Closure Study Report
Channel Landfill

July 1991

Submitted to

CITY/BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY

and

Channel Landfill, Inc.

Sweet-Edwards/EMCON, Inc.

Closure Study Report

Channel Landfill

Juneau, Alaska

Prepared for

The City and Borough of Juneau

and

Channel Landfill, Inc.

July 1991

Prepared by

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Project X32-01.01

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EXECUTIVE SUMMARY

Channel Landfill, a privately owned facility in Juneau, Alaska, is the City and Borough of Juneau's primary solid waste handling and disposal facility. The landfill has been in operation since approximately 1963. In 1985 two Consummate Incinerators were placed in operation to reduce the volume of waste being landfilled. The landfill has received a wide variety of waste, including ash from the incinerators. The landfill is unlined and located in a wetlands area. The City and Borough of Juneau is currently considering purchase of this facility.

Scope of Work

Sweet-Edwards/EMCON, Inc. was retained to prepare this closure study to provide the City and Borough of Juneau with information regarding capacity and service life, environmental and financial liability, and long-term operating considerations needed to evaluate the possible purchase of the facility, and provide Channel Landfill, Inc., with information needed to establish a landfill closure fund. Sweet-Edwards/EMCON was assisted by American North, Inc., of Anchorage, Columbia Analytical Services of Kelso, Washington, Hansen Engineering of Juneau, and Wink International Geotechnical, Inc., of Juneau.

Regulatory Requirements

The following regulations affect to landfill operation and closure:

Water Quality Standard Regulations 18AAC70. These regulations set water quality standards for fresh water and marine water. These regulations and proposed regulations may impact the operations of the Channel Landfill and the final closure design by imposing more stringent operating conditions on the landfill and by imposing more stringent design criteria on the final closure.

Solid Waste Management 18AAC60. These regulations set standards for solid waste management including landfill permitting, operation, monitoring, and closure. Certain aspects of landfill operation and landfill monitoring may need to be modified or a variance obtained to comply with these regulations.

Air Quality Control Regulations 18AAC50. These regulations focus on emission sources, such as incinerators. The incinerators appear to be in compliance with the air quality permit (R.W. Beck). Landfill gas emissions are not regulated at this time.

Drinking Water Standards 18AAC80. These regulations set standards for drinking water and are significant, as drinking water standards must be met in the aquifer adjacent to the Channel Landfill. Analytical results of samples taken from the ground water under the landfill indicate that the only national drinking water standard exceeded is benzene in a sample from a downgradient well (MW-4).

Alaska Coastal Management Program AS 46.40. Construction of major landfill improvements or modification of Channel Landfill's permit triggers the coastal consistency review process under this program.

Alaska Historic Preservation Act 41.35. Since the Channel Landfill site has been so extensively disturbed, it is doubtful any artifacts of historical value remain. The Juneau Community Development Department indicates that no historical structures are documented on the site.

Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257 and 258. The proposed revisions to these regulations have the potential to significantly impact the operation, monitoring, and closure of the landfill. Channel Landfill may be required to implement a program to exclude regulated hazardous waste, install a gas collection control system, install a leachate control system, and upgrade the environmental monitoring program.

National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges, 40 CFR 122, 123, and 124. These regulations require Channel Landfill to submit a permit application for a storm water NPDES permit. Channel Landfill has not yet submitted an application.

Permit Requirements. Permit 8511 BA016 issued by the Department of Environmental Conservation identifies several constraints on operations, in addition to the other regulations discussed.

Hydrologic Conditions

A single water table aquifer composed primarily of alluvial sands and gravels lies beneath the landfill. The aquifer is tidally influenced and water quality of the aquifer is impacted by landfill operations and marine waters. Surface water in the East Pond is impacted by landfill operations and runoff. Dissolved metals and volatile organic compounds appear to increase between the sample taken upgradient and samples taken downgradient. Surface waters in the tideflat and Lemon Creek do not appear to be impacted by landfill operations or runoff.

Landfill Expansion Alternatives

The three basic expansion approaches include: (1) continuing to fill the site in the current manner, (2) filling the site until minimum base grades can be achieved across the site and then covering with a cover/liner and continuing to fill on the liner, or (3) excavating and burning refuse that is now in place.

Phased installation of a cover/liner is recommended because of its value in reducing future landfill impacts to ground water and surface water and the control of landfill gas. The phased installation allows for time to establish a fund to support capital costs. The first phase consists of a cover/liner over 12 acres at a cost of approximately $2.8 million. A cover/liner over the entire landfill will cost approximately $8.3 million.

Site Capacity and Service Life

The remaining capacity at the Channel Landfill is approximately 775,000 cubic yards of solid waste. This represents approximately 23 years of service life continuing current operations.

Final Closure Considerations

Two basic closure approaches were examined: (1) utilizing a geomembrane cover section, or (2) utilizing a low-permeability soil cover section. The geomembrane cover section is recommended because of its low permeability to precipitation and landfill gas, its flexibility, and lower maintenance requirements.

Landfill Gas

Although no landfill gas was found in on-site structures at explosive levels, landfill gas is present at the Channel Landfill and the potential for migration exists. A landfill gas control system to control odors and migration is recommended as part of any major construction at the landfill, including final closure.

Surface Water Management

The Juneau region receives between 55 and 80 inches of precipitation annually. In addition, the Channel Landfill is located in a tidally influenced area within the 100-year flood plain of Lemon Creek. The final grading plan presents surface water control measures including vegetation, culverts, ditches, and reinforced berms.

Ground Water and Leachate Management

Landfill leachate is generated by infiltration of precipitation through the landfill and ground water movement through the landfill. The landfill operations are impacting the ground water beneath the landfill and the East Pit adjacent to the landfill. Leachate impacts will continue and increase unless covers/liners are used to prevent precipitation infiltration. The type and methods for installation of landfill covers will determine the quality of leachate reduction, up to a maximum of 90 percent at final closure.

Closure and Post-Closure Cost Estimates

The cost to close the landfill with the geomembrane approach is estimated to be $7.8 million. The annual post-closure maintenance costs are expected to be $210,000 annually. With the cover/liner expansion alternative, leachate treatment is estimated to cost an additional $650,000 annually, for a total of $860,000 annually.

INTRODUCTION

Channel Landfill, a privately owned facility in Juneau, Alaska, is the City and Borough of Juneau's primary solid waste handling and disposal facility. The City and Borough are currently considering the purchase of this facility from its present owner, Channel Landfill, Inc. The landfill has received a wide variety of wastes, including municipal and industrial waste materials, household wastes, and other putrescible wastes. The landfill is unlined and located in a wetlands area.

The Channel Landfill site encompasses approximately 45 acres (see Figure 1). Approximately 30 acres of the site have received refuse fill. Landfilled materials include both solid waste and demolition debris, and more recently, incinerator ash from the on-site refuse incinerators. Landfilling began at the site in 1963 and the site continues to receive incinerator ash from the on-site incinerators and solid waste. The solid waste is a combination of incinerator bypass waste and non-combustible materials, or typical municipal solid waste when the incinerator capacity is exceeded.

The long-term environmental management of this facility is a growing concern to the City and Borough of Juneau. Sweet-Edwards/EMCON was retained to prepare this closure study to provide the City and Borough with information regarding capacity and service life, environmental and financial liability, and long-term operating considerations needed to evaluate the possible purchase of the facilities. The study will also provide Channel Landfill, Inc., with information needed to establish a landfill closure fund.

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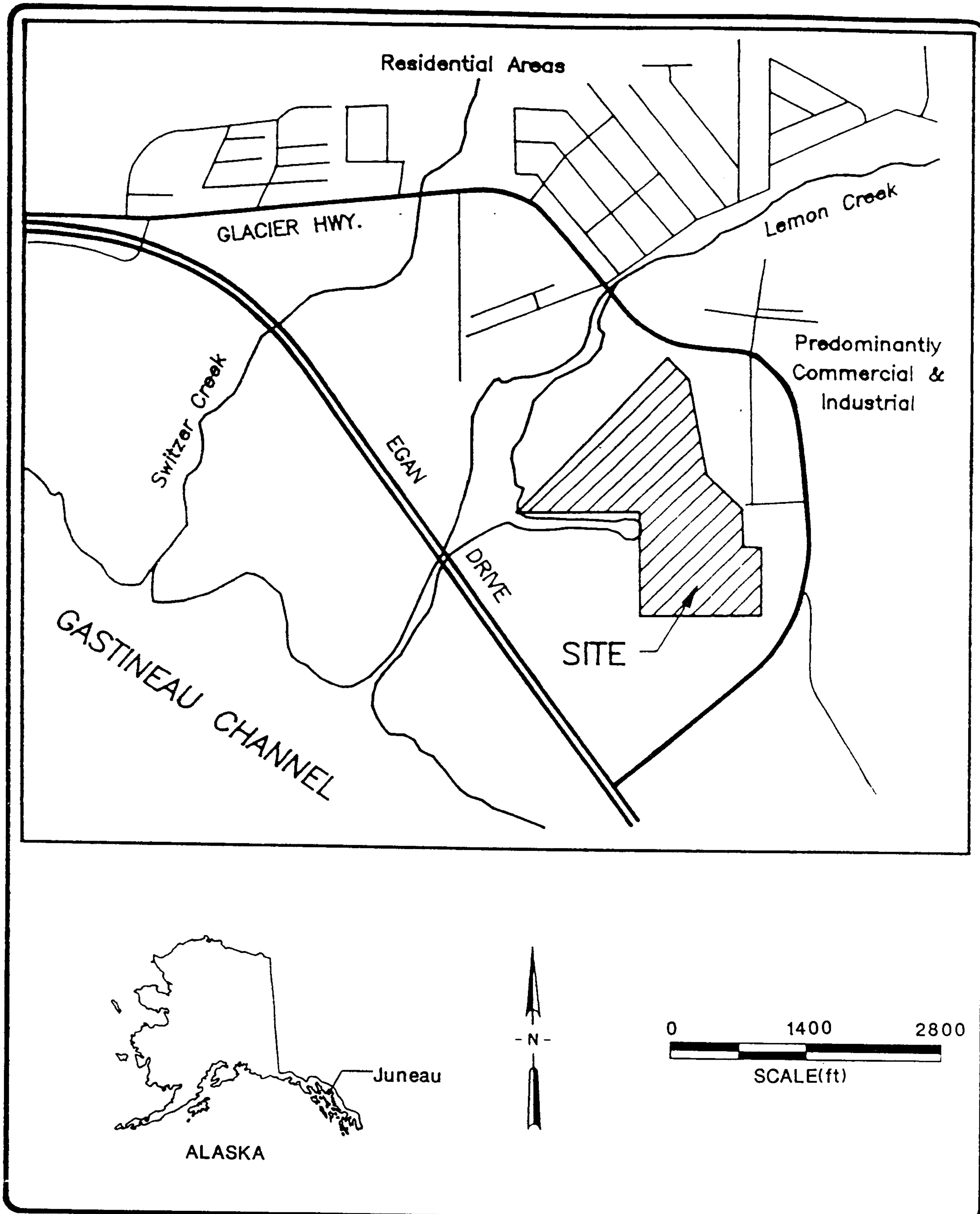

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Figure 1
CHANNEL LANDFILL

VICINITY MAP

1 PROJECT DESCRIPTION

The draft closure study for the Channel Landfill was conducted by Sweet-Edwards/EMCON, Inc. (SE/E), in general accordance with a contract between SE/E and the City and Borough of Juneau and Channel Landfill, Inc., as specified in Agreement Number 91-171. Sweet-Edwards/EMCON was assisted by American North, Inc., of Anchorage, Columbia Analytical Services of Kelso, Washington, Hansen Engineering of Juneau, and Wink International Geotechnical, Inc., of Juneau.

1.1 Scope of Work

The Channel Landfill Project was divided into two phases: Phase I – Hydrogeological Investigation and Phase II – Engineering Design Considerations. The findings of the 17 technical tasks have been compiled into this report. This report summarizes the methods of analyses, results, and conclusions, and provides recommendations for proceeding with the design and construction elements for closure of the landfill.

1.2 Objective

The objective of this project is to conduct a preliminary hydrogeological investigation and prepare a closure study for the Channel Landfill. The landfill closure study estimates the remaining capacity and service life of the landfill and the potential closure and post-closure environmental and financial liabilities. The product of this work effort will aid the City and Borough of Juneau in its preparation of a solid waste management plan and initial evaluation of the benefits of purchasing the landfill. The information provided will also aid Channel Landfill, Inc., in establishing a landfill closure fund.

2 REGULATORY REQUIREMENTS

The following regulations were evaluated for applicability to landfill operation, capacity, service life, closure requirements, closure costs, and post-closure costs.

2.1 Water Quality Standard Regulations 18 AAC 70

These regulations set water quality standards for fresh water and marine water based on its use. Adjacent to the Channel Landfill, fresh water and marine water are used for the growth and propagation of fish, shellfish, and other aquatic life and wildlife.

These regulations were last revised December 1989 and are scheduled to be revised again by the end of 1991. Public comment on the revisions will be solicited in late summer or early autumn by the Alaska Department of Environmental Conservation (ADEC).

The scope of the planned revisions covers two major areas. The first is the proposed adoption of quantitative toxic water quality criteria instead of qualitative criteria. The current regulations adopt the U.S. Environmental Protection Agency's (EPA) Quality Criteria For Water, 1986, by reference. The planned revisions propose to list these criteria explicitly. The second area includes planned adoption of water quality criteria which represent an acceptable exposure, i.e., a lifetime excess (or additional) cancer risk in the range of 1×10^{-5} to 1×10^{-7}. This represents 1 additional case in 100,000 to 1 additional case in 10,000,000 exposed individuals.

ADEC is also developing a policy to implement the anti-degradation language in the water quality legislation. This legislation prohibits the degradation of waters of the state. The schedule for development of that policy is also 1991.

These regulations and proposed regulations may impact the operations of the landfill and the final closure design by imposing more stringent operating conditions on the Channel Landfill and by imposing more stringent design criteria on the final closure. For example, lined filling operations discussed in Chapter 5 of this report may become a requirement.

2.2 Solid Waste Management 18 AAC 60

These regulations set standards for solid waste management including landfill permitting, operation, monitoring, and closure.

Permitting. The Channel Landfill operates under ADEC Permit 8511-BA016.

Operation. These regulations address the following aspects of landfill operation:

- Control surface water run-on. Surface water run-on appears to be controlled.
- Protect the landfill from wash-out from the 100-year flood.
- Ensure that solid waste is not placed in surface water. The Channel Landfill may require a variance or permission to continue placing material in the manmade East Pit, or draw down the water in the East Pit prior to continued filling.
- Meet drinking water standards in the aquifer adjacent to the landfill or revise the classification of the aquifer. The standard for benzene was exceeded in one sample from one of the four monitoring wells. This sample may not be representative of impacts from landfill operations.
- Meet fresh water and marine standards adjacent to the landfill. Lemon Creek does not appear to be impacted by landfill operations based on the samples taken. No samples were taken from Gastineau Channel.
- Control public access. Public access is controlled with fencing and bodies of water.
- Control disease vectors, birds, and animals. Baited traps to control vectors were observed. However, bird control may need to be improved.
- Operate the incinerators in compliance with Air Quality Control Regulations, 18 AAC 50. The incinerators appear to be in compliance with the Air Quality Permit.

- Control dust, odor, noise, traffic, and other nuisances and hazards. These appeared to be controlled. However, past complaints about odors are on file with ADEC.

- Control litter. Litter appears to be controlled but could be improved in the active area with litter fences.

- Maintain access roads in a passable and safe condition. Access roads appear to be maintained.

- Provide daily operational cover over compacted waste. The permit allows a tarp to be placed over solid waste and ash. A supply of cover soil is stockpiled on-site. Asbestos is to be covered immediately upon disposal and daily with 6 inches of non-asbestos-containing material under the permit. Asbestos is currently stored in tanks rather than buried.

