# SEATTLE-KING COUNTY ABANDONED LANDFILL TOXICITY/HAZARD ASSESSMENT PROJECT

DECEMBER 31, 1986

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# EXECUTIVE SUMMARY

## Introduction

This report presents the Seattle-King County Health Department's follow-up investigation of two City owned and four County owned abandoned landfills which was conducted from February to December, 1986. The study's focus was to specifically identify any chemical or physical condition, based upon each site's current state and current use, that would be hazardous to the health and safety of the public or site workers.

## Background

During 1984-85, the Seattle-King County Health Department conducted the preliminary hazard assessment of abandoned landfills within Seattle and King County. Approximately one-third of these were recommended for further testing to specifically identify any unknown chemical or physical hazard presented by each to the health and safety of the public or site workers.

In response to the Health Department's recommendation, the King County Solid Waste Division (owners of the Bow Lake, Corliss, Houghton and Puyallup/Kit Corner sites), the Seattle Engineering Department (owners of the South Park site), and the Seattle Parks Department (owners of the Genesee Park site) allocated funds to the Health Department to conduct this investigation.

## Project Scope

Surface waters, surface soils and subsurface landfill gases were examined at each site for the presence of toxic chemical agents that could be encountered by the public or site-worker during normal site use. Subsurface combustible gas levels were monitored at the estimated perimeter of each site to identify potential off-site migration problems. The physical condition of each site was examined to identify physical hazards to the public or site users.

This report presents the project findings and recommendations for these sites.

## Recommendation Summary

A. Chemical Hazards

With the exception of specific problems, there is no reason to believe that the surface of these sites presents a health risk to recreational site visitors or workers over and above background exposure risks.

Specific problems include:

1. Houghton:

   Highly unusual ambient air results suggest that immediate resampling of the area is needed in order to rule out sampling or analytical error.

2. South Park:

   The concentrations of certain compounds are greater than background levels. It is probable that this is due to the industrial nature of the area and adjacent highways, rather than from the landfill.

B. Combustible Gas Hazards

All six sites are active generators of combustible gas. Combustible gas was observed at the site perimeters of Bow Lake, Corliss, Houghton, and Genesee Park. Specific recommendations include:

1. Building requirements for new construction activities within 1000 feet of each site.

2. Identification, monitoring and venting (if needed) of on-site sewer utility lines at each site.

3. Periodic combustible gas monitoring of on-site or adjacent structures and/or residences at each site.

C. Physical Hazards

1. Added landfill cover material and/or surface grading is recommended for portions of Bow Lake, Corliss and Genesee Park.

2. A large manhole measuring 8 feet across and 10 feet deep at Puyallup/Kit Corner is open and exposed. It is recommended that this manhole be enclosed immediately.

3. Landfill brush maintenance is recommended at Houghton to control brush fire problems.

## CROSS REFERENCE BY SITE

| Site | Soil, Water Landfill Gas Methods | Soil, Water Landfill Gas Sampling Reports | Soil, Water Landfill Gas Results | Toxicology Evaluation | Combustible Gas Methods | Combustible Gas Sampling Reports | Combustible Gas Results | Project Conclusions and Recommendations |
|---|---|---|---|---|---|---|---|---|
| Bow Lake | Page 8 | Page 10 | Page 62, -, 79 | Page 53 | Page 83 | Page 84 | Page 85 | Page 105 |
| Corliss | 8 | 13 | 64, 77, 79 | 53 | 83 | 87 | 88 | 107 |
| Houghton | 8 | 16 | 68, 77, 80 | 54 | 83 | 90 | 92 | 109 |
| Puyallup/Kit Corner | 8 | 19 | 71, 77, 80 | 55 | 83 | 94 | 95 | 111 |
| Genesee Park | 8 | 22 | 66, 76, 81 | 54 | 83 | 97 | 99 | 113 |
| South Park | 8 | 26 | 73, 76, 81 | 56 | 83 | 102 | 103 | 115 |

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# I. INTRODUCTION

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## 1.0 INTRODUCTION

This report presents the Seattle-King County Health Department's study of six abandoned landfills located in Seattle and King County conducted from February 1986 to December 1986. The study was conducted to identify areas of unknown chemical contamination within surface soils, surface waters and landfill gases at each site, to identify sources of combustible gas migration into areas surrounding each former landfill and to identify any physical site hazards.

The study presents final conclusions and recommendations for each abandoned landfill which are designed to protect the health and safety of the public and site workers.

The study abandoned landfills and their locations appear in Table I and Figure 1.

## 2.0 BACKGROUND

From April 20, 1984 to August 17, 1984 Seattle's Gas Works Park, site of a former coal gasification plant, was closed to the public after the discovery of previously unknown toxic chemicals within surface and subsurface soils. In response to this, Mayor Charles Royer requested the Seattle-King County Health Department to screen Seattle's abandoned municipal landfills for any unknown chemical or physical hazard to the public, site workers or the environment.

In June of 1984 the Seattle-King County Department of Public Health began the preliminary assessment process of examining Seattle's 12 known abandoned landfills(1). At the request of King County Executive Randy Revelle, 23 abandoned landfills were subsequently identified and examined in King County(2).

Of the 35 abandoned landfills examined, 12 were recommended for further testing to specifically identify any unknown chemical or physical hazards presented by each to the health and safety of the public or site workers. Four of these sites (Bow Lake, Corliss, Houghton and Puyallup/Kit Corner) are owned by the King County Solid Waste Division, one (Genesee Park) is owned by the Seattle Parks Department and one (South Park) is owned by the Seattle Engineering Department.

In response to the Health Department's reocmmendation for further study, funding of $80,000 was allocated by the King County Solid Waste Division, $15,000 by the Seattle Parks Department and $22,000 by the Seattle Engineering Department to the Health Department to conduct the investigation.

This study presents the findings and recommendations for two City and four County owned abandoned landfills.

## 3.0 PROJECT GOAL

The goal of this study is to identify any chemical or physical condition, based upon each site's current state and current use, that would be hazardous to the health and safety of the public or site worker.

To meet this goal, the study has focused upon the following areas of investigation:

1. An examination of surface waters on or adjacent to each site, on-site surface soils and subsurface landfill gases for the presence of chemical agents that are toxic to human populations.

2. An examination of combustible gas concentrations at the perimeter of each site to provide preliminary, though limited, indications of off-site combustible gas migration into areas surrounding each abandoned landfill.

3. An examination of the physical condition of each abandoned landfill to identify physical hazards.

Study recommendations, based upon each area of investigation, are presented in Chapter VI.

## 4.0 STUDY LIMITATIONS

### 4.1 General Study Limitations

1. This study only represents follow-up work for six of the original 12 abandoned landfills that were recommended by the Health Department for further study. (An investigation of similar scope was conducted by the Health Department at the Interbay Abandoned Landfill during the fall of 1985 and spring of 1986.)

   Landowners of the remaining sites will be contacted by the Health Department to confirm the status of or plans for site investigations that meet the scope of this study.

2. Many of the abandoned landfills that were excluded for further investigation by the Health Department's Phase I review [1][2] had problems of their own. These problems, though not addressed by this report, were addressed with remedial recommendations in the Phase I report. These recommendations were left to the discretion of the property landowners to carry out.

3. The study does not represent a definitive work. The sampling data represent chemical or gas concentrations for selected surface waters, surface soils, subsurface landfill gases or subsurface combustible gases at a given point in time and are interpreted as representing that source at that time. There is a need to follow-up and expand upon the work that has been done.

### 4.2 Surface Water, Surface Soil and Landfill Gas Study Limitations

1. This study was limited to assessing the threat to public health from these six sites as a result of direct contact with the landfills from inhalation, ingestion, or contact with surface water, topsoil, or subsurface air at the site. Although ground water contamination is a potentially serious future loss of resources, it should not represent a direct threat to the public in the areas studied if residences use approved public water supply systems and do not have contact with water from wells penetrating contaminated ground water reservoirs. Ground water contamination may represent a public health threat in the future.

2. All samples taken were composite or discrete "grab" samples, which are not necessarily representative of all locations of the site.

3. Chemicals identified in surface water samples may represent general urban contamination, and may not be influenced by or reflect the presence of subsurface contaminants potentially present in landfill materials.

4. Leachate and runoff water sampling was conducted during a seasonally dry period (June 1986). Many of these sources are active only during the rainy seasons. Any speculation about these potential problems is based on site inspections identifying these sources as potential pathways of exposure.

5. All soil samples were collected from the first two inches of soil at each site. It therefore is likely that most of these samples will not contain hazardous substances from the fill material below the cover, as most of these sites have been covered and partly stabilized with presumably "clean" fill dirt. These samples therefore represent only that portion of the soil that is most likely to come into direct human contact on the site, and do not address the issue of hazardous components that may lie deeper than a few inches below the surface.

6. Although the "Microtox" Bioassay is recognized by numerous environmental agencies, including the EPA[3], its limitations must be acknowledged. This bioassay signifies the toxicity of a solution to bacteria, and does not necessarily indicate toxicity to humans. Furthermore, there may be additional parameters that the assay responds to in addition or instead of inherent chemical toxicity. "Microtox" is therefore not the only criterion used in this study to determine "toxic" samples from the sites. Instead, it is used in combination with the chemical data and site visits to interpret the health risks from the sites.

7. The air monitoring consisted of grab samples taken from bore holes extending three feet below the surface. The analyzed compounds were primarily those which tend to volatilize readily at the surface and would present much less of a hazard in these lower concentrations. Therefore, the direct risk to humans on the site from substances detected below this surface is difficult to predict without direct ambient air monitoring.

## 4.3 Combustible Gas Migration Study

1. This study was limited to assessing combustible gas levels along the estimated perimeter of each site from shallow (three foot depth) test holes. It does not address perimeter combustible gas levels at greater depths.

2. With the exception of monitoring perimeter residences and/or sewer utility lines at the Genesee Park and the Houghton Abandoned Landfills, this study did not address the migration of combustible gas beyond each site perimeter.

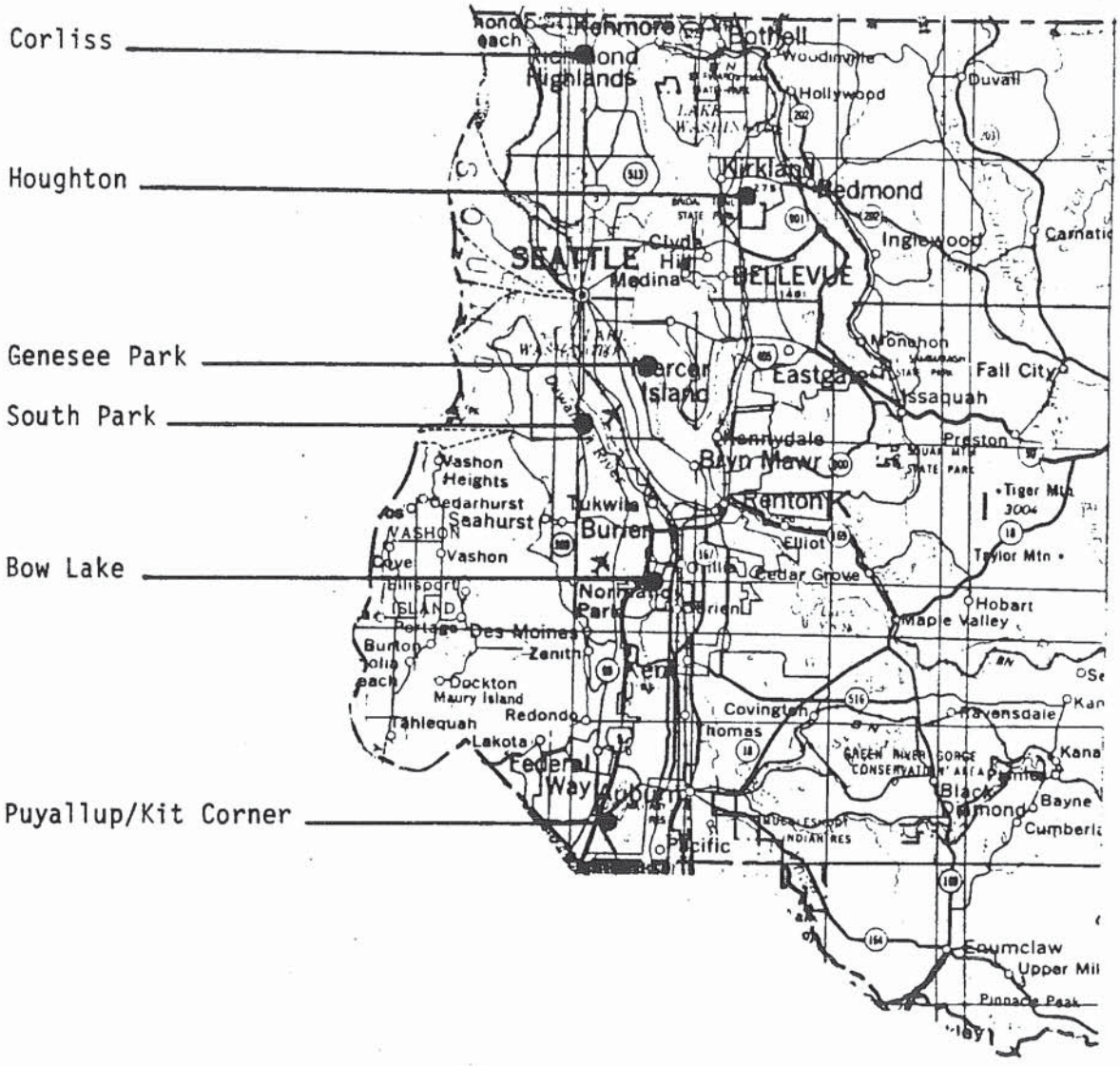
3. Combustible gas levels were measured from the test holes and perimeter residences on only one day at one time, rather than over a period of time and fluctuating barometric pressure.

Table I
Abandoned Landfill Locations
Abandoned Landfill Toxicity and Hazard Assessment Project

| Site | Ownership | Location |
|---|---|---|
| Bow Lake Abandoned Landfill | King County | Immediately east of I-5, across from South 188th Street |
| Corliss Abandoned Landfill | King County | Immediately west of I-5 between North 163rd Place and North 167th Street |
| Houghton Abandoned Landfill | King County | East of I-405, immediately north of Bridal Trails State Park and Northeast 60th Street, Kirkland |
| Puyallup/Kit Corner Abandoned Landfill | King County | Immediately east of I-5 just south of the Highway 18 Exit |
| Genesee Park Abandoned Landfill | Seattle | Rainier Valley on Lake Washington between 38th and 46th Avenue South |
| South Park Abandoned Landfill | Seattle | Immediately south of South Kenyon Street between Highways 509 and 99. |

FIGURE 1

Project Abandoned Landfill Locations



# II. Sampling Program for Surface Waters, Surface Soils and Landfill Gases

## 3.3 Landfill Gas Sampling Program

### 3.3.1 Sampling Program

The landfill gas sampling program involved the collection of discrete subsurface samples using a biased sampling strategy for sample location placement. Sub-surface gas samples were extracted through stainless steel tubes inserted to a depth of three feet and sealed at the surface with bentonite. Gas samples were collected in three liter Tedlar bags and received a modified EPA Method 8240 analysis for EPA Hazardous Substance List volatile organic components.[7,8]

### 3.3.2 Field Procedures

Sample wells were constructed to a depth of three feet using an earth drill with a two inch auger bit for the sites at Bow Lake and Puyallup/Kit Corner. Due to the mechanical failure of the earth drill, sample wells for the remaining four sites were constructed by driving a steel bar with a one inch outside diameter to a three foot depth and extracting the bar using a seven ton high liftjack. A stainless steel tube measuring six feet in length and two inches in outside diameter was used in each well constructed with the earth drill. A stainless steel tube measuring five feet in length and one inch in outside diameter was used in each well constructed using the steel bar method. The test wells were then sealed at the ground surface with a bentonite cap.

After a 30 minute venting period, the stainless steel tubes were fitted with a rubber stopper valve mechanism. Samples were collected at 24 hours (+/- four hours) after the time of well installation into three liter Tedlar bags using a vacuum box with air extraction bulb apparatus.

A detailed sampling and quality assurance plan is documented in Appendix B.

## 4.0 SAMPLING REPORTS

### 4.1 Bow Lake

#### 4.1.1 Site Description

The former landfill at bow Lake is located immediately east of Interstate 5, across from South 188th Street. Its current size is approximately 14 acres. It is the site of the South King County Transfer Station.

The transfer station grounds are enclosed by a chain link fence. Based upon historical aerial photographs, it appears that the former landfill extended beyond the confines of the fence along the north and east perimeters. The landfill's terrain slopes downhill from the westerly perimeter toward the east before dropping steeply beyond the east perimeter fence to Southcenter Parkway. The immediate terrain to the north, east and south of the landfill is currently undeveloped and inaccessible.

#### 4.1.2 Surface Water Sampling Program

The surface water sampling program was conducted from June 24 - 27, 1986. During this period the Bow Lake site was surveyed and no surface water or evidence of leachate outbreaks were observed.

A subsequent survey was conducted during the soil sampling program on July 25, 1986. At that time, a slow surface water stream containing an oily sheen was observed from Site F of Figure 2. This surface water source has been describedby the King County Solid Waste Division as an outfall point for surface runoff from the transfer station. A sediment sample was retrieved for analysis from this source.

An investigation of leachate outbreaks at the base of the steep slope behind the landfill was conducted on July 25. No leachate seeps were observed during the survey. The current property occupants at the base of the ridge (M.A. Segale, Inc.) were contacted and reported that leachate run-off onto their property had not been a problem to their knowledge.

During the Health Department's 1984 study of this site, a leachate seep was observed from Site D of Figure 2. There was no evidence of this during the recent surveys. The King County Solid Waste Division indicated that this had been controlled by adding to the landfill cap in that area and by diverting water run-off away from that area.

#### 4.1.3 Surface Soils Sampling Program

On July 25, 1986 six discrete soil samples and one soil sample field duplicate were collected from the Bow Lake Abandoned Landfill and submitted for chemical and bioassay analysis. These data are presented in the Project Toxicology Report and Appendices D and E. Sample locations appear in Figure 2.

Landfill artifacts were observed within the top four inches of soil from site D and E. These artificats included rusting cans, broken glass, wire and other metal objects.

As stated in Section 1.2, a soil sample was retrieved subsurface to a water run-off outfall from Site F and from the former leachate seep area of Site D.

Interpretation of the test results are reviewed in the Project Toxicology Report, Chapter IV.

### 4.1.4 Landfill Gas Sampling Program

On October 28, 1986 four sampling probes were installed at the Bow Lake site using the "Little Beaver" earth drill. On the following day four landfill gas samples and one ambient air sample were collected for analysis of volatile organic chemical components. The sample collected from Site D was damaged in transit to the laboratory and not analyzed.

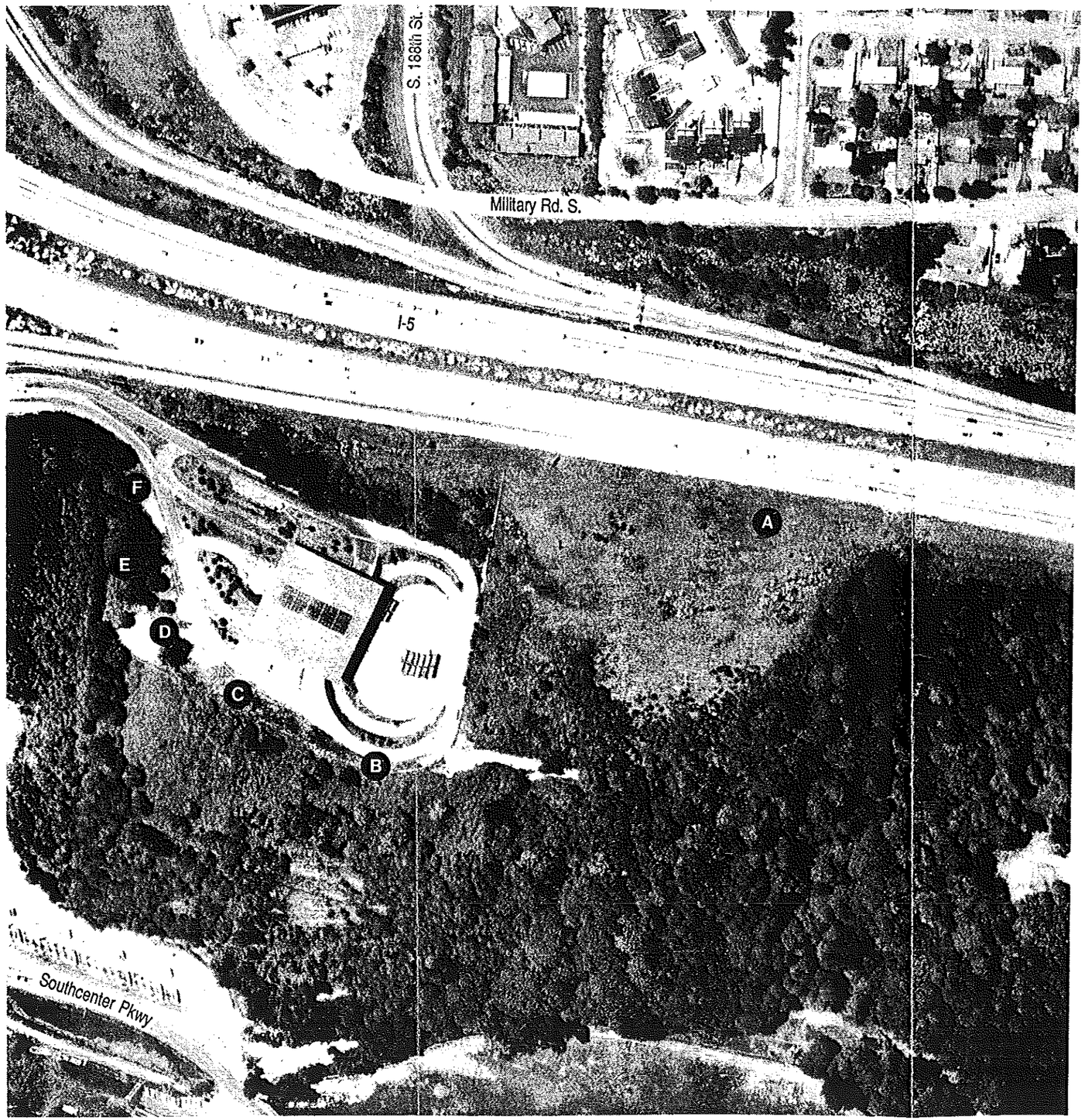
Sampling locations are presented in Figure 12. Sample data appear in the Project Toxicology Report and in Appendix F.

The landfill varied in density from loose sand to compact cobble soil. The initial attempt to install a probe in the northeast corner of the fenced compound failed due to the impenetrable compaction of cover material.

A loose sandy loam was encountered at Sites B and E. Landfill artifacts were observed from Site B.

Site C exhibited a loose clay cover to two feet, a shallow layer of rocky compact material, and breakthrough into the landfill at three feet. A wet sandy clay was encountered to three feet at Site D, followed by an impenetrable rocky layer.

Interpretation of the test results are reviewed in the Project Toxicology Report, Chapter IV.




## Bow Lake Abandoned Landfill

**Surface Soil Sampling Locations**

Sample Identification:

Soil: Sites A-F

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

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## 4.2 Corliss Abandoned Landfill

### 4.2.1 Site Description

This site is located north of Seattle bordering the west side of Interstate 5, between North 163rd Place to the south and North 167th Street to the north. This approximately 12 acre site is divided with the North King County Transfer Station occupying the northern section, and a vacant unmaintained area (McCormick Park) - on the south section. Thornton Creek runs toward the south just beyond the westerly perimeter of the site.

A housing development is situated immediately to the north of the transfer station. A smaller group of houses borders the southern perimeter of the former landfill. Immediately west of the fill, the terrain is undeveloped and wooded. A housing development is located approximately 300 feet to the west of the transfer station grounds.

The transfer station grounds are enclosed by a chain link fence and are inaccessible to all but the users of the transfer station. The southerly section of the former fill (McCormick Park) is easily accessible to the public with a dirt roadway leading on-site. The area is strewn with remnants of illegal dumping. The McCormick Park area is currently being studied by the Municipality of Metropolitan Seattle as the future site for its north operating bus base.

### 4.2.2 Surface Water Sampling Program

On June 26, 1986 the Corliss Abandoned Landfill was surveyed for the presence of surface water on or adjacent to the fill. No leachate seeps were observed. Thornton Creek which runs to the south from Ronald Bog Park and adjacent to the westerly perimeter of the former fill was sampled at locations upstream (Site 1); and downstream (Site 2) from the fill and analyzed for chemical components and bioassay toxicity. These data appear in Chapter IV and Appendices D and E. Water sampling locations are indicated in Figure 3. The stream was free flowing and signs of contamination were not visually evident.

