involve grading to achieve smooth contours and promote efficient drainage in accordance with the site grading plan discussed previously.

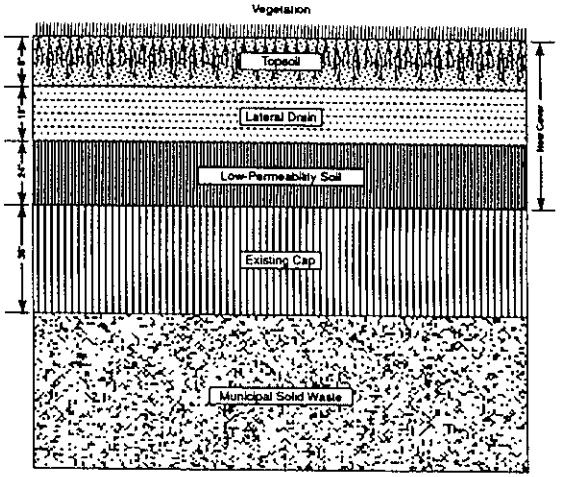
For evaluation purposes, it has been assumed that the regrading of the entire site to provide adequate drainage and smooth the surface topography, the repair of differential settlement areas, and the repair of desiccation cracking would be done. The selected stormwater conveyance system described under Section 4.2, Surface Water, would be constructed. The entire site would then be hydroseeded.



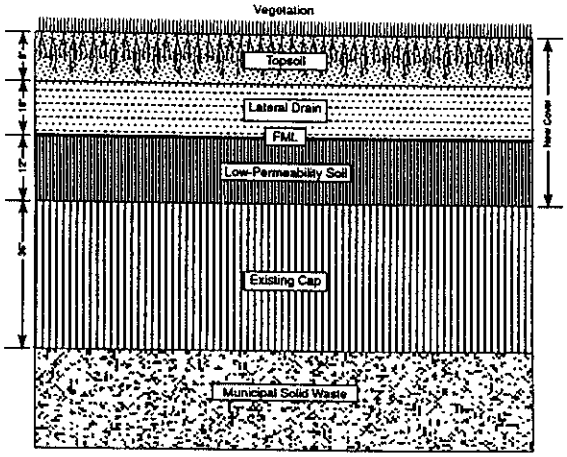
Final Cover Configuration for Concept 1,
Final Site Grading Only



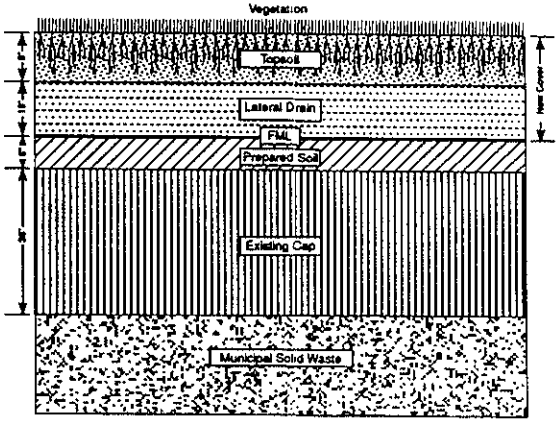
Final Cover Configuration for Concept 2,
Minimum Functional Standards Soil Cover



Final Cover Configuration for Concept 3,
Low-Permeability Soil Cover with Drainage Layer



Final Cover Configuration for Concept 4,
Low-Permeability Soil Cover with Geomembrane
and Drainage Layer



Final Cover Configuration for Concept 5,
Geomembrane and Drainage Layer

Note:
Strip drains, HDPE collector pipes, geogrid, and stormwater collection features not shown for clarity

Source: CH2M HILL, 1992a

Figure 4-1
Final Cover Configurations

Concept 2. Minimum Functional Standards Soil Cover

For this alternative, the minimum requirements of MFS would be met. The requirements for an MFS cover were taken from WAC 173-304-460 (3)(e), which states that the final cover must include either 2 feet of soil having a permeability of 10^{-6} cm/s or less or equivalent membrane of 50m thickness, have slope grades between 2 percent and 33 percent, and have a vegetated topsoil layer at least 6 inches thick. Two feet of soil cover meeting the permeability requirement specified by MFS would be constructed following site grading as described under Concept 1. The selected stormwater conveyance system described under Section 4.2, Surface Water, would be constructed. The entire site would then be hydroseeded.

Concept 3. Low-Permeability Soil Cover with Drainage Layer

Concept 3 represents the minimum MFS requirements, but it also includes enhancements that would be recommended for an actual cover system design for improved effectiveness, stability, and erosion protection.

Several differences exist between this cover and the minimal MFS cover. The topsoil layer is shown 2 inches thicker than the minimal MFS cover in order to provide extra soil thickness over the low-permeability soil for protection from frost.

A drainage layer with strip drains or other drainage enhancement where needed, such as perforated pipes or geonet is included to help remove precipitation that penetrates the topsoil layer and is not removed by evapotranspiration. The drain layer functions to improve cover effectiveness, slope stability, and erosion protection. The drainage layer conveys infiltrating water laterally to the collection system which transports and removes the water from the landfill cover. The drainage layer also serves to prevent erosion and instability by preventing the topsoil from becoming saturated.

Concept 4. Composite (Low-Permeability Soil Cover and Geomembrane) Cover with Drainage Layer

The discussion under Concept 3 applies to Concept 4 as well, except that this concept employs a composite cover consisting of a geomembrane overlying the low-permeability soil layer. A thinner layer of low-permeability soil was assumed compared to Concept 3 since the geomembrane was added. This concept exceeds the MFS requirements. This alternative is considered because a composite cover system consisting of a geomembrane in combination with a low-permeability soil layer offers benefits in addition to those of a low-permeability layer alone. The geomembrane on top of the soil layer acts as a vapor barrier and prevents soil moisture from escaping. This prevents desiccation of the soil which will adversely affect its low-permeability properties.

Concept 5. Geomembrane and Drainage Layer

This concept is similar to concept 3 except that the low-permeability soil layer has been replaced with a geomembrane. The 18-inch lateral drainage layer and the 6-inch layer of prepared soil underneath the geomembrane are not required by MFS; however, the drain layer is important to insure rapid removal of water from soil above the geomembrane. Geomembrane is a relatively slippery, impermeable material; and a poorly draining topsoil placed directly on the geomembrane, which would satisfy the minimum requirements of MFS, would be unstable on steep slopes during a heavy precipitation event because water would build up at the geomembrane-soil interface and act as a lubricant. The 6-inch layer of prepared soil would be necessary to protect the geomembrane from damage by sharp objects on the ground to be covered. This soil could be part of the fill material used for final grading of the landfill.

Cover Concept Performance Analyses

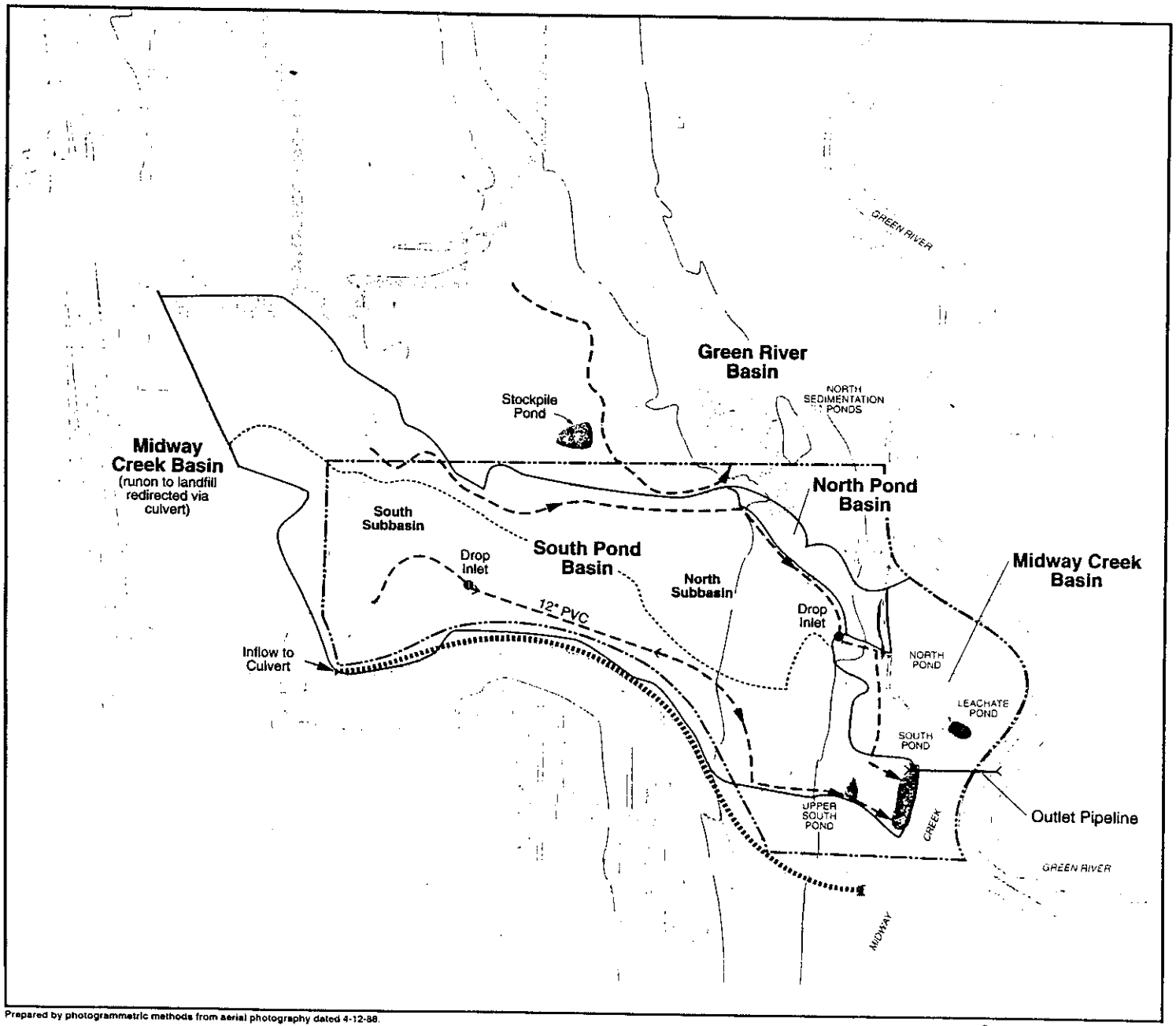
The system for analyzing the five final cover concept alternatives was a three-step process. First, the hydrologic efficiency of each concept was evaluated for conditions at the Kent Highlands site using a model of landfill cover performance (the HELP model) developed by the U.S. Environmental Protection Agency (Schroeder and Peyton, 1988). Then, using the results of the efficiency calculations and other site data, a landfill water balance was computed for each of the final cover alternatives. The water balance results in an estimate of leachate discharged to groundwater on an annual average basis. Finally, the water balance results and concentrations of indicator contaminant parameters found in leachate samples within the refuse were used as inputs to a groundwater contaminant transport model. While the cover efficiencies vary, all of the cover concepts identified are shown to be capable of meeting the groundwater performance standard.

4.2 Surface Water

Existing Surface Water Control System

The components of the existing surface water control system are shown in Figure 4-2.

Most of the landfill site (62 percent of area within the landfill site boundary) currently drains to the South Pond (CH2M HILL, 1992b) and is labeled South Pond Basin in Figure 4-3. The South Pond discharges into the Green River through an outflow pipeline. Runoff from 10 percent of the site (area within the landfill site boundary) drains into the Green River downstream of the landfill either directly or via a channel containing flows originating northwest of the site (Green River Basin). Twenty-three percent of the site drains directly to Midway Creek without interception by the landfill stormwater drainage system (Midway Creek Basin). Approximately 4 percent of the site drains into the North Pond (North Pond Basin). Water collected in this pond is currently pumped to the leachate pond and then into the sanitary sewer system (CH2M HILL, 1992c).



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

LEGEND

- Approximate site boundary
- Drainage basin boundary
- Major surface water drainage conveyance system and flow direction
- Subbasin boundary
- Approximate culvert location

N

0 100 200 500
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

Figure 4-2
Existing Surface Water System

Surface Water Conveyance System Alternatives

Final Grading Plan. As related to the surface water conveyance system, the grading plan for final cover conditions includes the following components: filling and grading of the southwest depression, filling and grading of the Upper South Pond and North Pond, excavation or filling for the system components (e.g., ditches), and miscellaneous grading to produce smooth contours for proper drainage. It is advantageous to stormwater drainage to fill any low areas that collect stormwater, including the Upper South Pond and North Pond. These ponds would serve no beneficial purpose after the site closure.

Existing topography currently divides drainage on the landfill and directs it to the north and south. These general gradients of flow are not proposed to be changed in the final grading plan. An extremely large amount of fill would be required to change the existing slopes across the entire landfill, and it is not desirable to concentrate flow into one system, as higher flows produce more potential for erosion. Therefore, except for filling of the southwest depression, flow directions into the perimeter ditches are not proposed to be significantly altered. The proposed grading plan for the southwest depression directs runoff to ditches along the west, south, and north refuse boundaries where possible.

Runon Collection System. Stormwater runon should be prevented from flowing onto the covered landfill area. It is also desirable to minimize the stormwater flow into the surface water conveyance system from off-site sources, as this additional water increases the required capacity of all stormwater related facilities. Currently, stormwater from a 19.3-acre area to the northwest and west of the landfill site (outside of landfill site boundary) runs onto the landfill. Approximately 1.6 acres of this area is on refuse. All of this runoff could be intercepted by the proposed perimeter ditch system, or some of it could be redirected away from the landfill.

Surface Water Detention

Construction of impermeable areas increases the volume and peak discharges of storm runoff. These increased flows can cause flooding in receiving waters. Attenuation of peak runoff rates before offsite discharge is commonly achieved by a controlled release (detention) structure such as a surface pond or underground vault. Ponds are the most commonly used type of detention facility. Vaults are rarely used due to significant cost and storage volume restrictions.

As an alternative to detention facilities, infiltration basins are sometimes utilized to catch and allow stormwater to infiltrate into the soil, thus eliminating releases to receiving waters entirely. These facilities are used when downstream discharge is not desired or required and when suitable soil types and groundwater conditions are present. Use of an infiltration basin is not feasible at the Kent Highlands Landfill due to the high water table and steep slopes resulting from the nearby Green River, and unsuitable soils. Cost considerations, groundwater conditions and the volume of runoff from the landfill make use of vault storage infeasible. A pond or series of ponds is therefore appropriate for detention facilities at the Kent Highlands Landfill.

Expansion of South Pond. Several methods are available for expanding the detention capacity or effective utilization of the existing South Pond, including:

- Dredging out deposited sediments
- Widening the pond
- Raising the pond embankment
- Increasing capacity of the principal outlet from the pond
- A combination of these alternatives.

Pond dredging would increase total pond volume but would not increase active detention storage volume without lowering of the existing outlet pipeline invert elevation. This would require replacement of some or all of the existing pipeline. Pond dredging would also require excavation and disposal of a large volume of dredged sediments. This alternative for expansion of the South Pond was rejected due in part to the extensive dredging requirements and the high cost of large-volume sediment disposal. Another serious disadvantage is that this option does not provide protection from flooding during high Green River stages.

Widening of the pond could be accommodated to the north, south and west of the current pond boundaries. Midway Creek confines the pond to the east. Widening of the pond should be kept to a minimum in order to reduce potential negative impacts to wetlands and floodway fringe, which may be present in this area.

Active detention storage volume could be increased by raising of the existing embankment surrounding the pond on the north, east, and south sides. Using this approach, additional detention volume would result by expansion of the pond water surface to the west. This approach is the most feasible alternative, requires a relatively small increase in pond surface area, and provides protection from river flooding.

An additional option includes increasing the capacity of the existing outlet structure or installing a second outlet pipe with discharge to the Green River. This increase in discharge capacity would decrease the detention storage volume required to handle design storm inflows.

Post-Closure Detention Design Basis

The following recommendations are made as the basis for design of the South Pond stormwater detention improvements for final landfill cover conditions (CH2M HILL 1992b and 1992c):

1. Expand the existing South Pond to provide a minimum of 5.7 acre-feet of active detention storage volume by raising and extending the existing embankments.

2. Provide an emergency spillway with capacity to pass at minimum the 100-year, 24-hour design storm overflow over the raised east embankment of the South Pond. The spillway crest elevation corresponding to the recommended minimum detention storage requirement is approximately 35.6 feet NGVD. Provide a minimum of 1 foot of embankment freeboard above the spillway water surface elevation corresponding to the spillway design storm flow (minimum embankment elevation of approximately 37.5 NGVD).

3. Enlarge the outfall pipeline to 24-inch-diameter for the existing 12-inch-diameter section (approximately 320 feet in length). Verify the condition/ improvement needs of the existing 24-inch section. Provide improved surface withdrawal outlet controls at the South Pond outlet for connection to the replacement pipeline.

4. Install a flap gate on the improved outfall pipeline (in the existing manhole) to prevent Green River backflow to the South Pond during high river stages. Install a slide gate at the pond outlet to provide positive shutoff of flows from the South Pond to the Green River at river stages corresponding to flows in excess of 9,000 cfs.

Water Quality Treatment

Disturbed areas or areas subject to vehicular or other commercial or industrial uses can contribute pollutants into stormwater runoff. Soil erosion by shearing forces of overland and concentrated flow can contribute sediment into waterways, causing constrictions and flooding and degradation of water quality. Several "best management practices" (BMPs) have been established for preventing erosion or trapping eroded sediment and pollutants before runoff discharges offsite.

Erosion Control Measures

Erosion control measures are applicable during final grading and placement of final cover and on a permanent post-closure basis.

Construction Phase Controls. BMP erosion source control measures include:

- Filter fence
- Straw bales
- Hydro-seeding/tackifier
- Mulch, compost, or straw
- Erosion control matting
- Sedimentation ponds

Filter fence is constructed with geotextile filter fabric, and is used to filter and decrease the velocity of sediment-laden runoff before discharge offsite. Filter fence is placed downhill of disturbed areas in an alignment suitable to intercept overland flow from upslope areas before it discharges into a defined drainage course.

Straw bales can be used in a capacity similar to filter fence by linking the bales as close together as possible and staking them tightly. Filter fabric is generally rolled up and over the top of the bale structure prior to staking.

Vegetative cover is highly effective in decreasing sediment yield and erosion potential by acting as a filter to trap sediment particles in transport and by producing a stable covering over the soil surface. Mulch or compost is used as a soil supplement to provide necessary nutrients for plant growth and stabilize the seeds during establishment. Tackifier is sprayed onto mulch to help hold it in place. Erosion control matting, typically excelsior, straw or other synthetic or natural materials with biodegradable netting, is generally used to provide slope stability on vegetated surfaces.