- Control landfill gas so as not to exceed the explosive limit concentration. Landfill gas was not measured in excess of the explosive limit in on-site structures. No gas monitoring was conducted off-site.

- A minimum buffer of 50 feet is required between the limits of waste and the property line. Waste has been found at the property line and may have been placed beyond the property line in the past by former owners. The waste may need to be removed, a variance obtained to leave it in place, or an easement purchased from the adjacent property owners, Harvey Hildre and Juneau Redi-Mix.

Special Waste Disposal. The regulations and the permit allow disposal of vehicles and trailers that have been drained of operating fluids. The regulations also allow disposal of septage and sewage sludge, but the landfill does not currently accept these wastes as an operational policy.

Hazardous Waste Disposal. Disposal of asbestos is permitted in designated areas of the landfill by modification of the permit dated March 5, 1991. Pathological waste or infectious waste must be treated to prevent a health hazard prior to disposal. Bartlett Memorial Hospital, the major source of this waste, currently delivers approximately 10,000 pounds per month to the incinerator for scheduled incineration prior to disposal. The hospital is building an incinerator that should begin operating in November 1991 at which time it will begin delivering incinerated waste to the Channel Landfill.

Monitoring. Visual monitoring is to be performed once per month to detect damage to the landfill or violation of permit conditions. Ground water monitoring devices and ground water and surface water quality sampling are also required. Channel Landfill, Inc., currently samples surface water. The ground water monitoring wells installed under this study may be used to partially fulfill the ground water sampling requirements. ADEC representatives have indicated a desire to install and sample additional monitoring wells off-site.

Closure. The final cover must be placed within 90 days after placing waste to final design grades. The cover must be revegetated or treated in a manner appropriate with the long-term use of the land. The long-term use of the land has not yet been identified.

2.3 Air Quality Control Regulations 18 AAC 50

The Air Quality Control Regulations are administered by the Department of Environmental Conservation. These regulations focus on emission sources, such as industrial equipment and incinerators. In Juneau, wood stoves are also regulated because the residential suburbs 10 miles north of the city are classified as non-attainment areas.

The two Consummate incinerators at the Channel Landfill are regulated under the Air Quality Control Regulations by permit. Generally, emissions from the incinerators appear to be within permit conditions (per discussions with R.W. Beck).

If a gas flare is installed as part of the landfill gas control system, these regulations may apply. In addition, if these regulations are revised to follow proposed federal air quality standards, landfill gas control may be covered by these regulations in the future. ADEC indicates that the Air Quality Control Regulations will be revised in four to five years to implement the November 1990 revisions to the federal Clean Air Act.

2.4 Drinking Water Standards 18 AAC 80

These regulations establish standards for drinking water quality and testing requirements. These regulations, dated 1982, follow federal drinking water standards and are revised periodically as necessary. Revised regulations to reflect federal drinking water regulation revisions were recently promulgated effective June 14, 1991. The scope of these revisions includes two major components. The first component involves modifications to the public notification requirements. The second component is a more stringent set of standards for volatile organic compounds (VOCs) in drinking water. The revisions to these regulations may affect landfill operations and closure decisions. Since ground water is classified for drinking, drinking water standards must be met in the aquifer beneath the site. However, since the aquifer is not used for drinking, it may be declassified. As discussed in Section 2.1, lined landfill operations and leachate collection may become a requirement to protect the water quality in the aquifer if the aquifer is not declassified.

2.5 Alaska Coastal Management Program AS 46.40

The purpose of the Alaska Coastal Management Program is to protect coastal areas. This program is implemented through the Juneau Coastal Management Program by the Division of Governmental Coordination. The Channel Landfill is located within the jurisdiction of this program. When a project requires a state or federal permit or modification to an existing permit, the coastal consistency review process is triggered. Construction of major landfill improvements also trigger the coastal consistency review process.

2.6 Alaska Historic Preservation Act AS 41.35

The Historic Preservation Act is administered by the Division of Parks and Outdoor Recreation within the Department of Natural Resources. The City and Borough of Juneau is a certified local government and administers the program locally. Public construction is required to be conducted to avoid damaging historic artifacts including fossils. If artifacts are discovered, construction must be stopped until the artifacts can be evaluated. If the artifacts are found to be of value, the Commissioner may halt construction for a period of time. All artifacts that are discovered become the property of the State of Alaska.

Since the Channel Landfill site has been so extensively disturbed, it is doubtful any artifacts remain. Community Development Department of the City of Juneau indicates a low probability of artifacts being located on the site.

2.7 Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257 and 258

The Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257 and 258 (Subtitle D) set recommended performance standards and guidelines for sanitary landfills. These regulations were last revised in 1981. In 1988, EPA proposed revisions to these regulations. The scope of these proposed regulations is extensive and includes definition of aquifer, requirements to exclude regulated hazardous waste, requirements to control explosive gases, restrictions on the recirculation of liquids, criteria for closure, ground water monitoring standards, and ground water sampling and analysis criteria.

EPA has received comments on these proposed revisions but has not yet promulgated the proposed revisions. The schedule for promulgation is uncertain. When they are promulgated, these regulations may have a significant impact on landfill operations. Channel Landfill may be required to implement a program to exclude regulated hazardous waste, install a gas control system, install a leachate control system, and upgrade the environmental monitoring program. The cost of installing leachate and gas control systems for the entire landfill is approximately $7.5 million assuming the cover/liner discussed in Section 5 is used to control landfill gas and leachate. Depending on program specifications, the program to exclude hazardous waste could be performed by one full-time-equivalent employee. The cost of the upgraded environmental monitoring program would also depend on program specifications. Its major cost will likely be the cost of laboratory analysis of samples.

2.8 National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges, 40 CFR 122, 123, and 124

The National Pollutant Discharge Elimination System (NPDES) Permit Regulations set standards and permit requirements for discharges of pollutants to navigable waters. In November 1990, EPA revised these regulations to include permit requirements for storm water discharge from industrial activities. Landfill owners are required to comply with the new storm water permit requirements.

There are three basic options available to submit a permit application. The first option is an individual application. The application process involves collecting and submitting site and water quality data and a description of the activities conducted on-site.

The second option is a group application. The application may be filed by four or more similar facilities, each of which is issued a separate permit. The application has two parts. The first part requires a list of all group members, identification of those members who will contribute data, and a summary of industrial activity. The second part requires submission of water quality data from sites that are representative of the group.

The third option is a general permit. Facilities within selected industries may be able to apply for coverage under a general permit prepared by the EPA. No water quality data are required with the applications, but the applicant must submit a storm water pollution prevention plan and several engineering studies.

The application deadlines vary with the type of permit application. For individual permit applications, the deadline is November 18, 1991. For group applications, the deadline is September 30, 1991, for the first part and May 18, 1992, for the second part. For general permits, the applicant must file a notice of intent to apply for a general permit within 60 days of a general permit becoming available. At this time a general permit is not available for landfills.

Channel Landfill has not made application for an NPDES permit at this time.

2.9 Permit Requirements

In addition to meeting the above regulations, the Channel Landfill must be operated in conformance with Permit 8511 BA016 issued by the Southeast Regional Office of the Department of Environmental Conservation and modified March 5, 1991. Permit requirements include:

- Identification of disposal location and restrictions for incinerator ash and residue
- Identification of disposal location and restrictions for relatively inert wastes
- Prohibitions of disposal of unincinerated putrescible waste, waste oil, oily waste, sewage sludge, septage, fish processing waste, and potentially hazardous waste
- Identification of battery neutralization and storage location and restrictions
- Identification of disposal location and restrictions for asbestos
- Monitoring, record-keeping, and reporting requirements

No evaluation was conducted of the Channel Landfill operator's compliance with monitoring, record keeping, or reporting requirements. Otherwise, the landfill appears to be in general compliance with its permit, with the exceptions noted under the discussion of the Alaska Solid Waste Management regulations (Section 2.2).

3 SITE CONDITIONS

The existing site conditions were investigated through record searches, site visits, and the hydrogeological investigation.

3.1 Location

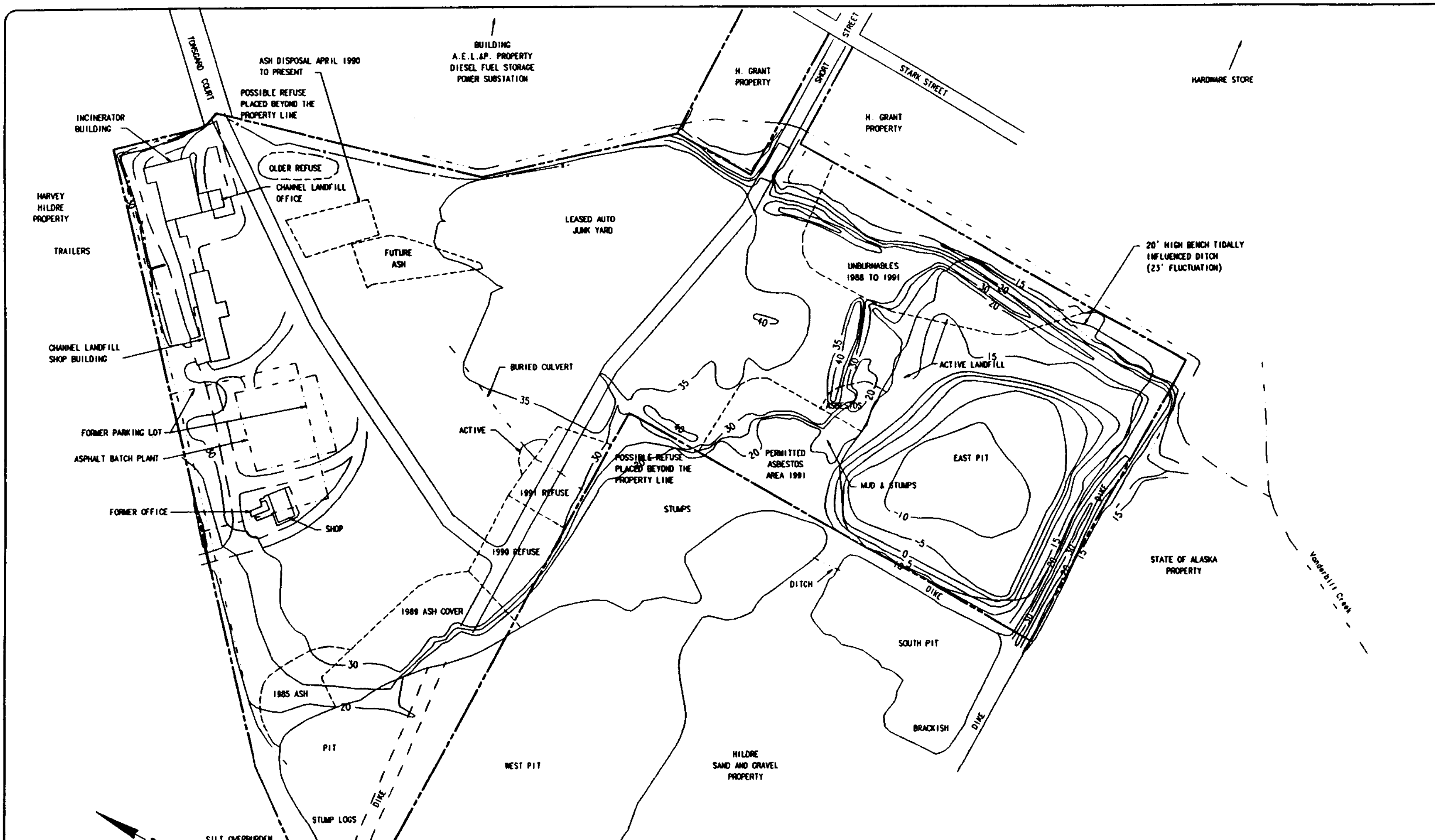
The landfill is located approximately 5 miles northwest of the City of Juneau on the east side of Gastineau Channel, at 5645 Glacier Highway, Juneau, Alaska. It is located in the South ½ of Section 34, Township 41 South, Range 67 East, Copper River Meridian. Lemon Creek is located north of the landfill. Vanderbilt Creek is located southeast of the landfill.

3.2 Existing Operations (Site Description, History)

The property occupied by the Channel Landfill has been operated as a solid waste disposal facility since approximately 1963. In 1966, C. Strohmeyer purchased 90 acres, including the landfill. The landfill was purchased by its current owners, Channel Landfill, Inc., in 1977. Two Consummate incinerators have been operating since October 1985.

Previous property owners may have placed solid waste beyond the boundaries of the property now owned by Channel Landfill, Inc. A large number of stumps was observed adjacent to the west pit and adjacent to the west central portion of the landfill property. Refuse was encountered in drilling monitoring wells 1, 3, and 4. Monitoring Well 1 is located near the northeast property line and Tonsgard Court. Monitoring Wells 3 and 4 are located near the west central property lines and the stumps that are located off the property.

Ash from the incinerators has been disposed of in several locations on the landfill. Material that is unsuitable for incineration, such as automobiles, white goods, or stumps, and refuse that exceeds the capacity of the incinerators, has also been disposed at the landfill. A map showing estimated locations of disposal areas is shown in Figure 3-1, Historical Site Use.



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JUNEAU, ALASKA

HISTORICAL SITE USE

FIGURE **3-1**
PROJECT NO X32 01-01

3.3 Climatic Conditions

The Juneau area is located in a temperate maritime climate characterized by heavy rainfall. The mean annual precipitation in the Juneau region near the Channel Landfill varies from 55 inches at the airport, to 76 inches in the Mendenhall Valley, to 80 inches in downtown Juneau.

The mean annual snowfall is approximately 100 inches, with greater snowfall at higher elevations. This snowfall contributes to surface water runoff when it melts in the spring and summer, causing flooding of Lemon Creek.

3.4 Surface Water Drainage

The Channel Landfill is located in a tidally influenced lowlands area. The landfill is also located within the 100-year flood plain of Lemon Creek. A system of existing earthen dikes and berms protects the landfill from flood inundation. Drainage ditches around the perimeter of the landfill convey surface water to Gastineau Channel. Several ponds on-site collect surface water runoff and convey it to Gastineau Channel by way of the tide flats.

4 HYDROLOGIC CONDITIONS

This section discusses the findings of the Phase I site investigation at the Channel Landfill site.

4.1 Phase I Background and Field Investigation

4.1.1 Environmental Data Review

A review of documents was made at the ADEC offices in Juneau. Records of site visits, correspondence, permitting procedures and a limited amount of surface and ground water quality data were available. The activities by ADEC personnel concerning the landfill were briefly discussed with Ed Emswiler of the ADEC Solid Waste Division. Reproductions of pertinent documents and records from this review are included in Appendix 3.

4.1.2 Beneficial Ground Water Use Inventory.

No downgradient beneficial ground water use was identified near the property. Therefore, the identification of cross-gradient and upgradient beneficial use was limited to a ¼ mile radius.

Beneficial ground water use within ¼ mile of the facility is limited to two wells. There are no potable drinking water wells within ¼ mile of the site. The Juneau Redi-Mix sand and gravel operation to the north and northwest of the property is currently using a ground water well to supply water for washing sand and gravel. The Mark and Pak well to the east of the property is used to supply water for truck washing.

The location of these wells near the landfill are presented in Figure 4-1.