Interpretation of the test results is presented in the Project Toxicology Report (Chapter IV).

### 4.2.3 Surface Soils Sampling Program

On July 18, 1986 six composite, one discrete, one background, and one discrete duplicate samples were collected for chemical and bioassay analysis.

Artifacts including broken glass, ceramic and brick segments were observed within the top four inches of soil from Composite E and F.

A discrete sample was retrieved from Site B of an apparent oil spill in which the surface vegetation had died.

Results of the chemical and bioassay analyses appear in Chapter IV and Appendices D and E. These data are interpreted in the Project Toxicology Report, Chapter IV.

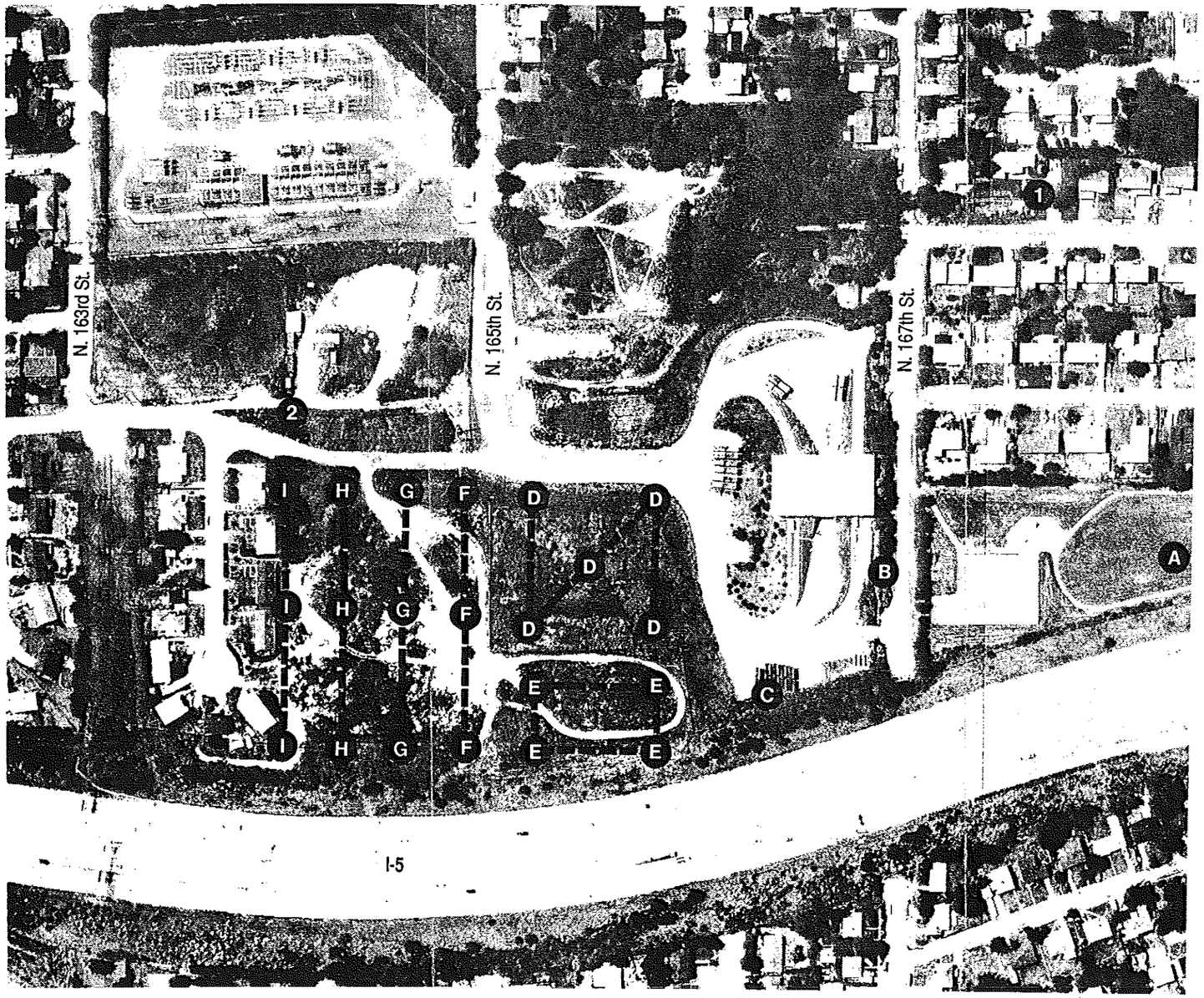
### 4.2.4 Landfill Gas Sampling Program

On November 6, 1986 three sampling probes were installed at the Corliss site using the bar hole driver technique. On the following day, three landfill gas samples and one ambient air sample were retrieved for volatile chemical component analysis.

The sampling locations are presented in Figure 13. Sample data are presented in Chapter IV and Appendix F.

The landfill cap density was variable between the three test probes. Site A exhibited low compaction to two feet increasing to compact at three feet. Site B exhibited compaction only in the upper six inches of soil and water saturated soil at three feet. The cap at Site C was compact to two feet only, followed by loose compaction to three feet.

Test results are interpreted in Chapter IV, Project Toxicology Report.




## Corliss Abandoned Landfill

**Surface Soil and Surface Water Sampling Locations**

Sample Identification:

Soils: Sites A-I

Discrete X

Composite X — X

Water: Sites 1-2

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

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## 4.3 Houghton Abandoned Landfill

### 4.3.1 Site Description

The Houghton Abandoned Landfill is located immediately north of Bridal Trails State Park in Kirkland just east of Interstate 405. The site comprises an area of approximately 30 acres. King County's Houghton Transfer Station is located at the south end of the fill. An abandoned tennis court is located midway along the east perimeter. The courts have been rendered unusable due to landfill settling. In the northeast corner stands two maintained baseball fields. The remainder of the site has been overgrown by brush, brambles and new growth trees.

On August 15, 1986 a brush fire broke out on site burning much of the northern half of the fill. The fire was contained just before reaching the nearby residences located along the northern perimeter of the site. According to residents, brush fires have apparently been a continuing problem at this site.

The landfill is interspersed with narrow dirt paths. Access to these paths by motor vehicles has been blocked by a damaged wooden gate at the eastern perimeter entrance. The former landfill is used by the area residents for casual recreation.

### 4.3.2 Surface Water Sampling Program

The Houghton Abandoned Landfill was surveyed for the presence of on-site or adjacent waters on June 27, 1986 as part of the surface water sampling program. A drainage ditch was observed along the west perimeter of the site which would drain to the south. No water was observed.

A shallow stagnant swamp was identified midway along the west perimeter at sample Site 1 and tested for chemical components and bioassay toxicity. These data are presented in Chapter IV and Appendices D and E. Sampling locations appear in Figure 4. The water quality did not indicate an soily sheen or other visually identified signs of contamination.

A dug well measuring 34 feet to the waterline and a total depth of 43 feet was identifie don the property identified by sample Site 1. The well pump has been disconnected and the well is out of service. A sample was not retrieved from the well for chemical and bioassay analysis due to the lack of equipment to collect a sample that would represent ground water conditions.

No other surface waters wree observed on that date.

### 4.3.3 Surface Soil Sampling Program

Surface soil sampling was conducted on July 30 through August 1, 1986. One background, one discrete, 15 composite and one composite duplicate sample were collected for chemical and bioassay analysis.

Sampling locations are presented in Figure 4. Chemical and bioassay results are documented in Chapter IV and Appendices D and E.

Surface fissure due to landfill gas release were observed at various locations on-site. A discrete "hotspot" sample from Site K was collected from a surface fissure. Black stains were observed on the soil. A landfill odor was apparent.

Gas fissures were also sampled as subsamples for Composite I and E. Landfill gas odors were apparent from both.

Artifacts consisting of broken glass fragments were observed within the top four inches of soil from individual subsamples of Sites I, E, D and C. No other artifacts were observed.

The sample test results are interpreted in Chapter IV, Project Toxicology Report.

### 4.3.4 Landfill Gas Sampling Program

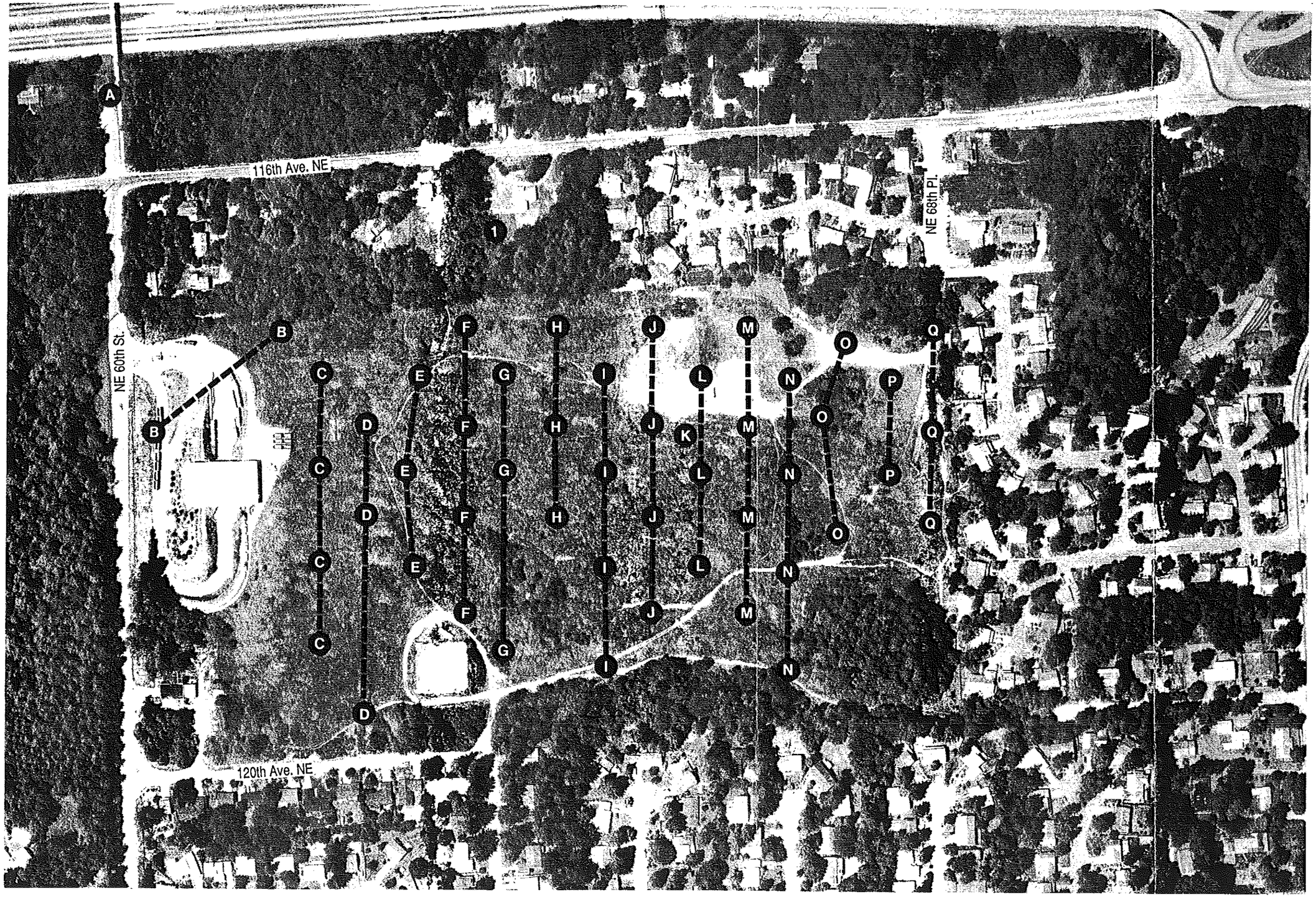
Four sampling probes for landfill gas collection were installed at the Houghton site on November 7, 1986. Four landfill gas samples and one ambient air sample were collected the following day and submitted for chemical analysis.

Sampling locations appear in Figure 14. Test results are presented in Chapter IV and Appendix F.

The landfill cap exhibited variable density observed during probe installation. Sites A and B exhibited an extremely compact cover to three feet. Sites C and D exhibited a cover of semi-compaction to three feet.

Test results are interpreted in the Project Toxicology Report.

FIGURE 4




## Houghton Abandoned Landfill

**Surface Soil and Surface Water Sampling Locations**

Sample Identification:

Soil: Sites A-Q

Discrete X

Composite X---X

Water: Site 1

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

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## 4.4 Puyallup/Kit Corner Abandoned Landfill

### 4.4.1 Site Description

The Puyallup/Kit Corner Abandoned Landfill is located immediately east of Interstate 5 just south of the Highway 18 Exit near the Pierce County border. It comprises an area of approximately 17 acres.

The perimeter of the site is marked by dense vegetation. A townhouse construction project located adjacent to the southwest corner is in the final stages of completion at this writing. A second development project along the east perimeter is now in progress.

The landfill is looped by a narrow dirt road. The landfill slopes up from the loop road approxiately for 10 to 30 feet before leveling at the landfill plateau.

The site is used extensively for recreational motorcyclists. The terrain is primarily bare or grass covered with areas of new growth trees developing.

A stream flows from the east toward the landfill perimeter (Site 1), diverts to the south along the landfill perimeter and flows into a culvert under the landfill. A culvert outfall (presumably for the same stream) is located to the center of the southern perimeter. Just northeast of the outfall, a large manhole has collapsed measuring approximately eight feet in diameter and 10 feet in depth. Stream water has been observed flowing through this in November 1986.

### 4.4.2 Surface Water Sampling Program

On June 25, 1986 three surface water samples were collected at the Puyallup/Kit Corner site for chemical and bioassay analysis.

Water sampling locations are indicated in Figure 5. Sample test results appear in Chapter IV and Appendices D and E.

The stream along the east perimeter of the fill was low and exhibited slow movement on the sampling day. An upstream sample was taken at Site 1, and a downstream sample from Site 2 immediately before the entrance to the culvert. No visual signs of contamination were apparent.

A stagnant pool of water was sampled at Site 3 within the vicinity of the new townhouse complex. The water exhibited a brown discoloration. Water vegetation (grasses) was observed growing in the pool.

There are signs of seepage along the north boundary of the site as evidenced by a rust stained drainage ditch. There is also a storm drain on the southwest corner which empties into a run-off ditch parallel to the highway. No water was observed at these locations on the sampling day.

No other surface water was observed on or around the site at that time.

### 4.4.3 Surface Soil Sampling Program

Surface soils were collected at the Puyallup/Kit Corner site on July 22-24, 1986. These consisted of one background, 11 composite and one discrete sample for chemical and bioassay analysis.

Soil sampling locations are presented in Figure 5. Test data appear in Chapter IV and Appendices D and E.

Landfill artifacts were not observed from any of the surface soils sampled. Landfill gas fissures were observed occurring on-site.

One discrete sample was collected from a run-off ditch at the site's north end (Site C). The ditch soils had a stained rust-colored appearance.

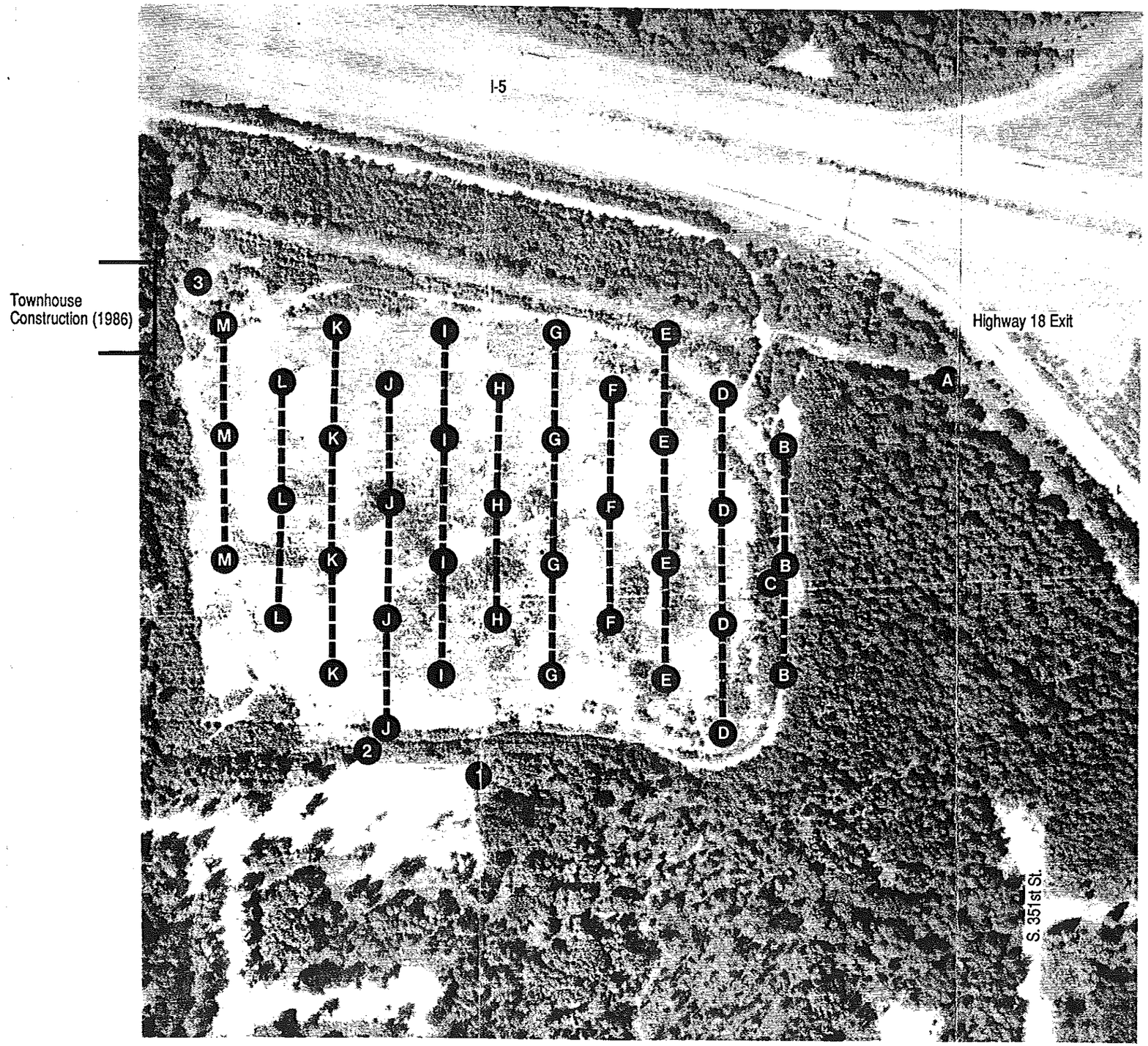
### 4.4.4 Landfill Gas Sampling Program

On October 29, 1986 four sampling probes were installed using the "Little Beaver" earth drill method. These sites are indicated in Figure 15. On the following day three landfill gas samples and one ambient air sample were collected in Tedlar bags for volatile chemical component analysis. A fourth sample from Site C could not be collected due to the high water table resulting from heavy rainfall.

Sample data are presented in Chapter IV and Appendix F. The sample from Site B was collected in a defective Tedlar bag and not analyzed.

The landfill cap at all sample site locations is characterized as compact and rocky. The drill shaft of the "Little Beaver" earth drill met its demise at this site.

FIGURE 5




## Puyallup/Kit Corner Abandoned Landfill

**Surface Soil and Surface Water Sampling Locations**

Sample Identification:

Soils: Sites A-M

Discrete X

Composite X — X

Water: Sites 1-3

Approximate scale: 1" = 200'
Aerial photo date: 1983
Source: State of Washington Department of Natural Resources

N

## 4.5 Genesee Park Abandoned Landfill

### 4.5.1 Site Description

The Genesee Park Abandoned Landfill is located in Rainier Valley on Lake Washington between 38th and 46th Avenue South at the center of large residential area. The site comprises an approximate area of 55 acres. A majority of the site is used as a well maintained major recreational area with playing fields and playground equipment. The five acre tract that borders 46th Avenue South has been recently used as a fill dirt storage area on the northerly half. The southerly half of this tract is vacant and relatively unmaintained with the exception of occasional cover grass maintenance.

The terrain of the former landfill is exhibiting the characteristics of landfill settling. Because of poor drainage on site ponding of rainwater in hollows created by landfill settling throughout the site is common, particularly in the landfill area along 46th Avenue South. Rust colored stains were observed on the sidewalk along 46th Avenue South, indicating a seepage problem.

### 4.5.2 Surface Water Sampling Program

On June 26, 1986 one surface water sample was collected from the Genesee Park Abandoned Landfill for chemical and bioassay analysis.

The location of this water sample is indicated in Figure 6. Chemical and bioassay test data are presented in Chapter IV and Appendices D and E.

The water sample was collected from an area that had been experiencing chronic irrigation system leaks. Water was flowing into and over a drainage ditch along the south border of the soccer fields saturating the southwest section of the field. An oily sheen was observed on the water surface.

It was noted on a subsequent survey that the irrigation system leak had been corrected by mid-summer.

No other surface waters or seeps were observed for sampling on that date.

### 4.5.3 Surface Soil Sampling Program

On July 16-17, 1986 seven composite, two discrete and one background surface soil samples were collected from the site for chemical and bioassay analysis.

Soil sampling locations are presented in Figures 6 and 7. Test data for chemical and bioassay analysis appear in Chapter IV and Appendices D and E.

Of note, ground fissures and zones of dead vegetation presumably caused by venting landfill gas were observed within the area bordered by 46th Avenue louth. One discrete sample (Site G) was retrieved from a fissure for analysis, but did not indicate a toxicity problem. Landfill odors were evident during the sampling at this location.

A strong landfill off-odor was observed within the top two inches of surface soil (gray clay) in the west sub-sample of Site E indicating a poor cover at that point.

A rust colored stain was observed across the paved walkway at Site C. A soil sample was retrieved on the downslope side of the walkway which did not indidicate evidence of toxic components or toxicity from the test results.

### 4.5.4 Landfill Gas Sampling Program

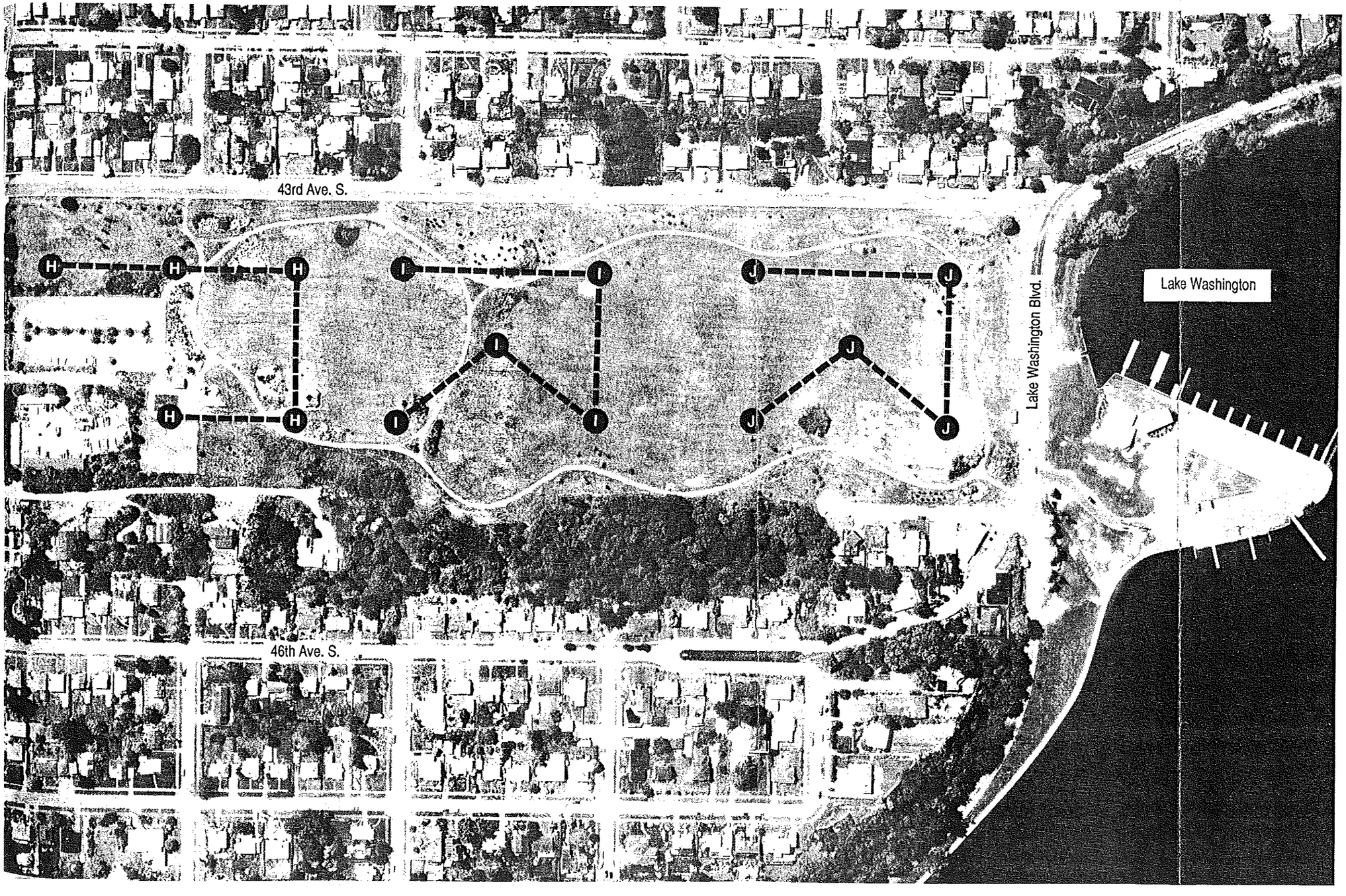
Five test probes were installed on November 4, 1986 at the Genesee Park site using the bar hole installation method. These sites are presented in Figures 16 and 17.