Proposed measures for controlling erosion on disturbed areas during placement of final cover include use of filter fence or straw bales as source erosion controls at the toe of the fill slope and composting and hydroseeding disturbed areas at the completion of disturbance activities. Tackifier is proposed to be applied onto mulch in areas with slopes steeper than 4H:1V. Erosion control matting is proposed for slopes steeper than 3H:1V. Sedimentation measures include trapping of sediment transported through the stormwater drainage system by a sedimentation pond. The existing South Pond is proposed to be used as the sedimentation pond during placement of final cover.

Operational Controls. Final cover of the landfill is proposed to be a vegetated surface underlaid by an impermeable liner. The vegetated surface would help to decrease surface erosion and provide for decreases in runoff peak flows by increasing infiltration rates into the surficial soil layer and by decreasing overland flow velocities.

Types of ditching proposed for stormwater conveyance include vegetated and rock-lined ditches, as previously discussed. Biodegradable erosion control matting is proposed for the vegetated ditches to provide extra protection from erosion and help establish a dense vegetative surface. Rock-lined ditches prevent erosion on steep areas by protecting the soil and slowing down flow velocities. Lateral collection berms and ditches are proposed on the steep east landfill slope. These controls would serve to catch overland flow before it concentrates into more highly erosive flows and transport it to the perimeter ditches. The berms and ditches would have relatively flat slopes so the velocities of the stormwater diverted along them would be low.

Water Quality Treatment Facilities

Treatment of runoff is proposed to be by vegetated water quality swales (CH2M HILL, 1992b). The grading and drainage plan for final cover conditions includes over 800 linear feet of vegetated ditch downstream from the west end of the site for both the north and south drainage ditch systems. Water quality swales design criteria would be incorporated in final design of those conveyance system improvements (CH2M HILL, 1992c).

These stormwater treatment capabilities inherent in the proposed conveyance system should be adequate for the post-closure conditions at the Kent Highlands Landfill. The only areas of the site proposed to be impervious and subject to vehicular travel include the flare facility access road, secondary access roads, and the parking lot on the north-west corner of the site.

Sedimentation control for the landfill site is currently provided by the South Pond. For final cover landfill conditions, the expanded South Pond is proposed to continue to function for end-of-pipe sedimentation control prior to discharge of landfill runoff to the Green River.

4.3 Leachate

The Kent Highlands Landfill leachate system has three major component systems:

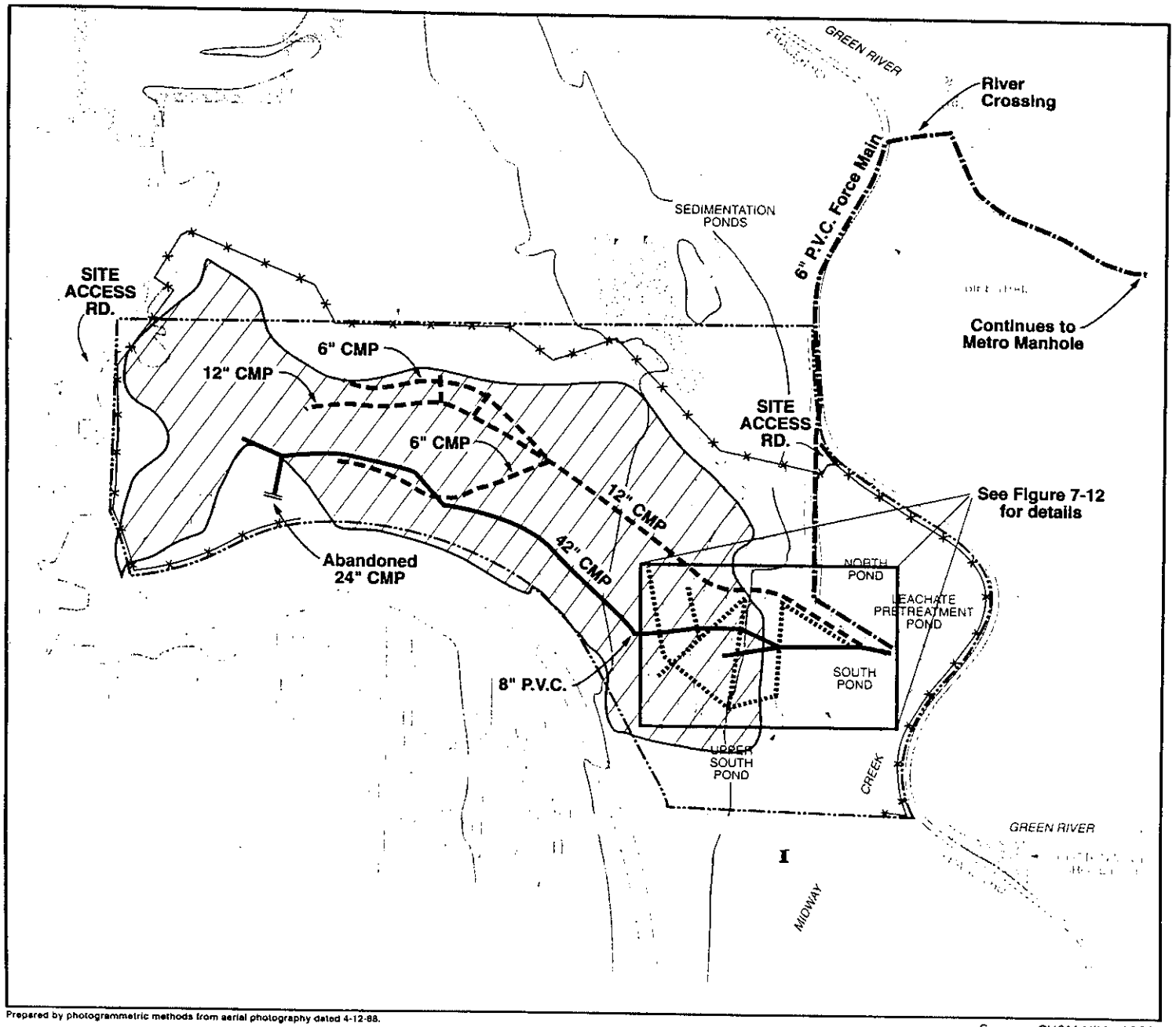
- Leachate collection system
- Pretreatment system
- Discharge system

Leachate Collection System

The leachate collection system is composed of the following three subsystems (Figure 4-3):

- Spring drain
- South leachate
- Toe buttress

The landfill was built in a deep ravine that sloped downward from west to east toward the Green River. A stream flowed through the ravine, fed by natural springs and drainage north and up-gradient of the site. To accommodate this drainage, drain pipes were installed to intercept and collect run-on (spring drain system) during the construction of the landfill. The south leachate collection system was installed during filling operations to collect leachate from the landfill. In the late 1970s, the toe buttress system was built to collect and route leachate to a pretreatment facility and away from the Green River. The pretreatment system partially treats the leachate prior to discharge via force main and gravity pipelines to the Metro sanitary sewer system.



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

Figure 4-3
Leachate Collection System Diagram

Inspection, Repair, and Maintenance. Results of the RI showed that there was no significant impact to groundwater from leachate. Therefore, increasing the collection effectiveness of the leachate system is not indicated. The existing collection system will be maintained and operated at the current level of effectiveness. A flow monitoring program will be developed to monitor system performance. This program will provide data for evaluating the condition of the collection system and should provide an early warning of system failure.

Subsurface investigations performed for the RI found no significant impact to groundwater from leachate (CH2M HILL, 1991a [pg. ES-17]). No primary or secondary or proposed organic drinking water standards were exceeded at the site or in the study area (CH2M HILL, 1991a, [pp 2-196 through 2-199]). The existing collection system as designed and installed is effective in reducing leachate impact to groundwater to below acceptable levels.

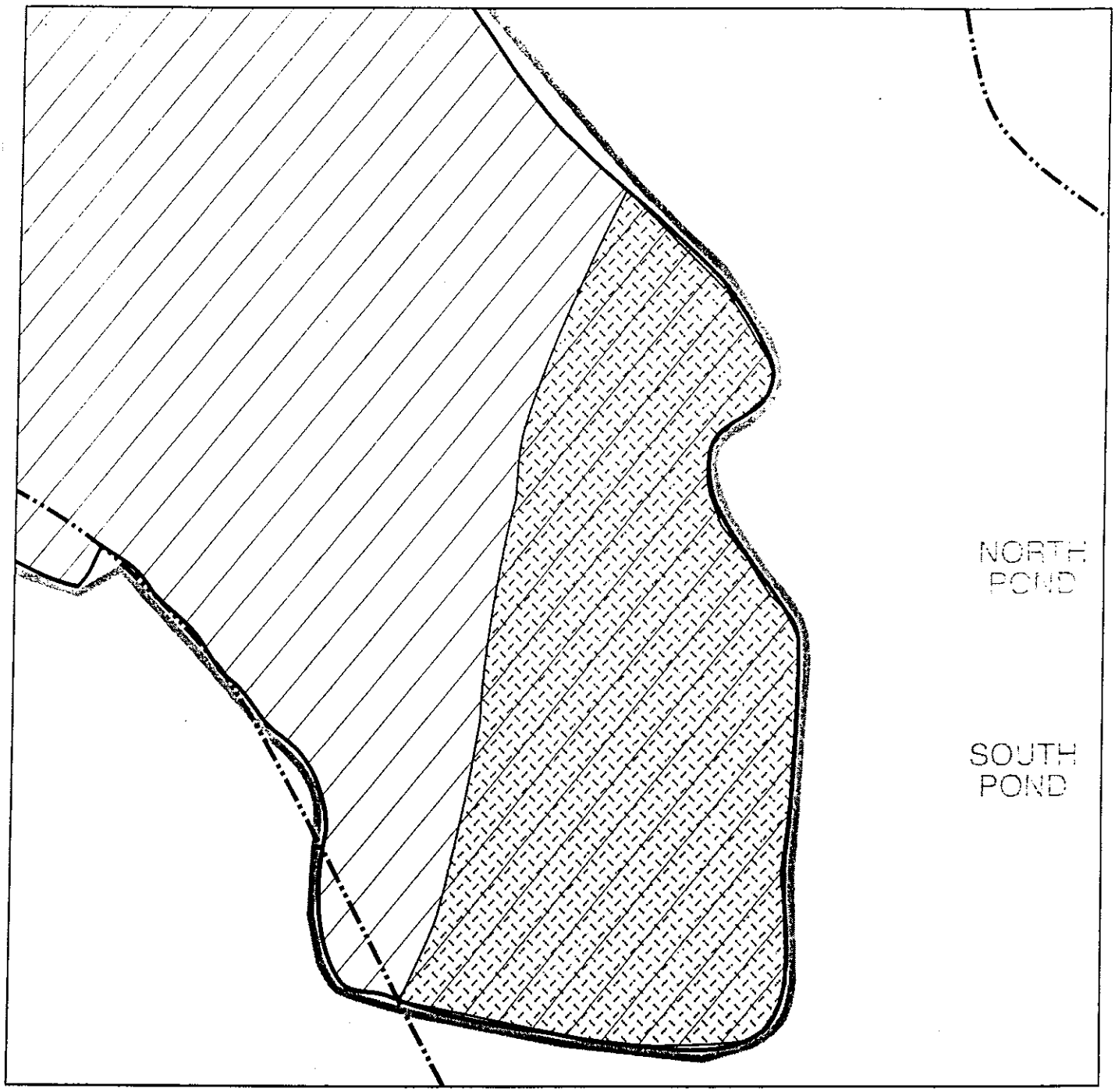
Seep Collection

A leachate seep collection system may be required to reduce the potential for leachate to flow or pool under the proposed cover and to intercept leachate seeps in the North Pond area. The seep collection system would be connected to the existing leachate collection system.

Purpose. Seeps through the existing cover have been reported and repaired by the landfill staff in the past. Areas of seepage occasionally occur on the east face above the toe buttress. If this seepage continues after the final cover system is installed, leachate could form pools and flow down the slope under the final cover. Over time this flow could erode the existing cap or the first layer of the final cover creating voids that would result in a slumping failure of the overlying cover. Severe slumping may result in breaks or tears of the low permeability soil layers or geomembrane which would then permit surface water infiltration.

To reduce the potential for such failures, a subcover seep collection system is proposed for placement between the final cover system and the existing interim cover. This subcover seep collection system would be placed in those locations where seepage has been seen to be a problem. The area most likely to be subject to seepage is the east slope of the landfill (Figure 4-4).

Seepage is a inflow component to the North Pond. Because this area is expected to be filled during final grading, seep collection may be required to prevent groundwater potentially affected by leachate to mix with underlying aquifers or the Green River.



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

LEGEND

- Approximate site boundary
- Approximate refuse limits
- Approximate final cover boundary
- Proposed area for subcover seep collection system

N

0 50 100 200
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

Figure 4-4
Final Cover Area Subject to Seepage

Source: CH2M HILL, 1992a

Seep Collection Concepts. The subcover and North Pond seep collectors could consist of one of the following concepts or a combination of them as deemed appropriate in the design phase:

- Collection trench network using perforated pipe in drain rock filled trenches
- Granular material drainage layer with a collection trench at the bottom of the slope(s) and piping to convey the leachate to the treatment system
- Geonet drain material used in lieu of the granular material mentioned above where stability calculations for the specific products to be used show this is feasible

For the subcover seep collection system, each of these would be placed below the barrier layer in the final cover and would extend to or into refuse. Only a small portion of the leachate generated would be expected to be collected by the system (an assumed 1 to 3 percent). This flow may be affected by installation of the final cover which will inhibit surface water infiltration into the refuse. The seep collector would be needed during and after final cover construction to prevent failure of the cover by erosion of materials immediately beneath it.

Leachate Treatment and Discharge System

The leachate pretreatment system consists of the collection manhole (manhole D), pretreatment pond, and hydrogen peroxide injection system. The discharge system consists of a wet well, pump station, force main, and gravity line discharging to the Metro sanitary sewer.

Two alternatives have been developed for the leachate treatment and discharge system: maintaining the existing system and separating the spring drain flow for separate treatment onsite and discharge to the Green River. Under the latter alternative, the existing system would also be maintained, but would handle only the flows from the leachate collection piping, not the spring drain flow.

Existing System Analysis. The pretreatment system was evaluated primarily to determine its effectiveness in maintaining aerobic conditions and secondly to determine its effectiveness in meeting Metro permit standards.

Approach. Data from the monitoring program established for the Metro permit compliance, monthly wet well data collected by the City, and the remedial investigation were reviewed.

The Metro permit parameters include:

- Biochemical oxygen demand (BOD), total suspended solids (TSS), dissolved oxygen (DO) and pH
- Six metals: cadmium, chromium, copper, lead, nickel, and zinc
- H_2S and TCLP

Results. The results of the pretreatment system evaluation are summarized below:

- Pond influent levels are generally below Metro permit limits
- Pond effluent limits are also within permit limits
- BOD and COD fluctuate around 300 ppm
- There have been no violations of the Metro permit limits.

Conclusions. The pond's aeration system is currently providing sufficient aeration to maintain DO levels above the Metro discharge limit of 2 mg/l. The pond also functions as an effective storage and flow equalization basin. No changes to the existing aeration system are currently recommended. The hydrogen peroxide system does not appear necessary for maintaining aerobic conditions in the force main. Since the effluent meets all Metro permit limits without pretreatment, and the additional effectiveness of pretreatment appears limited, the need for pretreatment will need to be further evaluated. However, since placement of the final cover system may affect the quantity and quality of leachate, no changes will be made to the system until after construction of final cover system.

Separate Spring Drain Treatment and Discharge

The spring drain was designed to intercept water from natural springs along the north side of the landfill. Currently that water is transported through a closed pipe system to the leachate pretreatment system. Since the spring drain flow is predominantly groundwater and therefore relatively uncontaminated, the option was examined of separating out the spring drain flow from the south leachate and toe buttress flows and discharging it to the Green River.

Discharges to the Green River are regulated by the National Pollutant Discharge Elimination System (NPDES) administered by Ecology under WAC 173-220. Effluent discharge limits are set on a site-specific basis. To determine whether the spring drain flow would require pretreatment prior to discharge to the Green River, conservative discharge limits were assumed based on Water Quality Standards for the Surface Waters of the State of Washington (WAC 173-203) and/or drinking water standards.

Water quality data for the spring drain is limited and includes data from the RI plus data from a ten-point sampling program done by the City of Seattle in 1987 to 1989.

Using this limited data, it appeared that treatment would be needed to address BOD removed, and adjustments to ensure that the pH and DO remained in the acceptable range. Metal removal may also be required for zinc.

Facility Requirements. A treatment system consisting of an aerated biological reactor with clarifier was developed and evaluated against the existing pretreatment and discharge program to determine which would be more cost effective.

Before any new treatment system is designed, more extensive water quality data are required, and detailed process engineering analyses should be completed. The spring drain treatment facility would also require the construction of an outfall into the Green River. No assumptions were made about locating the system. Any construction would require complying with wetlands, shoreline management act, and floodplain regulations.

Conclusions. The spring drain treatment system concept is designed to meet the Class A Water Quality Standards. Meeting these standards would adequately protect human health and the environment. A pilot treatability study would need to be completed to determine final process design parameters. Additional data should also be collected to better define the existing water quality of the spring drain effluent before additional design is done.

4.4 Landfill Gas

The following alternative actions and technologies have been considered for landfill gas control.

- Subsurface gas control systems:
  - Perimeter gas extraction wells
  - Interior gas extraction wells
  - Interior gas extraction trenches
  - Offsite gas extraction wells
- Gas disposal systems:
  - Activated carbon adsorption
  - Thermal treatment
- Condensate handling alternatives:
  - Condensate collection
  - Discharge to landfill
  - Discharge to leachate pretreatment system
- Gas utilization:
  - Onsite electric power generation
  - Sale of low-Btu gas to a local offsite customer
  - Cogeneration (electric power generation plus heat recovery)
  - Upgrade to pipeline quality—sale through pipeline

These alternatives are summarized below. See the final Closure Action Report (CH2M-Hill, 1992) for descriptions of major equipment requirements, utility requirements, special engineering requirements, operation and maintenance requirements, long-term monitoring requirements, and any special implementation considerations.