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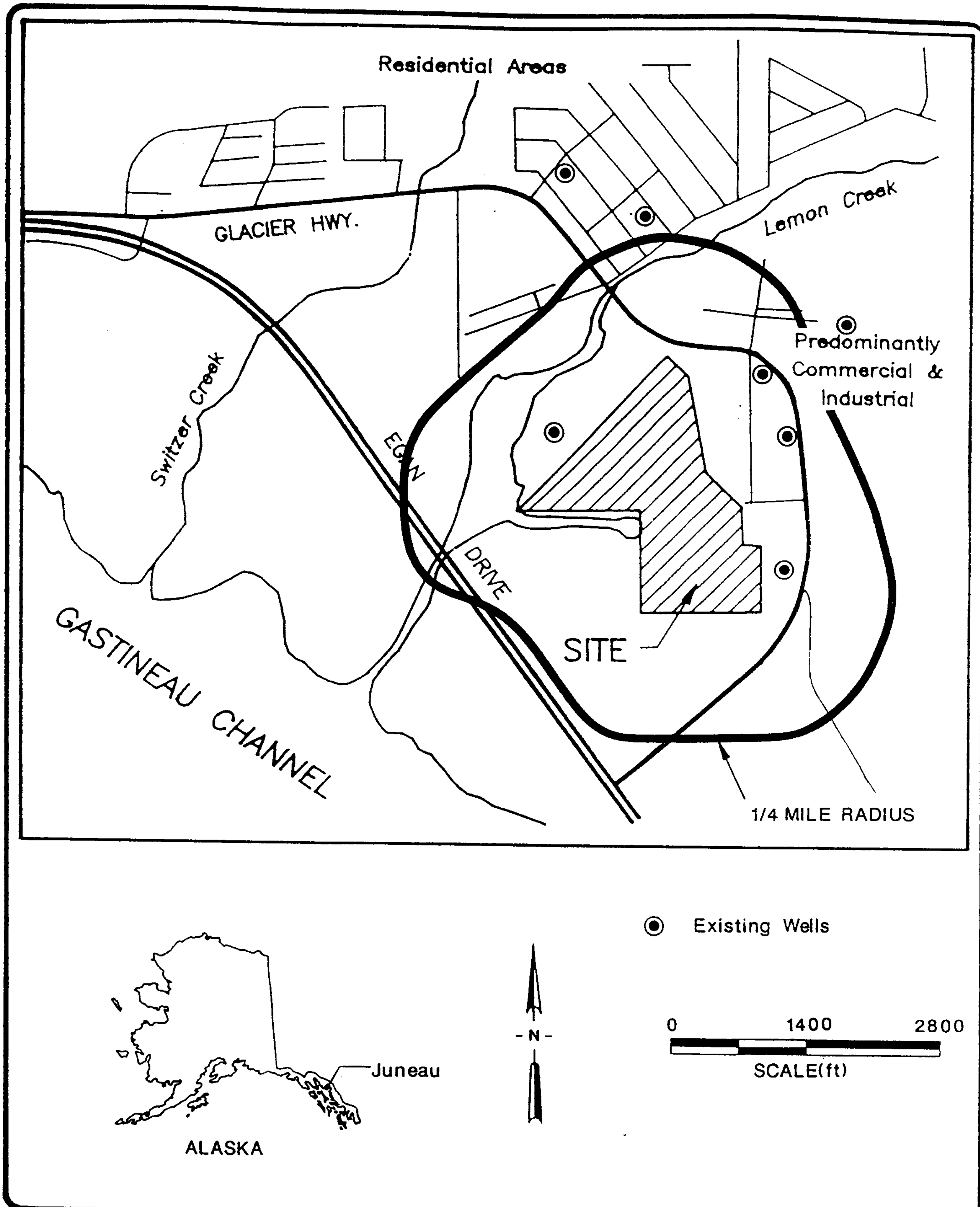

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Figure 4-1
CHANNEL LANDFILL

BENEFICIAL USE WELLS

4.1.3 Soil Borings and Monitoring Well Installation

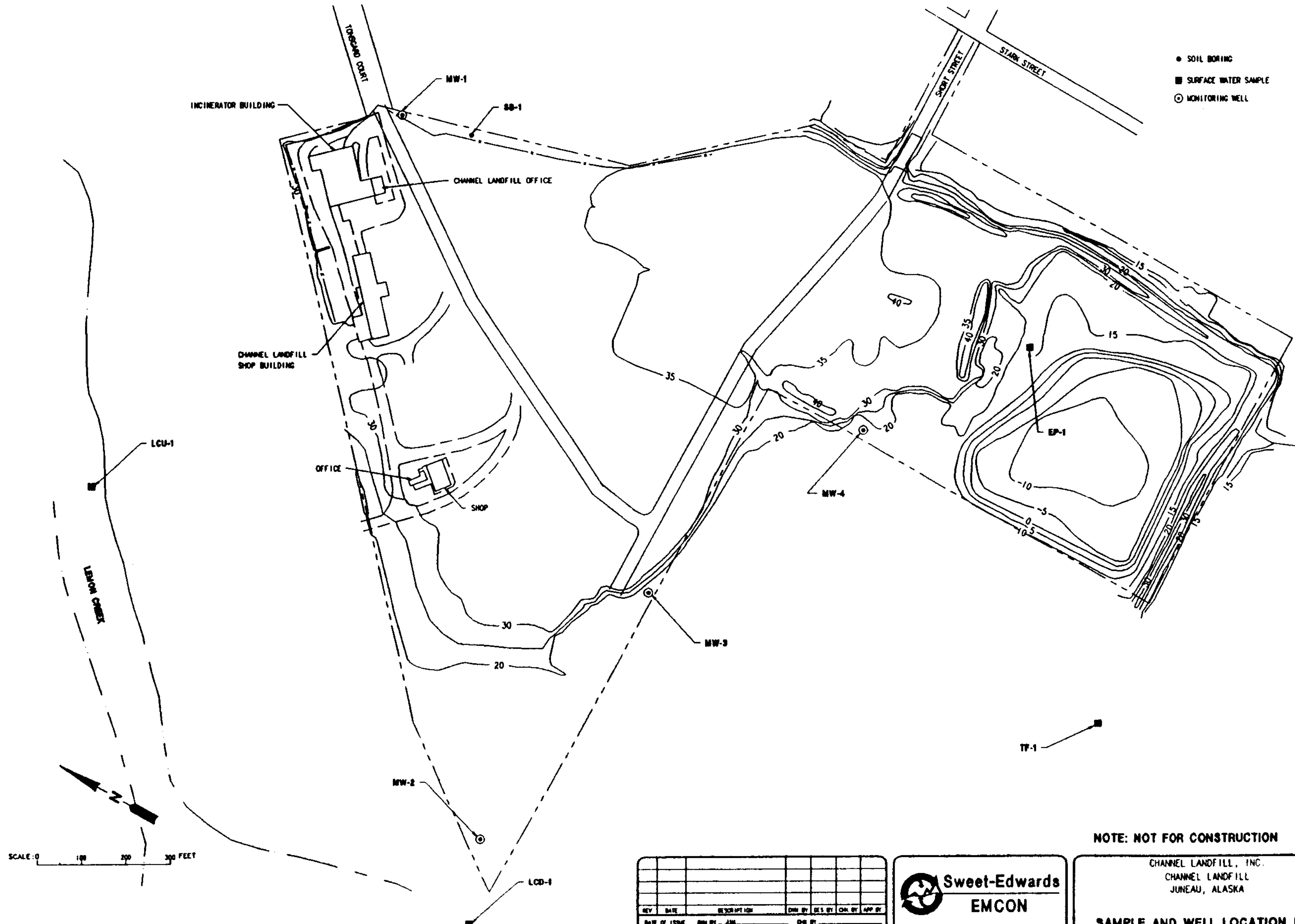
A total of 5 borings were drilled at the landfill. These borings are labeled SB-1 and MW-1 through MW-4 (see Figure 4-2). The borings range in depth from 18 to 41.5 feet below ground surface (bgs). The borings were drilled and monitoring wells installed by Wink International Geotechnical, Inc., of Juneau, using a B-30 mobile drilling rig and 6-inch O.D./3⅝-inch I.D. hollow-stem auger. The drilling was performed on March 7 to March 14, 1991. The auger flights and soil sampling equipment were steam cleaned before each soil boring.

The wells were located to intercept anticipated background/upgradient and downgradient ground water (flowing across the property boundaries). MW-1 was located to be a background/upgradient monitoring well (intercept ground water flowing onto the landfill property). MW-2, MW-3, and MW-4 were located to be downgradient monitoring wells (intercept ground water flowing away from the landfill). MW-4 could not be located at the anticipated furthest downgradient property boundary (near the East Pit) because of active filling.

Soil boring SB-1 was intended to be completed as the background/ upgradient monitoring well, but only silts and glacial till were encountered. This boring was not completed as a monitoring well because it did not appear representative of the site. The boring was abandoned by backfilling with bentonite cement grout. The other four borings were completed with 2-inch I.D. Schedule 40 PVC monitoring wells with 0.020-inch slotted screen. A locking above-grade aluminum monument was cemented over the well and steel bumper posts were placed around each well for security and protection from vehicular traffic. Soil boring logs with monitoring well completion details are presented in Appendix 4.

The wells were developed following installation and before ground water sampling. Four to ten pore volumes were bailed from the wells during development. Well development water was disposed of on the ground. The specific conductance and pH were monitored during development. Monitoring well and well development details are presented in Table 4-1. Each well was measured for depth to water during high and low tides to assess potential tidal influences on shallow ground water. The wells were surveyed by Toner, Nordling, and Associates of Juneau for horizontal (± 0.1 foot) and vertical (± 0.01 foot) position and referenced to the Mean Low Tide, City and Borough of Juneau datum.

Photographs of the landfill site taken at the time of the investigation have been submitted separately.



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JUNEAU, ALASKA

SAMPLE AND WELL LOCATION MAP

FIGURE
4-2
PROJECT NO
X32-01.01

Table 4-1

Monitoring Well and Development Details

Description	MW-1	MW-2	MW-3	MW-4
Monitoring Well Details				
Depth of Boring (ft bgs)	32.0	18.0	34.0	41.5
Elevation of TOC[a,b]	31.70	19.94	32.32	36.76
Well Screen Depth (ft bgs)	22-31.8	5-17.5	23-33	30-40
Filter Pack Interval (ft bgs)	20.5-32	4.5-18	21-33	28-40
Annular Seal Interval (ft bgs)	2-20.5	2-4.5	2-21	2-28
Depth to Water Below TOC[a] (ft)	16.94	9.67	23.57	26.40
Ground Water Elevation[b]	14.76	10.27	8.75	10.36
Well Development				
Date of Development	5/14/91	5/14/91	5/14/91	5/14/91
Purge Volume (gal)	25	15	15	10
Pore Volumes	10	11	7.5	4
Final pH	6.43	6.52	6.70	6.85
Final Conductance (μS/cm)	614	12,030	2,850	3,730

NOTE: bgs = below ground surface

[a] TOC = top of casing
[b] Elevation referenced to mean Low Tide, City/Borough of Juneau datum

4.2 Ground Water and Surface Water Sampling

4.2.1 Ground Water Sampling

The four monitoring wells were sampled on May 15 and 16, 1991, at low tide. A minimum of three pore volumes were purged from each monitoring well before sampling. Purge water was disposed of on the ground adjacent to the monitoring well. Specific conductance and pH were monitored with a DSpH brand calibrated meter. The meter was calibrated before sampling on each day with standard pH and conductivity solutions. Purging continued until specific conductance and pH stabilized to ±10 percent. Ground water samples were retrieved with a decontaminated teflon bailer. The bailers were decontaminated by washing with a liquinox detergent and rinsing with distilled water followed by rinsing with a hydrochloric (HCl) acid solution (pH <2), distilled water, methanol solution (1:1), and a final distilled water rinse. Each sample bottle was labeled with time, date, and well location. A duplicate sample was collected at MW-3 (labeled MW-3-1 and MW-3-2) for laboratory quality assurance/quality control (QA/QC). Well MW-3 was selected because of anticipated higher contaminant levels. A field quality control blank was collected prior to sampling MW-3 (labeled FB-1) for field method QA/QC.

4.2.2 Surface Water Sampling

Surface water was collected at four locations: Lemon Creek upstream from the tidegate outflow channel (labeled LCU-1), Lemon Creek downstream from the tidegate outflow channel (labeled LCD-1), the East Pond (labeled EP-1), and the tide flats adjacent to the West Pond at flood tide (labeled TF-1). The samples were collected directly from the surface water. Field parameters were measured and recorded and are presented in Table 4-2.

Table 4-2

Ground Water and Surface Water Field Parameters

Date	Time	Tide	Location	pH	Conductance (µmhos/cm)	Temp °C
5/15/91	0830	lo	MW-1	6.14	710	8
5/15/91	1415	hi	MW-2	6.85	7,860	8
5/16/91	1040	lo	MW-2	*	9,900	8
5/15/91	1330	hi	MW-3	6.33	2,950	9
5/15/91	0940	lo	MW-4	6.50	4,460	9
5/16/91	0850	lo	Lemon Cr[u]	7.02	320	6
5/16/91	0915	lo	Lemon Cr[d]	7.41	1,180	6
5/15/91	1500	hi	Tideflat	7.24	13,800	14
5/14/91	1600	hi	East Pond	8.10	1,900	15
5/16/91	0815	lo	East Pond #	7.08	1,170	15
5/14/91	1600	hi	West Pond	7.25	11,500	12
5/14/91	1600	hi	South Pond	7.55	14,350	12
5/15/91	1500	hi	Tidal Gate	7.05	1,000	5

* pH meter not operational
\# taken at different location from previous date
d downstream from tidegate channel
u upstream from tidegate channel

4.2.3 Laboratory Analysis

A total of ten samples were collected. The water samples were packaged and shipped in iced coolers with chain-of-custody forms to Columbia Analytical Services, Inc. in Kelso, Washington. The samples were analyzed for selected parameters based on proposed Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR 257 and 258), marine water quality standards, drinking water standards, and parameters expected to result from landfill impacts. Table 4-3 lists the parameters that were analyzed.

Table 4-3

Analytical Parameters for Water Samples

Ammonia (as N)	Total Dissolved Solids
Nitrate (as N)	Chemical Oxygen Demand (COD)
Calcium	Total Organic Carbon
Magnesium	Volatile Organic Compounds (VOCs)
Iron	pH
Manganese, dissolved	Arsenic
Potassium	Barium
Sodium	Cadmium
Sulfate	Chromium
Bicarbonate (as $CaCO_3$)	Lead
Chloride	Mercury
Cyanide	Selenium
Total Suspended Solids (TSS)	Silver

4.3 Geology

The materials encountered during this investigation consisted of municipal refuse or incinerator ash mixed with sand and gravel, alluvial sand and gravel, tideflat silts, and glacial till. The refuse overlies the native soils. The refuse consisted of a mixture of paper, plastic, wood, rubber and metal with interbedded layers of sand and gravel. The refuse was encountered in SB-1 (land surface datum [LSD] to 24 feet), MW-1 (LSD to 18 feet), and MW-4 (LSD to 25 feet). Incinerator ash was encountered in MW-3 (LSD to 18 feet). Native materials were encountered in MW-2. Native materials were found under refuse and ash in the remainder of the landfill borings. Fine to coarse alluvial sands with fine to medium subround gravels were encountered in MW-1 (18 to 32 feet bgs), MW-2 (0 to 18 feet bgs), MW-3 (18 to 32 feet bgs), and MW-4 (25 to 40 feet bgs). Tideflat silts were encountered in SB-1 (24 to 38 feet bgs). Glacial till (gravelly silty sand) was encountered in SB-1 at 38 to 41.5 feet below ground surface.

The stratigraphy of the site is complex and typical of a fluvial estuarine environment. Interbedded sand and gravel lenses were deposited by Lemon Creek. Silts were deposited in the adjacent tideflat estuary of Gastineau Channel. The glacial till was deposited by the now receded Lemon Creek Glacier. The unburned refuse and ash were apparently deposited on top of the tide flats or in pits excavated for sand and gravel. Extraction Procedure Toxicity tests performed by others indicate parameters typically found in solid waste incinerator ash.