The following day four samples were collected for volatile chemical analysis. A sample could not be extracted from Probe C due to the impermeable clay cap that was encountered at the three foot level.

Test data are presented in Chapter IV and Appendix F.

The landfill cap to three feet is characterized as extremely dense for all probe locations. Landfill gas odors were readily apparent after probe installation at Sites D and E.

FIGURE 6




## Genesee Park Abandoned Landfill (North Section)

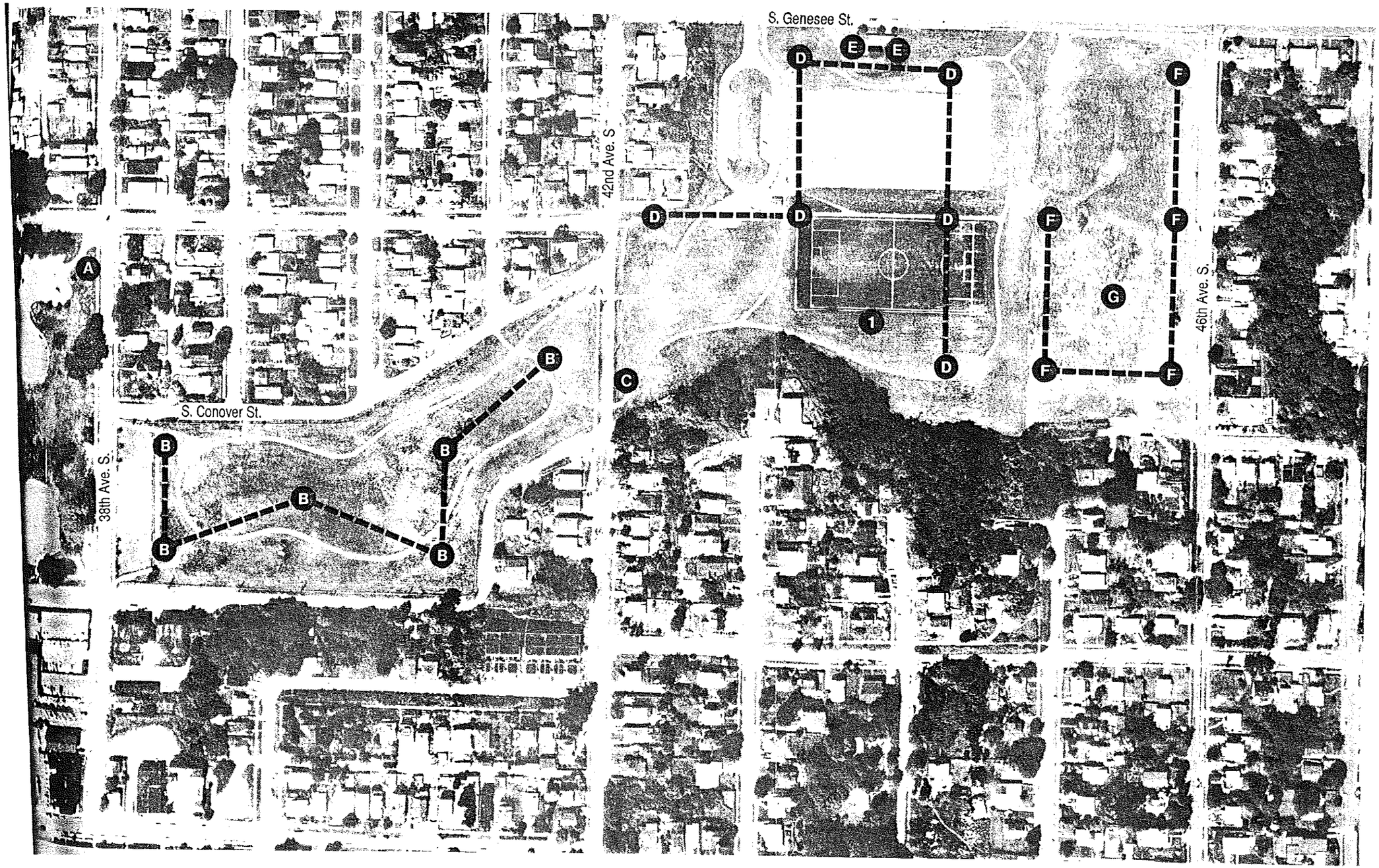
**Surface Soil Sampling Locations**

Sample Identification:

Soil composite sites H-J

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇨




## Genesee Park Abandoned Landfill (South Section)

**Surface Soil and Surface Water Sampling Locations**

Sample Identification:

Soils: Sites A-G

Discrete X

Composite X---X

Water: Site 1

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇧

## 4.6 South Park Abandoned Landfill

### 4.6.1 Site Description

The former landfill at South Park occupies an approximate area of 40 acres between Highways 509 and 99 immediately south of South Kenyon Street. The northeast quarter of the fill is occupied by the South Park Transfer Station. To the west of that is an industrial complex that is presumed to have been constructed over the former landfill. The remainder of the site is being used as a storage yard for trucks and heavy equipment, wood, and fill dirt. The former landfill area is not easily accessible to the public.

A drainage ditch runs along the west perimeter of the site and into a culvert at Site 4 of the water sampling location map (Figure 8). A second drainage ditch runs through the center of the fill which presumably enters the side from two culverts at Site 1 (Figure 8). It was not determined whether the two drainage ditches are interconnected due to the density of bramble cover growth at that area though this is presumably the case. The water within these drainage ditches looked to be of poor quality.

### 4.6.2 Surface Water Sampling Program

On June 24, 1986 four surface waters and one surface water duplicate were collected from the drainage ditches at the South Park sitefor chemical and bioassay analysis.

Water sampling locations are indicated in Figure 8. Test data for chemical and bioassay analyses appear in Chapter IV and Appendices D and E.

The drainage ditch running through the center of the landfill was sampled at Sites 1 and 2. Water movement was not observed from either location. Two water culverts were observed at Site 1. The water was observed as stagnant with an oily sheen. At Site 2 the water was observed as turbid due to algal growth.

The stream along the west perimeter was sampled at Site 3 and Site 4 adjacent to the outflow culvert. Stream movement to the north was apparent. Water quality was observed to be poor with a dense orange (presumed) algal growth along the stream bed. A strong creosote-like odor was observed in the ditch depression of Site 4.

### 4.6.3 Surface Soils Sampling Program

On August 1 and August 29, 1986 six discrete, one discrete duplicate and one background sample were collected at the site for chemical and bioassay analysis.

Soil sampling locations are presented in Figure 8. Test data for chemical and bioassay analyses appear in Chapter IV and Appendices D and E.

Soil samples were only retrieved from locations around the South Park Transfer Station grounds. The areas to the south and southeast of the transfer station have recently been cleared and recapped for storage of fill dirt, wood and heavy machinery.

Of the surface soils collected, artifacts were common. These included broken glass, ceramic, brick, plastic, nails and rusted metal fragments located immediately beneath the grass mat within the top four soil inches.

### 4.6.4 Landfill Gas Sampling Program

On November 5, 1986 three test probes were isntalled on the South Park Transfer Station grounds using the bar hole installation method. Probe locations are documented in Figure 18.

On the following day three probe samples and one ambient air sample were collected for volatile chemical analysis. A sample could not be extracted from Probe A due to clogging of the probe end.

The ambient air sample collected on November 6, 1986 deflated due to a defective Tedlar bag. A second ambient air sample was collected on the following day from Site A and submitted for analysis.

Cap density was compact at Probes A and B and semi-compact at Probe C based upon the difficulty of probe installation.

Test results are presented in Chapter IV and Appendix F.

# III. Public Water Systems

# III. PUBLIC WATER SYSTEMS

## 1.0 INTRODUCTION

A review of the public water systems around each of the study sites was conducted to determine well locations relative to each abandoned landfill. The information presented in this chapter was compiled through a review of Seattle-King County Department of Public Health records and contact with operators of water districts and municipal water supplies within a three mile radius of each site.

The review is limited by a lack of information regarding private water systems for single family residences or agricultural sources. No complete record of these sources has been compiled by any agency and would require an in-depth door-to-door survey.

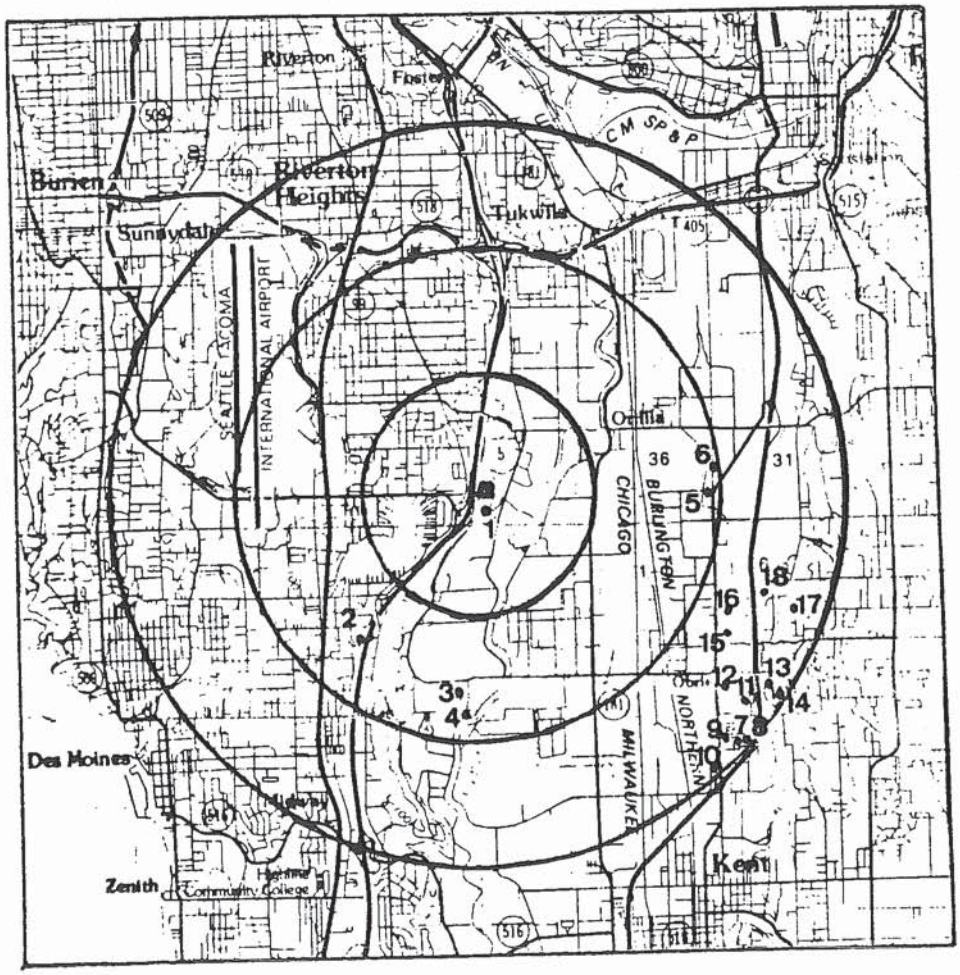
Public water system wells were observed within a three mile radius of the Bow Lake, Houghton and Puyallup/Kit Corner Abandoned Landfills. Names and locations of these public water supplies are presented in Tables II - IV and Figures 9 - 11.

All other areas are served by Seattle or sources which purvey from Seattle. At this time, Seattle receives all of its water from the Cedar and Tolt rivers. However, plans have been made by the City of Seattle for well drilling at the northeast end of Seattle-Tacoma Airport to supply water to the city. These wells may be situated just within the three mile radius of the Bow Lake Abandoned Landfill.

All public water supplies in the State of Washington are regulated by Rules and Regulations of the State Board of Health Regarding Public Health Water Systems, Chapter 248-54, Revised August 1983.

FIGURE 9

Bow Lake Abandoned Landfill Public Water Supply Systems
Within a Three Mile Radius*




Scale: 1 mile = 5/8 inches.
* Refer to Table II.

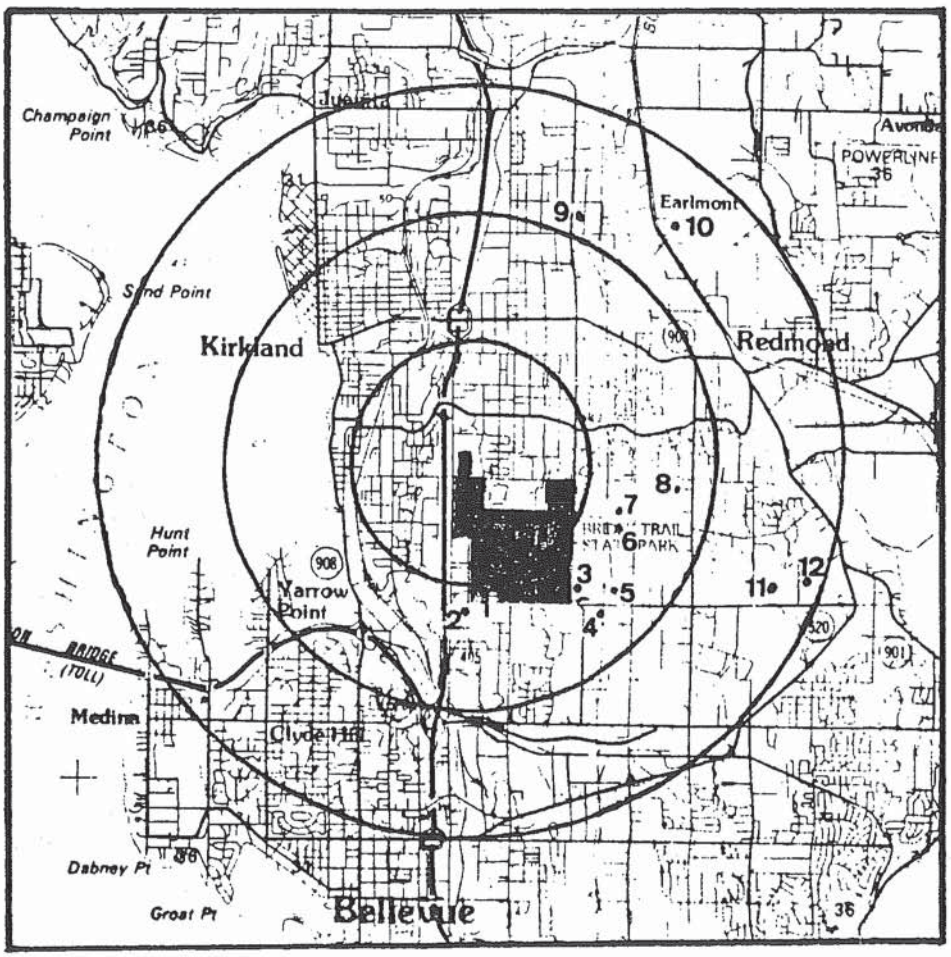
Table II

Bow Lake Abandoned Landfill
Public Water Supply Systems

| Name | Figure Reference | Class | Approximate Location |
|---|---|---|---|
| ONE MILE RADIUS | | | |
| Gunter Bros. | 1 | IV | 19060 Frager Rd |
| TWO MILE RADIUS | | | |
| Water District #75 | 2 | I | 32nd Ave S & S 209th St |
| Dreison | 3 | IV | 4854 S 216th St |
| Sanchiary | 4 | IV | 5035 S 216th St |
| Ikuta | 5 | IV | 19055 E Valley Hwy |
| Hedlund | 6 | IV | 18703 E Valley Hwy |
| THREE MILE RADIUS | | | |
| Freedom House | 7 | IV | 8602 S 222nd St |
| Montoure | 8 | IV | 8602 S 222nd St |
| Novak | 9 | IV | 8528 S 222nd St |
| Bernaseoni | 10 | IV | 22239-84th Ave S |
| Mauritsen | 11 | IV | 8812 S 218th St |
| Gouge | 12 | IV | 21244-84th Ave S |
| Stebner | 13 | IV | 21602-94th Pl S |
| Coleman | 14 | IV | 21421-94th Pl S |
| J. Wilson | 15 | IV | 20634-84th Ave S |
| Sainate | 16 | IV | 20444-84th Ave S |
| Jolley | 17 | IV | 9455 S 202nd St |
| Keyes-Twerton | 18 | IV | 19903-92nd Ave S |

FIGURE 10

Houghton Abandoned Landfill Public Water Supply
Systems Within a Three Mile Radius*




Scale: 1 mile = 5/8 inches.
* Refer to Table III.

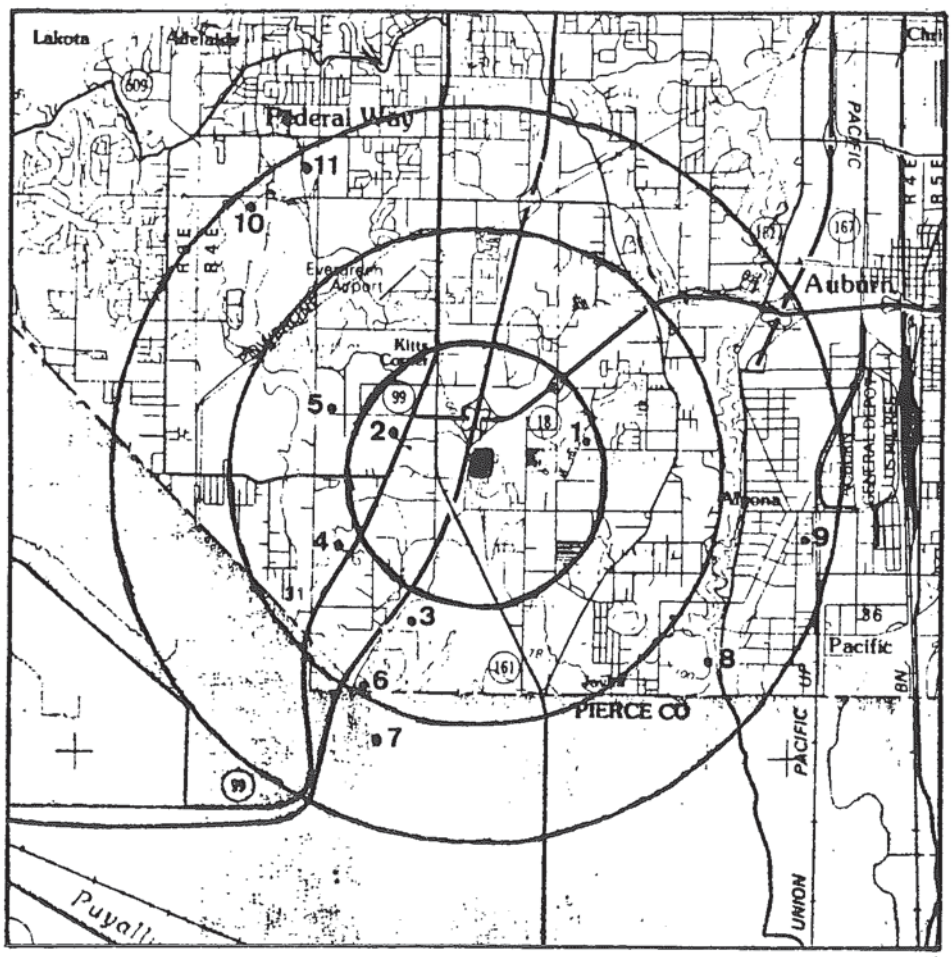
Table III

Houghton Abandoned Landfill
Public Water Supply Systems

| Name | Figure Reference | Class | Approximate Location |
|---|---|---|---|
| ONE MILE RADIUS | | | |
| No wells noted | - | - | - |
| TWO MILE RADIUS | | | |
| Sharp | 1 | IV | 118th Ave NE & 41st St |
| Porter | 2 | IV | 118th Ave NE & NE 36th St |
| Kauter | 3 | IV | Kauter Ln NE & NE 42nd St |
| Waterwell | 4 | IV | NE 40th St & 135th Ave NE |
| Trail's End | 5 | IV | NE 42nd St & 137th Ave NE |
| Anderson P | 6 | IV | NE 50th St & 140th Ave |
| Decker | 7 | IV | NE 52nd St & 140th Ave NE |
| Kick | 8 | IV | NE 59th St & 148th Ave NE |
| THREE MILE RADIUS | | | |
| Bowman | 9 | IV | 132nd Ave NE & NE 105th St |
| Peake Roofing | 10 | IV | NE 105th St & Willow Road |
| Kenny | 11 | IV | NE 41st St & 159th Ave NE |
| Johnson | 12 | IV | 182nd Ave NE & NE 44th St |

FIGURE 11

Puyallup/Kit Corner Abandoned Landfill Public Water Supply Systems Within a Three Mile Radius*




Scale: 1 mile = 5/8 inches.
* Refer to Table IV.

Table IV

Puyallup/Kit Corner Abandoned Landfill
Public Water Supply Systems

| Name | Figure Reference | Class | Approximate Location |
|---|---|---|---|
| ONE MILE RADIUS | | | |
| WD 124 Well 16 | 1 | I | S 356th St & 34th Ave S |
| WD 124 Well 15/15A | 2 | I | Pac Hwy S & S 348th St |
| TWO MILE RADIUS | | | |
| Seil | 2 | IV | S 375th St & 11th Ave S |
| Justus - spring | 3 | III | Pac Hwy S & S 363rd St |
| WD 124, Well 10/10A | 4 | I | S 348th St & 6th Ave S |
| Milton | 5 | I | Milton Rd at County line |
| THREE MILE RADIUS | | | |
| Milton | 7 | I | 7th Ave & Fir St |
| City of Pacific | 8 | Test Well | W. Valley Hwy & 5th Hwy |
| City of Algona | 9 | I | Wash Blvd & 3rd Ave S |
| WD 124 Well 17/17A | 10 | I | S 320th St & 11th Ave S |
| WD 124 Well 20/20A/23/23A | 11 | I | SW 316th St & SW 304th St |


# QUALITATIVE HEALTH RISK ASSESSMENT:

# KING COUNTY LANDFILLS

Bow Lake

Corliss

Genessee

Houghton

Puyallup/Kit Corner

South Park

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## EXECUTIVE SUMMARY

The Seattle-King County Department of Public Health is examining six closed municipal landfills within King County to assess the potential hazard that each may present to the public, onsite workers, downstream users, and the natural ecological community. This portion of the study has focused on human exposure pathways to toxic chemicals by examining surface soils, surface waters, leachate seeps, and landfill gas emissions for toxic chemical components.

This study reviews the environmental monitoring data for surface water, surface soil, and air samples, and provides a qualitative assessment of public health risk from exposure to all of the analyzed chemicals through inhalation, ingestion, or skin absorption.

The investigation specifically focuses on the health risk of casual use of the sites, including children playing on the sites and other recreational use. It does not address the long-term potential for contamination of potable groundwater by these sites and associated health risks posed to local residents. To address these issues would require extensive sampling of soils at various depths, leachate, and groundwater.

The study concludes that none of the sites are believed to pose an immediate threat to public health on the basis of available information. However, three sites merit additional investigation on the basis of some of the analytical results, including two sites which require immediate corrective action. These actions are to confirm analytical results of highly unusual air samples at the Houghton site, and to correct a safety hazard on the Kit Corner/Puyallup site not associated with landfill constituents.

TABLE OF CONTENTS

# A. INTRODUCTION

## STUDY PURPOSE

The purpose of this study is to review the environmental sampling data for water, soil and air samples taken from six landfills in King County, Washington by representatives of the Seattle-King County Department of Public Health. In November and December 1986, ETI was provided with these data and requested to perform a qualitative assessment of the public health risk from exposure to all of the chemicals through inhalation, ingestion or skin absorption.