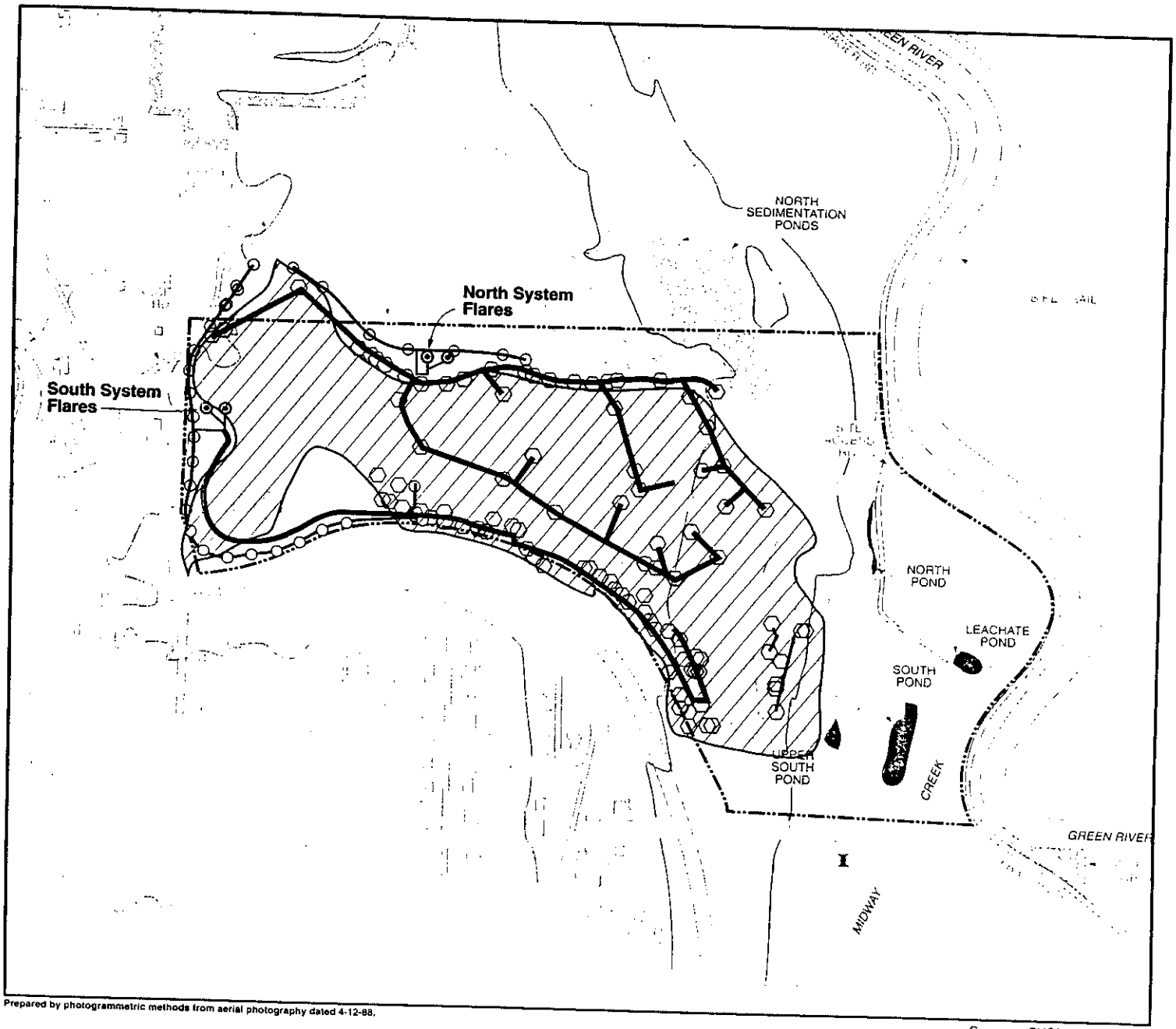
Existing Gas Control Systems

Several gas collection systems that collect gas from the interior of the landfill and from native soils around the perimeter of the landfill have been installed and are operational. The locations of these systems are shown in Figure 4-5 and described briefly below.

Two systems collect gas from the interior of the landfill. These are referred to as the interim interior and the interim south gas collection systems. Both systems consist of above-grade manifold piping connected to vertical PVC pipe risers protruding from the landfill surface. These risers were formerly topped with passive "tiki torch" flares. According to City landfill operational personnel, most of the risers are connected within the landfill to a network of pipes embedded in gravel-filled trenches placed along the sides of the filled ravine with the intention of providing a pathway for gas to vent to the surface. These pipes were never mapped. Some of the risers are also reportedly connected to a series of corrugated HDPE pipes installed at various depths in the landfill and intended to collect leachate. These pipes were not mapped either. The above-grade manifold pipes connecting the tops of the risers are in turn connected to centrifugal exhausters which discharge the collected gas to one of four temporary flares, as shown in Figure 4-5. The interim south system includes 45 risers and the interim interior system includes 55 risers arrayed as shown in Figure 4-5.

The perimeter gas collection systems consist of approximately 50 drilled wells installed in native soils just outside of refuse on the landfill perimeter. These wells are connected by manifold piping to the same centrifugal exhausters used to extract gas from the interior gas collection systems.

The remedial investigation showed that the existing gas collection systems are adequately controlling gas migration from the west end of the landfill and that the site stratigraphy and hydrogeology are effectively inhibiting gas migration to the south and east, but that subsurface gas migration to City-owned property north of the landfill was uncontrolled. Since the completion of the remedial investigation, additional perimeter gas wells have become operational, including wells to improve gas control on the south and west of]the landfill and a series of new wells along the north perimeter. Gas probe data north of the landfill show drastic reductions in methane content and pressure as a result of the influence of these new wells. The alternatives for gas collection described later in this chapter are in addition to preserving all or part of the existing system.



Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

Figure 4-5
Existing Gas Control Systems

Utility requirements of the existing system consist of the need for 3-phase, 230-volt power at the two flare locations shown in Figure 4-5. The system requires frequent (weekly at present) monitoring and adjustment of all gas extraction points because many of the collectors are so close to the surface as to cause them to be very sensitive to changes in surface conditions. Long-term monitoring requirements are the same as for all gas collection alternatives: regular monitoring of perimeter gas probes for gas migration (see Chapter 3, Compliance Monitoring Requirements). Special engineering considerations include the need to preserve and protect these existing systems in designing and installing the final cover and other systems in conjunction with final closure of the landfill.

Design Basis For Gas Control Options

Several elements form the design basis for gas collection and migration control systems. These include:

- Configuration of the fill
- Estimate of gas generation rate
- Data from and design of the existing gas collection systems
- Geology and stratigraphy of soils surrounding the landfill

The configuration of the original topography before filling was used to establish the locations and depths for collection systems in the interior of the landfill. A detailed topographic map from 1968 shows that the maximum depth of fill along the centerline of the original ravine is approximately 150 feet. The topographic map was used to estimate the volume of fill, which is approximately 8 million cubic yards. This volume, along with records of refuse tonnage delivered to the landfill, has been used to estimate the total tonnage of refuse in the landfill at 4.9 million tons and chart its pattern of deposition over time. These figures, in turn, have been used to estimate current and project future landfill gas generation, using a model of landfill gas generation developed by CH2M HILL. These estimates provide a design flow rate for the interior gas collection systems. The estimates of refuse tonnage and gas generation projections are presented in Chapter 6 of the remedial investigation. Total projected landfill gas generation at year-end 1991 is 1,468 to 2,540 standard cubic feet per minute (scfm). The existing gas collection systems are currently collecting approximately 2,000 scfm of gas from the interior of the landfill.

Active Gas Collection Technologies

Two basic types of gas collectors are used in the interior of a landfill. These are:

- Gas collection trenches
- Gas collection wells

Gas collection trenches consist of shallow trenches (approximately 4 feet deep) dug into the top of a lift of refuse. The trenches are lined with permeable geotextile, backfilled with gravel, and have a perforated pipe along the centerline of the trench. The perforated pipe is connected to a riser pipe (or pipes) that protrudes through the landfill cover. These riser pipes are in turn connected to manifold piping at or just under the surface, which conveys the gas to an exhauster that places a vacuum on the pipes and collection trenches.

Gas collection wells consist of wells drilled into the refuse. A perforated pipe casing is placed along the centerline of the well and connected to a manifold pipe in a manner similar to the connection of risers from gas collection trenches as described above.

Perimeter gas extraction wells are different from interior gas extraction wells because they are installed in the native soils outside the buried refuse. Rather than collecting gas from a region in which it is being generated, they are designed to intercept gas that would otherwise migrate beyond the perimeter of the landfill. The annular backfill around the well casing and the perforations in the well casings themselves must be sized so that they are not clogged by soil particles. Screen locations are placed depending on the soil stratigraphy, rather than the depth of refuse. This type of well may also be used to extract gas from any areas offsite that are beyond the range of perimeter gas extraction wells.

An initial evaluation of the concept of perimeter gas wells for migration control was conducted by the City in 1986 and 1987 (Parametrix, 1987a). Five gas extraction wells were installed near the west end of the landfill and connected to an active exhaust system that discharged to a temporary flare. Suction applied to these wells achieved a flow rate of 3.7 to 83 scfm, with an average of 33 scfm. The methane concentrations and pressures in gas probes installed approximately 200 feet away from these wells were reduced significantly, indicating that the extraction wells could achieve a region of influence at least 200 feet in diameter.

In 1988, three alternative concepts for perimeter gas migration control were evaluated for effectiveness, implementability, integration with interior gas collection systems, and cost-effectiveness, among other factors (CH2M HILL, 1988a). The three alternatives considered were a positive pressure air injection well system, perimeter gas extraction, and interior gas extraction. This evaluation concluded that, based on effectiveness, a perimeter system (either air injection or gas extraction) was necessary as a supplement to the existing or enhanced interior collection system. An evaluation of cost-effectiveness revealed that, on a life-cycle cost basis, an extraction system consisting of perimeter extraction wells connected to an exhauster is less costly than an air injection system. The air injection system was also considered riskier since it could inject air into the landfill and potentially start a composting reaction that could lead to a smoldering fire. The recommendation was therefore to design and construct a perimeter well/exhauster migration control system.

Based on the analyses discussed above, a system of perimeter gas wells and manifold piping was designed and installation of the wells was completed in May 1990.

In June and July 1990, a series of pump tests was performed to determine the operational flow rates and applied vacuums that would serve as design parameters for the manifold piping and exhauster/flare facility (CH2M HILL, 1990). Seven wells were tested by connecting them to a portable exhauster and flare assembly and extracting gas until a steady flow and pressure were achieved. Nearby gas probes were monitored for influence of the extraction wells. The results confirmed the results of the 1986 through 1987 tests that showed that the region of influence for this type of well could be expected to have a radius 200 feet from the well. The average flow rate from the wells was 44 scfm under an applied vacuum of 30 inches water column.

Two alternative types of interior gas collectors, wells, and gravel-filled trenches (Figures 4-6 and 4-7) were evaluated and both found to be appropriate for use in different parts of the Kent Highlands Landfill. A series of gas wells in the deeper parts of the landfill and gas collection trenches in the shallow part of the landfill (on the west end) have been laid out for the Kent Highlands Landfill. The criterion for location of the trench collector was an area where the depth of refuse was 40 feet or less over an area with a lateral dimension of 400 feet or more (corresponding to the demonstrated influence zone of 200 feet on each side of a trench collector). The conceptual layout, including manifold piping, is shown in Figure 4-8 and approximately 1,000 feet of gas collector trench are included in the conceptual layout.

Gas disposal will be accomplished by thermal incineration using enclosed flares that will be constructed at the toe of the east slope of the landfill. Mechanical exhausters will draw gas through the collection system manifold piping and discharge it to the flares. This system is currently under construction.

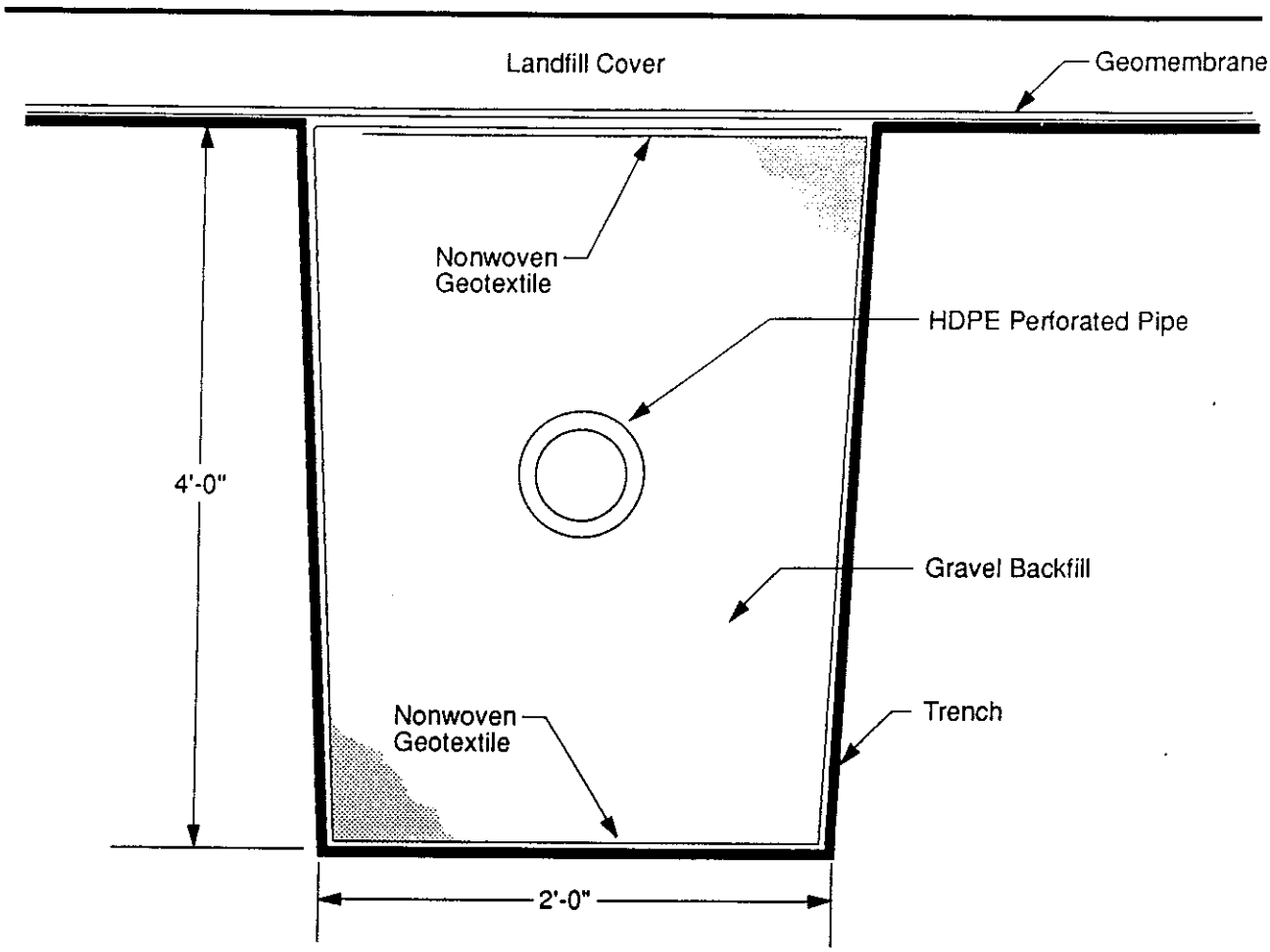


Figure 4-6
Horizontal Gas Collection Trench Section

Source: CH2M HILL, 1992a

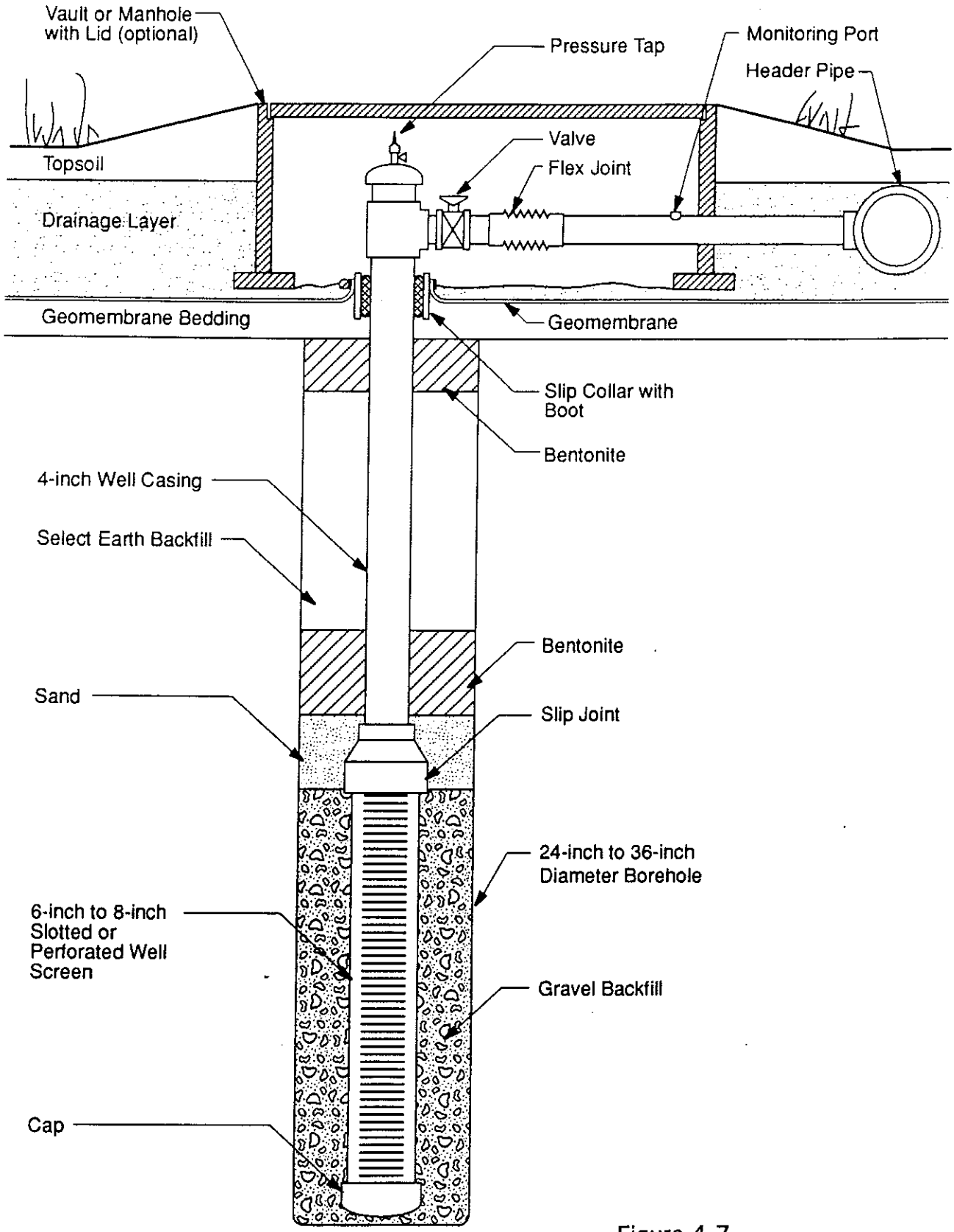
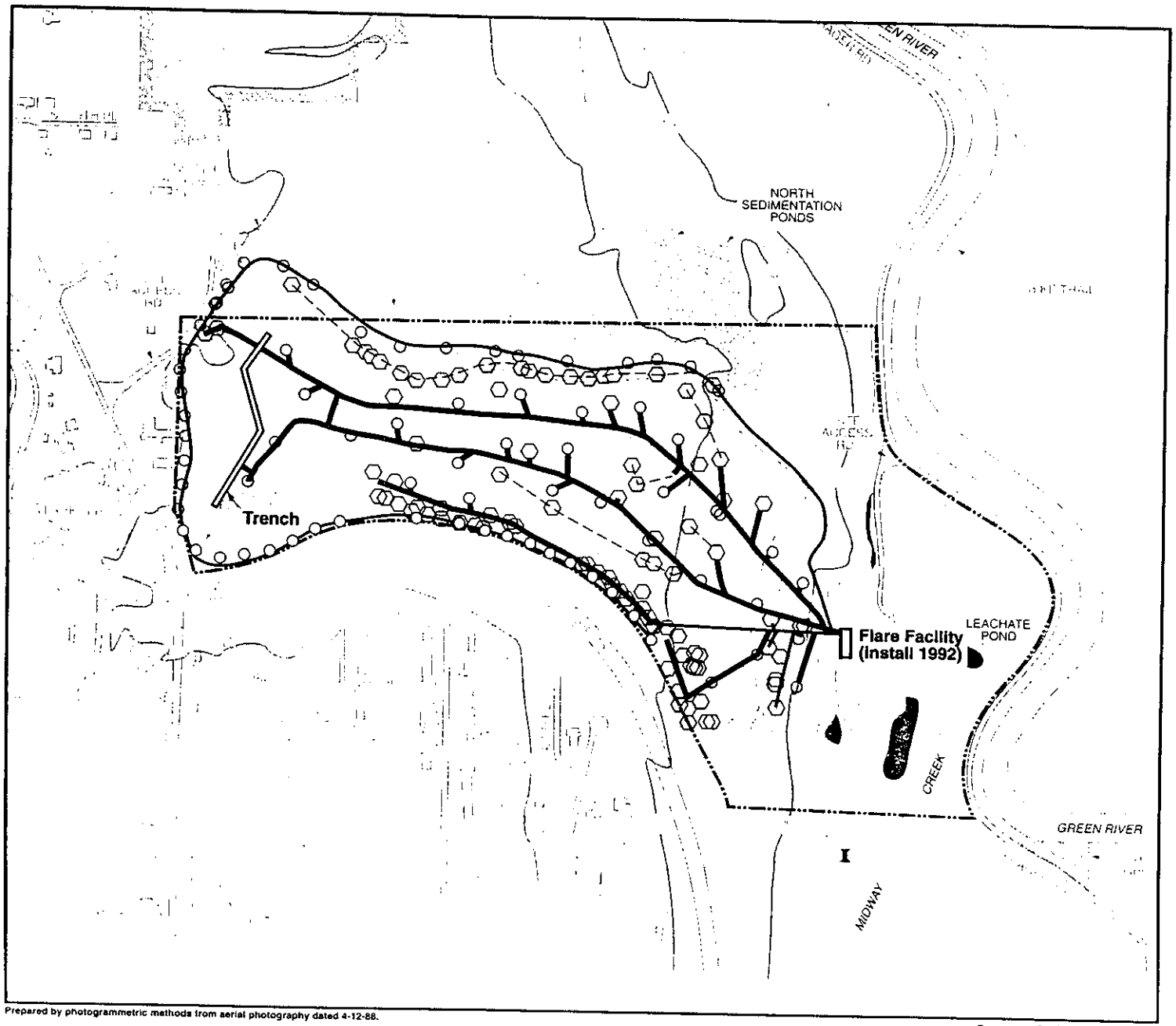