4.4 Hydrogeology

4.4.1 Hydrostratigraphy

At the time of this investigation, there was about 8 to 24 feet of unsaturated soils/fill underlying the landfill site. All borings encountered ground water. No pressurized (confined) ground water was encountered. Thin moist zones within the refuse fill are considered to be perched ground water lying above the static water table surface. The data indicate that a single water table aquifer underlies the site.

4.4.2 Hydraulic Conductivity

No hydraulic conductivity testing was done. The grain size distribution and depositional environment of the alluvial sands and gravels are characteristic of sediments with a hydraulic conductivity in the range of 10^{-2} to 10^{-4} cm/sec (Freeze and Cherry, 1977).

4.4.3 Water Levels

Depths to ground water were measured in each well after development and before ground water sampling. Table 4-4 summarizes the measured depths to ground water and calculated ground water elevations. The water elevations ranged from 8.32 to 14.57 feet (City and Borough of Juneau Mean Low Tide datum).

Ground water elevations in MW-2 rose by 1.68 feet from May 8 to May 16, 1991. Ground water elevation in the other three wells all rose slightly between May 14 and May 16 although at different rates. The slight rise in these wells is probably due to local recharge of the water table by infiltration of rainfall. The more significant rise in MW-2 is probably caused by the additional influence of monthly high tide maximums.

Surface water elevation changes were noted during the investigation, but were not measured. The water elevation in the East Pond appeared to be stable during the investigation. The water elevation in the South and West Ponds rose approximately 1 to 2 feet during the investigation. The South and West Ponds were connected by a ditch at the start of the investigation.

Table 4-4

Ground Water Elevations in Monitoring Wells (feet)

			MW-1 (31.51)*		MW-2 (19.33)*		MW-3 (31.97)*		MW-4 (36.96)*	
Date	Time	Tide	Depth to Water	Water Elevation	Depth to Water	Water Elevation	Depth to Water	Water Elevation	Depth to Water	Water Elevation
5/14/91	1500	hi	17.02	14.49						
5/15/91	0830	lo	16.94	14.57						
5/8/91	0830	hi			11.00	8.33				
5/14/91	0800	lo			10.04	9.29				
5/15/91	1415	hi			9.67	9.66				
5/16/91	1040	lo			9.32	10.01				
5/14/91	0925	lo					23.65	8.32		
5/15/91	1550	hi					23.57	8.40		
5/14/91	1200	hi							26.45	10.01
5/15/91	0940	lo							26.40	10.06
5/15/91	1545	hi							26.42	10.04

* Elevation of top of well casing; City and Borough of Juneau Mean Low Tide datum

The ditch was filled in on May 12. Water was observed flowing through the tidal gate into the West Pond during high tide on May 15. The flow was not reversed at low tide because the culvert was 2 feet above the level of the water in the pond. At high tide, water in the Lemon Creek Channel was approximately 4 feet above the level of the West Pond. The water had a conductance of 1000 μS/cm. This value is the same for Lemon Creek below the tidal gate at low tide indicating that the water entering the West Pond was water from Lemon Creek, and not marine water.

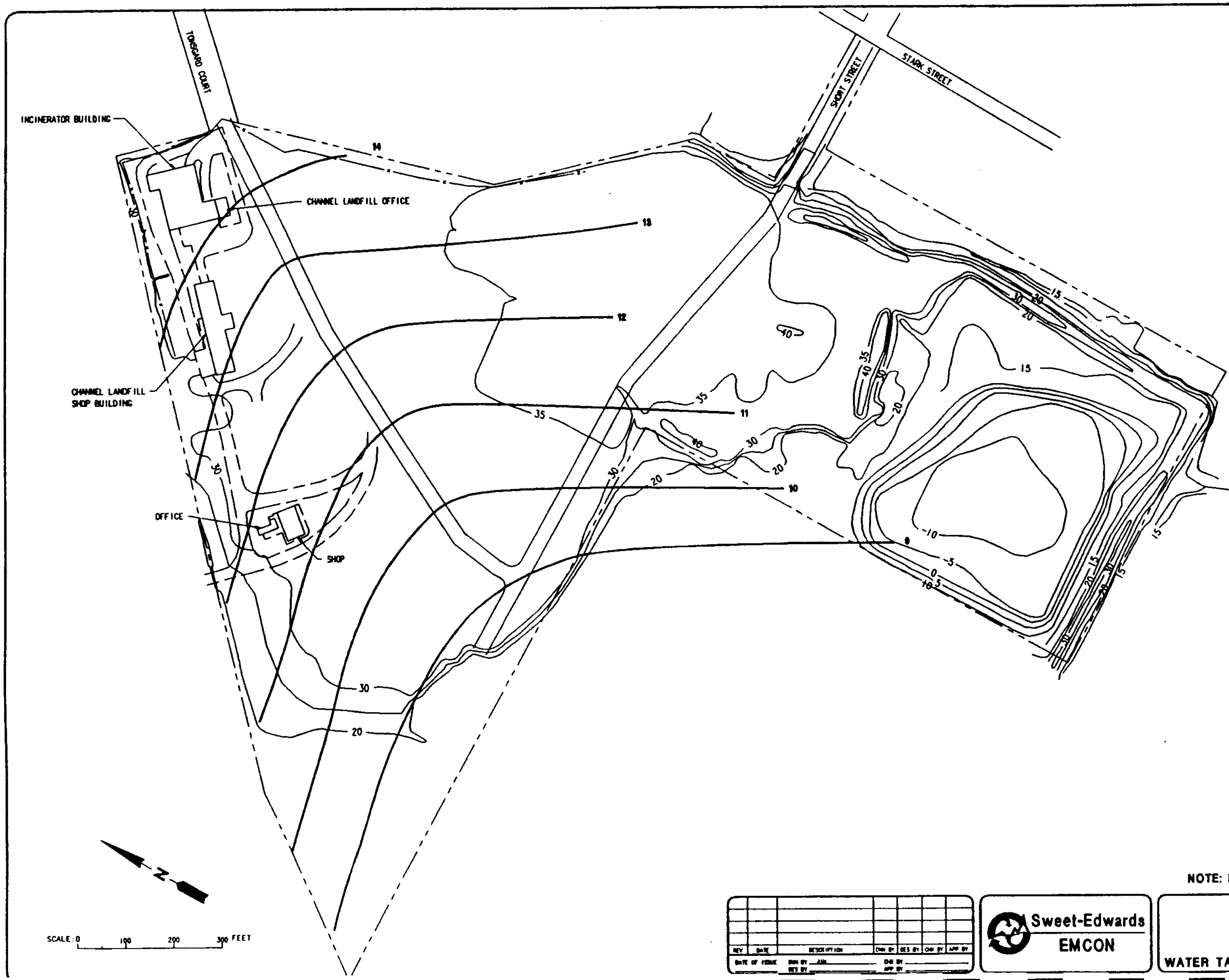
4.4.4 Tidal Influence

Ground water elevations in MW-2 were monitored periodically during two tidal cycles on May 14 to 16. There was no diurnal tidal influence on ground water elevation in this well. However, there was a 1-foot change in elevation over the two-day period. This corresponded with the rise in elevation in the West Pond. Fluctuations of ground water elevations are apparently attenuated by the filling and storage of water in the West Pond. The pond fills only at monthly maximums and then apparently drains out to the Gastineau Channel during monthly minimums, or is pumped down by the adjacent property owner for sand and gravel operations. The water elevation in MW-2 apparently follows this pattern.

4.4.5 Ground Water Flow

The ground water flow direction of the water table aquifer is southwesterly towards Gastineau Channel (Figures 4-3 and 4-4). The flow direction is consistent with the anticipated flow direction towards the channel. It appears that ground water flow was discharged into or towards the excavated sand and gravel pits at the time of the study. However, the south pit was recently enlarged by the Red Samm construction company. Therefore, the flow direction may be temporarily affected by the enlarged pit.

The average hydraulic gradient of the water table aquifer at the time of the investigation was 0.005 ft/ft. Assuming a hydraulic conductivity of 5×10^{-3} cm/sec or 1.4 ft/day and a porosity of 0.25, the average ground water flow is 0.3 in./day or 10 ft/yr. This ground water flow velocity is an average. Variations in the hydraulic conductivities of alluvial gravels is high and the velocity of ground water in some portions in the water table aquifer could range from 1 to 100 ft/yr.



NOTE: NOT FOR CONSTRUCTION

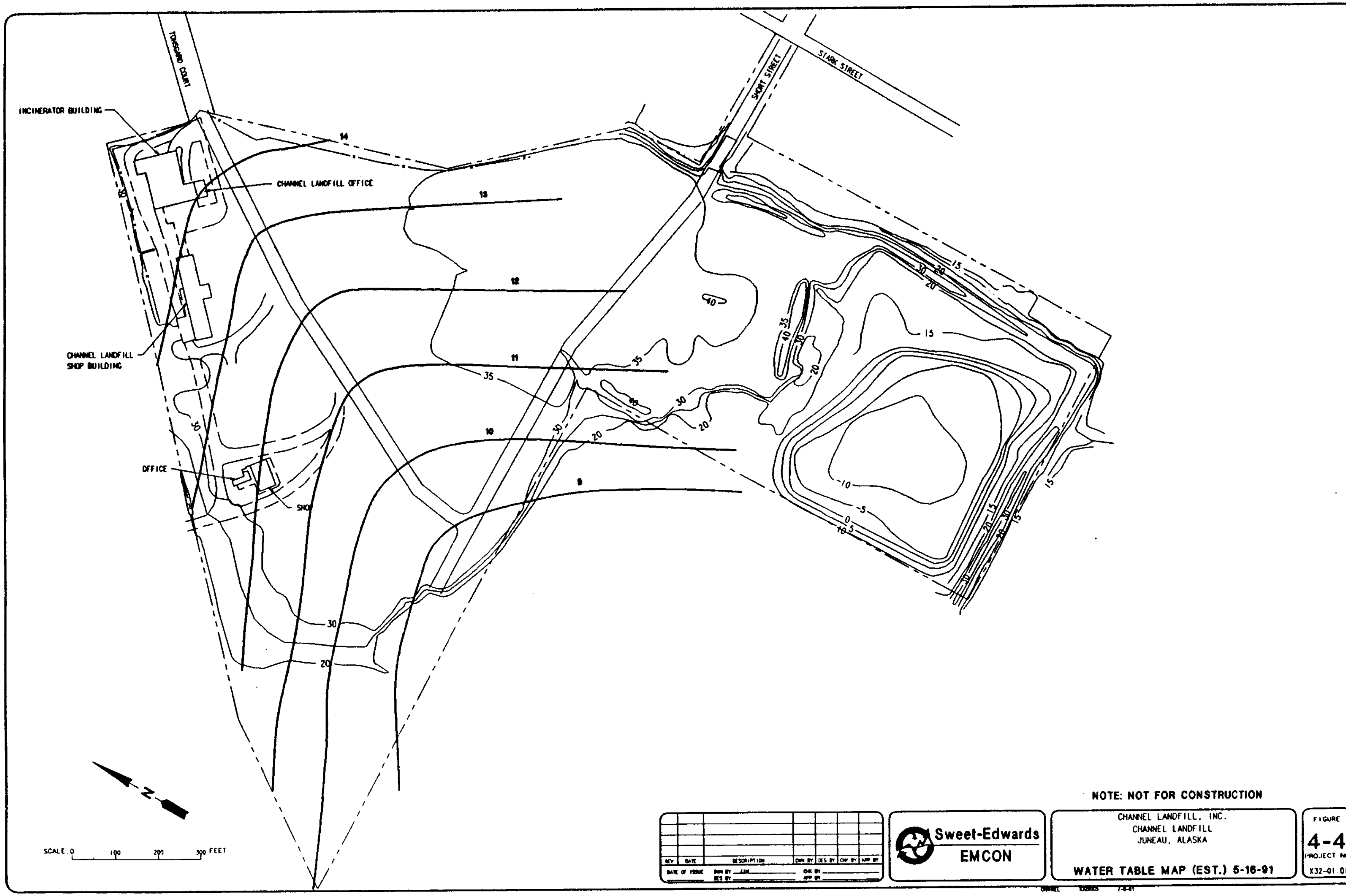
REV	DATE	DESCRIPTION	CHK BY	DES BY	CHK BY	APP BY

Sweet-Edwards EMCON

CHANNEL LANDFILL, INC.
CHANNEL LANDFILL
JUNEAU, ALASKA

WATER TABLE MAP (ESTIMATED) 6-8-91

FIGURE **4-3**
PROJECT NO X32-01.01



NOTE: NOT FOR CONSTRUCTION

Sweet-Edwards EMCON

CHANNEL LANDFILL, INC.
CHANNEL LANDFILL
JUNEAU, ALASKA

WATER TABLE MAP (EST.) 5-16-91

FIGURE 4-4
PROJECT NO X32-01.01

4.5 Hydrochemistry

4.5.1 Previous Studies

QA/QC. Historical water quality data were obtained from ADEC and Channel Corporation. In general, sampling procedures were not described. Chain-of-custody and laboratory reports necessary for a quality assurance/quality control (QA/QC) review were not available. It was assumed for this report that the analytical results of previous studies are useful for comparison purposes, but validity of concentration values is uncertain.

Ground Water. The water quality of the ground water near the landfill was tested in nine private wells located within a 1-mile radius of the landfill, as discussed in Section 4.1.2. Water quality data are presented in Appendix 5. Water samples were typically collected from a tap, and not from the wellhead. Therefore, analytical results may not reflect actual ground water quality. The concentrations of metals are highly variable ranging from non-detection to 2.7 mg/l for barium, non-detection to 0.025 mg/l for selenium, and non-detection to 0.006 mg/l for arsenic. Trace concentrations (< 5 μg/l) of benzene and solvents were detected in samples from the nearby Mark 'n' Pak and Old Charlie's Marina wells. Major anions and cations are also highly variable. For example, iron varies from 0.2 to 16.7 mg/l and manganese from non-detection to 2.2 mg/l.

Surface Water. The water quality of the surface water in the gravel pits located to the southwest of the landfill is tidally influenced (see Section 4.4.4). Metals concentrations are generally an order of magnitude lower than in ground water. No organic compounds were reported in gravel pit water samples. Their water quality is characterized by conductance greater than 1000 μS/cm, and iron and manganese concentrations on the order of 0.1 to 10 and 0.01 to 1 mg/l, respectively. Concentrations of sodium, sulfate, and chloride are interpreted to suggest a mixture of marine water and fresh water. Iron and manganese concentrations range from 0.05 to 0.2 mg/l and 0.005 to 0.01 mg/l, respectively, in all reaches of Lemon and Vanderbilt streams. Metals concentrations are generally near the detection limits and no organic compounds were reported. Conductance, chloride, sulfate, and sodium concentrations increase near the outlets of the streams, where tidal influence is greatest (Appendix 3).

Ash. A summary provided by Channel Landfill, Inc., of extraction procedure toxicity (EPTox) results from ash samples from 1986 to 1990 was reviewed. Levels of lead and cadmium sporadically exceed the levels at which the ash would be considered a hazardous waste under 40 CFR Part 261, Characteristics of Hazardous Waste. However, EPTox is no longer the tool used to determine if a waste is hazardous. Since September 1990, the Toxicity Characteristics Leaching Procedure (TCLP) is the EPA approved tool for determining if a waste is hazardous. A prediction can not be made if the ash would be considered hazardous utilizing TCLP.

4.5.2 On-site Ground Water Quality

Data Validity. The ground water chemistry of the water table aquifer was sampled at the four monitoring wells. The data were compared with EPA guidelines for laboratory QA/QC regarding holding times, matrix spike, and surrogate recoveries. The analytical values from the duplicate samples taken at MW-3 are within 10 percent relative percent difference for all compounds or parameters except for total lead (20 percent) and alkalinity (27 percent). The field method blank contained trace levels of dissolved lead and chloroform which are believed to have come from the distilled water used for decontamination. No detections were noted in the laboratory method blank. Therefore, the data set for ground water quality is considered valid for use in this report. The water quality laboratory results are presented in Appendix 5.