The available data limit the potential health risks that can be addressed to those associated with playing, walking, or otherwise being on or near the site for recreational or other casual purposes. The concerns that have been addressed in this report include questions such as is it safe for children to play on the sites, or should public access be restricted.

This study of the potential health effects of chemical constituents at the landfill sites does not address whether the sites present any public health risks to nearby residents. Extensive sampling of leachate, groundwater, and fill material at various depths would be necessary for such an assessment, as these media are likely to be a greater source of exposure to landfill constituents. The conclusions of this report include recommendations regarding areas that may merit further investigation. These recommendations are based on the analytical information available, as well as detailed observations of the sites.

## STUDY ASSUMPTIONS

- The selected pathways for potential exposure (surface water, top two inches of soil, subsurface air) are those of immediate health concern at these sites.
- The pollutants selected for analysis are those of primary health concern at the sites.
- The sampling work was performed consistently, all documentation was accurate, and QA/QC protocols were followed.
- The work performed by the analytical laboratory is accurate, and QA/QC protocols were followed.

## STUDY LIMITATIONS

- All samples taken were composite or discrete "grab" samples, which are not necessarily representative of all locations of the site.

- All soil samples were collected from the first two inches of soil at each site. It therefore is likely that most of these samples will not contain hazardous substances from the fill material below the cover, as most of these sites have been covered and partly stabilized with presumably "clean" fill dirt. The samples therefore represent only that portion of the soil that is most likely to come into direct human contact on the site, and do not address the issue of hazardous components that may lie deeper than a few inches below the surface.

- The air monitoring consisted of grab samples taken from bore holes extending three feet below the surface. The analyzed compounds were primarily those which tend to volatilize readily at the surface and would present much less of a hazard in these lower concentrations. Therefore, the direct risk to humans on the site from substances detected below this surface is difficult to predict without direct ambient air monitoring.

- Chemicals identified in surface water samples may represent general urban contamination, and may not be influenced by or reflect the presence of subsurface contaminants potentially present in landfill materials.

- Leachate and runoff water sampling was conducted during a seasonally dry period (June 1986). Many of these sources are active only during the rainy seasons. Any speculation about these potential problems is based on site inspections identifying these sources as potential pathways of exposure.

- Although the "Microtox" Bioassay is recognized by numerous environmental agencies, including the EPA (1), its limitations must be acknowledged. This bioassay signifies the toxicity of a solution to bacteria, and does not necessarily indicate toxicity to humans. Furthermore, there may be additional parameters that the assay responds to in addition or instead of inherent chemical toxicity. "Microtox" is therefore not the only criterion used in this study to determine "toxic" samples from the sites. Instead, it is used in combination with the chemical data and site visits to interpret the health risks from the sites.

- This study was limited to assessing the threat to public health from these six sites as a result of direct contact with the landfills from inhalation, ingestion, or contact with surface water, topsoil, or subsurface air at the site. Although groundwater contamination is a potentially serious future loss of resources, it should not represent a direct threat to the public in the areas studied if residences use approved public water supply systems and do not have contact with water from wells penetrating contaminated groundwater reservoirs. Groundwater contamination may represent a public health threat in the future.

## B. SITE DESCRIPTIONS

The following site descriptions are based upon historical information about the sites and personal observations made by ETI staff during the months of November and December, 1986. Photographs and maps of the sites are cincluded in appendices to this report.

### 1. BOW LAKE

#### Site Appearance

This site comprises 14 acres atop a hill in a semi-developed area just south of Southcenter at 188th and Military Road. The SW portion of the landfill is under I-5. Prior to its closure in about 1960, the site was the largest landfill in the county. A transfer station was constructed on the site in 1961, and updated in 1978 to its current annual volume of approximately 60,000 tons. It is currently the major transfer point for South King County.

Previous reports have speculated that some hazardous material may be on this site (2). Comments from private individuals and the City of Tukwila, documented in Reference 1, suggest that the major problem at this site has been uncontrolled leachate to the southeast. A 200-foot drop in elevation from the NW corner to the SE corner of the site is believed to aggravate this problem. However, uncontrolled leachate has not been recently observed by the current property occupants located in Southcenter Parkway at the base of the slope (M.A. Segale, Inc.) (10). The east side of the site borders a steep embankment which overlooks the Kent Valley area.

**Opportunities for Public Exposure to Potential Landfill Contaminants**

Inspections of the site in November and December 1986 show the transfer station to be in full operation and under constant surveillance by site personnel. The transfer station is landscaped and entirely fenced, and it appears that a portion of the landfill extends beyond the fence to the north and west. Within the fenced area, exposed fill material can be seen among a cover of thick grass and vegetation. In the SE corner of the fenced portion of the transfer site there is a PVC flex pipe which appears to divert potential leachate or runoff to the SE slope.

A significant amount of erosion on the hillside can be seen when standing at the bottom of the embankment to the east of the site, which indicates a substantial amount of water is flowing off the site. It appears that during heavy rains, the water level below this site is quite high. Strawberry crops are grown to the south-southeast of the property at the bottom of a steep embankment in the apparent direction of leachate flow, approximately half a mile away. A large acreage with a residence is located directly below the east embankment, and a storage yard lies to the southeast.

The potential for human contact with the fill material consists of possible leachate, surface and groundwater contact at the neighboring residences and commercial facilities to the east and southeast; some potential for crop contamination some distance away; and transfer station operation activities. In addition, the erosion of the hillside below the site could adversely affect its stability, creating drainage or landslide problems below.

## 2. CORLISS LANDFILL

### Site Appearance

This site is located north of Seattle in the Shoreline area, west of and adjacent to I-5 near Northeast 165th Avenue. Between 1946 and 1959, this site was used by King County as a sanitary landfill. Presently, a portion of I-5 runs over the excavated SE corner of the site. The remaining area consists of an undeveloped area called McCormick Park to the southeast, the Peat Company to the southwest, and the Northeast Transfer Station on the northern half of the property. Housing developments surround the site to the north, west, and south. A housing development abuts the southern edge of the McCormick area.

Previous soil exploration has found the fill depth to be 2 to 14 feet; groundwater has been encountered from 4 to 7 feet. Although there is no confirming documentation, it is possible that hazardous materials have been placed on the site (2).

This site exhibits the common landfill characteristic of unlevel ground caused by settling of the fill, compounded by uneven dumping and bulldozing. Thornton Creek runs along the east side of the fill and is diverted out at the Peat Company. Other drainage appears to be diverted just north of the southern housing development into the stream. The McCormick Park area appears to still be used as an unauthorized dump on occasion. There is exposed fill material on this portion of the site and some standing water.

**Opportunities for Public Exposure to Potential Landfill Contaminants**

The McCormick Park area probably gets some recreational use from the neighborhood. The housing development to the south appears to be at greatest risk of potential exposure to fill contaminants via surface water and runoff. There may be additional risks posed by contact with the decomposing refuse, broken glass, etc.

## 3. GENESEE LANDFILL

**Site Appearance**

The Genesee Site is located in Rainier Valley on Lake Washington between 38th and 45th Avenues South. From the early 1940's through 1966 or 1968, this 26-acre site was used as a major landfill for the area. Fill activities go as far back as 1890, when the area (formerly a slough) began to be used as a landfill site. Reports have concluded that commercial and municipal dumping occurred at this site. (3) The site is surrounded by residences, and a number of homes along the SW and SE perimeter of the site are located at a lower elevation than the landfill.

The site is currently a well-maintained, major recreational area, with playing fields and playground equipment. The terrain exhibits characteristics of a landfill in the process of settling -- two tennis courts were quickly rendered unusable as the surface became uneven. There is a great deal of standing water on the site, including in a playground area.

The King County report (3) suggests that the fill material has a high potential for gas generation and explosion. Furthermore, it states that the site has had seepage problems and has had a detrimental effect on storm drainage in the area. Ground and surface water contamination are considered potential problems on and near this site.

A portion of the cap is exposed through cracks and holes in the asphalt of the south parking lot. Standing water and seepage is also present in the south portion, surrounded by areas of saturated ground.

**Opportunities for Public Exposure to Potential Landfill Contaminants**

The major source of potential public exposure to landfill contaminants from this site is related to the drainage of water on the site. This seems particularly problematic to the SW and SE of the park, where runoff can be seen throughout the site and along the site boundary into the residential areas. Additionally, standing water is present in several spots in this southern portion of the park.

## 4. HOUGHTON

**Site Appearance**

This site is located north of Bridle Trails State Park in Kirkland, just east of and adjacent to I-405. A landfill was operated here from about 1945 to 1965; the transfer station in operation today on the site opened in 1970. The site was covered with over 8,000 cubic yards of top soil in 1970 and an additional 2,000 cubic yards of impervious cover material in 1972. The site was also plowed, fertilized and replanted with a new cover material at that time. (2)

The types of wastes at the site have not been documented. Problems with leachate and standing water in a low spot of the landfill have been identified previously. (2) The high water table indicates there is a strong potential for saturated refuse and possible groundwater contamination.

The site is densely vegetated, with residences immediately adjacent to the site on three sides; Bridle Trails lies to the south. There is no development directly on the site other than the transfer station. A number of animal trails and a neglected baseball field indicate the area does not get a great deal of recreational use. The transfer station is entirely fenced

and does not appear to pose any immediate health risks. Water was seeping from the slope east of the baseball field onto the playing area with some standing water present.

**Opportunities for Public Exposure to Potential Landfill Contaminants**

Potential sources of public exposure to landfill contaminants from this site appear to be related to drainage from the site as well as potential settling of the fill with associated standing water problems. The seepage of water onto the baseball playing area may be seasonal or as a result of heavy rains. The significant amount of rain coupled with the use that this area receives by neighboring children and residents suggests that seepage and surface water is a potentially significant exposure route at this site.

## 5. PUYALLUP/KIT CORNER SITE

**Site Appearance**

This site is located on the east side of I-5, north of South 360th Street near the Pierce County border. Landfill activities were discontinued at this site sometime around 1970. For the 25 years prior to that, it received refuse from a large geographical area. The land is currently vacant and being surplused by the County. It is suspected that a wide variety of substances may be found there (2), although no confirming documentation has been discovered.

Recent inspection of the site in November and December of 1986 shows the perimeter of the site to be densely vegetated. The center of the site is open and not well vegetated due to extensive recreational use by cmotorcyclists. Residential developments exist, or are being built, to the south and southeast of the site. A petroleum pipeline runs down the western border of the landfill.

There is evidence of seepage on the north and east boundaries of the site. There is a storm drain on the southwest corner which empties into a runoff ditch parallel with the highway.

There was evidence of recreational activity on the site, primarily from motorcycles. A pond located at the southern end of the site near the condominium development appears to get a lot of recreational use, probably by neighborhood children.

### Opportunities for Public Exposure to Potential Landfill Contaminants

Recently, a condominium complex was constructed on the southern boundary of the former landfill, and it appears that more development is planned to the east and southeast of the site as well. Any further development of this area should be accompanied by professional hydrological evaluation.

The most immediate safety hazard at this site is an uncovered manhole in the southeast corner of the site. This hole is in the middle of an area that appears to get heavy use by motorbikes and other recreational vehicles. The hole is approximately 8-10 feet in diameter and water is flowing about 10 feet below. Fill strata are observable in the cross-secton of this hole.

The other major concern is potentially direct exposure to landfill contaminants by children playing in the pond. This is of concern because the pond water may contain seepage from the landfill.

## 6. SOUTH PARK SITE

### Site Appearance

This approximately 40-acre site, located near West Marginal Way and 5th Avenue South, was used in the early 1950's as a disposal point for waste sawdust. It is believed that other industrial wastes have been disposed of at the site (3). In 1966 much of the site was converted to a solid waste transfer station.

Currently the transfer station is in operation in the northern part of the property, and the southern 20 acres of the site are for sale or lease by the county. The property for sale is being used as heavy equipment yard and other storage. The area is highly industrialized, and no residential areas are in the vicinity of the site. In addition, the area is largely enclosed by fences (some unlocked) and not readily accessible to the public. A drainage ditch runs through the center and also along the western perimeter of the site, and the water looks to be of poor quality.

### Opportunities for Public Exposure to Potential Landfill Contaminants

The entire area may pose a potential threat to groundwater and surface water. The potential threat to public health appears to be very limited due to the lack of residences in the area and access to the site.

## C. RESULTS

### GENERAL

This section provides an analysis of the analytical results provided to ETI in November and December, 1986. Information regarding sampling, analytical, and QA/QC protocols is provided in the text of the main report prepared by Seattle-King County Department of Public Health. The analytical results have been compiled into the tables included in the appendices.

#### Analytical Detection Limits

Although the samples generated in this study were analyzed for the 129 priority pollutants, only a small subset of these substances were actually detected in concentrations greater than the instrument and protocol detection limits. Furthermore, many of the concentrations of the compounds that were detected were laboratory estimates because these concentrations were so close to the detection limits. For the purposes of data interpretation, these estimated values will be presumed to represent actual values. It is important to recognize, however, that conservatively estimated values often result in overestimations of risk.

#### Soil and Surface Water

The soil and surface water samples analyzed in this study do not represent drinking water or any media that is likely to be ingested regularly. Because of the potential for children to play on some of the site areas, it is possible that some soil may be ingested. This potential exposure pathway has therefore been addressed in appropriate detail.

#### Compound Categories

The compounds that were detected in concentrations greater than the analytical detection limits can be segregated into the following chemical groups: chlorinated hydrocarbons and volatile organics, polycyclic aromatic hydrocarbons (PAH's), insecticides, and metals (see Appendix A).

1. Chlorinated Hydrocarbons and Volatile Organics

A number of samples yielded trace amounts of substances such as methylene chloride, toluene, phthalates, and acetone. Samples from

one site (South Park) also indicated PCB's. This is not unusual as these substances are increasingly found in trace amounts in much of the soil, water and air to which the public is exposed daily. The two substances that were most common in the samples were methylene chloride and several types of phthalates. Because both of these substances are widely used in analytical laboratories, sample contamination with trace amounts of both is quite common and almost unavoidable.

Although methylene chloride was believed for many years to be one of the safest of the widely used chlorinated organic solvents, recent evidence has found that lifetime exposure to high levels of methylene chloride increases the incidence of liver cancer in certain strains of mice. Based on these studies, methylene chloride is now classified by the USEPA as a potential human carcinogen.

Phthalates are used widely as plasticizers and can be found in the environment more often than methylene chloride. The drinking water limits for phthalates are in the parts-per-million range, and safe human exposure to a combination of phthalates has been estimated in amounts up to 8.4 milligrams per day. (4)

The concentrations of pthalates and methylene chloride in soil and surface water samples are all in the parts-per-billion range. The fact that these compounds are present throughout the environment in trace amounts makes it unreasonable to suggest that trace levels found in the soil and surface water at the sites represent risks in excess of those associated with any urban/suburban environment. As these chemicals rapidly volatilize upon contact with air, there is little hazard when they are present in trace amounts on the soil or water surface in an open environment.

2. Polycyclic Aromatic Hydrocarbons

These compounds are principally formed as products of combustion associated with industrial processes, wood-burning stoves, diesel engines, tobacco, forest fires, etc. Although the PAH's are not believed to produce harmful effects after a single exposure, some of these compounds such as benzo(a)pyrene and chrysene are human carcinogens. It is primarily because of their carcinogenic potential that these substances are regarded as harmful to humans. (5)

As combustion activities are widespread, PAH's are commonly present in the environment. It is typical for many different PAH's to be found

together in a single spot or sample, which suggests that where one PAH is found, others are likely to be found as well. Therefore, a sample showing only one PAH suggests that it is either a sampling or analytical artifact, or an unusual circumstance.

The PAH concentrations from three sites are less than 0.3 parts per million (ppm), which is approximately background level (5). Extremely high levels of PAH's in soil would be greater than 1000 ppm, which is three thousand times greater than the measured concentrations.(5) Corliss, Puyallup/Kit Corner, and South Park all had PAH concentrations over 0.3 ppm. Even so, the highest benzo(a)pyrene sample collected (the estimated 3 ppm sample at Corliss) was about one-tenth of the average subsurface benzo(a)pyrene concentrations found at Gas Works Park. (5)

3. Insecticides

Some of the insecticides detected at the sites include aldrin, lindane, DDD, DDE, DDT and endrin. Likely sources of these compounds include non-specific insecticide application on and near the site as well as dumping at the site.

Concentrations of the chemicals in this category were below the analytical detection limits in most of the samples (between 8 and 165 ppb, depending on the compound). Those present above detection limits were in the parts-per-billion range. The concentrations measured are similar to insecticide concentrations measured in background soil at various locations in the United States. For example, an average value for DDT residues in US non-cropland area is 0.6 ppm (600 ppb) (6), while the highest value recorded at the landfill sites was 0.063 ppm (63 ppb) at the Corliss site.

Because of the relatively low and undetected levels of insecticides in the surface water and soil samples, this category of priority pollutants does not appear to present a significant source of exposure to the public from recreational or casual use of the site.

4. Metals

Many of the target metal concentrations in the samples were below analytical detection limits. The only metal detected in concentrations which are of potential public health concern is lead. Most of the elevated lead concentrations were found at the South Park site.

Lead is a nonessential element to humans. Exposure to various levels of lead has been associated with adverse health effects such as changes in blood cell synthesis, nutritional disturbances, learning and behavioral problems in children, teratogenic effects, and some very acute systemic disturbances. (7)

Automotive emissions are a major source of lead as it is used as an anti-knock agent in gasoline. Because of this, roadside soils may contain concentrations of atmospheric lead ranging from 30-2000 ppm in excess of natural levels within 25 meters of the roadbed. Natural soil typically contains 10-30 ppm lead. Soil lead concentrations at the six sites were below 161 ppm except for the South Park samples and one from the Corliss site. The presence of lead in the South Park samples is expected, given the highly industrialized nature of this area.

A previous study of blood lead levels in children residing in King County (including 184 children living in the South Park area) found all blood lead levels within the normal range (none greater than 25 ug/dl, and only two greater than 15 ug/dl). (8)

Concentrations of lead in drinking water in Seattle has previously been documented as ranging from 6-70 ppm depending on the age of the house and pipes. (7) Surface water analysis yielded lead concentrations below 35 ppm at all sites except for South Park.

Air

The limitations of the air data have been briefly addressed in the introduction of this study. Few samples were above the ground, which would reflect the actual concentrations of substances in the air to which an individual may be exposed. Most of the air samples were collected below the surface and thus only reflect the presence of volatile organics chemicals below the surface. Although such samples give some indication as to the type of fill materials present, they provide little direct indication as to the concentrations of these substances in air that may serve as a source of human inhalation exposure. Furthermore, the samples are quick "grab" samples, and only identify the composition of a very small amount of the air at a short period of time at the site.

Threshold Limit Values (TLV's) were used to compare measured exposure concentrations at the site with one type of exposure standard. This approach is deficient for several reasons. In particular, TLV's were designed as limits for workers working 8-hour days and 40-hour weeks, and

therefore are not conservative enough to use as recommended concentrations for the type of exposure that may occur at the landfill sites. However, the comparison does illustrate the magnitudes of difference between the potential concentrations being inhaled vs. one type of "acceptable" exposure concentrations. In this study, we considered any ambient air concentration which is present in 0.1-1% of its corresponding TLV to represent a moderate concern to public health, and any concentration over 1% of the tLV to indicate a potentially serious concern. There are no federally accepted guidelines for public exposure to these chemicals, nor do we know of any accepted methodology for extrapolating concentrations from three feet below the surface to actual levels which may be inhaled.

Table 1 gives the highest air concentrations of the chemicals measured in the grab sample, as compared to the TLV for the specific compound at all sites. The air data is compiled by site and located in Appendix A.

The TLV's are from one to several thousand times greater than the highest chemical concentration measured at the site. Of these, the highest concentrations were measured at the Houghton site, where several chemicals were present in concentrations that approach the TLV. These high concentrations are highly unusual in an outdoor environment and suggest that immediate resampling of the area is needed in order to rule out sample contamination or analytical error.

## SITE-SPECIFIC EVALUATIONS

The following categories were developed in order to prioritize the potential health risks posed by the six landfill sites:

Category 1

Sites for which the results of chemical analysis suggest that on the basis of the available information, no chemical problems exist for the portions of the site that were sampled.

Category 2

Sites which require a discussion of the significance of specific soil, water, or air samples, but which do not require follow-up on the basis of the chemical analysis and the available information.

TABLE 1. COMPARISON OF AIR CONCENTRATIONS TO ACGIH THRESHOLD LIMIT VALUES

| COMPOUND | HIGHEST AMBIENT ($mg/m^3$) | HIGHEST SUBSURFACE ($mg/m^3$) | TLV ($mg/m^3$) | TLV / AMBIENT | TLV / SUBSURF. |
|---|---|---|---|---|---|
| Acetone | .15 (H) | 2.3 (B) | 1780 | 12,000 | 774 |
| Benzene | .19 (H)<br>.07 (P) | .84 (H)<br>.50 (B)<br>.17 (C)<br>.12 (G)<br>.09 (P) | 30 | 158<br>428 | 36<br>60<br>176<br>250<br>333 |
| Carbon Disulfide | .07 (S) | .21 (G)<br>.16 (B)<br>.10 (C)<br>.10 (S)<br>.05 (BLANK) | 30* | 429 | 143<br>187<br>300<br>300<br>600 |
| Carbon Tetrachlor. | --- | .02 (S) | 30 | --- | 1500 |
| Chlorobenzene | --- | .27 (G) | 350 | --- | 1296 |
| Chloroform | --- | .08 (S)<br>.12 (BLANK) | 50 | --- | 625<br>417 |
| 1,2-Dichloropropane | .077 (H) | --- | 350* | 65 | --- |
| Ethylbenzene | .09 (P) | 4.2 (H) | 435 | 4833 | 104 |
| MBK | --- | .13 (S) | 20 | --- | 154 |
| Methylene Chloride | 20 (H)<br>.62 (P) | 4.0 (P)<br>.67 (B)<br>.60 (S)<br>1.1 (BLANK) | 175 | 9<br>82 | 44<br>261<br>292<br>159 |
| MIBK | --- | .11 (P) | 205 | --- | 1864 |
| Styrene | .17 (P) | .58 (B) | 215 | 1265 | 371 |
| Toluene | .32 (H) | 9.2 (H) | 375 | 1172 | 41 |
| 111-Trichloroethane | .06 (P) | .08 (S) | 1900* | 31,667 | 23,750 |
| Vinyl Chloride | 8.7 (H) | 3.6 (H)<br>.99 (G)<br>.31 (C)<br>.24 (P)<br>.17 (G)<br>.05 (B) | 10 | 1.15 | 2.78<br>10<br>32<br>42<br>59<br>200 |
| Total Xylenes | .15 (P) | .15 (H)<br>.81 (C) | 435 | 2900 | 29<br>537 |

B = Bow Lake
C = Corliss
G = Genesee
H = Houghton
P = Kit Corner/Puyallup
S = South Park

* These figures denote TLV skin values and represent limits of concentrations in the ambient air to avoid adverse skin (not inhalation) effects.

Note: Analyzed substances which do not have a corresponding TLV are not included in this table.

BLANK indicates that this concentration was detected in the reagent blank.

Category 3

Sites for which specific surface water, soil or air samples suggest necessary follow-up.

The six sites were placed into one of these categories according to the results from the chemical analyses for soil, water, and air, and then listed in this section according to the highest ranking that site received for any sampling medium. The results from the Microtox Bioassay and significant site observations were combined with the chemical results to determine the overall public health threat attributed to the site. Each site is listed alphabetically.

Of general concern at all sites is potential leachate and groundwater contamination due to the presence of toxic constituents within the landfill. This study did not intend to address these issues; additional sampling of leachate and groundwater would be necessary to investigate the nature and extent of this potential problem.

**Bow Lake**

The chemical data available for this site places it in Category #1 for the soil samples. No surface water samples were available for interpretation.

All Microtox Assay results were labeled "non-toxic."

Some of the concerns previously addressed in the Seattle-King County 1984 report warrant further discussion, although they are outside the scope of this project. These include the potential for leachate and runoff collection below the embankment and general erosion of the hillside.

**Corliss**

This site falls into Category #2 on the basis of one soil sample. This discreet sample, collected on the transfer station property, had the highest concentrations of PAH's analyzed in this study (1.9-4.1 ppm per compound), as well as a high lead concentration (2000 ppm). The sample also registered "toxic" in the Microtox Assay. Although the PAH concentrations were the highest recorded of the six sites, they were less than five parts per million, a level that is generally not considered excessively high. Upon investigation, it was determined that the discreet sample was actually used motor oil taken from the road within the transfer station.

The high PAH and lead readings are believed to reflect constituents of used motor oil and not substances from the landfill.