Figure 4-7
Conceptual Gas Extraction Well Installation

Source: CH2M HILL, 1992a



LEGEND

- Approximate site boundary
- Existing interim interior manifold (to remain)
- Final closure interior manifold (install 1993-1994)
- Perimeter manifold (install 1992)
- Gas extraction well
- Existing interim interior extraction point (to remain)

N

0 100 200 400
Scale in Feet

Topographic Contour Interval: 20ft
Elevation Datum: National Geodetic Vertical Datum

Prepared by photogrammetric methods from aerial photography dated 4-12-88.

Source: CH2M HILL, 1992a

Figure 4-8
Conceptual Final Gas Control System Layout

Offsite Gas Extraction

A field evaluation was conducted, beginning in the summer of 1991, to assess the extent and the optimal method for removing subsurface gas that has migrated from the landfill to City-owned property north of the site. The evaluation included installation and monitoring of seven subsurface gas probes, which showed that gas has migrated approximately 800 feet north of the site boundary. Based on the results of this study, an array of eight gas extraction wells north of the site has been designed. Construction of the wells and the extraction system to withdraw gas through these wells is currently underway.

Gas Disposal Technologies

Thermal Treatment (Flaring)

Two gas disposal technologies are typically used for gas extracted from a municipal landfill. The most common is flaring the gas. Landfill gas flares can be constructed such that the combustion parameters (air mixture, residence time, and temperature) can be measured and controlled. Such flares have been shown to achieve at least 90 percent destruction of volatile organic compounds in the landfill gas. Operation and maintenance of flares includes regular inspection of burner heads, flame arrestors, insulation used to prevent corrosion of the flare components, and control sensors integral to the flare unit. Long-term monitoring requirements include testing of emissions from the flare on a regular basis.

Adsorption

Another technology that has been used when the gas extracted has a methane content too low to be burned is passing the gas through a bed of adsorptive material, such as activated carbon. This carbon may be impregnated with materials such as potassium hydroxide that remove sulfur compounds that would not otherwise be removed by activated carbon. Activated carbon has been shown to be effective in removing volatile organic compounds present in landfill gas. Operation and maintenance of activated carbon adsorption units includes replacement of the carbon bed as needed when it becomes saturated with organic compounds. Long-term monitoring requirements include regular emissions testing.

Gas Disposal Technology Analysis

Of the two gas disposal alternatives considered (adsorption and flaring), flaring is preferable when the gas stream contains enough combustible gas to support combustion without addition of supplementary fuel. Tests of landfill gas flares have shown consistent destruction efficiencies of greater than 90 percent for volatile organic compounds. An evaluation was conducted to determine if the mixture of low-methane perimeter gas and high-methane interior gas would be likely to contain enough methane to be self-combusting.

Combining the two gas streams of 1,730 scfm from the perimeter system, assumed for this purpose to contain zero percent methane, with the high estimate of gas generation in the interior of the landfill of 2,550 scfm containing 50 percent methane, produces a mixture containing 30 percent methane, which is well above the minimum recommended mixture of 20 percent for self-sustaining combustion. Gas generation within the landfill is expected to decline, but as it does the likelihood of needing to operate the entire perimeter migration control system will also decrease.

Adsorption technology would be appropriate if a separate system were set up to remove gas from offsite areas where it has migrated beyond the influence of the perimeter migration control system. This approach has been used successfully at Midway Landfill.

Condensate Collection and Disposal

The most common and practical method of collecting and disposing of the water vapor that condenses in landfill gas collection piping (condensate) is to allow it to drip back into the landfill from where it has been taken. This method is accomplished by installation of a "drip leg" or small downspout pipe at low points in the gas collection system. The drip leg has a U-trap at the bottom to prevent air being drawn in under the vacuum induced in the gas collection system. This method is currently used to collect and dispose of condensate from the interim gas collection systems.

The alternative approach is to collect condensate at low points in the gas collection piping and remove it for treatment and disposal. Special engineering and implementation considerations for this approach include:

- Designing the gas collection manifold piping to allow condensate to drain to one or more centralized collection points.

- Conveying the condensate from the collection points to the leachate collection and treatment system using gravity flow and pumping as appropriate.

Condensate Collection and Disposal Technology Analysis

Condensate formation in landfill gas collection piping is driven by temperature changes that occur in the gas stream as it emerges from the warm landfill and cools in the collection piping.

An evaluation was conducted to assess the effect of blending this condensate with the leachate flow (including the spring drain) that is pretreated and discharged to the Metro sewer system. Laboratory analyses were conducted on four samples of condensate taken from the existing interim gas collection systems in May 1990 (Eureka Laboratories, Inc., 1990). The samples were analyzed for all of the volatile and semi-volatile compounds on the EPA Target Compound List, ignitability (flash point), pH, and cyanide. The analyses showed that the condensate would not be considered a dangerous waste under Washington regulations (WAC 173-303).

Combining this small volume waste stream with the leachate would not cause detectable increases in the concentrations of organic compounds in the leachate, and would not adversely impact the treatability of the leachate stream in the Metro sewer. Based on chemical analyses of condensate samples taken from the Kent Highland's gas collection system, Metro has approved draining the condensate to the leachate collection and pretreatment system. The condensate will be combined with the leachate flow, pretreated, and discharged to the Metro sewer system.

Gas Utilization Alternatives

The Seattle Solid Waste Utility has conducted a preliminary evaluation of landfill gas recovery options for the Kent Highlands and Midway Landfills (City of Seattle, 1991). The four options evaluated are:

- Sale of low-Btu gas (after minimal cleanup and pressurization) to a local customer via a dedicated pipeline
- Conversion to electrical power onsite by burning the gas in an engine-generator
- Cogeneration-conversion to electricity using the heat energy produced by the conversion process
- Upgrade to pipeline quality (high-Btu gas) for injection into natural gas utility piping

Gas Utilization Technology Alternatives

An economic evaluation of the four identified gas utilization alternatives has been conducted by the City of Seattle (1991). All evaluations were based on expected landfill gas generation over time as presented in the RI report.

Upgrade to high-Btu gas for injection into natural gas distribution pipelines was found to be uneconomical.

Evaluation of the cogeneration and direct sale of low-Btu gas to a local customer required a survey of local businesses and institutions that could be potential customers for the gas or cogeneration products. With the assistance of the City of Kent Engineering Department, seven local businesses within 3 miles of the landfill were identified that have potential needs for fuel gas. No local institutions or businesses in the vicinity of the landfill that could use products of cogeneration (steam or hot water) were identified. Although several potential low-Btu users were contacted, the amount of low-Btu gas required in each case did not result in an attractive rate of return on the investment for a dedicated pipeline and a compression and delivery system.

Based on information provided by Puget Sound Power and Light, evaluation of the conversion to electric power option appears to offer the potential of a positive rate of return.

The City has solicited interest from entrepreneurs experienced in landfill gas energy recovery products for development of a project at Kent Highlands based on the evaluation discussed above.

V. MTCA CLEANUP LEVELS AND POINT OF COMPLIANCE

Chapter 5
Model Toxics Control Act Cleanup Levels and Points of Compliance

The MTCA Method B cleanup standards contained in WAC 173-340-700 through WAC 173-340-760 were demonstrated in the risk assessment prepared for the Remedial Investigation (CH2M-Hill, 1991a) to have been met at this site under existing conditions. The proposed closure actions will provide continued protection of human health and the environment. Therefore, the risk levels posed by the site will be further decreased as the proposed actions are implemented. Specific monitoring requirements under MTCA and points of compliance for monitored media are discussed in Chapter 3.

VI. IMPLEMENTATION SCHEDULE

Chapter 6
Implementation Schedule

Figure 6-1 shows the planned implementation schedule for the proposed cleanup and closure actions described in Chapter 2.

Design of the permanent landfill gas control system began on an accelerated basis in 1988. The gas control system is being installed in phases on a priority basis in order to prevent hazards from gas migration. The majority of the perimeter gas wells that will be included in the final system were installed in 1989 and 1990 and are operational as of this writing. Construction of the permanent flare facility has begun, as of this writing, with construction scheduled for completion in 1993.

The items shown as design and construction of final closure systems include the final cover, interior gas collection system, surface water conveyance system, and the expansion and upgrade of the surface water detention pond.

Post-closure monitoring will begin with the completion of the final closure in 1994.

All of the events in the proposed implementation schedule will be delayed to later dates if preceding events do not occur as anticipated. Because of the need to schedule site construction activities during the dry season of the year, any delays may delay the final implementation date by an entire year, even if the delay is of a lesser duration.

All dates and durations shown in the proposed implementation schedule are approximate, and are based on information available as presented in this report. Since final design for most of the closure systems has not yet been done, the exact nature of these systems and therefore time to implement them cannot be known at this time. The actual implementation schedule will therefore be different from the target schedule shown in Figure 6-1.

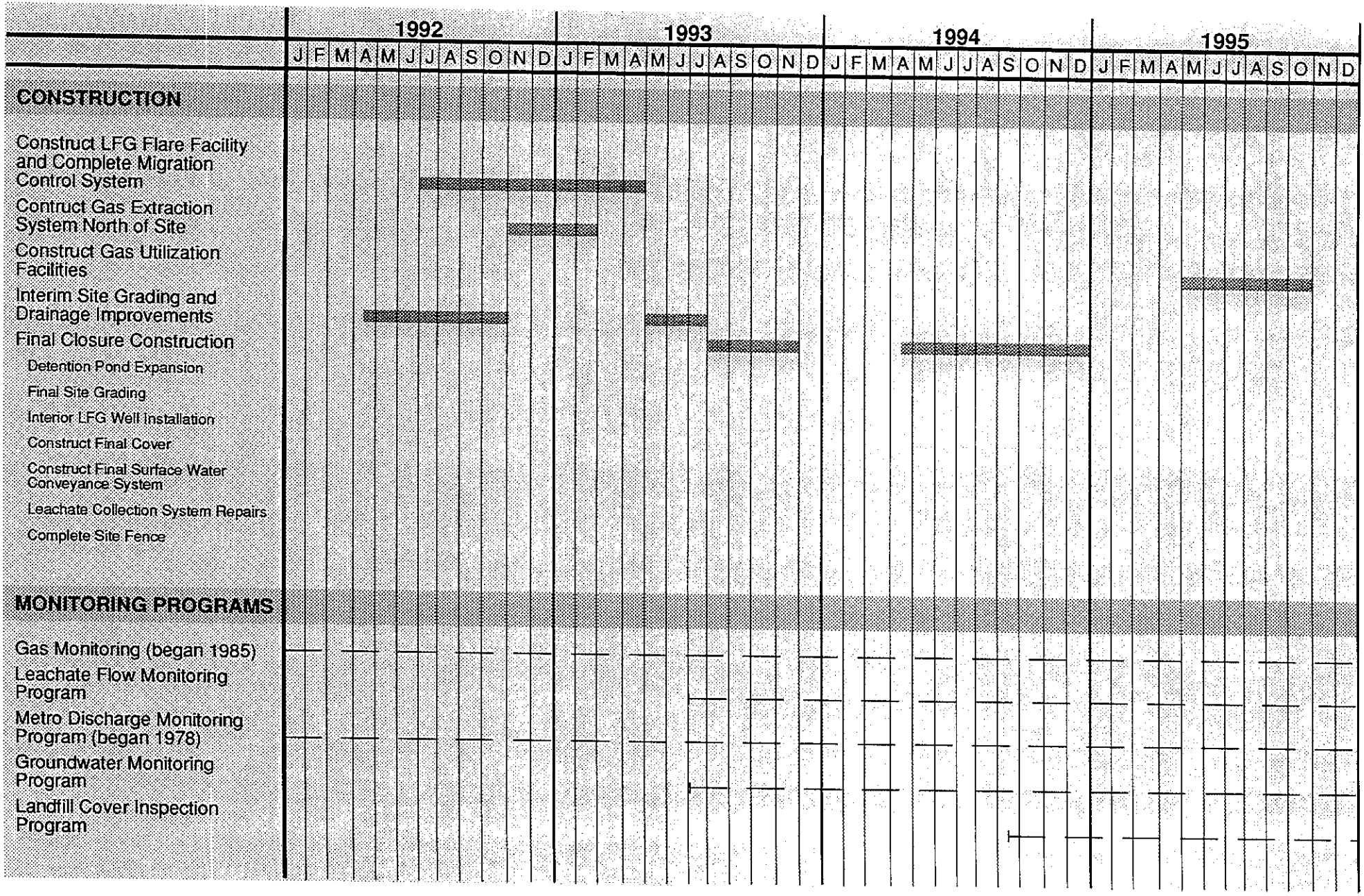


Figure 6-1
Implementation Schedule

VII. INSTITUTIONAL CONTROLS

Chapter 7
Institutional Controls

The purpose of institutional controls is to limit or prohibit activities that may interfere with the integrity of site closure actions or result in risk to human health and the environment. Protection of site closure actions involves maintaining the integrity of the landfill cover, leachate collection system, gas control system, and surface water control system.

This chapter focuses on existing regulatory controls and administrative institutional controls that can be implemented to supplement the closure actions. Implementation of institutional controls will require a cooperative effort involving the owners of the landfill, including the Seattle Solid Waste Utility and the following agencies:

- City of Kent
- Seattle-King County Health Department
- Washington State Department of Ecology

Upon closure of the site, physical controls and monitoring procedures will have been implemented to protect the integrity of the closure actions as well as human health and the environment. Implementation of institutional controls will provide additional protection. These controls include writing restrictive covenants into the property deed and supplementing existing regulations with coordination programs between the City of Seattle Solid Waste Utility and appropriate agencies to communicate information to prospective developers of the site or land adjacent to the site about the Kent Highlands Landfill.

7.1 Existing Regulatory Safeguards

Several existing regulations provide safeguards for ensuring the integrity of closure actions and the protection of human health and the environment. These safeguards are summarized by regulation below.

King County Solid Waste Regulations

KCSWR requires maps and a statement of fact concerning the disposal area to be recorded as part of the deed with the records division prior to approval of the final closure plan. The recorded information shall include records and plans specifying the general nature of the materials, location of the disposal areas, and periods of operation. In addition, it is required that the health officer be notified prior to the sale or transference of title of waste disposal areas and financial assurance provided, until the landfill has been stabilized for a period of 30 years or as long as required by the health officer.

KCSWR also specifies restrictions for all construction activities on/or within 1,000 feet of an active, closed, or abandoned landfill (distance from nearest site boundary to proposed structure) that has been documented by the health officer to be generating levels of methane gas onsite at the lower explosive limits or greater levels. The requirement is for all enclosed structures to have protection from potential methane migration. Protection is ensured by the following requirements:

- Submit report prepared by licensed civil engineer to local building department that presents the method for the structure's protection against methane migration

- Civil engineer must conduct a final inspection to verify that the building has been constructed in accordance with the recommended method for addressing methane migration

Model Toxics Control Act (WAC 173-340)

MTCA requires institutional controls for sites implementing containment technologies to ensure both the continued protection of human health and the environment and the integrity of a cleanup action. Institutional controls includes physical measures, such as fences and signs, as well as legal and administrative mechanisms as institutional controls (WAC 173-340-440). For the purposes of this document, physical measures have been addressed as closure actions and are not included as institutional controls.

MTCA specifies that a restrictive covenant be recorded with the deed and run with the land so that it will be binding on the owner's successors and assigns. In addition, financial assurances may be required to cover all costs of operation and maintenance including compliance monitoring and undertaking appropriate corrective measures.

Minimum Functional Standards For Solid Waste Handling (WAC 173-304)

Under General Facility Requirements (WAC 173-304-405), MFS requires that maps and a statement of fact concerning the location of the disposal site be recorded as part of the deed with the county auditor no later than 3 months after closure. In addition, MFS requires that records and plans specifying solid waste amounts, location, and periods of operation shall be submitted to the local zoning authority or the authority with jurisdiction over land use and be made available for inspection.