Ground Water Chemistry. Arsenic, barium, chromium, and lead were detected in all unfiltered samples from new on-site wells. Total arsenic concentrations ranged from 0.018 to 0.052 mg/l, total barium ranged from 0.481 to 1.50 mg/l, chromium ranged from 0.01 to 0.212 mg/l, and lead ranged from 0.008 to 0.065 mg/l. Selenium was detected only in MW-1 (0.013 mg/l). Barium was detected in filtered samples in all new on-site wells, ranging from 0.096 to 0.355 mg/l. Dissolved cadmium was detected in MW-2 (0.004 mg/l) and dissolved lead was detected in MW-3 (0.005 mg/l). No volatile organic compounds (VOCs) were detected in MW-1 or MW-2. Six VOCs were detected in MW-3 and MW-4. Acetone (69 to 107 mg/l), methyl ethyl ketone (MEK) (140 to 251 mg/l), ethylbenzene (1 to 13.5 mg/l), and total xylene (3.1 to 66.8 mg/l) were common to both wells. Chloroethane (2 mg/l) and toluene (23.5 mg/l) were detected in MW-3. Trichlorofluoroethane (210 mg/l) and benzene (69 mg/l) were detected in MW-4. Inorganic parameters are consistent between the wells except for sodium chloride, TDS, and TSS, which are higher than the average in MW-2, and ammonia, which is lower than the average in MW-2.

Spatial Variation in Ground Water Chemistry. Impacts to the ground water by landfill operations should be evident by comparison of water quality between the upgradient well and downgradient wells. Monitoring well MW-1 is the upgradient well on the property and MW-2, MW-3, MW-4 are the downgradient wells. Total metals concentrations of arsenic and selenium are highest in MW-1, total barium and chromium are highest in MW-2, and all total metals are lowest in MW-4. There does not appear to be a trend in total metals concentrations in ground water. Dissolved barium, cadmium, and lead are higher in downgradient wells than in MW-1. Dissolved barium is two to three times greater in MW-2 and MW-3 than in MW-1. Dissolved cadmium and lead were detected at the method detection limits in MW-2 and MW-3, respectively. There is slight indication that dissolved metals have increased from the upgradient property boundary to the downgradient property boundary. No VOCs were detected in MW-1 or MW-2. Six VOCs were detected in MW-3 and MW-4. All of the organic and inorganic parameters increase in concentration between MW-1 and the downgradient wells, with the exception of bicarbonate, manganese, ammonia, COD, and TOC in MW-2. These observations indicate that landfilling operations have impacted ground water quality beneath and downgradient of the landfill. The elevated concentrations of sodium, chloride, and TDS in MW-2 are similar to those found in marine water. Mixing of ground water and marine/brackish water entering the tide gate in the west pit may be responsible for these elevated concentrations.

The off-site ground water quality is variable and not readily comparable to on-site water quality. The unpublished ADEC and Channel Corporation ground water quality data are used for comparison. Ground water wells are located upgradient and crossgradient to the landfill (see Appendices 3 and 4 for data, Figure 4-1 for well location). Ground water was sampled from supply taps and not the wells. Iron and manganese concentrations are generally lower than those in MW-3 and MW-4. There are few detections of VOCs in ground water samples and in every case they are less than 5 $\mu g/l$. Inorganic parameters are variable and no spatial trends are indicated.

Comparison with Water Quality Regulations. Total trace metals exceeded the maximum contaminant levels (MCLs) for the national priority drinking water standards (NPDWS) in the upgradient well MW-1 (arsenic - 0.52 mg/l, selenium - 0.013 mg/l), and the downgradient wells MW-2 (barium - 1.5 mg/l, lead - 0.065 mg/l) and MW-3 (barium - 1.1 mg/l). The MCL for lead in marine and fresh water (both chronic exposure) was exceeded in all wells. The MCL for chromium in fresh water (chronic exposure) was exceeded in MW-2. These samples were not filtered before analysis and contained native silts drawn into the well during purging and sampling. A second set of samples was filtered and analyzed for comparison. The filtered samples did not contain any metal concentrations that exceeded MCLs. The turbidity of the unfiltered samples was not quantified. However, chemical analysis of these sediment-rich samples reports the combined concentrations of dissolved metals and metals occurring as (or chemically bound with) sediments. Therefore, chemical analyses of these unfiltered sediment-rich samples are overestimates of metals concentrations in ground water. Only the dissolved metals are considered mobile in ground water and useful for comparison with MCLs.

Acetone and methyl ethyl ketone were detected in the downgradient wells MW-3 and MW-4 (69 to 251 μg/l). BTEX compounds (benzene, toluene, ethylbenzene, xylene) were also detected in these two wells (1 to 67 μg/l). This is the only exceedance for a VOC in ground water. The concentration is close enough to the MCL that resampling is warranted to determine if the benzene exceedance was a unique sampling event.

The only other MCL exceedance for a compound was iron. The MCL is 1 mg/l in fresh water (chronic exposure). The MCL was exceeded in all ground water wells (MW-1 - 118 mg/l, MW-2 - 184 mg/l, MW-3 - 170 mg/l, MW-4 - 85.2 mg/l).

Impacts to Ground Water. Compounds such as iron, manganese, ammonia, chloride, sulfate, and the parameters COD, TOC, and TDS were detected in all wells. VOCs such as acetone and BTEX compounds were detected in two of the downgradient monitoring wells closest to active and historic landfilling. The concentrations of these compounds are greater in the two wells than in the upgradient well (which contains no VOCs). These inorganic and organic compounds are typically found where landfill operations impact ground water. The compounds sodium, chloride, and sulfate, and the parameters COD, conductance, and TDS are also indicative of marine water. These compounds are greatest in the downgradient well MW-2, closest to the tidal gate at the West Pit. Evidently the ground water is impacted by both landfilling operations and marine water mixing.

4.5.3 Surface Water Quality

Surface Water. Samples were collected at 4 sampling locations to provide background and downstream surface water quality data. One sample was collected at Lemon Creek upstream of the tidal gate channel, one sample collected downstream of the tidal gate channel, one sample collected at the tidal flats south of the West Pit at high tide, and one sample collected at the East Pit. Water quality laboratory results are presented in Appendix 5.

Barium was the only metal detected in unfiltered samples, ranging in concentration from 0.022 to 0.06 mg/l. A similar range of concentrations for filtered samples (dissolved barium) was detected (0.024 to 0.064 mg/l). The lowest concentration was found in the tideflat and the highest concentration in the East Pit.

Four VOCs were detected in the East Pit: acetone (22.1 μg/l), ethylbenzene (1 μg/l), toluene (2.6 μg/l), and xylene (2 μg/l). No VOCs were detected in the other samples.

There was a broad range of values for inorganic parameters. Concentrations were indicative of environment. The upstream sample from Lemon Creek had the lowest concentrations of dissolved and suspended solids, lowest pH,and lowest conductivity. These parameters increased in the following order: Lemon Creek downstream, East Pit, and tidal flat. The progression indicates increasing influence of mixing of fresh water with marine water.

Spatial Variations in Surface Water Quality. The analyses of samples from Lemon Creek and the East Pit are similar to those of previous studies (Section 4.5.1). The samples were collected at the same locations. It is evident from all analyses that the spatial variation of surface water quality is dependent on proximity to the Gastineau Channel. The samples from the West Pit and East Pit have concentrations of iron, manganese, and ammonia that are an order of magnitude higher than in other surface waters, in addition to low level concentrations (< 25 μg/l) of VOCs. The surface water quality of Lemon Creek and the tideflats of Gastineau Channel do not appear to be impacted by landfill operations. The water quality of the East Pit appears to be impacted by landfill operations.

There are no exceedances of any maximum contaminant levels (MCLs) for any compounds in the surface water samples except for iron (1.02 μg/l) in the East Pit.

4.5.4 Summary

The ground water beneath and downgradient of the landfill is impacted by the landfill operations and marine water. The only VOC exceedance was benzene in MW-4. The total metal samples contained arsenic, barium, lead, and selenium concentrations that exceeded MCLs. These concentrations are overestimated because of the presence of suspended solids in the sample. No dissolved metals exceed MCLs. Dissolved metals are those that are actually transported in ground water. Therefore, standards for metals in ground water are not exceeded. Surface water quality has also been impacted by landfill operations but only in the adjacent sand and gravel pit and at levels 4 to 10 times lower than in ground water.

Cross-gradient wells ('Mark-n-Pak' and Old Charlie's Marina) were noted to contain low levels of VOCs (< 5 μg/l). These compounds were not detected in the upgradient well MW-1. Given that the stratigraphy of the water table aquifer is complex and numerous permeable channels exist, a single upgradient well is not sufficient to be confident that no contaminants are flowing across the upgradient property boundary. The source of the VOCs may not be the landfill, but instead an upgradient source, especially given that the landfill is located in an industrial area. Additionally, ground water flow directions can only be estimated with four wells. The actual ground water flow is likely to be more complex than depicted on Figure 4-3. Additional monitoring wells should be installed for verification of upgradient ground water quality and flow conditions.

Ground water and surface water field parameters collected during ground water sampling are presented on Table 4-5. The pH in ground water samples ranged from 6.14 to 6.88. The specific conductance in ground water samples ranged from 710 to 9,900 μmhos/cm. The temperature in ground water samples ranged from 8° to 9°C. The pH in surface water samples ranged from 7.02 to 7.40. The specific conductance in surface water samples ranged from 320 to 13,800 μmhos/cm. the temperature in surface water samples ranged from 6° to 15°C.

The results from analytical testing are summarized in Table 4-5 for parameters that were detected in at least one sample. The complete laboratory results are presented in Appendix 5.

Table 4-5

CHANNEL LANDFILL WATER QUALITY DATA

ANALYTE	Water Quality Standards NPDWS	Marine Chronic	Fresh Chronic	Monitoring Wells MW-1	MW-2	MW-3-1	MW-3-2 (dupl)	MW-4	Surface Water EP-1 East Pit	TF-1 Tide Flat	LCU-1 Lem. Cr.	LCD-1 Lem. Cr.	Quality Control FB-1	Lab Blank
TOTAL METALS (mg/l)														
Arsenic	0.05			0.052	0.049	0.028	0.031	0.018	ND	ND	ND	ND	ND	ND
Barium	1			0.746	1.5	1.11	1.09	0.481	0.06	0.022	0.03	0.032	ND	ND
Cadmium	0.01	0.093	0.011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium			0.21	0.086	0.212	0.075	0.074	0.01	ND	ND	ND	ND	ND	ND
Lead	0.05	0.0056	0.0056	0.033	0.065	0.05	0.033	0.008	ND	ND	ND	ND	ND	ND
Mercury	0.002	2.5E-05	1.2E-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	0.01	0.054	0.035	0.013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	0.05		0.00012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DISSOLVED METALS (mg/l)														
Arsenic	0.05			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium	1			0.111	0.096	0.314	0.355	0.262	0.064	0.024	0.03	0.034	ND	ND
Cadmium	0.01	0.093	0.011	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium			0.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	0.05	0.0056	0.0056	ND	ND	0.005	ND	ND	ND	ND	ND	ND	0.007	ND
Mercury	0.002	2.5E-05	1.2E-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	0.01	0.054	0.035	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	0.05		0.00012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
VOLATILE ORGANICS (ug/l)														
Acetone				ND	ND	105	107	68.9	22.1	ND	ND	ND	ND	ND
Methyl Ethyl Ketone				ND	ND	234	251	140	ND	ND	ND	ND	ND	ND
Chloroethane				ND	ND	4.2	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane				ND	ND	ND	ND	210	ND	ND	ND	ND	ND	ND
Chloroform			1240	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.8	ND
Benzene	5	700		ND	ND	ND	ND	6.9	ND	ND	ND	ND	ND	ND
Ethylbenzene				ND	ND	1	1	13.5	1	ND	ND	ND	ND	ND
Toluene		5000		ND	ND	24	22	ND	2.6	ND	ND	ND	ND	ND
Xylene (tot)				ND	ND	3.2	3.1	66.8	2	ND	ND	ND	ND	ND
INORGANIC PARAMETERS (mg/l)														
pH		6.5-8.5	6.5-9	6.31	6.63	6.68	6.67	6.8	7.75	7.93	7.33	7.36	6.08	ND
Calcium				52.7	74	164	159	144	50.1	106	7.97	12.2	ND	ND
Iron			1	118	184	172	168	85.2	1.02	0.23	0.12	0.23	ND	ND
Magnesium				31.1	188	82.3	79.9	98.9	16.8	327	4.09	18	ND	ND
Manganese (diss)				1.12	0.186	9.92	10.2	1.77	0.23	0.021	0.009	0.013	ND	ND
Potassium				15	85	63	61	113	11	95	3	7	ND	ND
Sodium				20.6	1460	332	324	508	110	2580	31.6	138	ND	ND
Ammonia (as N)				3.88	0.24	5.33	5.59	67	0.52	ND	ND	ND	ND	ND
Nitrate (as N)				ND	0.3	ND	ND	ND	ND	ND	0.2	0.2	ND	ND
Bicarbonate				185	68	1002	918	1270	139	62	ND	ND	ND	ND
Chloride				17.6	2430	386	377	541	168	3860	59.4	368	ND	ND
Cyanide	0.001		0.0052	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Diss. Solids (TDS)				229	5160	1850	1820	2270	526	9425	111	697	ND	ND
Total Suspended Solids (TSS)				1040	3200	848	856	252	ND	12	ND	ND	ND	ND
Sulfate				2.3	380	5	5	107	68.1	704	13	57.6	ND	ND
ORGANIC PARAMETERS														
Chemical Oxygen Demand (COD)				189	82	248	297	591	30	215	ND	11	ND	ND
Total Organic Carbon (TOC)				11.9	4.1	73.9	70.2	184	7.7	1.9	0.6	ND	ND	ND

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5 LANDFILL EXPANSION ALTERNATIVES

5.1 Expansion Approaches

This section assumes that the City and Borough of Juneau and/or Channel Landfill, Inc., determine that it is in the best interest of the community to maximize the site capacity at Channel Landfill and that ADEC is in agreement with this approach.