This site also has some of the highest insecticide concentrations measured of all sites investigated, although all were less than one part per million. The discussion on insecticides in the preceding section suggests that the results found do not pose a significant public health threat.

Other concerns at the site include the undeveloped area adjacent to the housing development which is occasionally used by individuals as a dump. This portion of the site may pose a public health threat, and surficial cleanup may be recommended.

**Genesee**

The chemical data available for this site places it in Category #1 for the soil and surface water samples.

All Microtox Assay results were labeled "non-toxic."

Further investigation chould address the potential leachate problem on the southwest and southeast boundaries of the site. In these locations, the potential for seepage into adjacent residences that are located below the landfill may exist.

**Houghton**

The high air concentrations measured at the Houghton site, where several chemicals were present in concentrations that approach the TLV, place this site in Category #3. These data are highly unusual and suggest that immediate resampling of the area is needed in order to rule out sample contamination or analytical error.

The soil and surface water data are rated Category #2. The analytical results from one sample included an estimated acetone concentration of 13000 ppb (or 13 ppm) in soil. This estimation is more likely to be the result of a sampling or analytical artifact, as it is unlikely that such a concentration of acetone would be present at or close to the soil surface due to its volatility, unless it were very recently deposited on that site.

Three of the site samples registered "low toxicity" in the Microtox Assay. In each of these three samples, the priority pollutant concentrations gave no indication of high or "toxic" levels, and the background sample gave a reading of equal toxicity. This evidence suggests that the available chemical data should be relied upon more than the Microtox results to indicate potential health hazards at this site.

Other potential public health and environmental concerns at this site include the seepage of water near and onto the baseball diamond. This can be assessed by sampling leachate and seepage waters. Soil samples taken at the area did not have contaminant concentrations of concern to public health.

**Puyallup/Kit Corner**

This site falls into Category #2, warranting further discussion on the basis of the analytical results.

One soil sample at this site includes some PAH values that are higher than those found at the rest of the site, although the values are low (less than 1 ppm) and are largely estimated values. The site location and corresponding field notes show that the sample was taken in the middle of a dirt road on the NW corner of the site, not far from I-5.

A major source of PAH compounds in the environment, as mentioned in a preceding section, is the automotive combustion process. This one sample may represent proximity to auto emissions and is not believed to represent a potential health risk due to landfill contents or otherwise represent a significant public health hazard.

Two substances were present in the ambient air in concentrations which are of moderate public health concern: methylene chloride and benzene. The measured concentrations represent 0.4% and 0.3% of their respective TLV's.

The Microtox Assay results for this site were all "non-toxic."

Other public health concerns at or near this site include the pond located north of the condominium development, and the "manhole" in the SE corner. The pond appears to be a primary potential exposure site for neighborhood children, and additional sampling of the water or filling of the depression may be desirable to either confirm or control this source of exposure.

Analysis of the surface water sample taken in August did not yield any priority pollutant concentrations of concern.

The problem with the "manhole" is an immediate safety hazard and should be given prompt attention.

**South Park**

This site would fall into Category #3 on the basis of the sampling data except for its 1) inaccessibility, 2) lack of public use as a recreation area, 3) lack of nearby residences, and 4) location in an industrialized area which may be responsible for the high analytical results. As a result, it is classified as Category #2.

Some of the higher concentrations of heavy metals (particularly lead) and PAH's were detected in several of the surface soil samples from this site. One surface water sample also had high heavy metal concentrations relative to all other water samples in this study. These concentrations are believed to reflect those associated with a heavily industrialized location adjacent to two highways rather than substances from the fill material.

Microtox assays for the samples identified two "toxic" surface water samples and one "low toxic" soil sample. However, two out of three of these Microtox positives were not the same as the high-concentration samples mentioned in the preceding paragraph. There may be a correlation between high lead levels and sample "toxicity" as determined by the Microtox Assay.

Although these levels may be of concern if the site were used by humans recreationally, the site is in the middle of Seattle's industrial zone and is largely fenced in. It is possible that these concentrations are no higher than the surrounding areas outside of the site, which could be verified by additional sampling. There are no residences nearby, and it is unlikely that anybody uses the site other than workers. It may be desirable to determine whether workers at the site require protective gear in addition to that which is presently being used.

Ambient air sampling showed carbon disulfide present at the site in concentrations about 0.2% of the TLV. Concentrations above 0.1% of the TLV were considered to be of moderate public health concern in this study. These concentrations may also be attributable to the industrialized area in which the site is located.

## D. CONCLUSIONS

On the basis of the available information and the limitations and assumptions described earlier in this report, we conclude that there are three sites which may pose a potential risk to the public in excess of background risks: Houghton, Puyallup/Kit Corner, and South Park. Bow Lake, Corliss, and Genessee appear to pose no greater than background risk on the basis of the available information. The final comments and recommendations from the three sites are summarized below.

Houghton:

- o Highly unusual ambient air results at this site suggest that immediate resampling of the area is needed in order to rule out sampling or analytical error.

- o The analytical results suggest that the site surface presents no risk greater than background.

- o Because of the amount of seepage near and on the baseball diamond area, this site deserves further attention addressing this specific potential problem.

Puyallup/Kit Corner:

- o The analytical results suggest that the site surface presents no risk greater than background on the basis of the available information.

- o Ambient air concentrations of two substances are present in concentrations of moderate concern to public health.

- o Observations at the site suggest that both the pond and manhole described in the preceding section merit further attention.

- o Also of concern is any further development near the site and potential problems associated with uncontrolled leachate or seepage. This concern should be addressed by a qualified hydrogeologist.

South Park:

- o Because of its industrial location, the concentrations of certain compounds, primarily heavy metals and PAH's, are greater than background levels.

- It is probable that the relatively high concentrations are due to the general industrial nature of the area and adjacent highways rather than the existence of the landfill.

- This site is not likely to be used recreationally and public access is limited, which decreases its potential as a public health hazard.

General Comments

The intention of this study was not to assess the health risks posed by these six sites to nearby residents, but to assess the health effects of casual or recreational use of the sites, such as children playing on the sites. With the exception of the specific problems noted in this section, there is no reason to believe that the surface of these sites present a health risk to recreational site visitors over and above background exposure risks.

As it is unlikely that the samples analyzed in this investigation included many of the original landfill materials, no conclusion may be made with regard to the health risks posed by construction or other activities at the site which exceed the top two inches of soil. Additional types and quantities of hazardous materials may be present at lower depths at the sites and be subject to leaching into the groundwater or off the site over time. Any excavations on these sites should be performed by workers who have been trained to deal with the potential hazards posed by landfill materials (EPA Level C/D training).

No barriers are required around the unfenced sites on the basis of the available information. Future development on and near the sites should be evaluated carefully.

The health risks posed by the sites examined in this study cannot readily be compared to risks posed by other everyday activities because of the low concentrations of chemicals present. Health risk assessments typically include examples of excess risk expressed in terms of additional number of deaths expected in a population due to exposure to a given substance. The risks associated with these sites are so low or unquantifiable that it is not possible to make such an analogy in this case.

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# APPENDIX A

SOIL DATA

SURFACE WATER DATA

AIR DATA

# SOIL DATA

# Bow Lake Soil Data

| BOW LAKE | | methylene chloride | acetone | trichloro ethene | toluene | total xylenes | benzoic acid | phenanthrene | anthracene | fluoranthene | pyrene | butylbenzy phthalate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | |
| F | B-186-S | 32 | 140 | | | | | | | | | |
| E | B-1819HI-S | 160 | 61 | 2* | | | | 95* | 132* | 110* | 139* | 359* |
| D | B-181J-S | 31 | 17 | 1* | | | 158* | | | | | 34* |
| D | B-181J-SD | 31 | 17* | 1* | | | | | | | | |
| C | B-1617JK-S | 24 | 39 | | | | | | | | | |
| B | B-14KL-S | 59 | 59 | | | | | | | | | |
| A | B-8H-SB | 89 | 67 | | 1* | 3* | | | | | | |

| BOW LAKE | | di-n-butyl phthalate | bis (2-ethyl hexyl)phthalate | chrysene | di-n-octyl phthalate | benzo (b) fluoranthene | alpha BHC | beta BHC | aldrin | lindane | 4-4' DDD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| F | B-186-S | | 76* | | | | | | | | |
| E | B-1819HI-S | 183* | 929 | 132* | | 249T | | | | | |
| D | B-181J-S | 24* | 134* | | | 27T | | | | | |
| D | B-181J-SD | | 81* | | | | | | 2.4* | | 2.7* |
| C | B-1617JK-S | | 48* | | 43* | | | | | | |
| B | B-14KL-S | | 88* | | | | | | | | |
| A | B-8H-SB | | 22* | | | 26T | .6* | 1.5* | | 19.8 | |

* Denotes estimated value

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

Bow Lake Soil Data (cont.)

| BOW LAKE | | antimony | arsenic | beryllium | cadmium | chromium | copper | lead | cyanide | mercury | nickel | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | | |
| F | B-186-S | 34U | 4.5 | 0.43 | .7U | 33 | 18 | 25 (P) | .5U | .2U | 41 | 64 | N |
| E | B-1819HI-S | 2.8u | 17 | 0.47 | 2.5 | 42 | 54 | 160 (P) | 2.1 | 0.4 | 57 | 410 | N |
| D | B-181J-S | 2.6u | 2.8 | 0.4 | .6u | 37 | 21 | 20 (P) | .5u | .2u | 41 | 76 | N |
| D | B-181J-SD | 3.1u | 3.2u | 0.39 | .7u | 34 | 21 | 15 (P) | .5u | .2u | 38 | 72 | N |
| C | B-1617JK-S | 3.3* | 3.6 | 0.37 | .7u | 36 | 15 | 3 (F) | .5u | .2u | 45 | 36 | N |
| B | B-14KL-S | 3.5u | 3.3 | 0.36 | 0.84 | 41 | 18 | 9 (F) | .5u | .2u | 50 | 44 | N |
| A | B-8H-SB | 3.2u | 15 | 0.52 | 0.9 | 26 | 25 | 52 (P) | .5u | .2u | 23 | 57 | N |

* Denotes estimated value.

N Denotes non-toxic response.

# Corliss Soil Data

| CORLISS | | methylene chloride | acetone | toluene | total xylenes | ethyl benzene | benzoic acid | phenanthrene | anthracene | fluoranthene | pyrene | butylbenzy phthalate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | |
| A | C-41-SB | 159 | 53 | | | | 613 | | | | | |
| I | C-17-SC | 107 | 32 | | | | | | | 25* | 18* | |
| E | C-1113-SC | 110 | 32 | | | | | 37* | 11* | 55* | 48* | |
| C | C-9L-S | 51 | 36 | | | | | | | | | |
| C | C-9L-SD | 20 | 15* | | | | | | | | | |
| G | C-15-SC | 72 | 40 | | | | | 40* | | 50* | 50* | 130* |
| F | C-14-SC | 52 | 62 | | | | | | | 79* | 58* | |
| B | C-78J-S | 104 | 23* | 9* | 31 | 4* | | | | | 4160* | |
| H | C-16-SC | 113 | 31 | | | | | 30* | | 30* | 26* | |
| D | C-Z12-SC | 34 | 43 | 3* | | | | | | | | |

| CORLISS | | di-n-butyl phthalate | bis (2-ethyl hexyl)phthalate | chrysene | di-n-octyl phthalate | benzo (b) fluoranthene | benzo (k) fluoranthene | benzo-a-pyrene | benzo(g,h,i) perylene | alpha BHC | beta BHC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| A | C-41-SB | | 805 | | 39* | | | | | | |
| I | C-17-SC | | 211* | | 25* | 29T | | | | 5* | |
| E | C-1113-SC | 15* | 725 | 59* | 70* | 78T | | 41* | | 26.5 | |
| C | C-9L-S | | 236* | | 72* | | | | | 5* | |
| C | C-9L-SD | | 48* | | 14* | | | | | 6.4* | .8* |
| G | C-15-SC | 32* | 818 | 76* | 72* | 101T | | 79* | 40* | | |
| F | C-14-SC | 50* | 317* | 577* | 952 | | 188T | 115* | 58* | | |
| B | C-78J-S | | 3328* | 1872* | | | | 3336* | 4160* | | |
| H | C-16-SC | 45* | 314* | 34* | 37* | 45T | | | | 7* | |
| D | C-Z12-SC | | 578 | | 81* | | | | | | |

* Denotes estimated value.

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# Corliss Soil Data (cont.)

| CORLISS | | heptachlor epoxide | aldrin | lindane | dieldrin | 4-4' DDE | endrin | 4-4' DDD | 4-4' DDT |
|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | |
| A | C-41-SB | 14* | | | | | | | |
| I | C-17-SC | | | 1.1* | 2.6* | | | 21* | |
| E | C-1113-SC | | 20.8 | | 265.6 | 11.3* | 70.9 | 19 | |
| C | C-9L-S | | | | | | | 35.1 | |
| C | C-9L-SD | | | | 8.0* | | | | |
| G | C-15-SC | | | | 23.4 | | | 36 | |
| F | C-14-SC | | | | 36.2 | | | 71 | 47 |
| B | C-78J-S | | | | | | | | 63.1 |
| H | C-16-SC | | | | | | 1.3* | 9.5* | 13.3* |
| D | C-Z12-SC | | | | | | 1.7* | | |

| CORLISS | | arsenic | beryllium | chromium | copper | lead | cyanide | nickel | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | |
| A | C-41-SB | 14 | 0.45 | 32 | 15 | 69 (P) | 0.6 | 30 | 59 | N |
| I | C-17-SC | 5.2 | 0.44 | 32 | 18 | 25 (P) | .5u | 42 | 85 | N |
| E | C-1113-SC | 6.6 | 0.38 | 28 | 29 | 90 (P) | 0.8 | 44 | 97 | N |
| C | C-9L-S | 2.1 | 0.34 | 25 | 10 | 6 (F) | .5u | 37 | 27 | N |
| C | C-9L-SD | 1.4 | 0.35 | 31 | 10 | 4 (F) | .5u | 39 | 29 | N |
| G | C-15-SC | 5 | 0.37 | 26 | 21 | 230 (P) | .5u | 31 | 74 | N |
| F | C-14-SC | 3.6 | 0.41 | 36 | 22 | 61 (P) | 0.8 | 36 | 100 | N |
| B | C-78J-S | 2.8 | 0.34 | 27 | 14 | 2000 (P) | 0.5 | 37 | 57 | T |
| H | C-16-SC | 4.1 | 0.42 | 32 | 14 | 57 (P) | .5u | 32 | 53 | N |
| D | C-Z12-SC | 4.1 | 0.4 | 31 | 15 | 25 (P) | 0.6 | 37 | 48 | N |

* Denotes estimated value
N Denotes non-toxic response
T Denotes toxic response

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

## Genesee Park Soil Data

| GENESEE PARK | | methylene chloride | acetone | trichloro ethene | fluoranthene | pyrene | bis (2-ethyl hexyl)phthalate | chrysene | di-n-octyl phthalate | benzo (b) fluoranthene | benzo (k) fluoranthene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| H | G-III-SC | 75 | 49 | 5* | 29* | 29* | 272* | 25* | | 37T | |
| C | G-IIJ-S | 65 | 24* | | | | 220* | | | | |
| D | G-V-SC | 6* | 17* | | | | 761 | | 46* | | |
| G | G-2021KL-S | 8* | | | | | 443 | | 56* | | |
| E | G-SUB-SC | 45 | 137 | | | | 3999 | | 421* | | |
| A | G-36S-SB | 81 | 26 | | | | 127* | | | | |
| B | G-IV-SC | 54 | 27 | | | 31* | 1254 | | 66* | | |
| J | G-I-SC | 103 | 47 | | | | 387* | | | | |
| F | G-VI-SC | 76 | 43 | | 53* | 61* | | 46* | | 38T | 30* |
| I | G-II-SC | 84 | 50 | | | | 284* | | 30* | 19T | |

| GENESEE PARK | | benzo-a-pyrene | lindane | dieldrin | endosulfan I | 4-4' DDE | 4-4' DDD | endosulfan sulfate | 4-4' DDT |
|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | |
| H | G-III-SC | | | | | | .9* | | |
| C | G-IIJ-S | | | | | | | | |
| D | G-V-SC | | 1* | | | | | | |
| G | G-2021KL-S | 126* | | | 8.9* | | | | |
| E | G-SUB-SC | | | 5.3* | | | | | |
| A | G-36S-SB | | | | | | | | |
| B | G-IV-SC | | | | | | | | |
| J | G-I-SC | | | 23.9 | | 2* | 4.2* | | |
| F | G-VI-SC | | | | | | | 7.8* | 3.7* |
| I | G-II-SC | | | 25* | | | | | 5* |

* Denotes estimated value

Genesee Park Soil Data (cont.)

| GENESEE PARK | | arsenic | beryllium | chromium | copper | lead | cyanide | nickel | selenium | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| H | G-III-SC | 5.6 | 0.63 | 55 | 35 | 20 (P) | .5u | 57 | .7u | 86 | N |
| C | G-IIJ-S | 2.8 | 0.33 | 23 | 20 | 6 (F) | .5u | 29 | .7u | 33 | N |
| D | G-V-SC | 2 | 0.35 | 24 | 10 | 3 (F) | .5u | 27 | .5u | 27 | N |
| G | G-2021KL-S | 9.6 | 0.59 | 22 | 21 | 23 | 0.6 | 20 | .7u | 58 | N |
| E | G-SUB-SC | 2.5 | 0.4 | 24 | 11 | 8 (F) | .5u | 25 | .6u | 35 | N |
| A | G-38S-SB | 4.6 | 0.41 | 25 | 13 | 15 (F) | 5u | 31 | .6u | 40 | N |
| B | G-IV-SC | 4 | 0.44 | 31 | 17 | 14 (F) | .5u | 35 | 0.6 | 43 | N |
| J | G-I-SC | 9.3 | 0.55 | 33 | 26 | 39 (P) | 1 | 31 | .6u | 83 | N |
| F | G-VI-SC | 6.4 | 0.52 | 33 | 28 | 16 (P) | .5u | 29 | .6u | 78 | N |
| I | G-II-SC | 6.2 | 0.49 | 36 | 22 | 29 | .5 (P) | 35 | .6u | 57 | N |

* Denotes estimated value
N Denotes non-toxic response

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

## Houghton Soil Data

| HOUGHTON | | methylene chloride | acetone | chloroform | trichloro ethene | toluene | total xylenes | ethyl benzene | benzoic acid | phenanthrene | fluoranthene | pyrene | di-n-butyl phthalate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | | |
| L | H-8-SC | 55 | | 3* | | 2* | 3* | | | | | | 20* |
| B | H-1720-SC | 77 | 82 | 3* | 2* | 4* | 5* | | | | | | |
| J | H-9-SC | 14 | | 1* | | | 1* | | 180* | | | | |
| D | H-15-SC | 48 | 13000* | 5* | 3* | 7* | 14 | 2* | | | | | |
| M | H-7-SC | 3* | | 2* | | 2* | 12* | | | | | | |
| Q | H-3-SC | 24 | | 2* | | | 5* | | | | | | |
| K | H-8H-S | 2* | 22* | 4* | | | 1* | | | | | | |
| E | H-14-SC | 15 | 20* | 3* | | 2* | | | | | 21* | 38* | |
| G | H-12-SC | 8* | | | | | | | | | | | |
| H | H-11-SC | 4* | | 5* | | | 2* | | | | | | |
| I | H-10-SC | 19 | | 3* | | 2* | 17 | 2* | | | 24* | 21* | |
| L | H-8-SCD | 33 | | 1* | | 2* | | | | | | | |
| A | H-21A-SB | 4* | 20 | | | 2* | 4* | | | | 17* | 17* | |
| N | H-6-SC | 6* | | 3* | | 1* | | | | | | | |
| F | H-13-SC | 33 | | 5* | 2* | 6* | 28 | 4* | | 55* | 89* | 143* | |
| C | H-16-SC | 210 | 37 | 7* | 3* | 7* | 12 | | | | | | |
| P | H-4-SC | 48 | | 4* | | 2* | 5* | | | | | | |
| O | H-5-SC | 13* | | 6* | | 1* | 13* | | | | | | |

* Denotes estimated value

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

## Houghton Soil Data (cont.)

| HOUGHTON | | bis (2-ethyl hexyl)phthalate | chrysene | benzo-a-pyrene | benzo(g,h,i) perylene | dieldrin | 4-4' DDE | 4-4' DDD | 4-4' DDT |
|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | |
| L | H-8-SC | 38* | | | | | | | |
| B | H-1720-5C | 88* | | | | | | | |
| J | H-9-SC | 31* | | | | | | 2.6* | 7.3* |
| D | H-15-SC | 51* | | 110* | | | | | |
| M | H-7-SC | | | | | | | 1.9* | 6.6* |
| Q | H-3-SC | 37* | | | | | | | 8.2* |
| K | H-8H-S | | | 261* | | | | | 6.3* |
| E | H-14-SC | 65* | 17* | 113* | | | | 7.7* | |
| G | H-12-SC | 35* | | | | | | 10.9* | |
| H | H-11-SC | 32* | | | | | | 12.2* | 7.5* |
| I | H-10-SC | 38* | | | | | | .6* | 8.0* |
| L | H-8-SCD | 31* | | | | | | 2.2* | |
| A | H-21A-SB | 38* | | 41* | 21* | 4.1* | | | 15.0* |
| N | H-6-SC | 34* | | | | | | | |
| F | H-13-SC | 48* | | | | | 15.4* | | |
| C | H-16-SC | 3185 | | 160* | | | | 5.6* | 123* |
| P | H-4-SC | 37* | | | | | 3.3* | | |
| O | H-5-SC | 59* | | | | | | | |

* Denotes estimated value.