Under Financial Assurance for Public Facilities (WAC 173-304-467), the City of Seattle Solid Waste Utility is required to establish a closure/post-closure financial assurances for closure and post-closure. Financial assurance is provided by ordinances adopted by the Seattle City Council. The ordinances establish a business and occupation tax on garbage and solid waste handlers for landfill closure cost (Tupper, 1993).

Minimum Standards For Construction and Maintenance of Wells (WAC 173-160)

The regulations provide standards for installation of groundwater supply wells. The potential exists for a groundwater supply well to be installed near the site, although it is highly unlikely that landfill-derived contaminants would be drawn into such a well based upon the findings of the Remedial Investigation (CH2M HILL, 1991a p. 8-38 and Appendix AI). The following sections of the regulation provide safeguards against locating groundwater supply wells in an area that may be affected by the landfill:

- **WAC 173-160-020—General (1)** It will be necessary in some cases to construct wells with additional requirements beyond the minimum standards. Additional requirements are necessary when the well is constructed in or adjacent to a source of contamination. Sources of contamination include, but are not limited to, the following: septic systems, lagoons, landfills, hazardous waste sites, saltwater intrusion areas, chemical storage areas, and pipelines.

- **WAC 173-160-055—Well construction notification (start card).** All well contractors shall notify the department of their intent to construct, reconstruct, or abandon a well at least 72 hours before starting work.

- **WAC 173-160-205—Location of well site and access improvements.** A proposed water supply well should be located on high ground consistent with the general terrain. It shall be protected from a 100-year flood and from any surface or subsurface drainage capable of impairing the quality of the groundwater supply. The well shall be located away from possible sources of contamination.

- **WAC 173-160-205(2)—Individual domestic, irrigation, industrial, and other wells.** Wells shall not be located within certain minimum distances of potential sources of contamination. These minimum distances shall comply with local and state health regulations. Wells shall be located at least 100 feet from a sewer line, sewage or manure lagoon, pipeline, or known, or suspected source of contamination. Wells shall not be located within 1,000 feet of solid waste landfills.

The safeguards provided by these three regulations will only be effective if a potential developer is notified and sufficiently educated about the Kent Highlands Landfill. To facilitate this communication, the City of Seattle Solid Waste Utility will coordinate with the appropriate agencies (e.g., City of Kent, Ecology) to provide the required information as well as an information officer to answer questions.

For example, the City of Seattle Solid Waste Utility would provide Ecology with a detailed map of the site boundaries, refuse limits, and groundwater monitoring well locations.

The purpose of the map would be to allow easy identification of start cards submitted for wells to be installed in the vicinity of the landfill. Ecology would coordinate with the City of Seattle Solid Waste Utility to inform an applicant of the site hydrogeology and groundwater quality in the area.

Compliance with the performance standards for the gas control system and monitoring requirements will provide protection from landfill gas migration. Additional protection will be provided by the process that the City of Kent follows for development proposed near the site. The City of Kent requests the Seattle Solid Waste Utility to review and comment on proposed projects. The City of Kent would inform prospective developers of existing protective requirements and the City of Seattle Solid Waste Utility could provide additional pertinent information about the current conditions at the Kent Highlands Landfill.

7.2 Property Deed Restrictive Covenants

In addition to the regulatory requirement to disclose the existence of the landfill by recording a statement of fact with the property deed, restrictive covenants will be written into the property deed. These restrictions would be an effective method to notify any potential purchaser of the site that the land was used for waste disposal and that it will be the responsibility of the purchaser to ensure the integrity of the waste management system. Restrictive covenants may include:

- Provisions for continued operation, maintenance, and monitoring of all containment, control, treatment, and monitoring systems installed or implemented for closure of the site
- Limitations for subsurface development, including prohibition of any excavation that would damage any of the containment, control, treatment, or monitoring systems
- Limitations for vehicular traffic on the landfill cover
- Limitations for the use of groundwater beneath the site

7.3 Federal, State, and Local Permits

The following permits will be obtained by the City of Seattle for the closure of the landfill:

- Hydraulic Project Approval (HPA) for Washington Department of Fisheries for construction activities in Midway Creek and the Green River. Water quality modifications to the HPA are not required at this time by the Department of Ecology if Best Management Practices are implemented and no water quality violations occur.

- Shorelines Permit from the City of Kent and the Department of Ecology.

The following permits will not be obtained, however, the substantive requirements of the permits will be achieved by implementing the requirements of this Cleanup Action Plan:

- Solid waste permit from the Seattle-King County Health Department. A permit exemption is provided in the Minimum Functional Standards for Solid Waste Handling (WAC 173-304-600-lb) for facilities performing corrective action under a State cleanup order.

- National Pollutant Discharge Elimination System and State Waste Discharge Baseline General Permit for Storm Water Discharges. A permit exemption is provided in the State Water Pollution Control Law (RCW Chapter 90.48) for facilities under order issued under the Comprehensive Environmental Response, Compensation, and Liability Act and Model Toxics Control Act.

- Section 404 of the Clean Water Act from the U.S. Army Corps of Engineers for impacts to the wetlands. A permit exemption is provided for National Priority List facilities undergoing cleanup by order or decree.

VIII. SELECTION OF CLEANUP TECHNOLOGIES

Chapter 8
Selection of Cleanup and Closure Technologies

The selected cleanup and closure technologies involve primarily on site containment measures in an engineered facility to minimize the future release of hazardous substances. These actions are ranked fifth in the order of preference of cleanup actions described in the MTCA regulations (WAC 173-340-360(4)).

The selection of these containment measures over other higher order of preference technologies are justified because practicable methods of treatment, or recycling or destruction of municipal solid waste landfills have not been developed. Furthermore, Ecology recognizes the need to use engineering controls, such as containment, for sites or portions of sites that contain large volumes of materials with relatively low levels of hazardous substances where treatment is impracticable WAC 173-340-360(9)(c).

IX. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Chapter 9
Applicable or Relevant and Appropriate Requirements

The identification and analysis of ARARs follows the process specified in the National Contingency Plan (NCP). Applicable requirements are those federal and state regulations that legally apply at the Site. Relevant and appropriate requirements are those federal and state regulations that do not legally apply but address situations sufficiently similar that they may warrant inclusion as a requirement. The different types of ARARs and the criteria used to identify them are defined below.

Applicable requirements are defined as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, action, location, or other circumstance at the site (40 CFR 300.5). For a requirement to be applicable, the action or the circumstances at the Site must meet the jurisdictional prerequisites of that requirement.

Relevant and appropriate requirements are defined as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, action, location, or other circumstance at the site, address problems or situations sufficiently similar to those encountered at the site (relevant) and their use is well suited to the particular site (appropriate) (40 CFR 300.5). ARARs were identified and categorized as location-specific, action-specific, or chemical-specific.

In addition to the legally binding requirements identified as ARARs, many federal and state programs have developed criteria, advisories, guidelines, or proposed standards "to be considered" (TBC). Although TBCs are not legally binding, they may provide useful information or recommend procedures if no ARAR addresses a particular situation or if existing ARARs do not provide protection. In accordance with EPA guidance, local requirements (e.g., city and county) are designated as TBCs unless a state regulation authorizes a local agency to adopt and implement the state regulation as a local regulation (EPA, 1989). In that case, a local requirement is evaluated as applicable or relevant and appropriate.

The ARARs identification process also includes distinguishing between substantive and administrative requirements. Onsite actions must comply with applicable or relevant and appropriate requirements but need to comply only with the substantive parts of those requirements. Substantive requirements are defined as requirements that pertain directly to actions or conditions in the environment (40 CFR 300.5). Examples of substantive requirements include quantitative health- or risk-based restrictions that limit exposure to types of hazardous substances or restrictions upon activities in certain special locations. Administrative requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation.

Administrative requirements include approvals by administrative bodies, consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement. Administrative requirements are not included in the identification of ARARs.

The following sections present a brief description of the ARARs, categorized by whether they are location, action, or chemical specific.

9.1 Location-Specific ARARs

Location-specific ARARs are requirements that relate to the geographical or physical position of the site, rather than the nature of the contaminants or the actions at the site. These requirements address the type of action that can be implemented onsite. The laws and regulations that were evaluated and designated as potential location-specific ARARs are briefly described below and tabulated in Table 5-1 of the Final Closure Action Report (CH2M-Hill, 1992a).

Federal Requirements

Executive Order on Floodplain Management

This order requires federal agencies to evaluate the potential effects of an action they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. The eastern, lower portion of the site is within the 100-year floodplain of the Green River and the site is on the EPA National Priorities List, therefore the order is applicable.

Executive Order on Protection of Wetlands

This order requires federal agencies to avoid, to the maximum extent possible, the adverse impacts associated with destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. Because wetlands have been identified in the eastern, lower portion of the site, this order is applicable.

Clean Water Act

All wetlands onsite are regulated under the Clean Water Act Section 404, which is administered by the U.S. Army Corps of Engineers. Any proposed action that places fill in a wetland would trigger compliance with the substantive requirements of the Clean Water Act.

The Fish and Wildlife Coordination Act

The regulation requires federal agencies involved in actions that will result in the control or structural modification of any natural stream or water body for any purpose to take action to protect the fish and wildlife resources which may be affected by the action.

The U.S. Fish and Wildlife Service and appropriate state agencies are consulted to ascertain the means and measures necessary to mitigate, prevent, and compensate for project-related losses and to enhance the resources. This regulation is applicable to the site if a closure action modifies Midway Creek or the Green River so that fish or wildlife resources are affected by the action.

State Requirements

Hydraulic Code

Washington State requires Hydraulic Project Approval prior to construction of any form of hydraulic project or other work within the ordinary high water line that will use, divert, obstruct, or change the natural flow or bed of state waters or that will use any of the salt or fresh water of the state or materials from the beds. Any action within the ordinary high water line of the Green River or Midway Creek will require compliance with the substantive requirements of the regulations, as specified by the Washington Department of Fisheries.

Shoreline Management Act

The Washington State Shoreline Management Act regulates any action within 200 feet of the ordinary high water mark of a shoreline or any action within a wetland associated with a shoreline. The regulations are administered by local government and are further discussed below, under Local Requirements.

Local Requirements

City of Kent

The City of Kent has regulations that direct any action taken in or affecting floodplains, wetlands, and shorelines that are applicable for actions taken in the lower, eastern portion of the site. The City of Kent administers the state Shoreline Management Act through a master program for the management of all shorelines and wetlands associated with shorelines within its corporate limits. The objectives of the City of Kent Shoreline Master Program include enhancing environmental qualities and preserving or restoring the remaining natural resources along city shorelines. Under this program, the Green River adjacent to the site is designated as a shoreline and the wetlands onsite have been designated as associated wetlands of the Green River (Terra Associates, 1990). Actions taken in these areas will be subject to the substantive requirements of the master program.

The City of Kent Department of Public Works regulates development in special flood hazard areas. Onsite, the requirements apply to the 100-year regulatory floodplain of the Green River and Midway Creek, as designated by the Federal Emergency Management Agency (FEMA). Compliance with local floodplain management ordinances is required under the Minimal Functional Standards for Solid Waste Handling (MFS) (WAC 173-304-460(3)(d)). Therefore the local floodplain requirements are applicable.

In addition, the City of Kent regulates the area along the Green River under the Green River Corridor Special Interest District Regulations. These requirements specify restrictions on land use and standards for development. These requirements are TBCs for potential actions taken in the lower, eastern portion of the site.

Green River Management Agreement

The City of Kent is a participant in the Green River Management Agreement (GRMA), dated July 18, 1985. The GRMA was entered into by King County and the cities of Kent, Auburn, Renton, and Tukwila. The purpose of the agreement is to provide for regional regulation and management of operations for contributing inflows (pumping stations and outfalls) to the Green River. The substantive requirements of the GRMA include restrictions on P1 pumping plant operations (Black River outfall to Green River), along with new pressurized or gravity outfalls to the river as defined in the Final Green River Pump Operations and Procedures Plan (Green River Basin Program, 1986). Because the site is located within the City of Kent and contributes inflows to the Green River (South Pond discharge), and because the eastern portion of the site is within a floodplain, these requirements are TBCs.

9.2 Action-Specific ARARs

Action-specific ARARs are requirements that define acceptable containment, treatment, storage, and disposal procedures. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. The laws and regulations that were evaluated and designated as potential action-specific ARARs are briefly described below and tabulated in Table 5-2 of the Final Closure Action Report (CH2M-Hill, 1992a).

Federal Requirements

Resource Conservation and Recovery Act

Subtitle D of the Resource Conservation and Recovery Act (RCRA) is not applicable to the site because it did not receive waste after October 9, 1991, the effective date of the regulation. Subtitle D regulations were revised and published in the Federal Register (FR) on October 9, 1991. The state has the lead in implementing the regulations and must incorporate the final rule into their programs, although some flexibility is specified in its adoption for states with approved program status.

Clean Water Act

Stormwater discharges from the site into the Green River or Midway Creek are regulated under the Clean Water Act as part of the National Pollutant Discharge Elimination System (NPDES). The intent of the Clean Water Act was that states would develop and implement permit programs to enforce the regulations. Washington has an EPA-approved program and implements the regulations under the Water Pollution Control Act, which is discussed below under State Requirements.

State Requirements

Solid Waste Management Act

The Minimum Functional Standards for Solid Waste Handling are the implementing regulations (WAC 173-304) of the Solid Waste Management Act, which establishes the state program for solid waste handling. These regulations are applicable to the site and are considered the primary ARARs for closure of the site. MFS specifies requirements for landfill cover, surface water control, landfill gas collection, access control, and compliance monitoring.

On March 11, 1993, Ecology issued for public review and comment draft Chapter 173-351 WAC, Criteria for Municipal Solid Waste Landfills, that updates the existing rule (Chapter 173-304 WAC) and includes relevant Subtitle D requirements. WAC 173-351-010(2)(b) of the proposed rule states that municipal solid waste landfills that stopped receiving waste prior to October 9, 1991, are subject to closure and post-closure rules under Chapter 173-304 WAC. Kent Highlands Landfill stopped receiving waste on December 31, 1986. Therefore, WAC 173-304 will continue to be the applicable state solid waste regulation for closure and post-closure of the Kent Highlands Landfill.

Water Pollution Control Act

The NPDES permit program regulations (WAC 173-220) establish the state program for implementation of the federal NPDES requirements, created by section 402 of the Clean Water Act. The regulations specify compliance monitoring requirements for the discharge of pollutants to surface waters of the state and may be applicable to the point source discharge of stormwater from the site to the Green River.

Model Toxics Control Act

The state Model Toxics Control Act (MTCA) regulations (WAC 173-340) specify that when evaluating cleanup actions performed under the federal cleanup law, Ecology shall consider WAC 173-340-360 and 173-340-700 through 173-340-760 to be legally applicable requirements under Section 121(d) of CERCLA (i.e., federal cleanup law). These requirements were evaluated as ARARs for the site although a cleanup action to remediate a release that poses a risk to human health and the environment is not being conducted onsite. The selection criteria for cleanup actions (WAC 173-340-360) cannot be categorized as action-, location-, or chemical-specific ARARs because these criteria are for evaluating and selecting actions. These criteria have been incorporated into the evaluation of cleanup and closure actions presented in Chapter 2 and 6. The action-specific requirements are compliance monitoring and implementation of institutional controls. These requirements are applicable because closure of the Kent Highlands Landfill will utilize containment technologies.

Local Requirements

City of Kent

The City of Kent specifies requirements for actions affecting the control of surface water in the Green River Basin. The City of Kent regulates surface water control in accordance with the Green River Management Agreement, Green River Pump Operations and Procedures Plan, and the King County Surface Water Design Manual for surface water control. The requirements for control of the quantity and quality of the offsite discharge of stormwater are TBCs because surface water control actions taken onsite may potentially affect the surface water management of the Green River Basin.

King County Solid Waste Regulations

The Seattle-King County Department of Public Health is charged with the authority to oversee and enforce the rules for solid waste handling. The King County Solid Waste Regulations (also known as King County Board of Health Rules and Regulations No. 8) are the local jurisdiction adoption of the state requirements; therefore these regulations are applicable to the site. The King County Solid Waste Regulations (KCSWR) meet or exceed the minimum standards established by Ecology in MFS (WAC 173-304). The compliance monitoring requirements for groundwater protection are more stringent than the state requirements. These more stringent requirements are presented in Table 5-2 of the Final Closure Action Report (CH2M-Hill, 1992).

Municipality of Metropolitan Seattle

The Municipality of Metropolitan Seattle (Metro) has a program in place to implement the general and specific requirements for discharge of waste materials from industrial, commercial, and municipal operations into its sewerage system, under authorization of the state Water Pollution Control Act and Section 307 of the Clean Water Act. This program is implemented by issuance of a Wastewater Discharge Permit. The leachate collection and treatment system currently discharges to Metro under permit number 7115. The specified monitoring requirements (e.g., sampling frequency) are applicable for compliance monitoring of effluent from the leachate collection and treatment system.

9.3 Chemical-Specific ARARs

Chemical-specific ARARs are laws and regulations governing the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. Chemical-specific ARARs generally set health- or risk-based concentration limits (e.g., discharge limits) for specific hazardous substances. Because cleanup levels are not being established for a release of specific hazardous substances, the chemical-specific ARARs have been identified as performance standards and compliance monitoring requirements for site closure actions. The laws and regulations that were evaluated and designated as potential chemical-specific ARARs are briefly described below and tabulated in Table 5-3 of the Final Closure Action Report (CH2M-Hill, 1992).

Federal Requirements

Clean Water Act

The purpose of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Section 307 established a national pretreatment program to control the indirect discharge of pollutants to publicly owned treatment works (POTWs) with the goal of protecting the POTW from damage (e.g., inhibition of the processes, worker safety, damage to physical facilities).

These requirements are applicable for the discharge of leachate to the Metro sewerage system.

Section 402 established the NPDES program, which regulates the point source and non-point source discharges to the waters of the United States, including stormwater discharges. Under the NPDES program, effluent limitations are established for any point source discharge based on technology or water quality standards. EPA has promulgated regulations for using NPDES permits for stormwater discharges. The stormwater regulations, which are administered by the State of Washington, are applicable to stormwater discharge from the south pond to the Green River.

Resource Conservation and Recovery Act

Subtitle D of RCRA specifies compliance monitoring requirements for groundwater and landfill gas media. These regulations are administered by state government and are further discussed below under State Regulations. The regulation also specifies that the site may not violate applicable ambient air standards. This requirement is also relevant and appropriate because of the production and emission of landfill gas, although the results of the RI demonstrated that the site was in compliance with applicable ambient air standards.

Clean Air Act

The regulations specify primary and secondary National Ambient Air Quality Standards (NAAQS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and performance standards for new and existing stationary sources. The NESHAP and performance standards regulations are not ARARs because they address specific sources, control systems, or hazardous air pollutants that are not found onsite. The NAAQS are applicable to actions onsite that modify an existing source or add a new source of emissions of criteria pollutants.