The three basic expansion approaches include:

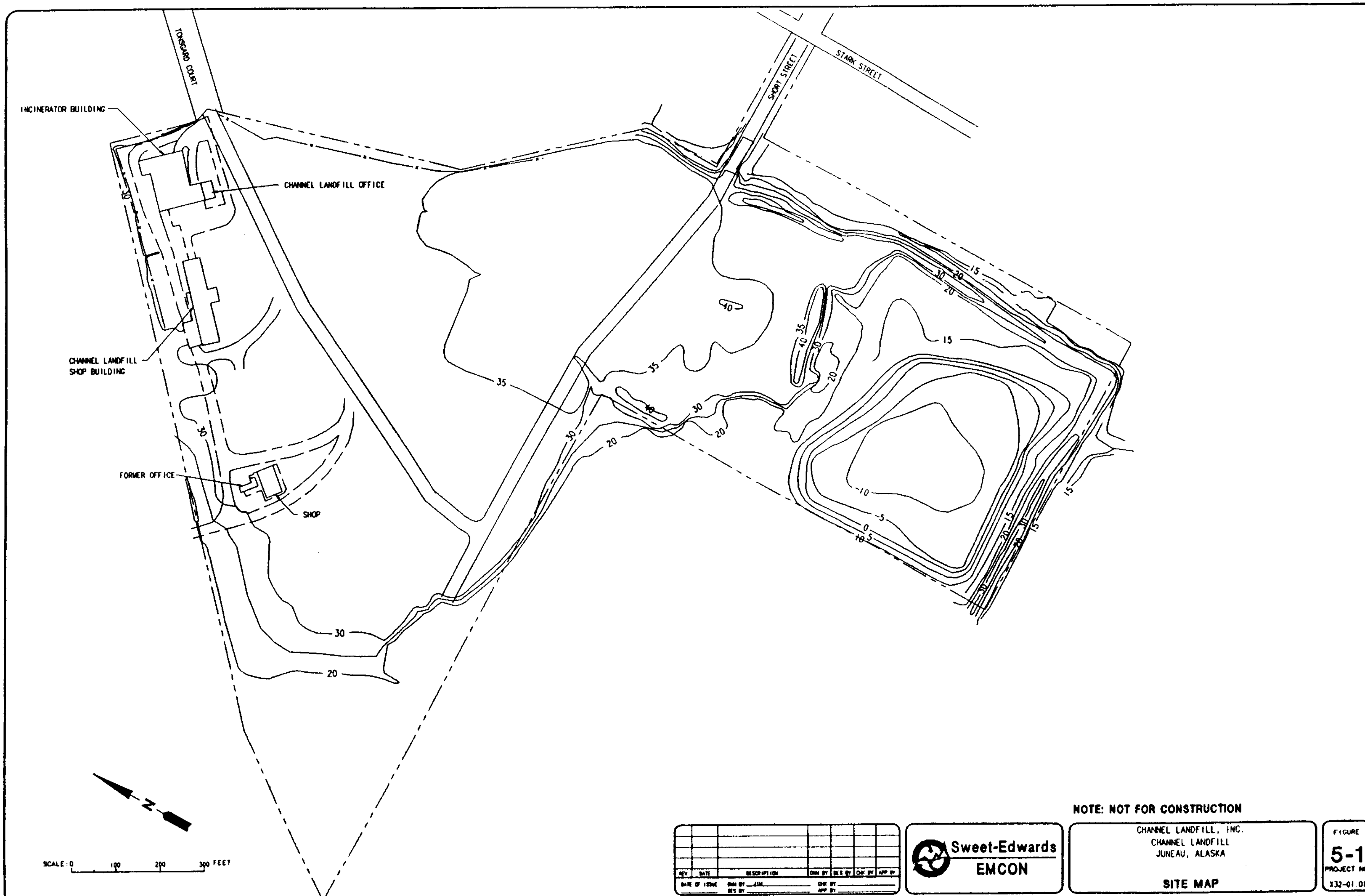
1. Continue to fill the site in the current manner.

2. Fill the site until minimum base grades can be achieved across the site, and then cover the site with a composite (low-permeability soil/geomembrane) cover/liner. Leachate collection would then be installed over the liner and the facility would be operated as a lined landfill.

3. Excavate portions of the existing fill, recover the scrap metal, incinerate the excavated waste, and bury the incinerator ash.

5.2 Continued Unlined Filling Operations

Visual observations at the site reveal a relatively flat surface area with significant airspace available for expansion. However, as shown in Figure 5-1, the irregular nature of the property ownership at the site provides added constraints in developing a final grading plan to maximize capacity at the site. Nevertheless, there is still considerable capacity remaining at the site in merely filling to achieve grades across the site for surface water drainage after closure. If site capacity is maximized through an optimum final grading plan, the site will provide disposal capacity, assuming a continuation of existing practices, for well into the next century.



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JUNEAU, ALASKA

SITE MAP

FIGURE
5-1
PROJECT NO
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5.3 Lined Filling Operations

As an alternative expansion approach, lined filling operations can mitigate the infiltration of precipitation into the existing waste while collecting leachate from continued operations. This may result in long-term improvement of ground water and surface water quality. Using this expansion approach, an interim grading plan would be designed to prepare the existing landfill surface for acceptance of a composite low-permeability soil/geomembrane cover/liner. The grading plan would ensure adequate slope on the landfill surface to promote leachate drainage once landfilling begins on top of the cover/liner. This slope would be on the order of 6 to 10 percent, with the greater slopes over the deeper refuse fill areas, where maximum settlement can be expected. Figure 5-2 shows a typical section for a geomembrane cover/liner. The final grading plans for the two alternatives would be essentially the same, with the primary difference being the lost capacity due to the volume taken up by the liner. This lost capacity represents less than 10 percent of the total volume of the Channel Landfill. The landfill could continue to receive waste in the northwestern area while construction of the cover/liner proceeds in the southeastern area.

The cost estimate is based on several major assumptions. A 24-inch foundation layer is included, to protect the liner/cover from puncture from underlying refuse. The foundation layer material is assumed to be available locally. For purposes of estimation, the geomembrane is assumed to be 60-ml high density polyethylene (HDPE) that must be imported from another state. Other geomembrane materials may be specified instead, such as low density polyethylene, chlorinated polyethylene (CPEA), or polyvinyl chloride (PVC), but would also be imported. A geotextile is included to minimize movement of fine particles into the granular soil and through the foundation layer. Gas collection trenches and gas collection wells are included to provide passive gas venting for solid waste under the liner/cover. These are assumed to be spaced 200 feet apart. Leachate collection piping and a leachate holding tank are included to manage leachate that is collected on top of the liner/cover form newly placed solid waste and ash. The spacing of leachate collection pipes is also assumed to be 200 feet apart. Leachate may be trucked to the local sewage treatment plant for treatment and disposal. The nearby sewer line may have capacity to carry leachate flows to the sewage treatment plant as an alternative.

Table 5-1 presents the estimated cost of placing a cover/liner over approximately 12 acres of previously placed ash, inert waste, and municipal solid waste, which totals approximately $2.8 million. The cost of constructing a liner/cover over 35 acres of the site is approximately $8.3 million. All costs are presented in 1991 dollars.

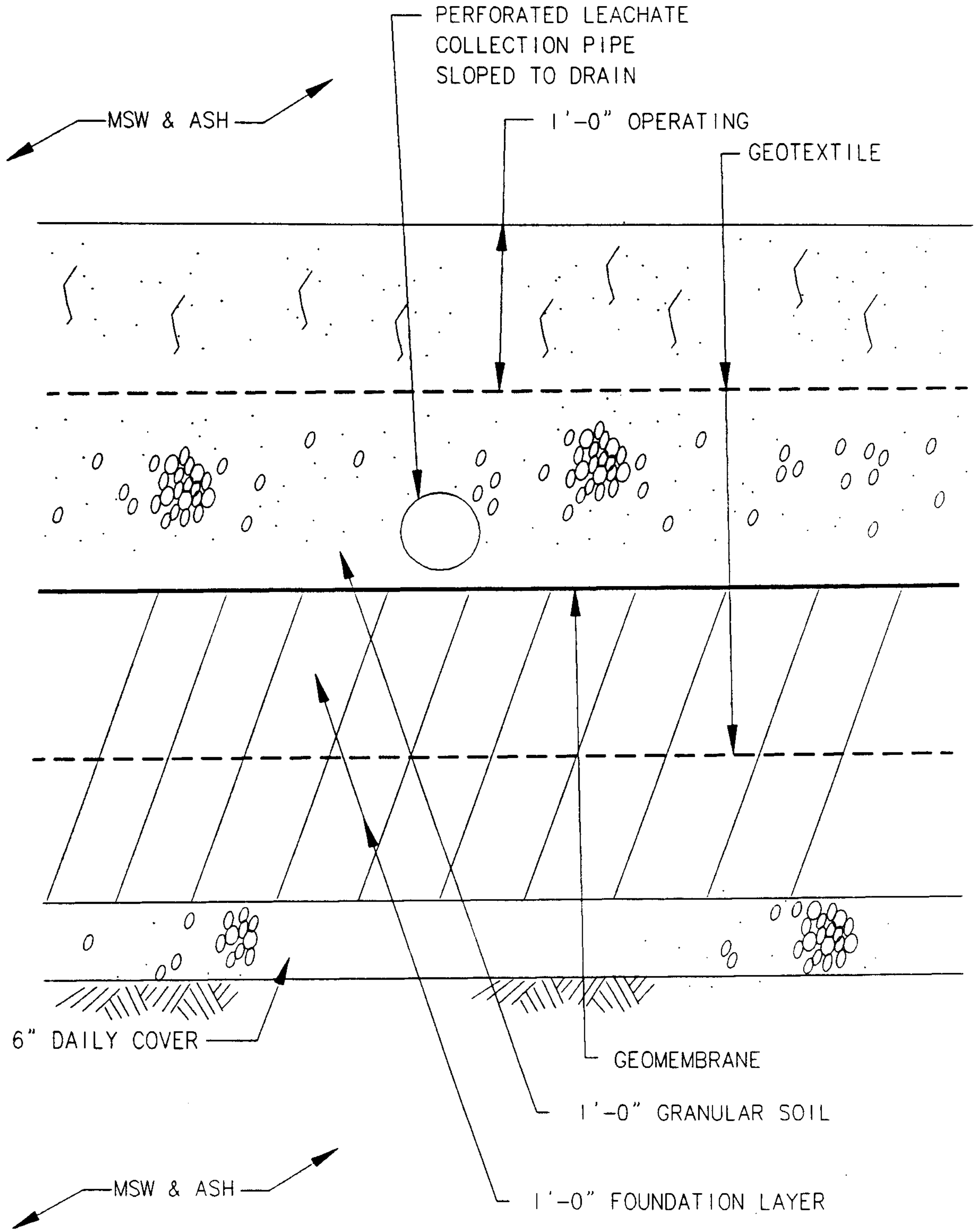

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Figure 5-2
CHANNEL LANDFILL

LINER/COVER SECTION

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Table 5-1

Liner/Cover Cost Estimate

Cap/Liner	Unit Cost ($)	Unit	Quantity	Price
24-inch Foundation Layer	6.00	CY	20,000	$ 120,000
Geotextile/Geogrid	2.50	SY	58,100	145,000
Geomembrane (60 ml HDPE)	8.50	SY	58,100	494,000
12-inch Granular Layer	14.00	CY	20,000	280,000
Geotextile	2.50	SY	58,100	145,000
24-inch Operating Layer	14.00	CY	39,000	546,000
Leachate Collection (200-foot spacing)	20.00	LF	5,900	118,000
Leachate Holding Tank With Pump (30,000-gallon)	75,000.00	EA	1	75,000
Gas Collection Trenches and Wells (200-foot spacing)	20.00	LF	5,900	118,000
Subtotal				2,041,000
Engineering @10%				204,000
Services During Construction @ 10%				204,000
Contingency @ 20%				408,000
Total				$2,857,000

NOTES: This estimate is for 12 acres. The cost to line the entire landfill is approximately $8,333,000.
CY = cubic yards
SY = square yards
LF = linear feet
EA = each

5.4 Final Grading Plan

The final grading plan for Channel Landfill shown on Drawing 1 in the pocket at the end of the report, achieves the following:

- Provides stable grades suitable for long-term closure
- Diverts rainfall runoff to surface water control structures
- Provides access to the landfill surface and gas control facilities for routine maintenance and control
- Controls leachate surface seeps and gas migration
- Meets current and reasonably anticipated final landfill closure requirements

A large portion of the capacity of the southeast fill area relies on the ability to continue to fill the East Pit with inert material. Approximately 240,000 cubic yards are needed to bring the East Pit up to grade. About 18,000 cubic yards of clean soil are needed along the property line within the East Pit so as to avoid placing inert waste at the property line. If clean soil is required to bring the entire pit to grade, the cost will be approximately $1.2 million. If the pit is left unfilled, the capacity of the southeast fill area would be severely reduced, and the service life of the landfill would be reduced by approximately 10 years.

An agreement may be possible between the landfill operator and the adjacent property owner to pump the East Pit dry and maintain it in that condition while filling with inert waste. This action would likely meet with the approval of ADEC officials. It may be possible to fill the East Pit with non-inert solid waste while it is pumped down. However, a consideration is that waste will be located below the ground water table when the area is filled and pumping stops.

The grading plan shows filling the landfill to elevation 60 feet in the southeast area and 85 feet in the northwest area. The final form of the landfill will be visible from Egan Drive and may be visible from neighboring properties at higher elevations, as it will be the most prominent feature of the landscape in the immediate vicinity. To respond to potential neighborhood concerns, future landfill visibility can be predicted by tethering balloons at various elevations and observing whether or not the balloons are visible from surrounding neighborhoods.

5.5 Site Capacity and Service Life

A preliminary review of the remaining capacity at Channel Landfill indicates that approximately 775,000 cubic yards of additional solid waste could be placed at the site. This results in varying lengths of time to final closure, based largely upon continued use of the incinerator to reduce volume. Table 5-2 illustrates this relationship based on waste reduction and waste placement densities. Table 5-3 illustrates the relationship between total landfill volume capacity and landfill height. Table 5-3 also illustrates the net volume available in incremental increases in elevation. Assuming a growth in population peaking at 32,665 in 1998, and continued filling of the landfill in the current manner, the landfill has capacity through the 20-year planning time horizon.

Table 5-2
Landfill and Service Life

Waste Stream Projections	Service Life* With 2 Incinerators	Service Life* Without Incinerators
Baseline	2014	2006
With Recycling	2024	2009
With A.J. Mine	2011	2005
With A.J. Mine and Recycling	2020	2008
With A.J. Mine and Kensington Mine	2010	2004
With A.J. Mine, Kensington Mine, and Recycling	2018	2007
Baseline with Mandatory Collection	2010	2001

* Service life estimated to expire at year listed

Another major influence on service life is the amount of refuse delivered to the landfill for incineration or burial. The City and Borough of Juneau does not mandate refuse collection. It has been estimated that 80 percent of the Juneau area households contract for refuse collection and 80 percent of the waste generated in Juneau is from residences (R.W.Beck). The service life of the landfill could be shortened considerably if collection service was mandated. For the baseline case, the life of the landfill could be shortened by 3 years with mandatory collection.

Table 5-3

Volume Capacity and Landfill Height

Elevation (ft)	East Fill		West Fill		Total Landfill	
	Net Volume	Cumulative Volume	Net Volume	Cumulative Volume	Net Volume	Cumulative Volume
0 to 35	339,700	339,700	0	0	339,700	339,700
40	57,390	397,090				
45	48,500	445,590	153,960	153,960	202,460	559,550
50	38,770	484,360				
55	26,830	511,190	133,685	287,645	160,515	798,835
60	11,200	522,390				
65	340	522,730	100,020	387,665	100,360	910,395
70	0	522,730				
75	0	522,730	70,540	458,205	70,540	980,935
80	0	522,730	22,500	480,705	22,500	1,003,435
85	0	522,730	10,550	491,255	10,550	1,013,985
90	0	522,730	900	492,155	900	1,014,885
Subtotal		522,730		492,155		1,014,885
Total Landfill Volume						1,014,885

NOTE: All volumes in cubic yards. Volumes include inert and MSW fill and daily and final cover.

5.6 Landfill Excavation Alternative

As a third alternative, landfill capacity could be gained by excavating portions of the existing fill, recovering scrap metal, incinerating the excavated waste, and re-burying the incinerator ash. While this has been done on a pilot scale at other landfills, the landfill air space in those cases was worth in excess of $200 per ton. To conduct an excavation such as this, in compliance with occupational health and safety standards, workers must receive safety training, wear personal protective equipment that may include supplied air, and monitor for explosive and toxic gases. Equipment and workers must be decontaminated prior to leaving the site. In addition to on-site workers, the risks and nuisance to the surrounding community must be controlled.

Potential exposure of workers and adjacent property owners to odors, noxious gases, vectors (rats, birds), asbestos, infectious waste, and hazardous waste must be addressed. On a small scale these exposures may be avoided by proper management. Prior to deciding on this alternative, a test excavation should be conducted to evaluate feasibility and cost-effectiveness.