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

Houghton Soil Data (cont.)

| HOUGHTON | | methoxychlor | arsenic | beryllium | chromium | copper | lead | cyanide | nickel | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| L | H-8-SC | | 3.6 | 0.42 | 32 | 17 | 11(F) | .5u | 28 | 43 | N |
| B | H-1720-5C | 2.5* | 4.1 | 0.44 | 38 | 12 | 15(F) | 0.6 | 29 | 40 | LT |
| J | H-9-SC | 3.9* | 4.8 | 0.43 | 35 | 10 | 9(F) | 0.7 | 30 | 33 | N |
| D | H-15-SC | 3.7* | 5.6 | 0.39 | 28 | 13 | 19(P) | .5u | 26 | 39 | N |
| M | H-7-SC | | 6 | 0.41 | 27 | 8 | 14(F) | 0.6 | 26 | 31 | N |
| Q | H-3-SC | .5* | 3 | 0.34 | 22 | 13 | 13(F) | .5u | 28 | 33 | N |
| K | H-8H-S | | 5.9 | 0.39 | 34 | 11 | 11(F) | 0.6 | 27 | 31 | N |
| E | H-14-SC | | 5.7 | 0.36 | 30 | 24 | 54(P) | .5u | 23 | 69 | LT |
| G | H-12-SC | | 4.3 | 0.38 | 29 | 10 | 9(F) | .5u | 23 | 38 | N |
| H | H-11-SC | | 5.4 | 0.54 | 28 | 10 | 7(F) | 0.7 | 27 | 35 | N |
| I | H-10-SC | 1.3* | 4.5 | 0.42 | 25 | 10 | 8(F) | .5u | 27 | 38 | N |
| L | H-8-SCD | | 4 | 0.42 | 28 | 17 | 9.(F) | .5u | 26 | 37 | N |
| A | H-21A-SB | | 3.6 | 0.4 | 24 | 11 | 15.(F) | .5u | 29 | 53 | LT |
| N | H-6-SC | | 3.8 | 0.4 | 29 | 9 | 10(F) | .5u | 31 | 34 | N |
| F | H-13-SC | | 4.9 | 0.38 | 33 | 10 | 14(F) | .5u | 27 | 48 | N |
| C | H-16-SC | 6.8* | 7.4 | 0.55 | 41 | 74 | 71(P) | 0.6 | 44 | 150 | N |
| P | H-4-SC | | 3.4 | 0.36 | 30 | 7 | 12(F) | .5u | 22 | 27 | N |
| O | H-5-SC | | 4.4 | 0.37 | 25 | 11 | 12(F) | .5u | 25 | 40 | LT |

* Denotes estimated value
N Denotes non-toxic response
LT Denotes low-toxic response

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# Puyallup/Kit Corner Soil Data

| PUYALLUP | | methylene chloride | acetone | 1,1,1 tri chloroethane | trichloro ethene | toluene | total xylenes | benzoic acid | acenaph thene | fluorene | phenanthrene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| J | P-16-SC | 23 | 17* | 1* | 3* | 1* | 1* | | | | |
| M | P-19-SC | 3* | 22* | | | | 4* | | | | 34* |
| A | P-66-SB | 91 | 15* | | 2* | 1* | | | 62* | 40* | 470 |
| I | P-15-SC | 1* | | | | | 1* | | | | |
| H | P-14-SC | 2* | | | 1* | 1* | | | | | |
| G | P-13-SC | 4* | 12* | | 2* | 1* | | | | | |
| E | P-11-SC | 7* | | | 1* | 1* | | | | | |
| B | P-9-SC | 29 | | | | - | | 168* | | | 70* |
| C | P-9JK-S | 43 | 27* | | | | | | | | |
| L | P-18-SC | 7* | 52 | | | 1* | | | | | |
| F | P-12-SC | 2* | | | 1* | 1* | 1* | | | | 21* |
| D | P-10-SC | 10 | 8* | | | | | | | | |
| K | P-17-SC | 46 | 51 | 9* | 19 | 2* | 1* | | | | |

| PUYALLUP | | anthracene | fluoranthene | pyrene | benzo(a) anthracene | bis (2-ethyl hexyl)phthalate | chrysene | di-n-octyl phthalate | benzo (b) fluoranthene | benzo-a-pyrene |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | |
| J | P-16-SC | 10* | 75* | 75* | | 31* | 78* | | 126T | 99* |
| M | P-19-SC | | | | | | | | 24T | |
| A | P-66-SB | 136* | 507* | 411* | 217* | 33* | 235* | | 294T | 209* |
| I | P-15-SC | | | | | | 17* | | 21T | |
| H | P-14-SC | | | | | 21* | 21* | | 24T | |
| G | P-13-SC | | | | | 28* | | | 35T | |
| E | P-11-SC | | 28* | 21* | | 17* | | | 52T | |
| B | P-9-SC | 17* | 140* | 147* | 112* | 24* | 129* | 21* | 231T | 195* |
| C | P-9JK-8 | | 51* | 43* | | 83* | | | 163T | 112* |
| L | P-18-SC | | | | | | 14* | | 20T | |
| F | P-12-SC | | 63* | 59* | | 38* | 83* | | 122T | |
| D | P-10-SC | | | | | | 31* | | 65T | 31* |
| K | P-17-SC | | | | | 24* | | | 28T | |

* Denotes estimated value

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# Puyallup/Kit Corner Soil Data (cont.)

| PUYALLUP | | arsenic | beryllium | cadmium | chromium | copper | lead | cyanide | nickel | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| J | P-16-SC | 3.9 | 0.36 | .6u | 18 | 12 | 13 (F) | .5u | 20 | 33 | N |
| M | P-19-SC | 4 | 0.39 | .7u | 22 | 14 | 13 (F) | .5u | 22 | 37 | N |
| A | P-66-SB | 7.3 | 0.47 | .6u | 20 | 14 | 9 | 0.7 | 20 | 47 | N |
| I | P-15-SC | 4.6 | 0.4 | .6u | 21 | 15 | 16 (F) | .5u | 23 | 38 | N |
| H | P-14-SC | 5.1 | 0.4 | .6u | 17 | 14 | 17 (F) | .5u | 22 | 36 | N |
| G | P-13-SC | 7.1 | 0.54 | .6u | 21 | 46 | 26 (P) | .5u | 24 | 81 | N |
| E | P-11-SC | 3.4 | 0.47 | .6u | 30 | 14 | 18 (F) | .5u | 26 | 51 | N |
| B | P-9-SC | 4.4 | 0.4 | 1.2 | 22 | 19 | 37 (P) | .5u | 22 | 160 | N |
| C | P-9JK-S | 22 | 0.3 | 1.5 | 22 | 29 | 63 (P) | 1.3 | 24 | 300 | N |
| L | P-18-SC | 3.7 | 0.4 | .6u | 22 | 14 | 12 (F) | 0.5 | 23 | 35 | N |
| F | P-12-SC | 5.2 | 0.32 | .6u | 15 | 12 | 14 (P) | .5u | 19 | 30 | N |
| D | P-10-SC | 3.9 | 0.36 | .6u | 18 | 15 | 11 (P) | .5u | 22 | 51 | N |
| K | P-17-SC | 4.5 | 0.37 | .6u | 21 | 12 | 13 (F) | .5u | 21 | 29 | N |

| PUYALLUP | | indeno (1,2,3) pyrene | dibenz (A,h) anthracene | benzo(g,h,i) perylene | beta BHC | aldrin | 4-4' DDD | 4-4' DDT |
|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | |
| J | P-16-SC | 48* | | 41* | | | | 6.7* |
| M | P-19-SC | | | | | | | |
| A | P-66-SB | 62* | 26* | | 171 | | | |
| I | P-15-SC | | | | | | | |
| H | P-14-SC | | | | | | | |
| G | P-13-SC | | | | | 2.9* | | |
| E | P-11-SC | | | | | | | |
| B | P-9-SC | 77* | | 70* | | | 25 | |
| C | P-9JK-S | | | | | | | |
| L | P-18-SC | | | | | 1.4* | | |
| F | P-12-SC | 35* | | 35* | | | | |
| D | P-10-SC | | | | | | | |
| K | P-17-SC | | | | | | | |

* Denotes estimated value
N Denotes non-toxic response

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# South Park Soil Data

| SOUTH PARK | | methylene chloride | acetone | chloroform | trichloro ethene | benzene | toluene | total xylenes | ethyl benzene | benzoic acid | phenanthrene | pentachloro phenol | anthracene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | | |
| B | S-13J-S | 4* | | | | | 4* | | | | | | |
| A | S-21P-SB | 22 | | 2* | | | 1* | | | 233* | 22* | | |
| G | S-6J-S | 7* | | | | | 1* | 3* | | | 203* | 434* | 46* |
| E | S-9H-S | 16 | 22 | | 2* | | 8* | | | | 112* | | 27* |
| C | S-12NO-S | 43 | 63 | 1* | | 1* | 22* | 15 | 3* | | 451 | | 98* |
| F | S-9LM-S | 8* | | | 3* | | | | | | | | |
| D | S-11J-S | 6* | | | | | | | | | 258* | | 70* |
| D | S-11J-SD | 9* | | | | | | | | | 352* | | 70* |

| SOUTH PARK | | fluoranthene | pyrene | benzo(a) anthracene | butylbenzyl phthalate | di-n-butyl phthalate | bis (2-ethyl hexyl)phthalate | chrysene | di-n-octyl phthalate | benzo (b) fluoranthene | benzo-a-pyrene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | |
| B | S-13J-S | 66* | 66* | | 42* | 31* | 187* | 59* | | | 59* |
| A | S-21P-SB | 40* | 44* | | | | 73* | 33* | | 51T | 29* |
| G | S-6J-S | 238* | 245* | | 56* | 35* | 298* | 137* | | 203T | |
| E | S-9H-S | 177* | 184* | 88* | | 163* | 167* | 109* | 340* | 218T | 133* |
| C | S-12NO-S | 747 | 786 | 303* | 248* | 496 | 385 | 462 | | 834T | 696 |
| F | S-9LM-S | | | | | | 78* | | | | |
| D | S-11J-S | 381* | 455 | 225* | | 49* | 107* | 279* | | 545T | 353* |
| D | S-11J-SD | 376* | 513 | 211* | | 170* | 2514 | 252* | 58* | 505T | 323* |

* Denotes estimated value

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# South Park Soil Data (cont.)

| SOUTH PARK | | indeno (1,2,3) pyrene | benzo(g,h,i) perylene | dieldrin | 4-4' DDE | 4-4' DDD | 4-4' DDT | arochlor-1242 | arochlor-1254 | arochlor-1260 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | |
| B | S-13J-S | | | | | | | | | |
| A | S-21P-SB | | | 129.4 | 3.6* | 7.8* | 17.4* | | | |
| G | S-6J-S | 63* | 63* | | 8.5* | 10.2* | 7.4* | | | |
| E | S-9H-S | | 82* | | | | | | | |
| C | S-12NO-S | 263* | 285* | | | | | 589.6 | | 1238.8* |
| F | S-9LM-S | | | | | | | | | |
| D | S-11J-S | 135* | 172* | | | | | | | 332.2* |
| D | S-11J-SD | 123* | 157* | | | | | | 603.3 | |

| SOUTH PARK | | antimony | arsenic | beryllium | cadmium | chromium | copper | lead | cyanide | mercury | nickel | silver | zinc | "microtox" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Sample Code | | | | | | | | | | | | | |
| B | S-13J-S | 2.6u | 14 | 0.49 | .6u | 38 | 24 | 48 P | .5u | .5u | 38 | .6u | 100 | N |
| A | S-21P-SB | 2.6u | 10 | 0.51 | .6u | 25 | 24 | 95 (P) | .5u | .2u | 26 | .6u | 120 | N |
| G | S-6J-S | 2.7u | 12 | 0.67 | 1.8 | 35 | 110 | 310 (P) | 1.1 | 0.4 | 61 | .6u | 370 | T |
| E | S-9H-S | 7.1 | 14 | 0.56 | 3.4 | 62 | 240 | 500 P | .5u | 0.5u | 74 | .6u | 830 | N |
| C | S-12NO-S | 2.6u | 22 | 0.58 | 7.1 | 98 | 460 | 1200 P | 1.3 | 1 | 75 | .6u | 1800 | N |
| F | S-9LM-S | 3.0u | 4.9 | 0.39 | .7u | 30 | 24 | 47 P | .5u | .5u | 36 | .7u | 100 | N |
| D | S-11J-S | 79 | 37 | 0.77 | 15 | 260 | 1300 | 1800 P | .5u | 1.7 | 180 | 5.3 | 3800 | N |
| D | S-11J-SD | 56 | 42 | 0.73 | 19 | 210 | 2000 | 2500 P | .5u | 2.3 | 190 | 8.4 | 5200 | N |

* Denotes estimated value
N Denotes non-toxic response
T Denotes toxic response

Organic Concentrations in ug/kg
Inorganic Concentrations in mg/kg

# SURFACE WATER DATA

SURFACE WATER - ug/l

| SITE | GENESEE | SOUTH PARK | | | |
|---|---|---|---|---|---|
| SAMPLE | 0-15K-WS | S-160-WS | S-15F-WS | S-9C-WS | S-15D-WD1 |
| SAMPLE LOCATION | 1 | 1 | 2 | 4 | 3 |
| COMPOUND | | | | | |
| | | | | | |
| ORGANICS | | | | | |
| | | | | | |
| methylene chloride | 18 | 1* | 4* | | 1* |
| acetone | | 19 | 3* | 3* | 4* |
| chloroform | 14 | | | | |
| toluene | | 1* | 1* | | |
| xylenes | | | | | |
| styrene | | | 1* | | |
| methyl pentanone | | 1* | | | |
| fluoranthene | | 2* | | | |
| di-n-butylthalate | | | | | |
| bis-2-ethylhexylphthalate | 2* | 54 | 14 | | 10* |
| di-n-octylphthalate | 1* | 4* | | | |
| alpha-BHC | | | | | |
| beta-BHC | | | | | |
| endrin ketone | | | | | |
| lindane | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| antimony | 5u | 5u | 5u | 5u | 5u |
| arsenic | 4u | 20 | 15 | 4u | 13 |
| beryllium | 1u | 1u | 1u | 1u | 1u |
| cadmium | 1u | 5 | 3 | 1u | 1u |
| chromium | 1u | 61 | 18 | 3 | 8 |
| copper | 3 | 240 | 97 | 4 | 8 |
| lead | 34 (F) | 610 (P) | 280 (P) | 12 (P) | 22 (P) |
| cyanide | 5u | 5u | 5u | 5u | 5u |
| mercury | 0.2 | 0.4 | 0.4 | 0.4 | 0.4 |
| nickel | 2u | 69 | 29 | 2u | 2 |
| selenium | 3u | 3u | 3u | 3u | 3u |
| silver | 1u | 1u | 1u | 1u | 1u |
| thallium | 3u | 3u | 3u | 3u | 3u |
| zinc | 95 | 900 | 690 | 20 | 51 |
| | | | | | |
| "microtox" | N | T | T | N | N |

* Denotes estimated values

SURFACE WATER - ug/l

| SITE | CORLISS | | HOUGHTON | PUYALLUP | | | Blank |
|---|---|---|---|---|---|---|---|
| SAMPLE | C-16709-WS | C-17H-WS | H-13D-WP | P-16M-WS | P-N14-WS | P-19E-WP | |
| SAMPLE LOCATION | 1 | 2 | 1 | 2 | 1 | 3 | |
| COMPOUND | | | | | | | |
| | | | | | | | |
| ORGANICS | | | | | | | |
| | | | | | | | |
| methylene chloride | 3* | 2* | 527* | 2* | 3* | 30 | 5* |
| acetone | | | | | | 9* | 12 |
| chloroform | | | | | | | |
| toluene | | | | | | | |
| xylenes | | | | | | | |
| styrene | | | | | | | |
| methyl pentanone | | | | | | | |
| fluoranthene | | | | | | | |
| di-n-butylphthalate | 2* | | | | | | |
| bis-2-ethylhexlphthalate | 21 | 81 | 12 | 16 | 9* | 5* | 10* |
| di-n-octylphthalate | 1* | 1* | 1* | 1* | 1* | 1* | 1* |
| alpha-BHC | | | | | | | |
| beta-BHC | | | | | | | |
| endrin ketone | | | | | | | |
| lindane | .01* | | | | | | |
| | | | | | | | |
| INORGANICS | | | | | | | |
| (mg/l) | | | | | | | |
| | | | | | | | |
| antimony | 5u | 5u | 5u | 5u | 5u | 5u | 5u |
| arsenic | 4u | 4u | 5 | 4u | 4u | 4u | 4u |
| beryllium | 1u | 1u | 1u | 1u | 1u | 1u | 1u |
| cadmium | 1u | 1u | 1u | 1u | 1u | 1u | 1u |
| chromium | 3 | 1u | 3 | 3 | 1u | 2 | 1u |
| copper | 3 | 2 | 10 | 5 | 4 | 10 | 3 |
| lead | 21 (P) | 3u (F) | 21 (F) | 4 (F) | 3u (F) | 28 (P) | 3u (F) |
| cyanide | 5u | 5u | 5u | 5u | 5u | 5u | 5u |
| mercury | 1.1 | 0.4 | 0.4 | 0.2 | 0.3 | 0.6 | 0.6 |
| nickel | 2u | 2u | 10 | 3u2 | 2u | 3 | 2u |
| selenium | 3u | 3u | 3u | 3u | 3u | 3u | 3u |
| silver | 1u | 1u | 1u | 1u | 1u | 1u | 1u |
| thallium | 3u | 3u | 3u | 3u | 3u | 3u | 3u |
| zinc | 61 | 16 | 43 | 15 | 26 | 24 | 46 |
| | | | | | | | |
| "microtox" | N | N | N | N | N | N | |

* Denotes estimated values

# AIR DATA

Bow Lake Landfill Gas Data

| Sample Code: | B-1718-VB | B-18H-V | B-12H-V | B-17J-V |
|---|---|---|---|---|
| Sample: | A | B | E | C |
| Volatiles: ug/m$^3$ | | | | |
| Methylene Chloride | 150 | | | 670 |
| Acetone | 170 | | | 2300 |
| Benzene | 40 | 30 | 40 | 500 |
| Toluene | 50 | 120 | 110 | 140 |
| Ethylbenzene | 240 | 100 | 70 | 100 |
| Styrene | 580 | 130 | 130 | 160 |
| Total Xylenes | 150 | 120 | 110 | 170 |
| 1,1,1-Trichloroethane | | 40 | 60 | |
| Tetrachloroethene | | 20 | 20 | 20 |
| Vinyl Chloride | | | | 50 |
| Carbon Disulfide | | | | 160 |
| trans-Dichloroeth | | | | 30 |
| MIBK | | | | TR |
| MEK | | | | 150 |

Landfill Gas

CORLISS

| Sample Code: | C-16J-V | Ambient | C-11L-V | C-78JK-V |
|---|---|---|---|---|
| Sample Location: | C | A | B | A |
| Volatiles: ug\m$^3$ | | | | |
| Acetone | | | 790 | 160 |
| Benzene | 50 | 20 | 170 | 50 |
| Toluene | 60 | 60 | 99 | 60 |
| Ethylbenzene | 120 | 60 | 190 | |
| Chlorobenzene | | | 65 | |
| Styrene | 190 | 110 | 350 | 180 |
| Total Xylenes | 100 | 80 | 810 | |
| 1,1,1-Trichloroethane | 30 | | 41 | 30 |
| Tetrachloroethene | 10 | | | 10 |
| Vinyl Chloride | | | 310 | |
| Carbon Disulfide | | | 100 | 90 |
| trans-Dichloroeth | | | 14 | |
| MIBK | | | 90 | |

Landfill Gas

HOUGHTON

| Sample Code: | H-8F-V | Ambient | H-3HI-V | H-10LM-V | H-20EJ-V |
|---|---|---|---|---|---|
| Sample Location: | C | A | B | A | D |
| Volatiles: ug\m$^3$ | | | | | |
| Methylene Chloride | | 20000 | | | 510 |
| Acetone | 410 | 150 | 150 | | |
| Benzene | 22 | 190 | 840 | 17 | 100 |
| Toluene | 94 | 320 | 9200 | 210 | 170 |
| Ethylbenzene | 45 | 38 | 4200 | 160 | 140 |
| Styrene | 100 | | | 160 | 170 |
| Total Xylenes | 93 | | 15000 | 410 | 420 |
| 1,1,1-Trichloroethane | | | 20 | 24 | |
| Trichloroethene | 12 | 110 | 50 | | |
| Tetrachloroethene | 17 | 200 | 160 | 15 | 12 |
| Vinyl Chloride | | 8700 | 3600 | | 400 |
| Carbon Disulfide | 90 | | | | |
| trans-Dichloroeth | | 9100 | 3600 | 25 | 46 |
| Dichloroethane | TR | 10 | | | |
| Dichloropropane | | 77 | | | |

Landfill Gas

PUYALLUP

| Sample Code: | P-11I-V | P-16F-V | Ambient |
|---|---|---|---|
| Sample Location: | D | A | A |
| Volatiles: ug\m$^3$ | | | |
| Methylene Chloride | 140 | | 620 |
| Acetone | | 4000 | |
| Benzene | 90 | | 70 |
| Toluene | 50 | 120 | 190 |
| Ethylbenzene | 100 | | 90 |
| Chlorobenzene | | 70 | |
| Styrene | 130 | 180 | 170 |
| Total Xylenes | 140 | 150 | 150 |
| 1,1,1-Trichloroethane | | | 60 |
| Tetrachloroethene | | | 30 |
| Vinyl Chloride | 240 | | |
| Carbon Disulfide | | | |
| trans-Dichloroeth | | 30 | |
| MEK | | | |
| MIBK | 110 | | |
| Dichloroethane | 50 | | |
| Trichloroethane | 10 | | |
| MBK | | | |

Landfill Gas

GENESEE

| Sample Code: | 6-3E-V | Ambient | 6-20E-V | 6-11M-V | 6-5HI-V |
|---|---|---|---|---|---|
| Sample Location: | A | A | B | D | E |
| Volatiles: ug\m$^3$ | | | | | |
| Acetone | | | 970 | 1000 | |
| Benzene | | | 120 | 75 | |
| Toluene | 60 | 17 | 210 | 60 | |
| Ethylbenzene | 40 | | 130 | | |
| Chlorobenzene | | | 270 | | |
| Styrene | 130 | 90 | 280 | 240 | 250 |
| Total Xylenes | | | 870 | | |
| 1,1,1-Trichloroethane | | | 39 | | |
| Trichloroethene | | | 12 | TR | |
| Tetrachloroethene | 30 | | 15 | | |
| Vinyl Chloride | | | 170 | 990 | |
| Carbon Disulfide | | | 210 | | |
| trans-Dichlroeth | | | 23 | 10 | |
| Dichloroethane | | | | 50 | |

Landfill Gas

SOUTH PARK

| Sample Code: | S-6J-V | Ambient | S-9H-V |
|---|---|---|---|
| Sample Location: | C | A | B |
| Volatiles: ug\m$^3$ | | | |
| Methylene Chloride | | | 600 |
| Benzene | | 10 | 50 |
| Toluene | 80 | | 80 |
| Ethylbenzene | | | 220 |
| Styrene | 100 | 80 | 260 |
| Total Xylenes | | | 80 |
| 1,1,1-Trichloroethane | | 30 | 80 |
| Trichloroethene | 200 | | |
| Tetrachloroethene | 750 | | |
| Carbon Disulfide | 100 | 70 | |
| MBK | 130 | | |
| Chloroform | 60 | | 80 |
| Carbon tetrachloride | 20 | | |

Landfill Gas

| ug/m3 | Reagent Blank | Reagent Blank | Reagent Blank | Reagent Blank | Reagent Blank | Reagent Blank |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| Methylene Chloride | 75 | 330 | 160 | | 1100 | 70 |
| Acetone | 35 | | 112 | 1600 | 92 | TR |
| Benzene | | | 17 | | | |
| Toluene | 10 | 22 | 27 | 50 | 20 | 30 |
| Ethylbenzene | 5 | | 29 | 130 | 14 | |
| Total Xylenes | | | 36 | | 27 | |
| 1,1,1-Trichloroethane | | | 60 | | | 10 |
| Tetrachloroethene | | | 18 | | | |
| Carbon Disulfide | 10 | | 50 | | 39 | 50 |
| MEK | TR | | 230 | 180 | | |
| Dichloropropene | | | | 20 | | |

# V. COMBUSTIBLE GAS MIGRATION STUDY

## 1.0 INTRODUCTION

Methane, the major component of landfill combustible gas, is an odorless, colorless gas that is naturally generated during the anaerobic decomposition of organic landfill waste. Though non-toxic to humans, it can be explosive if concentrated to levels of from approximately 4% to 18% per volume of air.

Landfill combustible gas will ordinarily rise and vent at the landfill surface unless impeded by an impermeable layer such as an extremely dense landfill cover. When this occurs, the landfill gas will follow the path of least resistance which can lead to migration away from the landfill and off-site venting.

Combustible gas venting off-site can present a hazard to human populations if it enters and becomes concentrated to potentially explosive levels in enclosed areas such as home basements or crawl spaces.

During the summer and fall of 1984, the Health Department conducted a preliminary investigation of combustible landfill gas generation at 35 abandoned landfills in Seattle/King County, which included the six abandoned landfills of this study. Each of the six study sites was observed producing combustible gas at levels that exceeded the explosive concentration for methane gas as measured from on-site test probes.

## 2.0 OBJECTIVES

The current investigation objective was to provide preliminary, though limited indications of off-site combustible gas migration at each of the study abandoned landfills. This information has been used to develop recommendations to protect the health and safety of the public.

## 3.0 SAMPLING METHODS

Landfill combustible gas was measured at the observed or estimated perimeter of each site from shallow test probes. The probes were formed by driving a pointed solid steel bar with a one inch diameter to a depth of 36 inches (unless impeded by an impenetrable object) followed by extraction using a high lift seven ton jack. Test probes were capped for a minimum of one hour prior to sampling. Combustible gas levels were recorded in the field using a Bacharach Model 503 Sniffer and a Bacharach Model L Combustible Gas Detector. Combustible gas was recorded as percent combustible gas per volume of air.

Barometer readings have been taken from records compiled by the National Weather Service at the Seattle-Tacoma International Airport.

A detailed combustible gas sampling and quality assurance program is documented in Appendix C.

## 4.0 SAMPLING REPORTS

### 4.1 Bow Lake Abandoned Landfill

On October 5, 1986 ten test probes were placed and measured for combustible gas levels along the fenced perimeter of the Bow Lake Transfer Station grounds. The barometric pressure during the test period was recorded at 30.30 inches.

The test probe locations are found in Table V. Combustible gas data are presented in Figure 12.

#### 4.1.1 North Perimeter

The northwest perimeter beyond the transfer station fence is bordered by terrain that slopes steeply upward to Interstate 5. The terrain beyond the northeast perimeter fence maintains a level elevation before sloping steeply downward to the east. The terrain is overgrown with brambles. The area is undeveloped and inaccessible.

Significant combustible gas levels of 19% and 25% were observed from Probes 6 and 7 respectively. Based upon historical photographs, it is presumed that these probes are located directly over the former landfill.

#### 4.1.2 East Perimeter

Beyond the east perimeter fence, the terrain slopes downward before dropping steeply to South Center Parkway approximately 200 feet below. Historical aerial photographs indicate that landfill wastes extended onto and down this slope. The slope is currently overgrown with brambles and trees. It is undeveloped and inaccessible.

One significant combustible gas observation was made of 27.5% from Probe 4, which was presumably located over the former landfill material.

#### 4.1.3 South Perimeter

The south landfill perimeter fence is bordered by an undeveloped, inaccessible wooded area.

Combustible gases were not observed from the south perimeter test probes.

#### 4.14 West Perimeter

The west perimeter fence is bordered by Interstate 5.