State Requirements

Model Toxics Control Act

The MTCA regulations specify that the cleanup standards presented in Section 173-340-700 through 173-340-760 are applicable to the site when evaluating cleanup actions conducted under CERCLA. In accordance with Method B, cleanup standards are established for particular hazardous substances onsite and the specific areas or pathways through which humans and the environment can become exposed to these substances. Cleanup standards are established so that the following risk levels are not exceeded:

- Total excess lifetime cancer risk shall not exceed one in one hundred thousand (1×10^{-5})
- Hazard index for noncarcinogenic risk shall not exceed one (1).

The estimated risks, carcinogenic and noncarcinogenic, for the site are considerably less than the acceptable levels specified by MTCA; therefore, the cleanup standards have been met and the determination of cleanup standards for specific substances and pathways are not necessary. For this reason, the specific MTCA cleanup standards (WAC 173-340-700 through 173-340-760) are not included as identified ARARs for the site and thus not presented in Table 5-3 of the Final Closure Action Report, CH2M-Hill, 1992). The evaluation of MTCA cleanup standards is based upon the risk assessment conducted as part of the RI (CH2M HILL, 1991a). The Remedial Investigation report was reviewed and approved by Ecology.

Solid Waste Management Act

The regulation specifies parameters for monitoring groundwater quality and landfill gas migration. These requirements are applicable for compliance monitoring programs and as performance standards for the design of control systems.

Water Pollution Control Act

The state NPDES permit program regulations (WAC 173-220), authorized under the Water Pollution Control Act, are applicable for discharges from the site to Midway Creek and the Green River.

Washington Clean Air Act

The regulation establishes acceptable source impact levels (ASILs) for toxic air pollutants emitted from new sources to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality as will protect human health and safety. The specified concentrations will be applicable to the performance of new controls implemented onsite or the modification of an existing source.

Local Requirements

Puget Sound Air Pollution Control Agency, Regulation I, II, and III

The Puget Sound Air Pollution Control Agency (PSAPCA) is a regional body authorized by Ecology to implement the Washington Clean Air Act. Regulations I, II, and III were adopted to meet or exceed the standards and programs developed under the authority of the state and federal clean air acts. PSAPCA implements Regulations I, II, and III through issuance of Notice of Construction approvals. The substantive requirements that are applicable include ASILs and ambient air quality standards for new sources constructed onsite or modification of existing sources. An additional consideration is that any new or modified source will use current technology as defined through a best available control technology (BACT) analysis.

King County Solid Waste Regulations

The regulation specifies parameters for monitoring groundwater quality and landfill gas migration. These requirements meet or exceed the state MFS regulations and are applicable for compliance monitoring programs and as performance standards for the design of control systems.

Municipality of Metropolitan Seattle

As stated previously, Metro has a program in place to implement the general and specific requirements for discharge of waste materials from industrial, commercial, and municipal operations into its sewerage system, under authorization of the state Water Pollution Control Act and Section 307 of the Clean Water Act. This program requires monthly monitoring of the leachate collection and treatment system effluent. The pretreatment standards specified by Metro are applicable as compliance monitoring parameters.

9.4 Closure Action Requirements

The closure action requirements for the site are the performance standards that must be met for closure of the site and maintained during the post-closure period. These requirements include specific performance standards for control systems and concentration limits that must be attained or maintained in the various media potentially affected by the landfill. Some of the requirements address multiple media and are specific actions necessary to protect the overall site.

The purpose of developing closure action requirements is to provide minimum criteria for evaluating closure actions. Alternative technologies were evaluated for compliance with the closure action requirements in the Closure Action Report (CH_2M Hill, 1992a). Selected technologies can be expected to attain the closure action requirements where pertinent.

Closure action requirements for the site have been formulated to achieve the following closure action objectives identified for the site:

- Prevent direct contact with refuse
- Reduce leachate migration to groundwater
- Control surface water runon/runoff and erosion
- Control offsite subsurface landfill gas migration

The closure action requirements are derived directly from the potential ARARs summarized in this Chapter. The potential ARARs, listed as location specific, action specific, or chemical specific, are developed into actions for site-specific conditions according to the affected media and the most stringent ARAR.

The media-specific closure action requirements are presented in Table 9-1. The citation column of Table 9-1 indicates the federal, state, and local ARARs that have been combined, if pertinent, in development of the closure action requirement. Table 9-1 also presents the point of compliance for each of the closure action requirements if pertinent.

Table 9-2 presents closure action requirements that are not media-specific (e.g., access control). These requirements are derived primarily from action-specific ARARs that are general in nature and may address multiple media.

Table 9-1
Closure Action Requirements by Medium

Medium	ARAR/TBC Citation	Requirement	Point of Compliance	Comments
Groundwater (performance standard)	MFS WAC 173-304-460 KCSWR Part V, Section 4	Close, cover, and maintain the landfill in a manner that will prevent contamination of groundwater beyond the point of compliance. Contamination is defined as allowing a discharge that would cause any substance in groundwater to exceed maximum contaminant levels as defined by WAC 173-304-9901, or present a substantial risk to human health or the environment if the substances significantly exceed background levels.	That part of the groundwater that lies beneath the perimeter of a solid waste facility's active area. This area is where solid waste disposal and treatment operations have been carried out. For this site, the point of compliance is the vertical surface extending down into the uppermost aquifer, at the down gradient site boundary.	WAC 173-304-9901 sets the primary drinking water standards of WAC 248-54 as the maximum contaminant levels, "until such time as the department establishes groundwater quality standards for all types of activities impacting groundwater." The latter has been accomplished by WAC 173-200, however WAC 173-200 specifically exempts CERCLA sites. The requirement to not cause groundwater concentrations that present a substantial risk to human health or the environment, if they significantly exceed background levels, will be taken as the operative requirement of MFS and KCSWRs.

Table 9-1
Closure Action Requirements by Medium

Medium	ARAR/TBC Citation	Requirement	Point of Compliance	Comments
Groundwater (compliance monitoring)	MFS WAC 173-304-490 KCSWR, Part VI, Section 1	At least one upgradient and three downgradient wells must be at appropriate locations and depths to yield representative samples from the uppermost and all hydraulically connected aquifers below the active portion of the facility. Quarterly sampling and analysis for a list of 11 parameters. Quarterly determination of groundwater surface elevation, flow rate and flow direction. Annual sampling and analysis of 14 organic compounds or organic parameters approved by the health department and Ecology. The presence of significant contamination is determined through statistical analysis and MCL comparisons. If significant contamination is found then corrective action requirements are implemented.	Monitoring wells at or near the point of compliance described in WAC 173-304-460 (see above)	MFS and KCSWR groundwater monitoring and corrective action requirements are the same except for the KCSWR specification for annual sampling, analysis, and reporting of organic parameters.
Surface Water (performance standards)	RCRA 40 CFR 258.26 MFS WAC 173-304-460(3)	Construct and maintain run-on/runoff control systems to prevent all the run-on resulting from a maximum flow of a 25-year storm and collecting the runoff resulting from a 24-hour, 25-year storm from the active and closed areas of the landfill.	Site boundary	MFS requirements are more stringent than RCRA.
	RCRA 40 CFR 258.27 MFS WAC 173-304-460 KCSWR Part V, Section 4	Control discharges to surface water in accordance with federal and State Clean Water Acts and NPDES Programs (40 CFR 122, 123, and 124 and WAC 173-220).	The Green River and Midway Creek where they pass through or are contiguous with the site and wetlands onsite.	RCRA, MFS, and KCSWR requirements are the same in that they prohibit violations of the Clean Water Act protection standards.
	City of Kent Department of Public Works (Ordinance No. 2130)	Provide detention storage adequate for a 10--year or 25-year recurrence storm event, and erosion/sedimentation control measures for these events.	Prior to discharge of stormwater to Midway Creek or the Green River.	The design requirements will be considered along with requirements of MFS, WAC 173-304-460, and RCRA 40 CFR 258.26.

Table 9-1
Closure Action Requirements by Medium

Medium	ARAR/TBC Citation	Requirement	Point of Compliance	Comments
Surface Water (performance standards continued)	Green River Management Agreement	Any modification to the existing surface water discharge system from the South Pond to the Green River shall be designed in accordance with the requirements of the Green River Pump Operations and Procedures Plan.	Discharge of South Pond to Green River	The design requirements will be considered along with requirements of MFS, WAC 173-304-460, and RCRA 40 CFR 258.26.
	40 CFR 6, Appendix A (Floodplain) MFS WAC 173-304-460 (3)(d) KCSWR Part V, Section 4 City of Kent, KCC 14.22	For any action taken within the floodplain (defined as any flat area adjoining inland waters), avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values of the floodplain. Do not take any action within the 100-year floodplain that will restrict the flow of the base flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste.	Floodplain (as defined) adjoining Green River, Midway Creek	MFS and KCSWR specify compliance with local floodplain management ordinances.
	40 CFR 6.302(g) Fish and Wildlife Coordination Act	For any action that will result in diversion, channeling, or any other modification of Midway Creek or Green River take all possible measures to protect fish and wildlife.	The streambeds of Midway Creek and Green River	
	Hydraulic Code WAC 220-110	For any action that will use, direct, obstruct, or change the natural flow or bed of state waters, provide specified information regarding the action to the Department of Fisheries.	The streambeds of Midway Creek and Green River	
Surface Water (compliance monitoring)	NPDES 40 CFR 122, 123, 124 and WAC 173-220	Monitor point sources of stormwater discharges for required substances. Parameters for monitoring are set on a case-by-case basis if known or believed to be present.	Any point source discharges from onsite facilities to the Green River or Midway Creek	State has the lead in implementing the NPDES program.
Wetlands (performance standard)	Clean Water Act, 40 CFR 125; 40 CFR 6, Appendix A	Take all possible precautions to avoid or minimize the destruction, loss, or degradation of wetlands.	Wetlands onsite	

Table 9-1
Closure Action Requirements by Medium

Medium	ARAR/TBC Citation	Requirement	Point of Compliance	Comments
	Shoreline Management Act WAC 173-22 City of Kent Planning Department	Conduct a wetlands analysis for any action that may affect wetlands. This analysis includes delineation of wetlands, identification of wetland functions, values and types, relationship to offsite wetlands, assessment of potential impact, and proposed mitigation for potential impacts as necessary.		
Landfill Gas (performance standard)	RCRA 40 CFR 258.23 MFS WAC 173-304-460(-a)(b) KCSWR Part V, Section 4	Prevent concentrations of combustible gases generated within the landfill from exceeding 25 percent of the lower explosive limit (LEL) in facility structures and from exceeding the LEL at the property boundary; and 100 ppm by volume of hydrocarbons (expressed as methane) in offsite structures.	Within facility structure and in subsurface monitoring probes at or near the property boundary as noted	MFS and KCSWR are more stringent than RCRA.
Landfill Gas (compliance monitoring)	RCRA 40 CFR 258.23 KCSWR Part VI, Section 2	A quarterly sampling and testing program to monitor gas production and migration is required for determining if performance standards are met.	Within the landfill (production), at the site boundary (migration), and within structures as appropriate.	MFS does not require monitoring. The requirement represents the combination of RCRA and KCSWR.
Ambient Air (performance standard)	Clean Air Act 40 CFR 50, RCRA 40 CFR 258.24, Washington Clean Air Act, WAC 173-460 PSAPCA Regulation I and II,	Demonstrate that any new source, including landfill gas flares or energy recovery facilities, will not violate acceptable source impact levels (ASILs). ASILs have been established for a list of compounds identified in WAC 173-460.	Ambient air at site boundary	PSAPCA enforces state requirements, which are in conformance with all federal requirements.
Leachate (compliance monitoring)	Clean Water Act, Section 307 Water Pollution Control Act, WAC 173-216 Metro Resolution 3374	A periodic monitoring program to test effluent quality for compliance with specified pollutant limitations is required.	Discharge to Metro sewer	Metro administers state and federal requirements.

Table 9-2
Closure Action Requirements That Are Not Media-Specific

ARAR/TBC Citation	Requirement	Comments
RCRA 40 CFR 258.22 MFS WAC 173-304-460(3)(g)(vi) KCSWR Part V, Section 4	Close, cover, and maintain the landfill in a manner that will prevent onsite disease vectors appropriately for protection of human health and the environment.	Similar requirements in RCRA, MFS, and KCSWR have been combined in this closure action requirement.
RCRA 40 CFR 258.25 MFS WAC 173-304-460(3)(g) KCSWR Part V, Section 4	Access must be controlled to prevent unauthorized traffic and illegal dumping of wastes, with entry allowed only through locked gates, throughout the post-closure care period. Approach and exit roads shall be of all weather construction. A sign will be maintained at the site entrance that identifies the site and gives an emergency telephone number.	Similar requirements in RCRA, MFS, and KCSWR have been combined in this closure action requirement.
RCRA 40 CFR 258.60 MFS WAC 173-304-460(3)(e) KCSWR Part V, Section 4	Construct a final cover that includes at least 2 feet of 10^{-6} cm/sec. or lower permeability soil or equivalent. Artificial liners may replace soil covers provided that a minimum 50-mil thickness is used. Grade of surface slopes shall be not less than 2 percent, nor the grade of side slopes more than 33 percent. The top of the final cover shall consist of at least 6 inches of topsoil seeded with grass or other shallow-rooted vegetation.	The final cover requirements of MFS and KCSWR are more stringent than the requirements of RCRA 40 CFR 258, for this site.
RCRA 40 CFR 258.61 MFS WAC 173-304-407 MTCA WAC 173-340-410, 173-340-440 KCSWR Part V, Section 3	Post-closure performance standard: Provide post-closure activities to allow for continued facility maintenance and monitoring of air, land, and water for 20 to 30 years or as long as necessary for the fill to stabilize and to protect human health and the environment.	The King County health officer has authority to determine stability of site.

X. COMPLIANCE WITH MODEL TOXICS CONTROL ACT THRESHOLD AND OTHER REQUIREMENTS

Chapter 10
Compliance with Model Toxics Control Act Threshold and Other Requirements

As discussed in Chapter 5, the MTCA Method B cleanup standards contained in WAC 173-340-700 through WAC 173-340-760 were demonstrated in the risk assessment prepared for the remedial investigation to have been met at this site under existing conditions. The proposed cleanup and closure actions will provide continued protection of human health and the environment, as shown in the analysis and evaluations presented in this chapter and in Chapter 4. Therefore, the risk levels posed by the site will be further decreased as the proposed actions are implemented. Specific monitoring and institutional control requirements under MTCA are discussed in Chapters 3 and 7, respectively.

Selection of cleanup actions is addressed under WAC 173-340-360.
WAC 173-340-360(1) (Purpose) states that "Because cleanup actions will often involve the use of several cleanup technologies or methods at a single site, the overall cleanup action shall meet the requirements of this section." The following discussion relates the analysis and evaluations presented in this Closure Action Report to the requirements for selection of cleanup actions contained in WAC 173-340-360. This discussion is presented in order to show that the minimum requirements of MTCA will be met by the proposed closure actions described earlier.

The proposed closure action must comply with the MTCA threshold requirements (WAC 173-340-360(2)) and other requirements (WAC 173-340-360(3)).

The four threshold requirements are: 1.) that the actions shall protect human health and the environment, 2.) shall comply with the standards set forth in WAC 173-340-700 through 173-340-760, 3.) shall comply with applicable state and federal laws, and 4.) shall provide for compliance monitoring.

Each action proposed for the Kent Highlands Landfill has been evaluated for the first threshold requirement, overall protection of human health and the environment. Ecology has determined that the proposed closure actions meet the first threshold requirement.

The proposed actions comply with the second threshold requirement by reducing the risk levels associated with the site, which have been demonstrated to be within an acceptable range in the remedial investigation.

The third threshold requirement, compliance with applicable state and federal laws, has been determined for the proposed closure actions through an exhaustive analysis of ARARs presented in Chapter 9.

The fourth threshold requirement will be met by the compliance monitoring program described in Chapter 3. The proposed compliance monitoring program is derived from the ARARs analysis presented in Chapter 9 and continuation of existing monitoring programs at the site.

The three other requirements of WAC 173-340-360 are: 1) to use permanent solutions to the maximum extent practicable; 2) provide for a reasonable restoration time frame; and 3) consider public concerns raised during public comment on the draft cleanup action plan.

With regard to using permanent solutions to the maximum extent practicable, WAC 173-340-360(5)(d) states that "Ecology recognizes that permanent solutions may not be practicable for all sites," and lists seven criteria to be used to determine whether a cleanup action is "permanent" to the maximum extent practicable." These criteria are the similar to those required under CERCLA and were used to evaluate the proposed closure actions. Table 10-1 contains a summary showing how each of the proposed closure actions and alternative actions developed was evaluated in relation to the seven criteria. Based upon these evaluations and the supporting analysis contained in the Closure Action Report the proposed closure actions will meet the requirements of WAC 173-340-360(5) CH_2M Hill, 1992a.

Further regarding use of permanent solutions to the maximum extent practicable, WAC 173-340-360(5)(e) lists the following requirements intended to ensure a bias toward permanent solutions:

(1) The cleanup action shall prevent or minimize present and future releases and migration of hazardous substances in the environment;

(2) The cleanup action shall provide for a net reduction in the amount of a hazardous substance if active measures are technically possible;

(3) The cleanup action shall not rely primarily on dilution and dispersion of the hazardous substance if active measures are technically possible;

(4) A cleanup action relying primarily on institutional controls and monitoring shall not be used where it is technically possible to implement a cleanup action alternative that utilized a higher preference cleanup technology for all or a portion of the site; and

(5) A cleanup action involving off-site transport and disposal of hazardous substances without treatment shall not be used if a treatment technology or method exists which will attain cleanup standards and is practicable.

The first requirements listed above will be met by the proposed final cover, gas migration control systems, surface water control systems, and leachate collection and treatment systems. The analysis of final cover options presented in Chapter 4 showed that the final cover will effect a net reduction in the amount of hazardous substances being released from the source area by reducing the production of leachate. The gas control system in the landfill interior will also effect a net reduction in the amount of gas released from the landfill. These two effects will meet the second requirement listed above.

The third requirement will be met because the proposed actions do not rely primarily on dilution or dispersion. The actions rely primarily on containment and also include active extraction of gases and collection and permanent treatment of leachate. For the same reasons, the fourth requirement will be met because the proposed closure actions do not rely primarily on institutional controls and monitoring. The fifth requirement listed is not appropriate for this site because practicable methods of treating (vs. containing) municipal solid waste landfills have not been developed.