6 FINAL CLOSURE CONSIDERATIONS

6.1 Final Cover Design

The following discussion provides a basis for engineering design considerations for the final cover. The design approaches discussed assume a state-of-the-art approach to closure. Although the new amendments to the Federal regulations have not been finalized, it is assumed that the Channel Landfill site will be required to follow an approach similar to those discussed because of the co-disposal of ash and solid waste at the site.

6.1.1 General

The primary environmental concern in the closure of a landfill is the protection of ground and surface waters, and the control of methane gas migration. Leachate is formed when precipitation or surface water drains through the waste and absorbs soluble contaminants. Leachate can cause environmental problems by seeping from the sides of the site and entering surface water drainage systems, or exiting through the base of the landfill and entering the ground water system.

The gas produced by decomposing refuse within a landfill can present an explosion hazard, and can migrate off-site if improperly handled.

The approximate limits of waste at the Channel Landfill were found during drilling at the property line in some locations. Waste may have been placed beyond the property line during historical operations according to anecdotal information. The final design of the closure cover and gas collection systems should address waste that may have been placed beyond the property line. Waste may need to be removed. A variance obtained from ADEC, or an easement from the adjacent property owners, may allow it to remain in place. The waste that is left in place on adjacent property should receive a final cover after locating the extent of the waste. Landfill gas venting should also be provided for waste left in place on adjacent property. The strategy for addressing waste located on adjacent property will depend on negotiations with ADEC, negotiations with adjacent property owners, and cost-effectiveness of the solutions.

6.1.2 Slope Stability

To evaluate the stability of the proposed landfill slopes, two modes of failure must be evaluated. The first considers large slides with a failure surface through the refuse and encompassing a large portion of the slope. The second condition evaluates the stability of the cover itself, especially critical for geomembrane covers.

To evaluate the overall stability of the proposed landfill slopes, the physical properties of the waste must be estimated. Municipal solid waste is not amenable to conventional shear strength testing due to its physical composition. Consequently, there is a lack of published data on the stability of refuse. To estimate the shear strength of refuse, the results of a 1975 field study performed by Converse Davis Dixon Associates were reviewed. The field test consisted of a full-scale field load test performed on one portion of an existing slope at Operating Industries Sanitary Landfill located in southern California. The field test was stopped before slope failure occurred, but displacements were measured. Based on the measured displacements, Converse (1975) calculated the minimum strength properties that would likely have been in effect for the slope to remain stable during the field test. The results of the estimated shear strength parameters are presented in Figure 6-1.

There is also a lack of published data for ash residue from solid waste incinerators. However, ash residue can be compacted to higher densities than municipal solid waste.

The 5 percent top slopes and the 25 percent (4:1) side slopes shown in the final grading plan (Drawing 1) provide an adequately stable slope based upon the assumed landfill composition and refuse strength data.

6.1.3 Final Cover Section

The final cover section selected for a landfill should provide six basic functions:

- Prevent erosion of the final cover soil
- Reduce or eliminate rainfall infiltration into the waste

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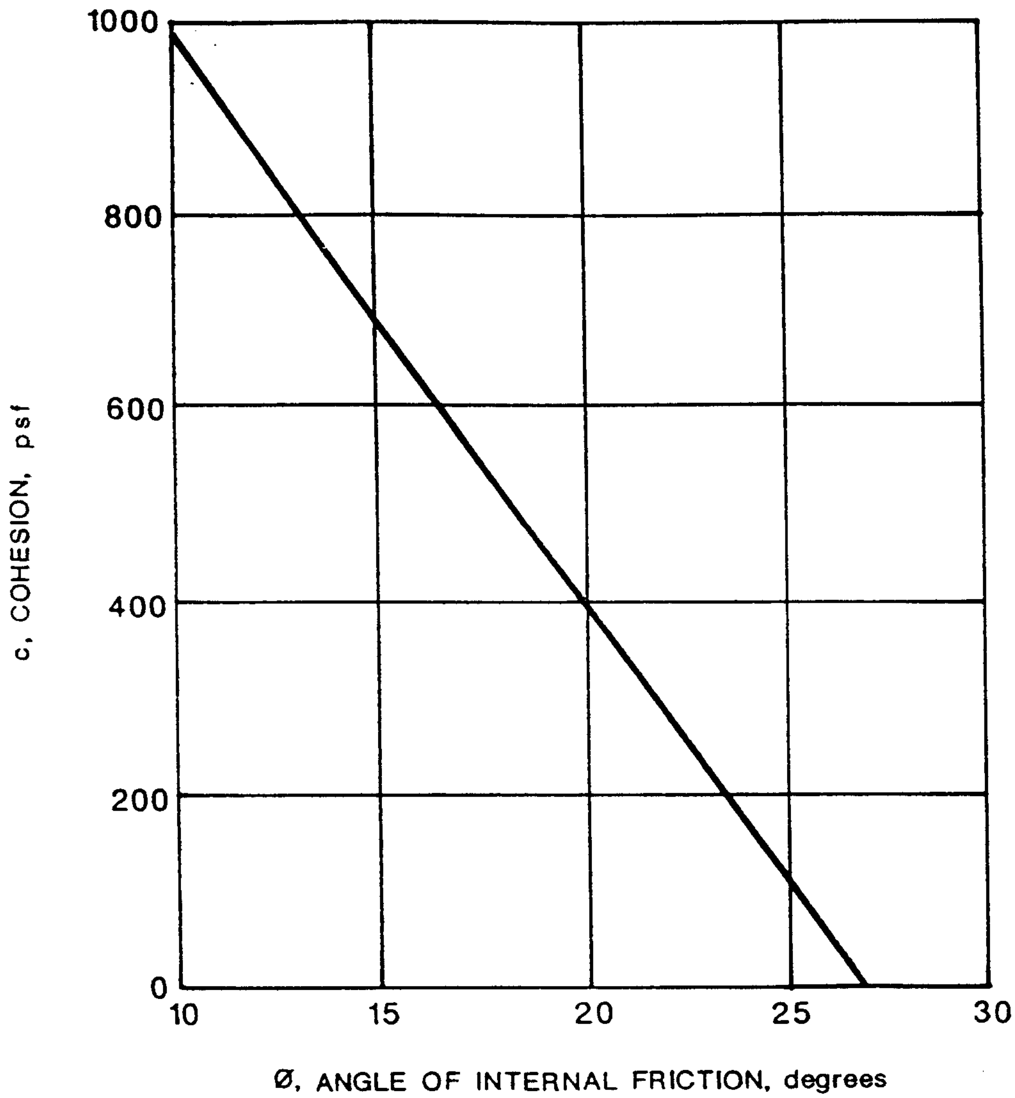

SHEAR STRENGTH PARAMETERS FOR REFUSE

NOTE: The shear strength parameters shown are based on data obtained from a field test performed at the Operating Industries Sanitary Landfill located in Southern California (Converse et al., 1975)

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Figure 6-1
CHANNEL LANDFILL

SHEAR STRENGTH PARAMETERS

- Provide a barrier to prevent uncontrolled venting of landfill gas
- Provide a barrier to prevent seeping of landfill leachate
- Control vectors, and
- Provide an aesthetically pleasing final landform appropriate for final site use.

Two alternative final cover systems were considered for closure of the Channel Landfill. One cover system uses a geomembrane to restrict the surface water infiltration into the waste. The other cover system uses two feet of a silty or clayey soil to form a low-permeability layer to reduce surface water infiltration. If necessary, native soils can be mixed with bentonite to reduce their permeability to an appropriate range. Figures 6-2 and 6-3 show typical drawings of the proposed final cover sections.

A further discussion of the proposed geomembrane and bentonite clay amended soil cover systems is presented in the following subsections. Table 6-1 provides a comparative summary of the alternatives.

Geomembrane Cover Alternative. The primary advantage of a geomembrane cover is that it is much less permeable than a soil cover. Typical values of geomembrane permeability, as measured by water vapor transmission tests, range from approximately 1×10^{-10} to 1×10^{-13} cm/sec. A cover system using low-permeability soil would probably have a permeability of about 1×10^{-6} to 1×10^{-7} cm/sec. Therefore, use of a geomembrane cover rather than a soil cover would result in a significant decrease in the amount of water entering the landfill and generating leachate. However, the use of a geomembrane also presents concerns that must be considered during design of the final cover system. These concerns include:

- The potential for slippage of soil placed on the geomembrane.
- Drainage of water that accumulates on top of the geomembrane.
- The potential for landfill gas buildup under the geomembrane.

The proposed geomembrane cover section incorporates a geomembrane with drainage layers above and below it, and a vegetative planting layer as a surface cover. A geotextile will be placed between the vegetative and drainage layers to prevent fine grained soil particles from migrating into, and plugging, the drainage layer. The geomembrane may consist of either high

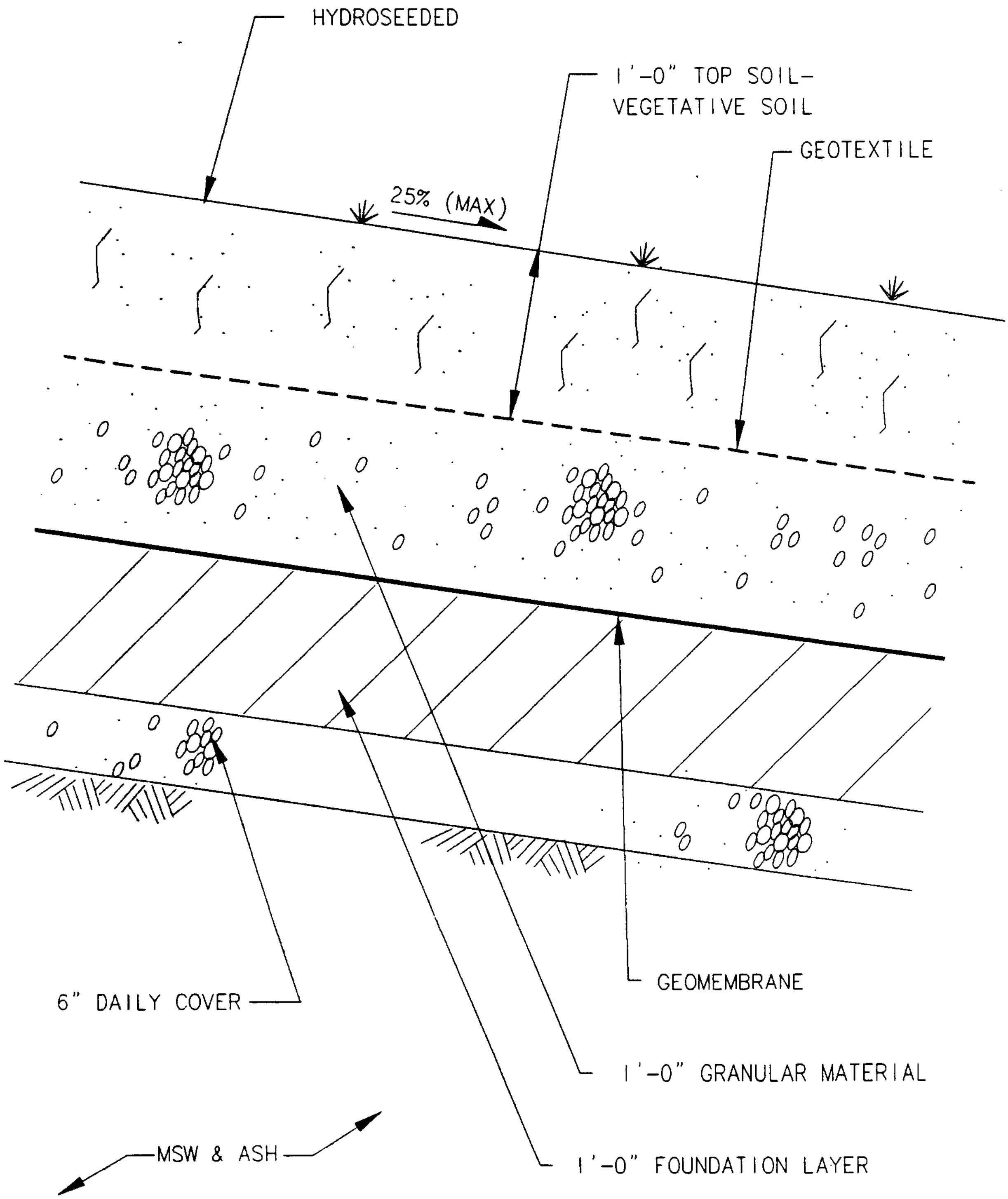

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Figure 6-2
CHANNEL LANDFILL

FINAL COVER SECTION USING GEOMEMBRANE

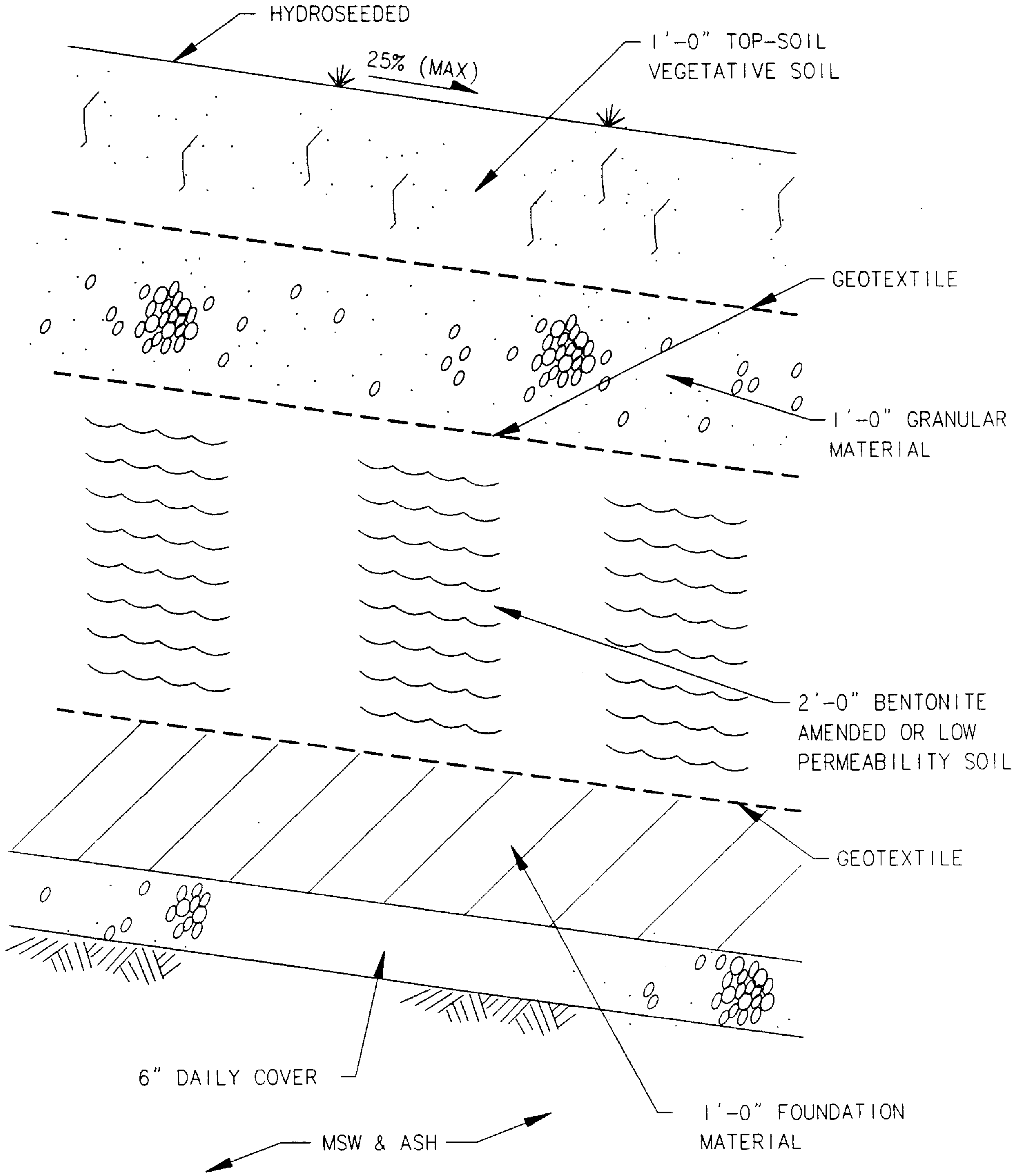

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Figure 6-3
CHANNEL LANDFILL
FINAL COVER SECTION
USING BENTONITE AMENDED SOIL

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Table 6-1

Alternative Comparison

Membrane Cover Alternatives
Advantages • Lower permeability to water and gas • Flexible and conforms to settling landfill surface • Lower maintenance required • Lower cost to install **Disadvantages** • Specialized labor required • Less use of local labor to install • Susceptible to damage during construction
Low-Permeability Soil Cover Alternative
Advantages • High factor of safety against sliding • Construction with local labor **Disadvantages** • Susceptible to cracking due to landfill settlement • Susceptible to root holes and animal burrowing • Higher permeability to water and gas • Higher maintenance required • Lack of locally available low-permeability soils

density polyethylene (HDPE), linear low (medium) density polyethylene (LLDPE), very low density polyethylene (VLDPE), chlorinated polyethylene (CPEA), or polyvinyl chloride (PVC). A granular drainage layer should be placed below the geomembrane to allow landfill gas trapped below the geomembrane to flow to the gas control system and to transmit potential leachate seeps. A typical cross-section of the proposed cover system using a geomembrane is shown on Figure 6-2.