Combustible gases were not observed along the south perimeter test probes.

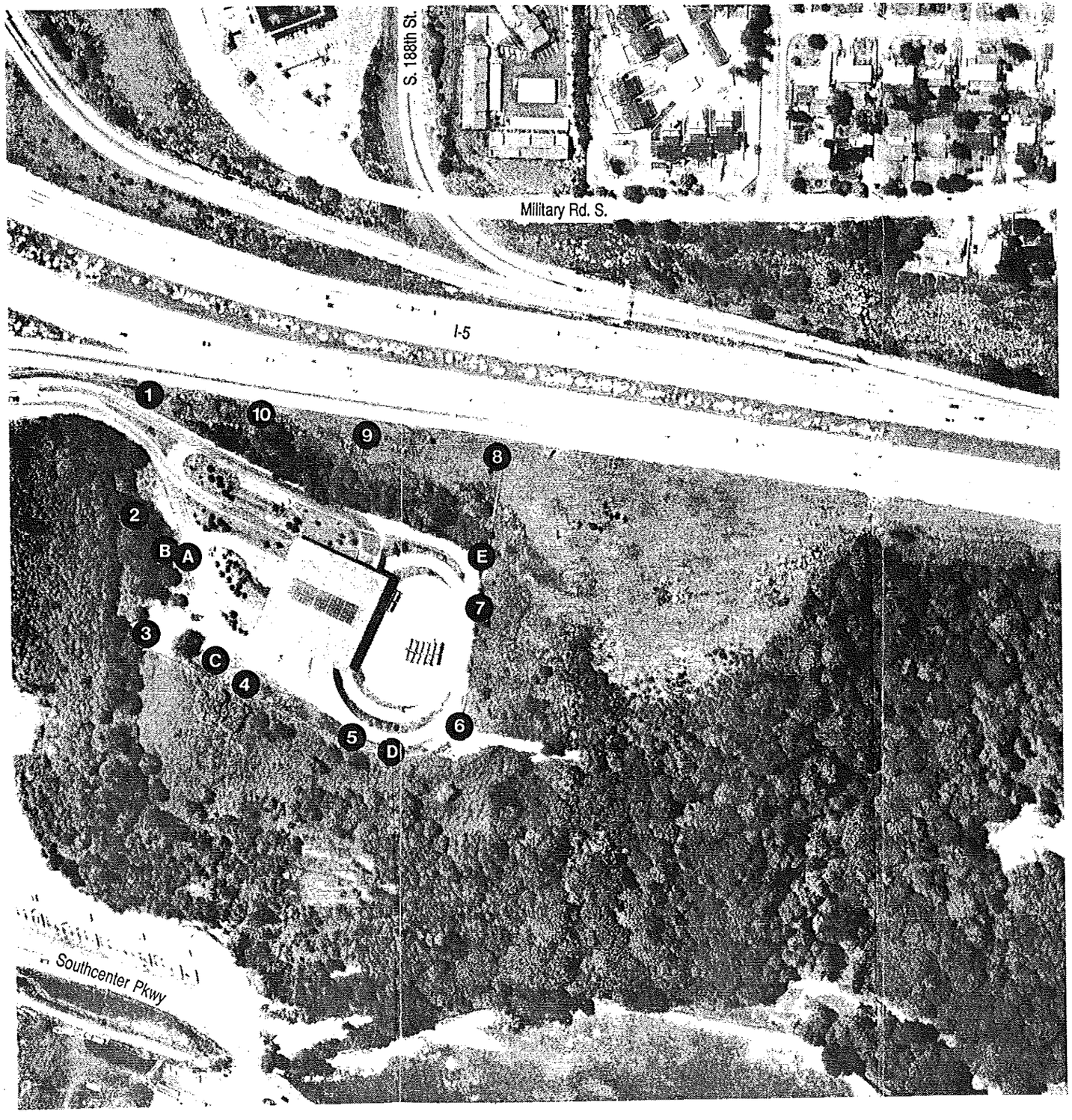
TABLE V

Bow Lake Abandoned Landfill(1)
Perimeter Combustible Gas Levels

| Site(3) | Probe Depth | Combustible(2) Gas Level (%) |
|---|---|---|
| 1 | 30" | 0.0 |
| 2 | 36" | 0.0 |
| 3 | 36" | 0.0 |
| 4 | 36" | 27.5 |
| 5 | 32" | .25 |
| 6 | 36" | 19.0 |
| 7 | 36" | 25.0 |
| 8 | 36" | 0.0 |
| 9 | 28" | 0.0 |
| 10 | 36" | 0.0 |

(1) Sampled October 5, 1986
(2) Data reported as methane equivalent values
(3) Refer to Figure 12.

FIGURE 12




## Bow Lake Abandoned Landfill

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 1-10

Volatile organic gas: Sites A-E

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇨

## 4.2 Corliss Abandoned Landfill

On October 8, 1986 fourteen test probes were placed and measured for combustible gas levels along the existing and/or estimated perimeter of the Corliss Abandoned Landfill. The barometric pressure during the testing period was recorded at a steady 30.16 inches.

The test probe locations are found in Figure 13. Combustible gas data are presented in Table VI.

### 4.2.1 North Perimeter

The north perimeter of the Corliss landfill is bordered by North 167th Street. Across the street is a baseball park and a residential neighborhood.

Combustible gas was not observed at significant levels within test probes along this perimeter.

### 4.2.2 East Perimeter

During the construction of Interstate 5, the easterly portion of the Corliss landfill was excavated. The existing perimeter is now bordered by Interstate 5. A residential neighborhood lies immediately to the west of the freeway.

One significant combustible gas level of 8% was recorded along the perimeter from probe 5. This probe most probably lies directly over the former landfill.

### 4.2.3 South Perimeter

The estimated southerly perimeter is bordered by a small housing development. Test probes 1 through 3 were placed within approximately 40 feet from the existing homes.

No combustible gases were observed along this perimeter.

### 4.2.4 West Perimeter

The southwesterly perimeter is bordered by Corliss Avenue North. Immediately across the street, the terrain drops sharply for approximately 20 feet to Thornton Creek and a peat bog company.

Significant combustible gas levels were not observed from the probe located on the southwest perimeter.

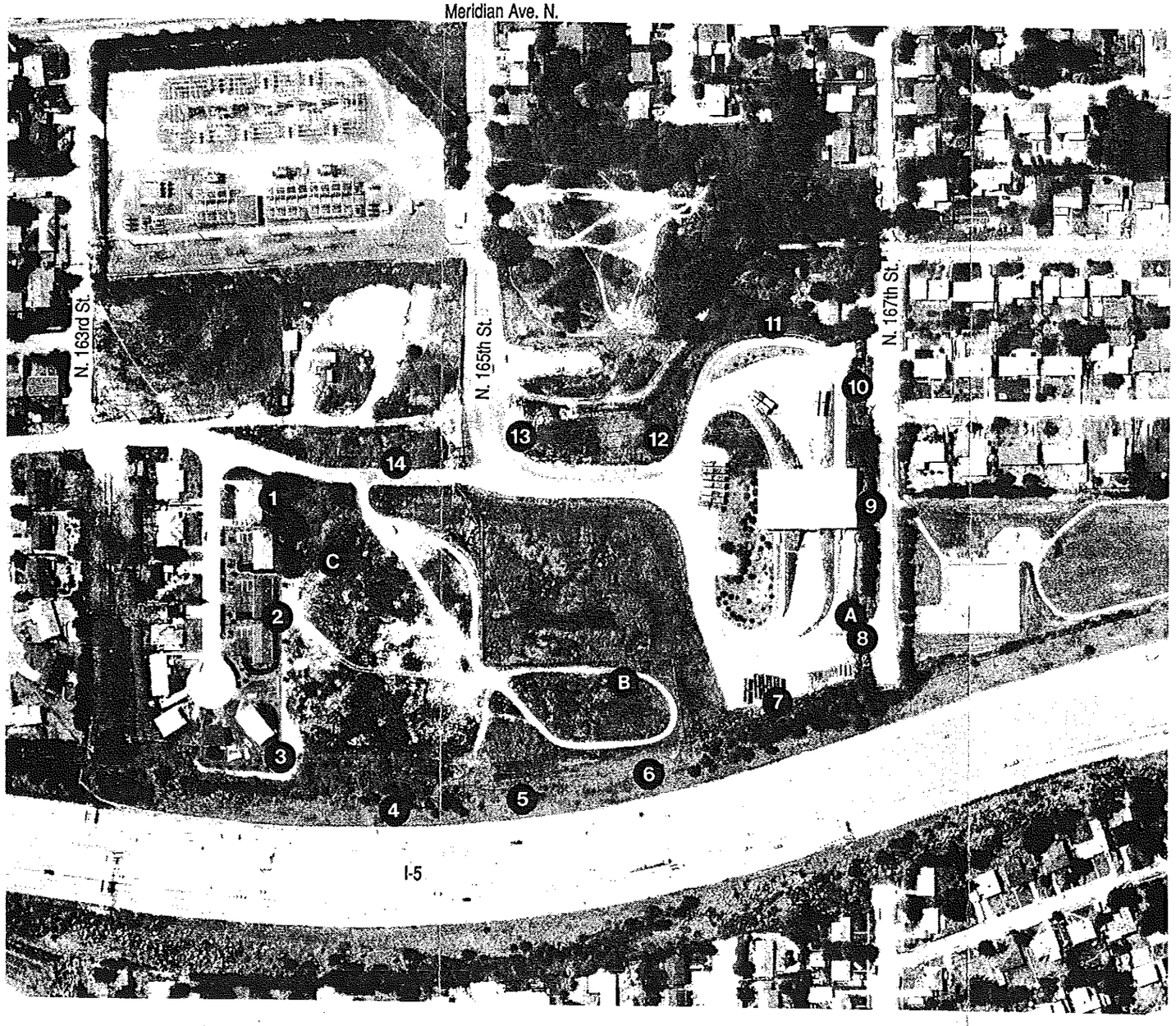
The northwesterly perimeter lies just east of Thornton Creek. One significant combustible gas level of 26% was observed along this perimeter from Probe 13.

TABLE VI

Corliss Abandoned Landfill[1]
Perimeter Combustible Gas Levels

| Site[3] | Probe Depth | Combustible[2] Gas Level (%) |
|---|---|---|
| 1 | 36" | 0.0 |
| 2 | 36" | 0.0 |
| 3 | 36" | 0.0 |
| 4 | 36" | 0.016 |
| 5 | 36" | 8.0 |
| 6 | 36" | .02 |
| 7 | 24" | 0.0 |
| 8 | 36" | 0.004 |
| 9 | 28" | 0.0 |
| 10 | 36" | 0.014 |
| 11 | -- | No Reading |
| 12 | 36" | 0.625 |
| 13 | 36" | 26.0 |
| 14 | 36" | 0.002 |

(1) Sampled October 8, 1986.
(2) Data reported as methane equivalent values.
(3) Refer to Figure 13.




## Corliss Abandoned Landfill

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 1-14

Volatile organic gas: Sites A-C

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇨

## 4.3 Houghton Abandoned Landfill

On October 9, 1986 twenty-four test probes were placed and measured for combustible gas levels along the observed and estimated perimeter of the Houghton Abandoned landfill. The barometric pressure level during the test period was recorded at a steady 30.20 inches.

The test probe locations are found in Figure 14. Combustible gas data are presented in Table VII.

### 4.3.1 North Perimeter

The north perimeter is bordered by a residential neighborhood. Probe 15, located at an approximate distance of 40 feet to the nearest residence, had measured a combustible gas reading of 24%.

### 4.3.2 East Perimeter

The northeasterly perimeter is bordered by a steep wooded hill sloping upward to an elevation of approximately 40 feet above that of the landfill. At the top of the slope is a residential neighborhood.

A significant combustible gas level of 12% was measured from probe 11, which is located approximately 250 feet downhill from the nearest residence.

The southeasterly perimeter is bordered by 120th Avenue Northeast. A residential neighborhood is situated on the east side of this roadway.

No significant combustible gas levels were observed from the test probes along this area.

### 4.3.3 South Perimeter

The south landfill perimeter is bordered by Northeast 60th Street. Immediately to the south of this is the Bridal Trails State Park, which remains undeveloped.

Combustible gas levels of 28% and 15% were observed from probes 2 and 3 respectively along this perimeter.

### 4.3.4 West Perimeter

The southwesterly perimeter is bordered by a wooded terrain. Several homes are located beyond the perimeter.

No combustible gas levels were observed from the test probes along this perimeter.

The northwesterly perimeter is partially bordered by a residential neighborhood and partially by an area of dense wooded growth.

Significant combustible gas levels were observed from probes 17 and 20 at concentrations of 21% and 12% respectively. Both probes were situated at distances of over 200 feet to the nearest residence.

### 4.3.5 Follow-up Investigation

Due to the proximity of homes to probes exhibiting significant combustible gas levels, and the potential for landfill gas migrating into these homes, the King County Solid Waste Division initiated a survey of combustible gas levels within residences along the north and northeasterly perimeters. On October 19 and 20, 1986, twenty homes and the Houghton Transfer Station were monitored for the presence of combustible gas using a Bacharach Model 503 Sniffer.

No combustible gas was detected within any of the tested homes or the transfer station. Combustible gas was detected at a level which exceeded the lower explosive level for methane at the top of the casing of an abandoned irrigation well. Upon venting the levels significantly dropped.

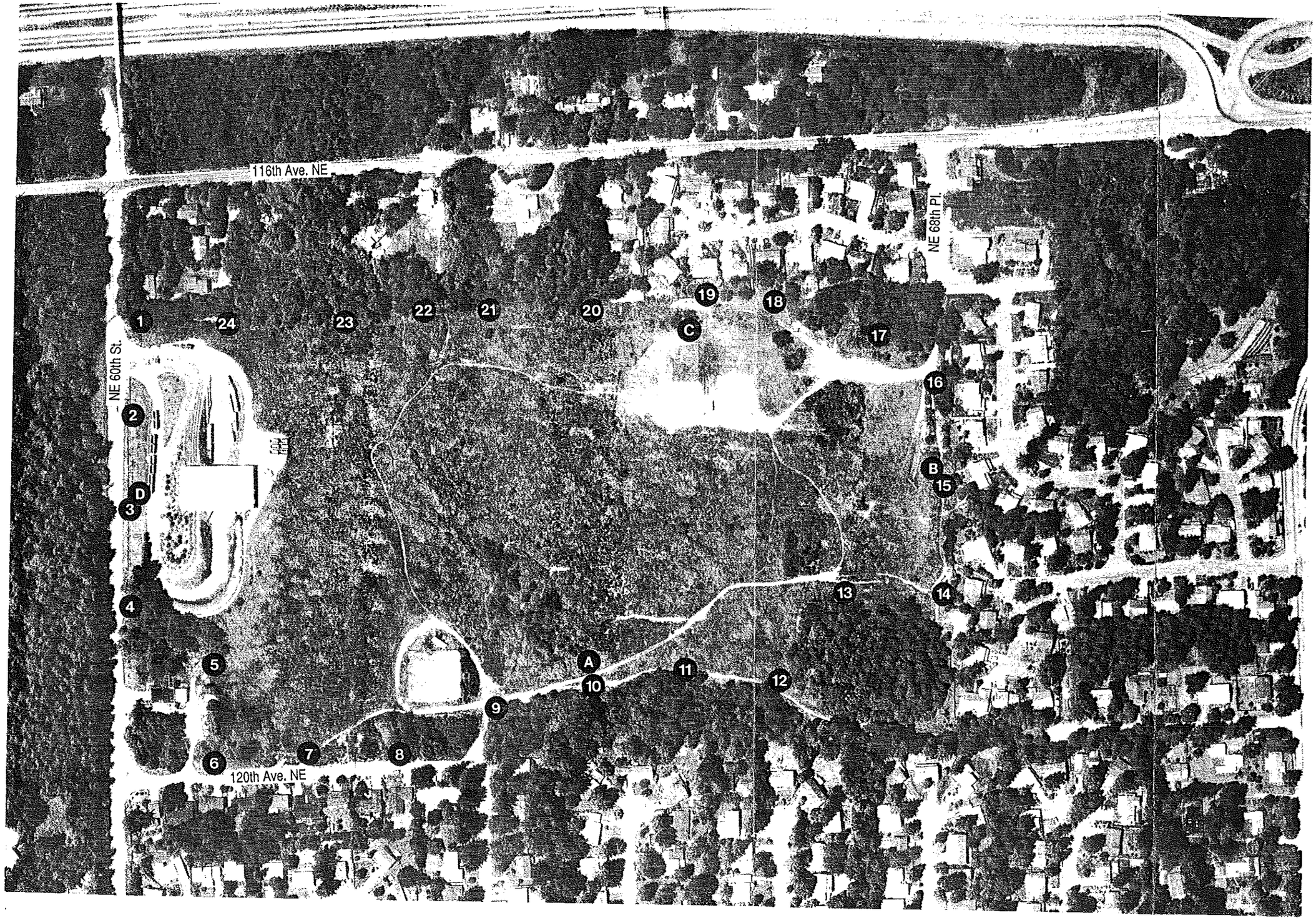
TABLE VII

Houghton Abandoned Landfill(1)
Perimeter Combustible Gas Levels

| Site(3) | Probe Depth | Combustible(2) Gas Level (%) |
|---|---|---|
| 1 | 36" | 0.0 |
| 2 | 36" | 28.0 |
| 3 | 36" | 15.0 |
| 4 | 36" | .03 |
| 5 | 32" | .016 |
| 6 | 36" | .02 |
| 7 | 36" | .01 |
| 8 | 36" | 0.0 |
| 9 | 36" | 0.0 |
| 10 | 36" | 0.2 |
| 11 | 36" | 12.0 |
| 12 | 18" | .04 |
| 13 | 36" | .006 |
| 14 | 36" | .026 |
| 15 | 36" | 12.02 |
| 16 | 24" | .04 |
| 17 | 36" | 21.0 |
| 18 | 33" | 0.0 |
| 19 | 36" | .02 |
| 20 | 36 | 12.0 |
| 21 | 36" | 0.0 |
| 22 | 36" | .008 |
| 23 | 36" | 0.0 |
| 24 | 36 | .02 |

(1) Sampled October 9, 1986.
(2) Data reported as methane equivalent values.
(3) Refer to Figure 14.

FIGURE 14




## Houghton Abandoned Landfill

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 1-24

Volatile organic gas: Sites A-D

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇨

## 4.4 Puyallup/Kit Corner Abandoned Landfill

Fifteen test probes were placed and measured for combustible gas levels on October 7, 1986 at the Puyallup/Kit Corner Abandoned Landfill. The barometric pressure was recorded at a steady 30.13 inches.

The test probe locations are found in Figure 15. Combustible gas data are presented in Table VIII.

The Puyallup/Kit Corner Abandoned Landfill is looped by a narrow dirt road. The landfill rises approximately 20 to 30 feet above the elevation of the dirt road. All test probes were placed at the base of the landfill slope to the outside of the loop dirt road.

### 4.4.1 North Perimeter

The terrain immediately north of the north perimeter is characterized as wooded and undeveloped.

No significant combustible gas levels were observed along the north perimeter.

### 4.4.2 East Perimeter

The terrain immediately beyond the east perimeter loop road slopes steeply downward for approximately 10 to 20 feet. A stream runs midway toward the landfill from the east, flows south along the slope base and into a culvert under the landfill. The northeast terrain is wooded and undeveloped. The terrain immediately beyond the southeast perimeter is currently being developed at this writing.

No combustible gases were observed from the test probes along the east perimeter.

### 4.4.3 South Perimeter

The southeast perimeter is bordered by a steep rising bank. Immediately beyond the southcenter perimeter lies a stream culvert outfall and a sharp downslope into an undeveloped wooded area. The terrain rises again toward the southwest perimeter. A townhouse construction project is in the final stages of completion within this area at this writing.

No significant combustible gas levels were observed from test probes along the south perimeter.

### 4.4.4 West Perimeter

The terrain immediately beyond the west perimeter is wooded, undeveloped and slopes gradually to Interstate 5. A natural gas pipeline is found running parallel to the west perimeter.

Significant levels of combustible gas were not observed along the west perimeter.

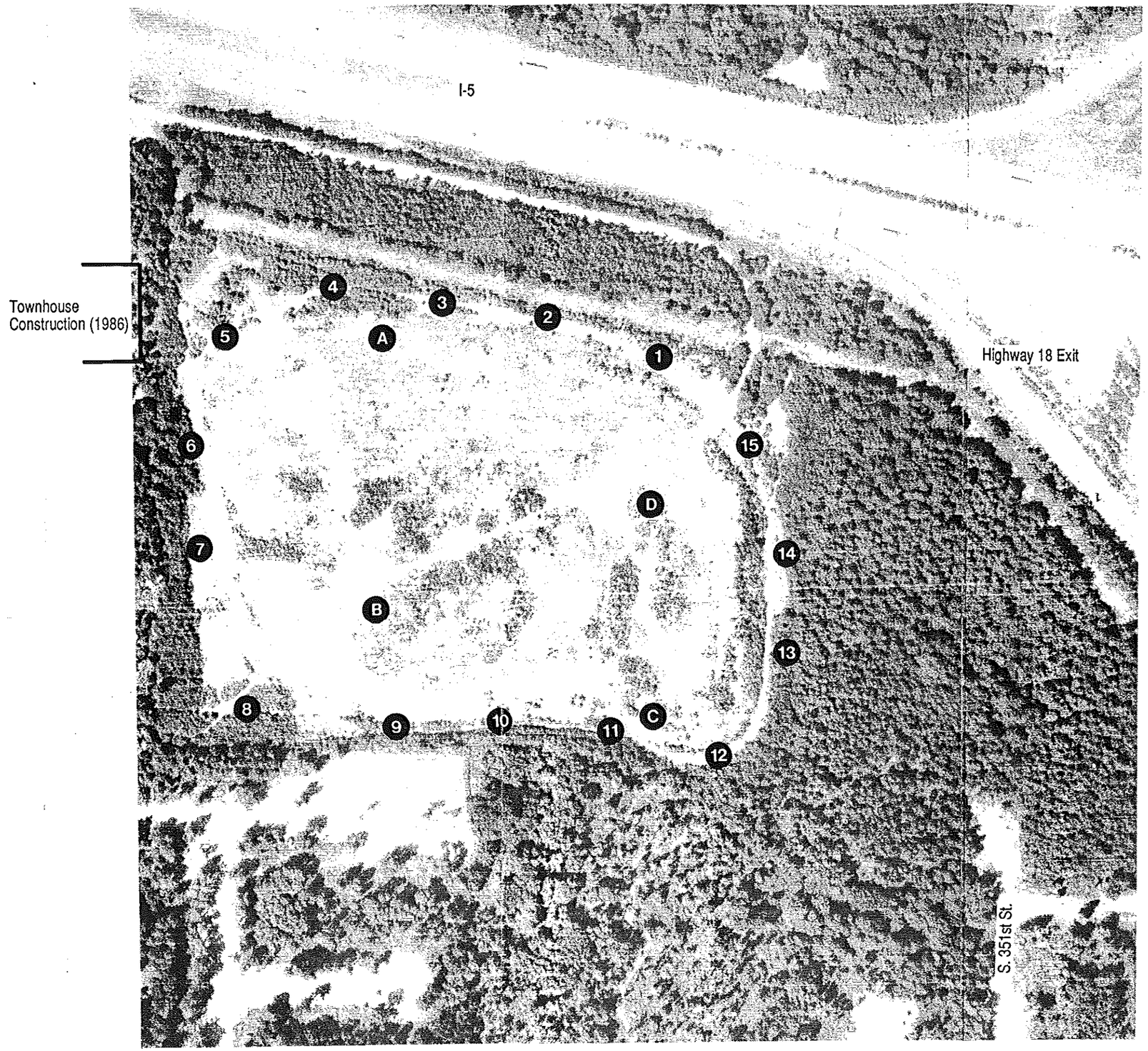
TABLE VIII

Puyallup/Kit Corner Abandoned Landfill(1)
Perimeter Combustible Gas Levels

| Site(3) | Probe Depth | Combustible(2) Gas Level (%) |
|---|---|---|
| 1 | 18" | 0.0 |
| 2 | 23" | 0.0 |
| 3 | 12" | 0.0 |
| 4 | 36" | 0.0 |
| 5 | 36" | 0.0 |
| 6 | 36" | 0.0 |
| 7 | 32" | 0.08 |
| 8 | 36" | 0.02 |
| 9 | 24" | 0.01 |
| 10 | -- | No Reading |
| 11 | 24" | 0.002 |
| 12 | 36" | 0.02 |
| 13 | 36" | 0.01 |
| 14 | 33" | 0.01 |
| 15 | 12" | 0.014 |

(1) Sampled October 7, 1986.
(2) Data reported as methane equivalent values.
(3) Refer to Figure 15.