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	Overall Protection of Human Health and Environment	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
Refuse							
Access Controls							
Site fence, signage	Meets all criteria	Adequate	Adequate	Not applicable	No adverse impacts	Some difficulty in limited area	Cost-effective
Refuse Outside Site Boundary							
Removal/disposal offsite	Meets all criteria	Adequate	Adequate	Adequate. Most likely to reduce mobility and volume.	Some potential for adverse impacts (odor, dust, gas exposure) during excavation	No problems with implementation. Requires agreement with offsite landfill operator.	Highest cost for all these areas
Removal/disposal onsite	Meets all criteria	Adequate	Adequate	Adequate. More likely to reduce mobility and volume than covering in place.	Some potential for adverse impacts (odor, dust, gas exposure) during excavation.	No problems with implementation	May be cost-effective for Areas 2 and 3
Covering in place	Meets all criteria	Adequate. May be somewhat less protective than other alternatives.	Adequate. May be slightly less effective than other alternatives.	Adequate. Less likely than other alternatives to reduce mobility and volume.	Less potential for short-term adverse impacts than other alternatives.	Requires easements or property purchase	Apparent least cost alternative for Areas 2 and 3 (easement, property purchase costs not considered)
No Action (Area 1)	Meets all criteria	Adequate	Adequate	Adequate	No Impact	No problems with implementation	Least-cost alternative for Area 1

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	**Overall Protection of Human Health and Environment**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume**	**Short-Term Effectiveness**	**Implementability**	**Cost**
Site Grading	Meets all criteria except for slope east slope exceeds 33%	Adequate	Adequate - Engineering analysis shows east slope is stable. Engineered features will provide cover stability	Not applicable	No adverse impacts. Requires erosion controls during construction.	No implementation problems	Cost-effective
Final Cover							
Concept 1. Final grading only	Does not meet minimum MFS requirements.	Adequate. Least protective alternative.	Alternatives without drainage layer have less permanence.	Least effective in reducing mobility of waste constituents	Requires erosion control during construction	No implementation problems	Least cost alternative
Concept 2. MFS minimal site cover	Meets all criteria.	Adequate.	Alternatives without drainage layer have less permanence.	Reduces mobility of waste constituents	Requires erosion control during construction	No implementation problems	Highest cost alternative
Concept 3. Low-permeability soil cover with drainage layer	Meets all criteria.	Adequate.	Alternatives with drainage layer have greater permanence.	Reduces mobility of waste constituents	Requires erosion control during construction	No implementation problems	Next-to-highest cost alternative
Concept 4. Low-permeability soil cover with geomembrane and drainage layer	Meets all criteria.	Adequate. Most protective—equal to Concept 5.	Alternatives with drainage layer have greater permanence.	Most effective in reducing mobility of waste constituents (equal to Concept 5)	Requires erosion control during construction	Geomembrane requires special tools and reinforcement on steep slopes	Middle cost alternative
Concept 5. Geomembrane and drainage layer	Meets all criteria.	Adequate. Most protective—equal to Concept 4.	Alternatives with drainage layer have greater permanence.	Most effective in reducing mobility of waste constituents (equal to Concept 4)	Requires erosion control during construction	Geomembrane requires special tools and reinforcement on steep slopes	Next-to-lowest cost alternative

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	Overall Protection of Human Health and Environment	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
Leachate							
Collection System Modifications							
Repair existing system	Meets all ARARs	Adequate	Adequate. Requires periodic monitoring and maintenance.	Could reduce leachate volume discharged to groundwater	No adverse impacts; workers protected by site safety plan; no offsite releases	Uses standard and available technology	Cost-effective options not mutually exclusive.
Seep Collection System	Meets all ARARs	Adequate	Adequate. Requires periodic monitoring and maintenance.	Could reduce leachate volume discharged to groundwater	No adverse impacts; workers protected by site safety plan; no offsite releases	Uses standard and available technology	Cost-effective
Treatment and Discharge System							
Separate treatment of spring drain system	Meets all ARARs; would require wetlands permit for construction	Adequate	Adequate. Requires full-time operation and monitoring.	Leachate meets Water Quality Standards and Permit Requirements after treatment.	Wetlands impacts	Uses standard construction and design methods	Not cost-effective
Upgrade existing system	Meets all ARARs	Adequate	Adequate. Requires full-time operation and monitoring.	Leachate meets Permit Requirements after treatment.	No adverse impacts	Uses standard construction and design methods	Cost-effective
Landfill Gas							
Subsurface Gas Control Systems							
Perimeter gas wells	Meets all criteria	Adequate	Adequate. Requires long-term maintenance.	Reduces gas mobility	No adverse impacts	Appropriate only for limited areas of the site	Cost-effective for appropriate areas of the site

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	Overall Protection of Human Health and Environment	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
Landfill Gas (cont.)							
Interior gas wells	Meets all criteria	Adequate	Requires long-term maintenance.	Reduces gas mobility	No adverse impacts. Emission controls required during construction.	Appropriate only for limited areas of the site	Cost-effective for appropriate areas of the site
Interior gas trenches	Meets all criteria	Adequate	Adequate. Subject to settlement damage. Requires long-term maintenance.	Reduces gas mobility	No adverse impacts. Emission controls required during construction.	Appropriate only for limited areas of the site	Cost-effective for appropriate areas of the site
Offsite gas extraction wells	Meets all criteria	Adequate	Adequate. Requires long-term maintenance. Subject to vandalism.	Reduces gas mobility	No adverse impacts	No problems with implementation	Cost-effective for offsite gas capture.
Gas Disposal Systems							
Activated carbon adsorption	Meets all criteria	Adequate	Less permanent than flare but compensatory reduction in mobility; requires maintenance.	Reduces mobility of toxic constituents in gas	No adverse impacts	No problems with implementation	May be cost-effective for offsite gas disposal only
Thermal treatment (flare)	Meets all criteria	Adequate	Provides permanent destruction of toxic constituents. Requires maintenance.	Reduces toxicity of toxic constituents in gas	No adverse impacts	No problems with implementation	Cost-effective for onsite (including perimeter) gas disposal

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	Overall Protection of Human Health and Environment	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
Landfill Gas (cont.)							
Condensate Handling							
Discharge to landfill	Does not meet Ecology directive (Ecology 1990)	Adequate	Adequate. Requires maintenance.	Reductions in toxicity and mobility less than other two alternatives.	No adverse impacts	No problems with implementation	Least costly alternative
Discharge to leachate pre-treatment system	Meets all criteria	Adequate	Adequate. Requires maintenance.	Provides reductions in toxicity and mobility	No adverse impacts	No problems with implementation	More cost alternative
Surface Water							
Conveyance Systems							
With final cover drainage layer	Meets all criteria	Adequate. Reduces leachate generation.	Adequate. Requires maintenance.	Reduces waste mobility by preventing infiltration.	Requires temporary erosion controls during construction.	No major implementation problems	Lower cost alternative
Without final cover drainage layer	Meets all criteria	Adequate. Reduces leachate generation.	Adequate. Requires maintenance.	Reduces waste mobility by preventing infiltration.	Requires temporary erosion controls during construction.	No major implementation problems	High-cost alternative
Detention Facility							
South Pond expansion/ discharge pipe upgrade	Meets all criteria. Wetlands mitigation may be required.	Adequate	Adequate. Requires maintenance.	Not applicable	Requires temporary erosion controls during construction.	Dredged expansion not appropriate. Raised berms okay.	Cost-effective
Alternative pond locations	Meets all criteria. Wetlands mitigation may be required.	Adequate	Adequate. Requires maintenance. Requires long-term erosion control measures.	Not applicable	Requires temporary erosion controls during construction.	Implementation not feasible due to pond locations in relation to conveyance system.	Extreme cost (pump stormwater, high erosion control cost)

Table 10-1
Summary of CERCLA Evaluations Performed

Alternative Action	CERCLA Criteria						
	Compliance with ARARs	Overall Protection of Human Health and Environment	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
Surface Water (cont.)							
Water Quality Treatment							
Detention pond and vegetated ditches	Meets all criteria	Adequate	Adequate. Requires long-term maintenance.	Removes sediment and any adhering toxic constituents.	No adverse impacts	No implementation problems	Cost-effective
Erosion and sediment control, including vegetation maintenance	Meets all criteria	Adequate	Adequate. Requires long-term maintenance.	Removes sediment and any adhering toxic constituents.	No adverse impacts	No implementation problems	Cost-effective

XI. WASTE CHARACTERIZATION & CLOSURE ACTION REQUIREMENTS

Chapter 11
Waste Characterization and Containment Measures

11.1 Waste Characterization

When the Kent Highlands Landfill first opened in 1968, the City of Seattle was already operating the Midway Landfill, which is located west of Interstate 5 about one mile south of Kent Highlands. With the opening of Kent Highlands, the City established a policy of sending industrial wastes and demolition material selectively to Midway and the municipal waste from its transfer stations to Kent Highlands. As a result, Kent Highlands received primarily municipal garbage (the type of waste disposed by households) throughout the first 15 years of its operation (CH2M HILL, 1988b).

In 1983, the Midway Landfill was closed. As a result, in addition to municipal waste, the industrial wastes and construction and maintenance debris received at the City's transfer stations were delivered to Kent Highlands. However, a review of the City's solid waste records for the years 1980 and 1986 indicates that while industrial waste deliveries to Kent Highlands increased after the closure of Midway Landfill, the quantity of industrial waste received remained a very small fraction (less than 1/2 percent) of the total wastes received at Kent Highlands (CH2M HILL, 1988b).

In 1980, the Seattle-King County Health Department began a program to screen potentially dangerous or hazardous wastes (as defined by state and federal environmental laws) to prevent them from being disposed of in solid waste landfills. As a part of this program, the department began to keep records of the materials that they screened and approved for disposal at the City's landfills. Early in the program, many requests to dispose of certain materials in the City's landfills were rejected. The Department's records show decreasing numbers of rejected requests over time as a result of growing awareness among waste generators and haulers of the proper disposal practices for certain types of wastes. Because of this screening program, it is unlikely that significant quantities of hazardous wastes were delivered to the Kent Highlands Landfill in the industrial-type wastes that were accepted there after Midway Landfill's closure (CH2M HILL, 1988b).

11.2 Waste Containment Measures

The proposed closure actions for Kent Highlands Landfill involves on-site containment of the waste characterized above. Measures to prevent migration and contact with the waste are presented in Chapter 2

VII. BIBLIOGRAPHY

Should be XII

Chapter 12
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XIII. COMMENTS ON THE CLEANUP ACTION PLAN

November 6, 1992

TO: Ching-Pi Wang

FROM: Curtis Dahlgren CD
Toxics Cleanup Program

SUBJECT: Draft Cleanup Action Plan for Kent Highlands Landfill

I have not read the entire document, but I did read the declarative statement and purpose section. As we discussed on the phone yesterday, I have some suggested changes to the language regarding the plan's compliance with the National Oil and Hazardous Substances Pollution Contingency Plan.

I suggest the declarative statement read as follows:

> Consistent with the Chapter 70.105D RCW, "Model Toxics Control Act", as implemented by Chapter 173-340 WAC, "Model Toxics Control Act Cleanup Regulation", it is determined by Ecology that the selected cleanup actions are protective of human health and the environment, attain Federal and State requirements which are applicable or relevant and appropriate, comply with cleanup standards, and provide for compliance monitoring. The cleanup actions satisfy the preference expressed in WAC 173-340-360 for the use of permanent solutions to the maximum restoration time frame, and consider public concerns raised during public comment on the draft Cleanup Action Plan.
>
> Furthermore, it is Ecology's opinion that the selected cleanup actions are consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300) and that they meet the CERCLA preference for a remedy that reduces toxicity, mobility and volume. Final authority regarding the consistency of the selected cleanup actions with the National Oil and Hazardous Substances Pollution Contingency Plan rests with the US Environmental Protection Agency.

For the purpose statement, I suggest the first paragraph read as follows:

> This document presents the draft Cleanup Action Plan (dCAP) for the Kent Highlands Landfill, Kent, Washington. This documentation is required by the site cleanup process established by the

Washington Department of Ecology (Ecology) under Chapter 173-340-WAC, "Model Toxics Control Act Cleanup Regulation", and meets the requirements specified in WAS 173-340-360(10), Draft Cleanup Action Plan.

It is also Ecology's opinion that this documentation will satisfy the site remediation process specified in the Superfund Memorandum of Agreement between Ecology and EPA for Ecology lead sites which are on the National Priorities List.

As I stated on the phone, I am suggesting the changes to better reflect the fact that Ecology does not have the final authority in determining whether an Ecology-lead cleanup action is consistent with the NCP.

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

Northwest Regional Office, 3190 - 160th Ave S.E. • Bellevue, Washington 98008-5452 • (206) 649-7000

November 13, 1992

TO: Ching-Pi Wang, Toxics Cleanup

FROM: Barry Wenger, Shorelands

RE: Kent Highlands Landfill

I offer the following comments as a result of my review of the subject Cleanup Action Plan and Closure Action Report and the discussions held on-site October 20th.

First, there is no doubt that the proposed actions are within the jurisdiction of the Kent Shoreline Master Program (KSMP) and that a shoreline permit must be obtained from the City of Kent. The proposal is associated with the Green River - a shoreline of state-wide significance (Section 5.1). Only on-site activities within Superfund sites being cleaned up solely by the EPA are exempt from Coastal Zone Management Act permit requirements. The current proposal is being cleaned up under the Model Toxics Control Act. A permit should be applied for as early in the process as is possible to allow for processing and to avoid delaying cleanup actions scheduled for next fall.

Secondly, in accordance with the provisions of the KSMP Section 3.1 - Conservancy Designation, Section 4 - Elements, and Section 5 - General Performance Standards (especially 5.4, 5.5 and 5.6), essential mitigation for activities affecting the stream and wetlands needs to be clearly delineated. Landfill must meet the standards of Section 6.6. Potential improvements could include daylighting the culvert from the detention pond to the creek, deletion of the remainder of the underground pipeline and outfall to the Green River, and restoration of the creek bed and riparian corridor in conjunction with salmonid and other habitat requirements. Certainly, additional data is needed to assess impacts upon fish from the potential quantity and quality of water leaving the pond. It would appear that a discharge permit would not be required to daylight the pond outflow to Midway Creek. With regard to the subject of an existing discharge permit for the outfall to the Green River, we have no record of said permit.

Third, recognizing that security and safety measures need to be maintained around the treatment facilities, such as the leachate pond, public access improvements need to be considered in accordance with KSMP Section 4.2 and 5.7. For example, by relocating portions of the existing fencing along Fraeger Road, provision for shoreline parking and/or a bicycle rest area could be made.

Although the above comments are based on preliminary information and are not exhaustive, we are providing them as guidance on issues which should be addressed through the shoreline permit process in conjunction with the City of Kent and our department.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office, 3190 - 160th Ave S.E. • Bellevue, Washington 98008-5452 • (206) 649-7000

November 13, 1992

TO: Ching-Pi Wang
Toxics Cleanup

EIW ~~FM~~: Erik Stockdale
Wetlands Specialist

RE: **Kent Highlands Stormwater Pond Wetlands**

I would like to provide you with some comments and observations after our November 2, 1992 site visit to the Kent Highlands Landfill. You asked me to evaluate potential wetland impacts at the site.

The City of Seattle is proposing to improve the stormwater control facilities at their Kent Highlands Landfill site, to comply with closure requirements. The stormwater system will (upon closure) essentially consist of a series of surface runoff collection pipes connected to a pond at the bottom of the landfill. The stormwater pond ("South Pond") is located entirely within a wetland in the floodplain of the Green River. The City is proposing to raise the elevation of an existing road berm around South Pond by approximately four feet. This is necessary to increase the active storage capacity of the pond. The berm raising will enclose a 1-2 acre (approx.) palustrine forested / scrub shrub wetland. This will not only floodproof the wetland from the floodplain but will significantly alter its' hydroperiod. A wetland's hydroperiod is defined as its water signature, or the depth, frequency, duration and seasonality of inundation or saturation.

The pond itself is not a regulated wetland because it was created prior to the Clean Water Act of 1971, and has been maintained actively for stormwater purposes since then. The floodplain wetlands surrounding the pond, however, are regulated. The City is encouraged to contact the Army Corps of Engineers for a determination on whether and individual permit will be required for this project, pursuant to Section 404 of the Clean Water Act. Likewise, the Corps may spell out actions that they will require the City to follow in order to comply with the substantive requirement of the Clean Water Act.

I asked the City to evaluate the changes that will result to the affected wetland's hydroperiod as a result of the berm raising. I am waiting for this information before I can provide you with an analysis of the expected impacts. Because the affected

wetland will be flooded to a greater extent (in terms of depth, duration, frequency, and seasonality), I am concerned that the trees in the wetland may be stressed beyond their range of flooding tolerance. The worst case scenario would be for the trees to die as a result of the heightened flooding regime. This cannot be determined at this point, however, until the City provides me with the information requested of them.

Regardless of the potential wetland impacts, I am concerned with the pond's present design. I asked the City to consider installing two baffles within the pond so as to create three cells. The pond presently is one big open cell. This design is antiquated and can become a source of stormwater pollutants when storm events re-suspend pollutants that have settled out.

Barry Wanger is sending you a separate memo discussing Shoreline jurisdiction and permitting.

Thank you for the opportunity to comment on this project. If you have any questions, please call me at 649-7061.

cc: Barry Wanger, Shorelands

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CURT SWITCH
Director

RECEIVED
OCT 30 1992
DEPT. OF ECOLOGY

STATE OF WASHINGTON
DEPARTMENT OF WILDLIFE
16018 Mill Creek Blvd., Mill Creek, WA 98012 Tel. (206) 775-1311

October 28, 1992

Mr. Ching-Pi Wang
Department of Ecology
Toxics Cleanup Program
3190 - 160th Avenue Southeast
Bellevue, Washington 98008-5452

RE: DRAFT KENT HIGHLANDS LANDFILL CLEANUP ACTION PLAN

Dear Mr. Wang:

The Department of Wildlife supports the cleanup of this landfill. Our comments and concerns regarding this project and its impacts to fish and wildlife are:

1. Page 3, 1-2. This landfill has filled a forested wetland and tightlined a stream when it was first constructed. Has the city proposed any mitigation for the loss of this habitat in its reclamation plan. Did the original EIS cover habitat mitigation both upland and wetland in the closure plan.

2. Page 12, 3 & 4. Any upgrade of the pipeline that involves work in the Midway Creek or the installation of the flap gate at the Green River will require a Hydraulics Project Approval. A summer time window for work in Midway Creek would be required.

3. Page 12, last paragraph. The extent of wetlands that will be filled should be delineated and the extent of the fill should be known, not "estimated" as stated in this paragraph. The fill should be mitigated if it cannot be avoided, especially if this wetland is associated with Midway Creek which, as this document states, supports salmonids.

4. Page 50. If the water quality of the spring can be assured to meet the Class A Water Quality Standards, could this spring water be diverted into Midway Creek. This could only be done if the creek channel can handle the additional quantity of water. Typically, streams that have been impacted by development within its watershed tend to have low summer flow and the addition of this spring water could provide more rearing habitat for fish.

Thank you for the opportunity to comment on this project. If you have any questions, please call me at (206) 775-1311, extension 107.

Sincerely,

Philip Schneider
Habitat Biologist

PS:ks

cc: Joe Robel, WDF
Connie Iten, Olympia

CITY OF KENT

Dan Kelleher, Mayor
Don E. Wickstrom, P.E., Director of Public Works

December 7, 1992

Mr. Ching-Pi Wang
Department of Ecology
Toxic Cleanup Program
3190 160th Ave. SE
Bellevue, Washington 98008-5452

RE: Toxic Cleanup Program

Dear Mr. Wang:

Thank you for the opportunity to comment on the Cleanup Action Plan for the Kent Highlands Landfill. Based on our review, we have the following comments:

Pg. 7: The discussion of surface water quality in Midway Creek concludes that metals concentrations downstream of the landfill are within State ambient thresholds. While this is generally true, it is not entirely the case. Very little attention has been given to aluminum concentrations, which on two of the four sampling days exceeded acute toxicity criteria downstream of the landfill, but not upstream (Cleanup Action Report, June, 1991). Is there a possibility that landfill leachate is contributing to elevated total aluminum concentrations in the creek? At the very least, some plausible explanation for the downstream increase should be given, especially if no future monitoring is planned.

Pg. 13: Leachate treatment system. Based on a schematic diagram contained in the Cleanup Action Report, the leachate pond has an overflow to the Green River. If the preferred option is to continue to use this treatment system, what is the overall implication of this overflow to the Green River, in terms of effluent quality, number of overflows, duration, etc.?

Would any system improvements with regard to the 6-inch sewer force main on 228th Ave. S. alleviate the occasional sewer manhole overflows at 228th and Pacific Propeller, Inc.?

If you have any questions or comments, please call me at 859-3383.

Very truly yours,

Richard Chase

Richard Chase
Water Quality Engineer

T1291
cc: Martha Burke

Seattle
Solid Waste Utility
Division of Seattle Engineering Department

Terry Zaker, Director of Engineering
Nancy Glaser, Director, Solid Waste Utility

November 10, 1992

Ching-Pi Wang, P.E.
Department of Ecology
Northwest Regional Office
3190 160th Avenue S.E.
Bellevue, WA 98008-5452

Dear Mr. Wang:

There are several regulatory or legal issues in the Draft Kent Highlands Landfill Cleanup Action Plan (CAP) that we wish to comment on:

Institutional Controls: The City of Seattle does not believe that the financial assurance requirements of WAC 173-304-467 are applicable or appropriate for Kent Highlands. Under WAC 173-304-467(1)(a) the financial assurance requirements are only applicable to landfills that were not closed prior to November 27, 1989. Since Kent highlands closed in 1986, the City accordingly believes that section 467 should be deleted as an institutional control in the CAP. The City believes that its current structure for landfill closure cost funding satisfies the intent of the financial assurance requirements in section 467. Under the current rate structure, the City collects a surcharge on residential solid waste collections as well as a business and occupation surtax on solid waste disposal companies that are dedicated to landfill closure costs. These surcharges will insure that the City has sufficient revenue to implement the CAP.

Access Agreements: The Draft CAP does not address access to property that is not owned by the City of Seattle. King County, the City of Kent and a group of private investors known as Griffin-Jensen own three separate portions of the landfill. To date these parties have not objected to the development of the CAP or interim remedial measures. The City has access to the Griffin-Jensen property through an access agreement that expires in June 1993. The City anticipates that these parties will continue to cooperate in implementing the CAP. To the extent any owner denies access to the City, the City anticipates that the Department of Ecology will exercise its authority under WAC 173-340-800 to compel compliance with the CAP.

Closure Action Requirements: Table 9-2 on page 86 lists access control under federal, state and local regulations as requirements. The City of Seattle believes that the CAP should recognize that future use of the site by the public would be permissible under these requirements as long as such use did not expose users to increased risk, or unduly interfere with maintenance and monitoring of the site.

In addition to the above comments, we have the following editorial comments to make:

1. Add section 9.4, "Closure Action Requirements" to the table of contents.

2. Delete "approximately 8,400 feet" in the first paragraph of page 8.

3. Replace "170,000" with "320,000" in the third paragraph of page 8.

4. Figure 2-1 should be modified. Not all of the fence is currently completed as shown in this figure. Eliminate the cross-hatching in the area to the north; there is no legend for the cross-hatching, nor is there a real need to show it this way. Title the figure simply "Refuse Limits".

5. Replace the first sentence on page 12 with the following: " In compliance with the substantive requirements for the GRMA, as well as detention requirements for the City of Kent and Department of Fisheries, the following recommendations . . ."

6. Change the second sentence on page 14 to read "Approximately 50 perimeter extraction wells, 30 new deep interior wells,..."

7. Change the first sentence in the second paragraph on page 16 to read "The point of compliance for the site for groundwater is..."

8. Change the second sentence in the third paragraph on page 27 to read "The landfill gas condensate will be monitored..."

9. Change the first sentence on page 28 to read "The City currently contracts to conduct..."

10. Eliminate the fourth sentence in the second paragraph on page 31.

11. Change the next to last paragraph on page 33 to read "The total fill volume needed to meet the requirements of the proposed grading plan is approximately 320,000 cubic yards. Approximately 300,000 cubic yards is needed..."

12. The figure reference on page 51 should be to Figure 4-5.

13. Change the second paragraph on page 52 by replacing "39" in the first line with "approximately 50" and eliminating the last sentence.

14. Add the following paragraph to the end of page 55: "Gas disposal will be accomplished by thermal incineration using enclosed flares that will be constructed at the toe of the east slope of the landfill. Mechanical exhausters will draw gas through the collection system manifold piping and discharge it to the flares. This system is currently under construction."

15. Change the last sentence in the third paragraph on page 66 as follows: "...coordination programs involving the owners of the site including the City of Seattle...".

16. Since there are only two alternatives identified for condensate disposal on page 95, the cost column should read something like "Less costly alternative" and "More costly alternative". There needs to be a better reference to the ARAR other than "Does not meet Ecology directive". This is referring to an Ecology letter to the City dated March 27, 1990, which allowed for the discharge of condensate to the landfill until final closure is achieved. The legal basis for this policy directive needs to be included in the CAP.

17. The Fact Sheet states that the site was put on the NPL in 1986. In fact, this did not occur until 1990.

Thank you very much for the opportunity to comment on this document. Please contact Martha Burke, Program Manager, if you have any questions.

Sincerely,

Nancy Glaser
Director
Seattle Solid Waste Utility

LAW OFFICES OF
JOHN C. O'ROURKE
618 SOUTH 223RD, SUITE 6
P. O. BOX 98741
DES MOINES, WASHINGTON 98198

206-824-2802

November 13, 1992

Mr. Ching-Pi Wang, P.E.
Senior Hydrogeologist
Department of Ecology
Northwest Regional Office
3190 - 160th Avenue S.E.
Bellevue, WA 98008-5452

RE: Griffin/Jensen Real Property

Dear Mr. Wang:

The undersigned represent the owners of a tract of land approximately fifteen acres in area located north of S.R. 516 and east of Military Road South and lying generally in the southwesterly portion of the Kent Highlands Landfill. This property was added to the landfill area in 1970 after landfill operations had already begun in the Kent Highlands portion of the fill. At that time the City of Kent issued a "Conditional Exception" by Resolution of the Board of Adjustment (BA-72-10) which set forth the terms and conditions peculiar to the "Conditional Exception" and which integrated by reference the prior ordinances of the City (Ordinance 1071 as amended by Ordinance 1390) relating to the placement and operation of the Kent Highland Landfill which had started at an earlier date. The "Conditional Exception" was signed by the Board of Adjustment on December 1, 1972. From that time forward filling began and was carried on in the Griffin/Jensen portion of the Kent Highlands Landfill by the City of Seattle.

The City of Seattle had a lease contract with the Kent Highlands principals but never obtained nor solicited any direct contract with the Griffin/Jensen owners. The landfilling continued on the Griffin/Jensen parcel from early 1973 through the end of 1986. The City of Seattle violated the terms of the "Conditional Exception" and the terms of the City of Kent Ordinances in many particulars, the most important of which relate to the elevation of refuse piled onto the Griffin/Jensen ownership and to the mix of fill to organic matter which was contemplated.

At this juncture the City of Seattle is charged with the responsibility of closing the total landfill pursuant to consent order with the Washington State Department of Ecology which was signed in late May 1987. The Griffin/Jensen owners are not parties to the consent order nor have any real property rights in terms of ownership, lease, or easement ever been acquired from the

Griffin/Jensen owners. A limited license was granted to the City by agreement between the parties in June 1988. This Agreement was recorded under King County Auditors Receiving Number 8806280989 and this agreement expires on May 10, 1993. The City of Seattle has acquired all other property and property rights formerly held by the Kent Highlands owners so that the Griffin/Jensen tract remains the only part of the Kent Highlands Landfill in private ownership.

1) CLOSURE ACTION REPORT/CLEANUP ACTION PLAN

A Closure Action Report (CAR) was prepared regarding the Kent Highlands Landfill and a hearing on this report was held in May 1992. A Cleanup Action Plan (CAP) was issued in draft form in October 1992 and was the subject of a public meeting held October 28, 1992. This letter is intended as a response to the documents above noted.

2) LACK OF OWNERSHIP OR NECESSARY PROPERTY RIGHTS

Both documents, the CAP in particular, assume that the City of Seattle owns the Griffin/Jensen parcel or has the right to deal with it on some exclusive basis. As noted above, the limited license to the City will expire in May of next year, yet the CAP requires continuing maintenance of and supervision over the closed landfill for a period of thirty years or more following closure (see CAP Draft pp. 66 & 67). This requirement is imposed by the King County Board of Health Code as revised. It is obvious that the draft CAP presupposes public ownership of the Griffin/Jensen parcel since the draft refers to the recorded maps and statements which the King County Board of Health Code requires being filed for record prior to the approval of the final closure plan and the information required for filing is known only to the City of Seattle. In addition, the CAP refers to controls on City sale or transfer of the former landfill areas (see CAP p. 66).

While the CAR concedes that neither the City of Seattle nor State of Washington own the Griffin/Jensen tract, that report takes for granted that there will be a thirty year plus presence following closure and does not define how this presence will be compensated. This is the case even though the CAR refers to acquisition of appropriate easements from the State of Washington Department of Transportation and from the City of Kent on those parcels owned by them which were covered with refuse during the filling operation. The CAP also assumes City of Seattle ownership.

3) EXCLUSION OF OWNER FROM SITE

Besides the inconsistency noted above as to title, the Griffin/Jensen owners are and have been effectively excluded from

their property. Said property is currently fenced by a six foot chain link fence and will be for many years to come. Access to the site can only be gained by permission from the City of Seattle and then only for those persons who are certified by completion of the Washington State Labor and Industry training program. Thus, the owners are not permitted to exercise any possessory rights whatsoever now or in the foreseeable future.

4) INSTITUTIONAL CONTROLS

The CAP (see p. 69 - 7.2 Property Deed Restrictive Covenants) refers to certain restrictive covenants being "written into the property deed". Those covenants are not specifically defined but the examples given create substantial servitudes on the Griffin/Jensen real property and, if implemented, would clearly amount to a violation of Article I, Section 16, Amendment 9 of the Washington State Constitution.

5) INCONSISTENCIES IN EXISTING REGULATIONS

The conditional exception as referenced above assumes a maximum fill elevation which has already been substantially exceeded and which will continue to be exceeded by the elevation shown in the CAR and CAP as grading for final cover. Obviously the final grading for closure leaves the property in permanent and continuing violation of the "Conditional Exception" for landfilling previously adopted by the City of Kent.

The CAR as filed assumes that the City of Seattle used state of the art methods in its fill operation on the Kent Highlands site (see chapters 2,3, and 4) and that very little industrial or potentially hazardous materials were disposed of at the site. The methodology or protocol in arriving at this conclusion is found at the bottom of 3.1. In other words, the report concludes that almost all hazardous wastes ended up at the Midway landfill and not Kent Highlands (see also 2-16). Yet if this is true, one cannot account for the various heavy metals such as lead, zinc, cadmium, and other metallic compounds that exist in the Kent Highlands Landfill.

In summary, the CAP as well as the CAR have the cart before the horse in assuming public ownership or long term public control of the Griffin/Jensen parcel when, in fact, the limited license granted to the City of Seattle expires some six months hence and the reports contain no references whatsoever to public acquisition of the parcel or any property rights connected therewith.

Respectfully Submitted,

John C. O'Rourke

Cynthia L. Vranizan

JCO/cv
cc: Frank Jensen

XIV. DEPARTMENT OF ECOLOGY RESPONSE TO COMMENTS ON THE CLEANUP ACTION PLAN

Chapter 14
Department of Ecology
Response to Comments on the
Cleanup Action Plan

1. **Response to comments submitted by Mr. Curtis Dahlgren, Toxics Cleanup Program, Washington State Department of Ecology**

   Changes are incorporated in the declarative statement and the first paragraph of page 1 of the Cleanup Action Plan.

2. **Response to comments submitted by Mr. Barry Wenger, Shorelines Program, Washington State Department of Ecology**

   There are three issues identified in this comment letter.

   a. Obtain shoreline permit.

      The City of Seattle will obtain a shoreline permit.

   b. Mitigation of impacts to stream and wetlands.

      The City of Seattle evaluated impacts to wetlands due to construction of the storm water detention pond (CH2M-Hill, 1993). The result of the investigation indicated no adverse impact to the wetlands due the expansion of the storm water detention pond.

   c. Provide public access.

      Public access will be provided by the City of Seattle to meet the requirements of sections 4.2 and 5.7 of the City of Kent Shoreline Master Program. The City of Seattle will work with the City of Kent to identify ways in which public access might be accommodated.

3. **Response to comments submitted Mr. Erik Stockdale, Shorelines Program, Washington State Department of Ecology.**

   There are two issues identified in this comment letter.

   a. Determine need to obtain a permit from the Army Corps of Engineers pursuant to Section 404 of the Clean Water Act.

      Per telephone conversation with Ms. Ann Uhrich of the Army Corps of Engineers, a 404 permit will not be required for the improvements proposed for the storm water detention pond.

b. Evaluate changes to hydroperiod of the affected wetland.

No substantial changes to the hydroperiod of the wetland are predicted for the planned expansion of the storm water detention pond. This prediction is based on a wetlands impact analysis conducted to address this issue (CH2M-Hill 1993).

4. **Response to comments submitted by Mr. Philip Schneider, Washington State Department of Wildlife.**

a. No mitigation is necessary for the loss of wetlands. See response to comment #3 above. The Environmental Impact Statement for the closure of the landfill included conditions for impacts to the wetlands. These conditions were minimization of the pond size and the use of settling ponds during construction.

b. The City of Seattle will obtain a Hydraulics Project Approval (HPA) for upgrade of the pipe crossing Midway Creek and repair of the flap gate at the Green River. The HPA will specify a time period during the summer for work in Midway Creek.

c. The extent of wetlands west of the existing pond is approximately 15,150 square feet. The approximate area within the wetlands requiring fill for the expansion of the pond is 1,200 square feet (CH2M-Hill, 1993). No mitigation is necessary for this small loss of wetlands.

d. The quality of the water from the spring drain line will be tested. If the test results show the water quality meets Class A water quality standards then the flow may be diverted to Midway Creek.

5. **Response to comments submitted by Mr. Richard Chase, Water Quality Engineer, City of Kent.**

a. Second Paragraph: According to the City of Seattle:

"It is the opinion of our consultant that the general trend of higher aluminum concentrations downstream are due to stream dynamics and the concentration of total suspended solids, not leachate. The aluminum concentrations represent total concentrations which reflects both the dissolved and particulated fractions. The downstream sampling station was in a more turbid location than the upstream station, as evidenced by consistently higher total suspend solid concentrations". (City of Seattle, 1993a).

b. Third Paragraph: According to the City of Seattle there have been two known overflows from the leachate pond to the Green River. One was reported in 1979 and the other in 1990 when the METRO trunk line was overloaded and unable to accept flow during severe storms.

The impacts of leachate overflow to the Green River is probably low because any overflow would likely occur during heavy rainfall which would result in higher flow volumes in the Green River (City of Seattle, 1993a).

c. Fourth Paragraph: The City of Seattle will inspect and clean the six-inch force main. Maintenance and repairs will be made as needed to correct the foaming from the top of the manhole at 228th. For a period after cleaning of construction debris from the gravity portion of the pipeline, no reports of foaming were made. The City has recently re-cleaned this section of the line in response to recent foaming.

6. **Comments submitted by Ms. Nancy Glaser, Director, Seattle Solid Waste Utility.**

a. Institutional Controls: The financial assurance requirement for closure and post-closure of the landfill is satisfied by the ordinances adopted by the Seattle City Council. The ordinances establish a business and occupation tax on garbage and solid waste handlers for landfill closure costs. Rate studies have been completed by the Seattle Solid Waste Utility and approved by the City Council for the years 1986-1987, 1989-1990, and 1992-1994. Each rate study includes an analysis and estimate of landfill closure costs and addresses how those costs will be funded through utility rates and the B & O tax revenues (City of Seattle, 1993b).

b. Access Agreements: The Department of Ecology encourages the City of Seattle and the Griffin-Jensen property owners to resolve the access agreement issue. If an agreement cannot be reached then the Department of Ecology will consider initiating enforcement action by naming the landfill owners and operators as potentially liable parties (PLP) for contamination of the ground water by leachate migration. This PLP notification may be followed by a request to negotiate a consent decree for the cleanup of the affected ground water. The consent decree would provide for access for cleanup and closure activities. An enforcement order will be issued if an agreement on a consent decree cannot be reached.

c. Closure Action Requirements: Future use of the site by the public would be permissible as long as such use does not expose users to increased risk or interfere with the maintenance and monitoring of the site.

d. Editorial Comments: The changes are incorporated in the text of the cleanup action plan.

7. **Comments submitted by Mr. John O'Rourke and Ms Cynthia Vranizan on the behalf of the owners of Griffin/Jensen portion of the landfill.**

a. Closure Action Report/Cleanup Action Plan

Response to comments are provided as follows.

b. Lack of ownership or necessary property rights.

The Closure Action Report (CAR) and Cleanup Action Plan (CAP) assume the City of Seattle and the owners of the Griffin/Jensen portion of the landfill will cooperate and reach an agreement to complete the closure and post-closure requirements for the landfill. If an agreement cannot be reached then the Department of Ecology will consider initiating enforcement action by naming the landfill owners and operators as potentially liable parties (PLP) for contamination of the ground water by leachate migration. This PLP notification may be followed by a request to negotiate a consent decree for the cleanup of the affected ground water. An enforcement order will be issued if an agreement on a consent decree cannot be reached.

The institutional controls chapter of the CAP is revised to include owners of the land.

c. Exclusion of owner from site.

Access to the Griffin/Jensen property is controlled by agreement between the City and the property owners. The Department of Ecology is not involved in access agreements between the parties.

d. Institutional Controls

The institutional controls referred to in the CAP will be imposed in accordance with all legal requirements.

e. Inconsistencies with existing regulations

According to Mr. James Tupper, Jr., the Seattle Assistant City Attorney (City of Seattle, 1992):

> "Any conditional use permit applicable to the property was issued to Mr. Jensen as the applicant. There is no record that Mr. Jensen, his partners, or the City of Kent at any time complained about the elevation of fill or "mix" of refuse on the subject property. Mr. Jensen's attorneys also fail to substantiate in any way that the findings of the remedial investigation are inconsistent with the documented history of materials and management practices at the landfill."