FIGURE 15




# Puyallup/Kit Corner Abandoned Landfill

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 1-15

Volatile organic gas: Sites A-D

Approximate scale: 1" = 200'
Aerial photo date: 1983
Source: State of Washington Department of Natural Resources

N ⇨

## 4.5 Genesee Park Abandoned Landfill

On October 14, 1986 twenty-four test probes were placed and measured for levels of combustible gas along the perimeter of the Genesee Park Abandoned Landfill. The barometric pressure level during the testing period was recorded dropping from 30.23 to 30.16 inches.

The test probe locations are found in Figures 16 and 17. Combustible gas data are presented in Table IX.

### A. North Section

#### 4.5.1 North Perimeter

The north perimeter is bordered by Lake Washington Boulevard. Immediately beyond is Lake Washington.

A significant level of 29.6% combustible gas was measured from the one test probe along the north perimeter.

#### 4.5.2 East Perimeter

Immediately east of test probe 20 is a group of residential homes that are on the approximate surface elevation of the park.

A significant gas level was not observed from this test probe.

To the east of test probes 21 and 22 rises a steep slope and wooded terrain. On the slopes' plateau is a residential development which is situated approximately 250 feet upslope from the landfill.

Probe 21 exhibited a combustible gas level of 17%

Test probe 23 was located at the crest of a slope rising from the landfill and did not exhibit combustible gas.

Test probe 24 was placed at the entrance to the Parks Department facility, and did not exhibit combustible gas.

#### 4.5.3 West Perimeter

Test probes 14 through 18 were placed along the west perimeter of the north section. All were immediately across the street from a large residential development. All were within approximately fifty feet from the nearest residential structure.

Significant combustible gas levels were observed from test probes 16 (12%), 17 (12%) and 18 (56%).

B. South Section

4.5.4 West Perimeter Area

The perimeter of the west area was monitored by test probes 3 through 7. Test probes 3, 4 and 7 exhibited significant combustible gas levels of 44%, 42%, and 10% respectively. All were within approximately sixty feet to the nearest residence.

4.5.5 South Perimeter

Significant levels of combustible gas were observed from test probes 9 (56%) and 10 (5%). Test probe 9 was situated at the base of a slope and is approximately 150 feet from the nearest residence.

4.5.6 East Perimeter

The east perimeter is bordered by a stonewall that drops approximately six feet to the sidewalk of 46th Avenue South.

No combustible gas was observed from the test probes along this perimeter.

4.5.7 North Perimeter

Probes 1 and 2 are situated on the border of residential property. A combustible gas level of 25% was observed from probe 1, which is approximately 30 feet from the nearest residence. A combustible gas level of 8% was also observed from probe 13.

4.5.8 Follow-up Study

A low combustible gas level was observed in the ambient air of one home. The source was pinpointed to a sump pump on the basement floor that presumably lead directly to the sewer line. The sump pump valve was closed at that time.

A point source low combustible gas level was observed over a dry basement drain and a basement wall/floor crack located two feet away.

Significant combustible gas level within the explosive range was observed in one on-site sewer utility line. Lower levels of combustible gas were also observed in sewer utility lines located off-site at distances of up to two blocks away.

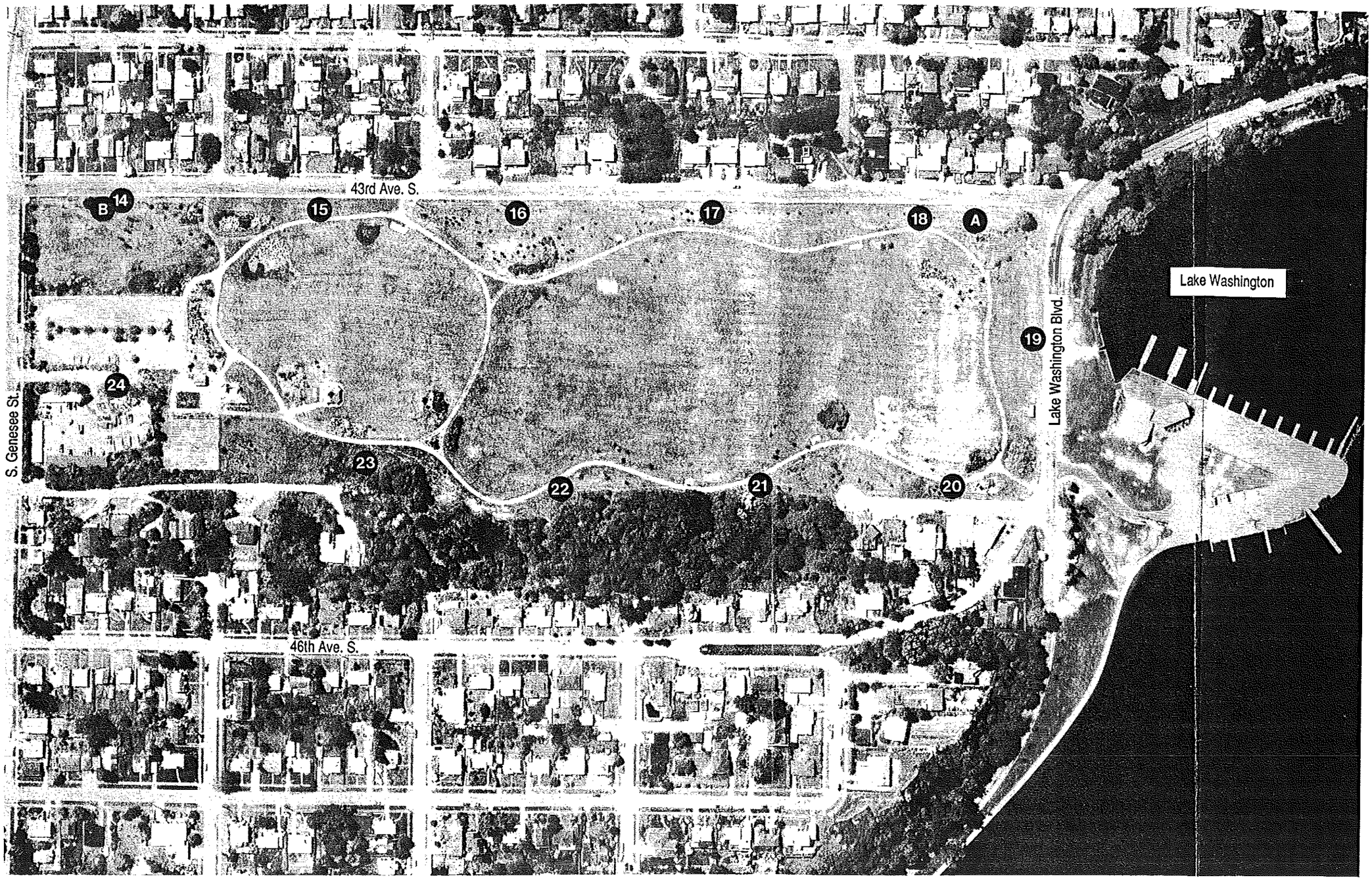
TABLE IX

Genesee Park Abandoned Landfill[1]
Perimeter Combustible Gas Levels

| Site[3] | Probe Depth | Combustible[2] Gas Level (%) |
|---|---|---|
| (South Section)[3] | | |
| 1 | 36" | .01 |
| 2 | 36" | 25.0 |
| 3 | 36" | 44.0 |
| 4 | 36" | 42.0 |
| 5 | 32" | .05 |
| 6 | 36" | .016 |
| 7 | 36" | 10.0 |
| 8 | 36" | .018 |
| 9 | 33" | 56.0 |
| 10 | 27" | 5.0 |
| 11 | 36" | 0.0 |
| 12 | 28" | 0.0 |
| 13 | 36" | 8.0 |
| (North Section)[4] | | |
| 14 | 36" | .20 |
| 15 | 36" | .084 |
| 16 | 36" | 12.0 |
| 17 | 36" | 12.0 |
| 18 | 36" | 52.0 |
| 19 | 36" | 29.6 |
| 20 | 36 | .004 |
| 21 | 36" | 17.0 |
| 22 | 36" | 0.0 |
| 23 | 36" | 0.0 |
| 24 | 36 | 0.0 |

(1) Sampled October 14, 1986.
(2) Data reported as methane equivalent values.
(3) Refer to Figure 16.
(4) Refer to Figure 17.

FIGURE 16




## Genesee Park Abandoned Landfill (North Section)

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 14-24

Volatile organic gas: Sites A-B

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇨

FIGURE 17


## Genesee Park Abandoned Landfill (South Section)

**Landfill Gas Sampling Locations**

Sample Identification:

Combustible gas: Sites 1-13

Volatile organic gas: Sites C-E

Approximate scale: 1" = 200'
Aerial photo date: 1985
Source: State of Washington Department of Natural Resources

N ⇧

## 4.6 South Park Abandoned Landfill

Eighteen test probes were placed and measured for concentrations of combustible gas on October 15, 1986 at the South Park Abandoned Landfill. The barometric pressure during the testing period was recorded as dropping from 30.08 to 30.05.

### 4.6.1 East Perimeter

Test probes 1 through 9 were placed along the landfill's east perimeter, which borders 5th Avenue.

No significant combustible gas levels were observed from these test probes.

### 4.6.2 South Perimeter

The south perimeter is bordered by Occidental Avenue South. From street level, the landfill slopes steeply upward from an elevation gain of approximately 15 to 20 feet. The landfill side bank has been covered with a thick layer of crushed rock measuring about 2 to 3 inches in diameter.

Combustible gas was not detected from test probes along the south perimeter.

### 4.6.3 West Perimeter

The west perimeter is also bordered by Occidental Avenue South. From the street level, the terrain drops steeply for 10 to 15 feet to the landfill edge, then rises steeply for an elevation gain of approximately 20 feet to the landfill plateau. A stream runs south through the depression between the road and the landfill.

Test probes were placed at the road edge at sites 15 and 16. No combustible gas was detected.

Because of the deep depression between the roadway and the landfill, probes were not placed in sites 17 and 18.

### 4.6.4 North Perimeter

Based upon examination of historical aerial photographs it is presumed that an industrial complex has been developed on the former north section of the landfill.

Test probes were placed along the south and east perimeters of this complex. One significant combustible gas level of 8% was observed from Probe 19, which is approximately 80 feet from the complex buildings.

TABLE X

South Park Abandoned Landfill[1]
Perimeter Combustible Gas Levels

| Site[3] | Probe Depth | Combustible[2] Gas Level (%) |
|---|---|---|
| 1 | 36" | 0.08 |
| 2 | 30" | 0.0 |
| 3 | 30" | 0.0 |
| 4 | 30" | 0.0 |
| 5 | 30" | 0.0 |
| 6 | 24" | 0.0 |
| 7 | 20" | 0.0 |
| 8 | 36" | 0.0 |
| 9 | 36" | 0.0 |
| 10 | 36" | 0.0 |
| 11 | 36" | 0.0 |
| 12 | 36" | 0.0 |
| 13 | 36" | 0.0 |
| 14 | 36" | 0.0 |
| 15 | 36" | 0.0 |
| 16 | 36" | 0.0 |
| 17 | No Probe | No Reading |
| 18 | No Probe | No Reading |
| 19 | 36" | 8.0 |
| 20 | 18 | 0.0 |
| 21 | 28" | 0.01 |

(1) Sampled October 15, 1986.
(2) Data reported as methane equivalent values.
(3) Refer to Figure 18.

# VI. Conclusions and Recommendations

# 1.0 BOW LAKE ABANDONED LANDFILL

## 1.1 Chemical Hazards

### 1.1.1 Conclusions

The analytical results for surface soils, surface waters and landfill gases indicate that the site surface presents no public health risk greater than background.

### 1.1.2 Recommendations

No surface use site restrictions are made based upon the analytical information.

## 1.2 Combustible Gas Hazards

### 1.2.1 Conclusions

a. Combustible gas data indicate that the site is actively generating combustible gas in the north and east areas of the landfill.

b. The closest combustible gas was detected along the south or west perimeters of the site.

c. A residential neighborhood is situated approximately 600 feet west of the landfill on the opposite of I-5.

### 1.2.2 Recommendations

a. Any construction activities on or within 1000 feet of the Bow Lake Abandoned Landfill must be protected from potential combustible gas migration as required by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

b. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas. Should combustible gas be observed, an appropriate venting system should be installed.

c. Any enclosed room or chamber within the King County Transfer Station should be periodically monitored for the presence of combustible gas. Should combustible gas be observed at combustible gas action levels developed by the Health Department, the appropriate abatement action should be followed.

## 1.3 Physical Hazards

### 1.3.1 Conclusions

a. The landfill cover on portions of the south and southeast area is inadequate, as observed from landfill contents at surface level.

b. Surface water runoff from the transfer station is apparently being diverted to Site 2 and Site 4 as indicated on Figure 12 which would potentially increase the generation of leachate.

c. Surfacing leachate was not observed at the base of the east slope adjacent to Southcenter Parkway during this study. However, other accounts have indicated that a leachate problem has existed to the southeast of the fill.(2)

### 1.3.2 Recommendations

a. Inadequately covered portions of the south and southeast landfill area should be properly capped as described by the King County Board of Health Rules and Regulations 8, Part V, Section 4C.

b. Surface water run-off from the transfer station should be collected and diverted into a storm drain system.

c. The potential surfacing leachate area at the base of the east slope should be periodically observed. Should leachates be discovered, appropriate testing and control actions should be initiated.

## 2.0 CORLISS ABANDONED LANDFILL

### 2.1 Chemical Hazards

#### 2.1.1 Conclusions

a. One soil sample taken from a small defined spill area (Site B, Figure 13) exhibited a high lead concentration of 2000 ppm.

b. Chemical data from all other surface soil samples and Thornton Creek samples suggest that the surface poses no significant public health risk greater than background.

#### 2.1.2 Recommendations

a. The contaminated soil within the small spill area should be replaced with clean fill dirt.

b. No other surface use site restrictions are made based upon the analytical information.

### 2.2 Combustible Gas Hazards

#### 2.2.1 Conclusions

a. Combustible gas data indicate that the site continues to generate significant levels of combustible gas along the east and west perimeters.

b. Combustible gas was not observed along the north or south site perimeters, both of which are adjacent to residential developments.

c. A residential neighborhood is situated approximately 300 feet from the perimeter of the landfill, with I-5 inbetween.

d. A residential neighborhood is situated approximately 600 feet west of the estimated west perimeter, with Thornton Creek in between.

#### 2.2.2 Recommendations

a. Any construction activities on or within 1000 feet of the Corliss Abandoned Landfill must be protected from potential combustible gas migration as required by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

b. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas. Should combustible gas be observed, an appropriate venting system should be installed.

c. Any enclosed room or chamber within the King County Transfer Station should be periodically monitored for the presence of combustible gas. Should combustible gas be observed at combustible gas action levels developed by the Health Department, the appropriate abatement action should be followed (Appendix G).

d. Residences that border the landfill along the east and west perimeters should be monitored for the presence of combustible gas during a period of falling barometric pressure.

## 2.3 Physical Hazards

### 2.3.1 Conclusions

a. The southern half of the landfill (McCormick Park) is readily accessible by the public. It has motor vehicle access and has been used as an illegal dump.

b. Portions of McCormick Park have settled creating poor drainage conditions. Rainwater is subsequently pooling on-site.

c. The terrain of McCormick Park is uneven and unmaintained, creating a hazard to site users.

### 2.3.2 Recommendations

a. The west entrance to McCormick Park should be fenced with a metal locking gate to make the site inaccessible to motor vehicles.

b. The illegal dumped waste should be removed form the site and properly disposed of by the site owners.

c. McCormick Park should be graded to improve drainage and to create an even terrain for site users.

d. McCormick Park should be periodically inspected and maintained (ie. grass maintenance) by the owners.

## 3.0 HOUGHTON ABANDONED LANDFILL

### 3.1 Chemical Hazards

#### 3.1.1 Conclusions

a. The analytical results for surface soils and waters indicate the the site surface presents no public health risk greater than background.

b. Highly unusual landfill gas and ambient air results were observed.

c. Surface seepage was observed onto the baseball field in December after the project sampling had been completed. One soil subsample taken from the baseball field in July did not suggest a chemical contamination problem.

d. Surfacing leachates were not observed at this site during the study. However, problems with leachate have been observed previously.(3)

#### 3.1.2 Recommendations

a. No surface site restrictions are made based upon the analytical results.

b. Immediate resampling of the area is needed in order to rule out analytical or sampling error for landfill gas.

c. Water seepage onto the baseball field should be analyzed for the presence of chemical components.

d. Water drainage should be diverted way from the baseball playing fields.

e. The westerly perimeter should be periodically inspected for leachate seeps during periods of heavy rainfall. Should surfacing leachate be confirmed, corrective action should be initiated.

### 3.2 Combustible Gas Hazards

#### 3.2.1 Conclusions

a. Combustible gas data indicate that the site continues to generate significant levels of combustible gas.

b. The north perimeter is bordered by a residential housing area. Significant combustible gas levels were observed along this perimeter.

c. Significant combustible gas levels were observed along sections of the northwest, south and northeast perimeters. Residential property is not abutting these perimeters.

d. A combustible gas survey of 20 homes along the northern and northwest perimeter by the King County Solid Waste Division did not reveal the presence of combustible gas within the homes on the sampling dates.

### 3.2.2 Recommendations

a. Any construction activities on or within 1000 feet of the Houghton Abandoned Landfill must be protected from potential combustible gas migration as required by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

b. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas. Should combustible gas be observed, an appropriate venting system should be installed.

c. Any enclosed room or chamber within the King County Transfer Station should be periodically monitored for the presence of combustible gas. Should combustible gas be observed, developed by the Health Department, the appropriate abatement action should be followed (Appendix G).

d. Homes that border the perimeter of the site should be periodically monitored for the presence of combustible gas during a period of falling barometric pressure. Should combustible gas be observed at combustible gas action levels developed by the Health Department, the appropriate abatement action should be followed (Appendix G).

## 3.3 Physical Hazards

### 3.3.1 Conclusions

a. During August, 1986 an extensive brush fire broke out over the north third of the landfill coming within approximately 40 feet to a row of residential homes. This has been reported as a reoccurring problem by the residents.

b. The east entrance gate that blocks access of motor vehicles on the site has been vandalized and is in need of replacement.

### 3.3.2 Recommendations

a. A program of landfill brush maintenance should be initiated at the Houghton site.

b. The east entrance gate should be replaced with a durable locking metal gate to impede unauthorized motor vehicles on-site.

## 4.0 PUYALLUP/KIT CORNER ABANDONED LANDFILL

### 4.1 Chemical Hazards

#### 4.1.1 Conclusions

a. The analytical results for surface soils, waters and landfill gas indicate that the site surface presents no public health risk greater than background.

b. The site is situated at a higher elevation than the surrounding terrain. Land development around the site could create uncontrolled surfacing problems due to soil removal and terrain alterations resulting from site excavation.

#### 4.1.2 Recommendations

a. No surface use site restrictions are made based upo the analytical results.

b. Land development around the site should have the potential for uncontrolled surfacing leachates addressed by a qualified hydrologist.

### 4.2 Combustible Gas Hazards

#### 4.2.1 Conclusions

a. No significant combustible gas levels were observed along the site's perimeter.

b. The site continues to generate significant levels of combustible gas.(3)

#### 4.2.2 Recommendations

a. Any construction activities on or within 1000 feet of the Puyallup/Kit Corner Abandoned Landfill must be protected from potential combustible gas migration as required by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

b. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas levels. Should combustible gas be observed, an appropriate venting system should be installed.

c. The lowest floors of the townhouses located along the sites southwest perimeter should be periodically monitored for combustible gas concentrations during a period of falling barometric pressure. Should combustible gas be observed at combustible gas action levels developed by the Health Department, the appropriate abatement action should be initiated (Appendix G).

## 4.3 Physical Hazards

### 4.3.1 Conclusions

A large manhole has had its cover recently collapse exposing a deep hole at approximately Site 7 of Figure 15. This hole is in the middle of a motorbike area.

### 4.3.2 Recommendations

The manhole should be immediately blocked and sealed.

## 5.0 GENESEE ABANDONED LANDFILL

### 5.1 Chemical Hazards

#### 5.1.1 Conclusions

a. The analytical results for surface soils, waters and landfill gas indicate that the site surface presents no public health risk greater than background.

b. Poor drainage on the five acre tract bordering 46th Avenue south has resulted in the formation of large pools which occur after rainfall which add to leachate production.

#### 5.1.2 Recommendations

a. No surface use site restrictions are made based upon the analytical results.

b. The five acre tract along 46th Avenue South should be recapped and regraded to improve site drainage and decrease leachate production.

### 5.2 Combustible Gas Hazards

#### 5.2.1 Conclusions

a. Significant levels of combustible gas have been observed along sections of all site perimeters.

b. The Genesee Park site is situated at the center of a large residential tract.

c. Significant levels of combustible gas is entering the sewer lines that run through the landfill channeling combustible gas away from the site.

d. A house to house combustible gas survey of homes along the eastern perimeter was conducted by the Seattle Solid Waste Division during October 1986.

   Low level combustible gas levels observed in two perimeter homes was traced to basement sump pumps or floor drains that are presumably connected to the municipal sewer lines.

#### 5.2.2 Recommendations

a. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas levels. Should combustible gas be observed, an appropriate venting system should be installed.

b. On-site underground sewer utilities that have been observed containing combustible gas should have manholes exposed and fitted with ventilating covers. An appropriate monitoring and ventilation program should be developed.

c. Homes that were observed with low level combustible gas should be remonitored to check the effectiveness of the corrective strategies.

d. Periodic combustible gas monitoring of homes around the site should be conducted during periods of low barometric pressure. Should combustible gas levels be observed at combustible gas action levels developed by the Health Department, the appropriate abatement action should be followed. (Appendix G)

e. Residents around the site should be advised to keep P-Traps of basement floor drains filled with water to prevent the entrance of sewer gas into their homes.

f. Any construction activities on or within 1000 feet of the Genesee Park Abandoned Landfill should be protected from potential combustible gas migration as described by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

## 5.3 Physical Hazards

### 5.3.1 Conclusions

a. The five acre tract that borders 46th Avenue South is unevenly landscaped and poorly maintained.

b. This area is readily accessible to the public.

### 5.3.2 Recommendations

a. The five acre tract that borders 46th Avenue South should be capped and graded as described by King County Board of Health Rules and Regulations 8, Part V, Section 4C.

b. Once properly landscaped, the five acre tract should be maintained by the property owner.

## 6.0 SOUTH PARK ABANDONED LANDFILL

### 6.1 Chemical Hazards

#### 6.1.1 Conclusions

a. Because of its industrial location, the concentrations of certain compounds, primarily heavy metals and polynuclear aromatic hydrocarbons (PAH's) are greater than found in non-industrial areas of Seattle or King County.

b. Public access is restricted on site.

c. A stream passes through the landfill center and along the west perimeter of the site that outfalls into the Duwamish River[1]. One surface water sample had high heavy metal concentrations, which may reflect background conditions rather than contamination by the landfill.

#### 6.1.2 Recommendations

a. No surface use site restrictions are made based upon the analytical results and the site's industrial use.

b. The stream running through the landfill should be run through a culvert to avoid direct leaching by the landfill. The drainage passage through the landfill should be filled in.

### 6.2 Combustible Gas Hazards

#### 6.2.1 Conclusions

a. The South Park site is generating significant levels of combustible gas.[1]

b. No significant combustible gas levels were observed around the true perimeter of the site.

c. One significant combustible gas level was observed at a distance of approximately 80 feet from an industrial complex, that is presumed built over a section of the former landfill.

#### 6.2.2 Recommendations

a. Any construction activities on or within 1000 feet of the South Park Abandoned Landfill should be protected from potential combustible gas migration as described by the King County Board of Health Rules and Regulations 8, Part VI, Section 3, Construction Standards.

b. Underground sewer utilities or storm drains that pass through the site should be identified and periodically monitored for combustible gas. Should combustible gas be observed, an appropriate venting system shall be installed.

c. Any enclosed room or chamber within the Seattle Transfer Station should be periodically monitored for the presence of combustible gas. Should combustible gas be observed exceeding combustible gas action levels developed by the Health Department, the appropriate abatement action should be followed (Appendix G).

d. Buildings located on the industrial complex at the sites northwest corner should be periodically monitored for the presence of combustible gas. Combustible gas action levels developed by the Health Department should be followed.

## 6.3 Physical Hazards

### 6.3.1 Conclusions

a. The South Park site presents physical hazards that are commensurate with its industrial use.

b. The site is primarily inaccessible to the public.

### 6.3.2 Recommendations

a. As an industrial site, OSHA safety standards should be followed by all site workers.

b. Given the inaccessibility of this site to the public, no physical hazard recommendations are made.

# VI. REFERENCES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