Both granular layers should consist of well-graded sand and gravel. This soil should have a permeability of at least 5×10^{-2} cm/sec to provide sufficient drainage. The use of a granular drainage layer rather than a synthetic drainage net is preferred since the coefficient of friction between the granular soil and the geomembrane is greater than that between drainage net and geomembrane. The coefficient of friction between smooth surface geomembrane and sand is approximately 0.31, while it is about 0.16 between smooth surface geomembrane and synthetic drainage net. To further increase frictional resistance, sand and gravel with a textured geomembrane can be used for a frictional coefficient of approximately 0.45. These coefficient of friction values were determined based on laboratory test data performed for similar projects. The coefficient of friction between the geomembrane and drainage material is important in determining the factor of safety against sliding.

To determine the factors of safety it was conservatively assumed that steady state seepage within the drainage layer on top of the geomembrane was occurring. The amount of water flowing within the drainage layer was evaluated assuming that the vegetative soil layer was saturated and vertical flow into the drainage layer was occurring.

An acceptable factor of safety against slippage of the cover soil is 1.5. Based on the calculated factors of safety textured surface geomembrane placed on slopes less than 29 percent has a safety factor greater than 1.5. The slopes for the Channel Landfill are 25 percent (4:1), so the factor of safety should be adequate. A synthetic geogrid could be used to reinforce the cover soils on slopes steeper than 29 percent (see Table 6-2).

Table 6-2
Summary of Cover Section Slope Stability Analyses

Final Cover Section				
Slope (percent)	(H:V)	HDPE Textured Surface Geomembrane Factor of Safety	*VLDPE Textured Surface Geomembrane Factor of Safety	Acceptable Factor of Safety
25	(4:1)	2.2	1.2	1.5
29	(3.5:1)	1.9	1.1	1.5
33	(3:1)	1.7	0.9	1.5

* Based on preliminary friction angle test performed by EMCON Soils Laboratory.

Rainfall infiltration can be almost completely eliminated, except for leakage due to holes and tears, by using a geomembrane final cover system. Therefore, leachate generation would primarily involve liquid already present in the refuse and ash mass. The overall volume of leachate generated by the site would be greatly reduced when compared with a more permeable final cover system. The calculated steady state flow of water through the geomembrane cover is about 0.07 gallons per acre per hour, assuming a permeability of 1×10^{-12} cm/sec, a geomembrane thickness of 60 mils, and an average head water acting on the liner throughout the year of 1 foot. The critical assumption in determining leachate generation is the rate of flow through the cover, which is dependent on the number of holes and tears occurring in the geomembrane system. Such imperfections can be the result of manufacturing flaws or construction-related damage. This analysis has assumed imperfections will increase the flow through the liner by 20 times to 1.4 gallons per acre per hour. Based on these assumptions, the steady state flow through the liner is 12,000 gallons per acre per year, or approximately 400,000 gallons per year for the entire site. This value should be conservative because the average head of water of 1 foot will not be present during the most of the year.

In addition to its low permeability, geomembrane also has the advantage of being flexible and able to conform to the shape of the landfill as it settles. A geomembrane cover requires less maintenance as well.

There are several disadvantages of a geomembrane cover to consider. Because it must be manufactured off-site and shipped to Juneau, the cost is significant. Specialized labor is required to install the geomembrane resulting in less local labor to complete construction. In addition, the geomembrane is susceptible to damage during construction.

Low-Permeability or Bentonite Clay Amended Soil Cover Alternative. Figure 6-3 shows a typical cross-section of a cover system using a silty or clayey soil mixed with bentonite clay to form a low-permeability layer. The main difference between this design and the geomembrane cover design is the use of 24 inches of low-permeability soil instead of the geomembrane. This may require that local soils be amended using bentonite to lower their permeability to 1 x 10^{-7} cm/sec or less. To achieve a consistent mixture of the bentonite with the soil, mechanical mixing would be needed.

The other soil and drainage layers used in the bentonite clay amended soil design are similar to the layers used in the geomembrane cover design. However, a geotextile may be placed between the bentonite clay amended soil layer and the bottom drainage layer to prevent plugging of the drainage layer, which could be caused by migration of fines.

The advantage of the low-permeability soil cover design is that the factor of safety against sliding on a 33 percent (3:1) slope is approximately 1.7. This factor of safety of 1.7 compares to a factor of safety of 1.3 for a geomembrane cover system without geogrid reinforcement on a 33 percent grade (3:1). However, a geomembrane cover system with geogrid reinforcement will have a factor of safety approximately equivalent to the low-permeability/soil cover. Since the final slopes for the Channel Landfill are 25 percent (4:1), sliding of the cover section should not be of concern for either geomembrane or low-permeability soil cover sections.

There are several advantages of the low-permeability soil cover alternative. First, the low-permeability soil cover layer is less prone to damage during placement of the overlying material during construction. Second, construction with local labor is possible. Third, the soil layer may exhibit some "healing" properties if damaged. Fourth, the soil cover is capable of steeper slope angles, up to 33 percent (3:1) without the use of geogrid reinforcement.

The major disadvantage of the soil cover is its greater permeability. Other disadvantages of the soil cover include the likelihood of cracking due to differential settlement of the refuse and other discontinuities which will develop over time, such as root holes and animal burrowing. Cracks in the cover may allow precipitation to infiltrate into the waste fill or allow landfill gas to escape. Higher maintenance is therefore necessary with a low-permeability soil cover, and greater amounts of leachate are expected to be generated.

Vegetation. Vegetation should be established on the final cover to reduce erosion. It should consist of a mixture of grasses, wildflowers, and legumes. This mixture may be applied by hydroseeding. Additional planting of shallow-rooted shrubs can also be incorporated into the final design cover system. A typical grass seed mixture is presented in Table 6-3.

Table 6-3
Typical Grass Seed Mixture

Kind of Seed		Rate ($lb/1,000\ ft^2$)
Bering Hairgrass *Deschampsia beringensis*		0.5
Backmania *Beckmania syzigachne*		0.2
Red Fescue *Festuca rubra var. Archtared*		0.3
	Total:	1.0

Reference: American North, Inc.

6.2 Refuse Settlement

Settlement in a landfill is caused by a combination of factors including the following:

- Compaction
- Consolidation
- Biological decomposition

Compaction relates to the mechanical effort used to place an initial layer of refuse and subsequent layers above it. A well compacted landfill will have refuse densities of approximately 1,000 to 1,200 pounds per cubic yard or more, and will not experience much short-term settlement. The equipment used at the Channel Landfill may result in refuse densities somewhat less than this, but because of the relatively slow rate of fill, short-term settlement is not expected to be substantial.

Consolidation is a mechanical process in which the refuse volume decreases as the refuse realigns to fill voids in its mass. Consolidation will occur during landfill operations as additional refuse is placed and the load on the lower layers of refuse increases. If the initial compaction of the refuse is poor, large amounts of consolidation will occur during landfill operations and following closure. Consolidation is a continuous process that contributes to both short-term and long-term settlement.

Biological decomposition is a long-term process that involves several types of decomposition and chemical changes in the landfill waste over time. Biological decomposition acts to break down the physical structure of the refuse. Settlement occurs as a result of decomposition. The type of refuse, its physical characteristics, and conditions in the landfill will affect the rate and magnitude of biological decomposition and settlement.

Settlement predictions are largely based on empirical data and theoretical calculations. One general assumption used is that total settlement will be approximately 20 to 30 percent of the overall refuse thickness. Given that approximately 25 feet of refuse were placed prior to the operation of the incinerators, long-term settlement of 5 to 10 feet is expected. The rate of settlement over time is not documented, but it is likely that a significant portion of the total settlement has already occurred.

The incinerator facility has operated for the past 5 years, incinerating a majority of the putrescible waste. Assuming the incinerator continues to incinerate a majority of this waste, the material being landfilled has a much lower settlement potential than waste placed prior to 1986. The final grading plan for the Channel Landfill shows an additional depth of fill of 50 feet for the west fill and 30 feet for the east fill. A maximum of 10 feet of total additional settlement is expected. The maximum elevation is shown as 80 feet in the final grading plan for the northwest fill area. With settlement, the long-term elevation will be approximately 75 feet. The final form of the landfill will be the most prominent feature of the landscape. Trees on the property along Tonsgard Court and Short Street currently shield the landfill from view from Glacier Highway. As the landfill is filled, or if the property owners clear the trees, the landfill may be visible from certain surrounding neighborhoods.

Settlement effects are most visible where an interface between the landfill and native ground occurs. At these locations settlement is noticeable through soil movement and cracking at the final cover interface. On the upper surface of the landfill, broad, warping settlement patterns may occur and will be less noticeable. However, if a landfill is constructed with a very slight slope, e.g., less than 5 percent, settlement may cause flat spots and ponding.

The effect of a potential 10-foot maximum settlement over the 1,000-foot width of the completed landfill surface was evaluated. For a geomembrane cover, the linear shortening would amount to approximately 2 feet, or 0.2 foot per 100 feet of geomembrane. This shortening should not impact the integrity of the geomembrane cover.

Most structures such as downslope flumes, culverts, and plastic underdrain pipes are capable of absorbing minor settlement, but can be damaged by excessive differential settlement. The potential for damage may be reduced by incorporating flexible connections and other design features that allow for differential movement in the final design of the landfill closure cap and other landfill facilities. Inspection and regular maintenance is also recommended to prevent problems.

The gas control system is also susceptible to damage from settlement. The gas piping system on top of the final cover should be designed to accommodate settlement through the use of flexible connections and anchors at critical junctions.

7 LANDFILL GAS

7.1 Landfill Gas Production

A significant by-product of the decomposition process at most sanitary landfills is landfill gas. This gas is produced by the bacterial decomposition of the landfill's organic components in an oxygen-free (anaerobic) environment. Landfill gas production may begin within weeks after refuse placement and continue for 20 to 100 years or more. Landfill gas production can be expected to continue until all organic material is decomposed.

The rate of gas production is affected by the suitability of the landfill environment for methanogenic-producing biological activity. Factors affecting this include percentage of burned vs. unburned refuse, refuse composition, pH, toxic chemicals, refuse compaction, and moisture. In southeast Alaska, refuse tends to have a high moisture content due to the wet climate, which results in a relatively fast rate of refuse decomposition. Therefore, gas in Alaskan landfills would be expected to be produced at an accelerated rate over a shorter period of time as compared with landfills in drier climates.

At the Channel Landfill several factors will tend to retard or reduce the generation of landfill gas. These factors (discussed below) include the quantity of ash being landfilled, the low average temperatures, the high water table, the relatively shallow refuse depth, and the age of the refuse in place.

For our purposes it is assumed that the ash would not generate significant landfill gas since the incineration process destroys much of the organic "substrate" necessary for methanogenic micro-organisms to survive. The ash may produce a small quantity of gas if the refuse was not burned completely, but this quantity is assumed to be insignificant. The high water table within the refuse will significantly retard methane generation, because the methanogenic micro-organisms do not survive in saturated conditions. Also, the saturated conditions will tend to keep the refuse temperature lower, slowing the biological activities and tending to reduce landfill gas generation. The shallow refuse depth also results in lower landfill temperatures and therefore provides a less than optimum environment for the methanogenic micro-organisms. In addition, oxygen intrusion may be more prevalent in shallow landfills which is toxic to the anaerobic microorganisms.

7.2 Landfill Gas Characteristics

The principal components of landfill gas are carbon dioxide ranging from 50 to 60 percent and methane ranging from 40 to 50 percent. Carbon dioxide, when dissolved in leachate, may have a minor impact on leachate quality. Carbon dioxide affects surface vegetation by displacing the air around the root zones of plants. Its greatest effect on human health and safety is its ability to act as a simple asphyxiant. In significant concentrations, the presence of certain trace constituents in landfill gas can also have an adverse impact on human health, if inhaled. The greatest hazard to life and property from landfill gas results from the accumulation of methane gas, which is combustible when present in air in concentrations between 5 and 15 percent by volume. Methane gas can explode if it accumulates in a confined area in the presence of an ignition source. Like carbon dioxide, methane gas is non-toxic to humans, although it does act as a simple asphyxiant. Another concern is due to the placement of potentially hazardous materials in landfills, which even if placed in small quantities, can become a constituent of the landfill gas and may have an adverse impact on human health.

Pure methane gas is colorless, odorless, and lighter than air. It seeks a path of least resistance to vent itself to the atmosphere. Thus it can become trapped in unventilated structures, where it can be difficult to detect by human senses. These characteristics make control of methane gas generation and migration an extremely important issue when a landfill is located adjacent to occupied structures or underground utilities. At the Channel Landfill the electrical and telephone services are located above ground and therefore are not susceptible to landfill gas migration. The water and sewer services, however, are below ground and may provide a conduit for landfill gas migration. A manhole located in Tongard Court is now fitted with a 6-inch vent because of previous problems with explosive gas.

Methane is usually present in concentrations above the upper-explosive-limit (UEL) in landfills, but as it migrates from the compacted refuse to the surface, dilution with air tends to lower the concentration. In landfills capped with soil cover materials, this dilution is aided by air present in the voids of the cover soils. When venting from a soil cover, the methane level of landfill gas is usually below the lower-explosive-limit (LEL) of five percent by volume. In unlined landfills capped with geomembrane covers, the landfill gas migrates horizontally until it is able to vent to atmosphere.

The dilution rate for landfill gas as it moves through the landfill cover and surrounding soil is dependent upon the velocity of the gas. The velocity, in turn, is influenced by the pressure gradient resulting from the continuous generation of landfill gas, the permeability of the soil, and the continuous settlement that is occurring within the landfill. Typical internal static pressures of refuse within landfills located in more arid regions of the country can be as high as 2 inches of water column. For landfills located in the Pacific Northwest, recorded pressures as high as 25 inches of water column are not uncommon.

These internal pressures could force the gas through the cover and surrounding soils at a high rate, thus requiring a greater period of time and distance to dilute the gas. Depending upon site-specific considerations such as the geological environment around the landfill and gas production factors, landfill gas has been known to laterally migrate distances approaching 1,000 feet.

7.3 Landfill Gas Migration

Nation-wide, there have been many recorded instances of fires and explosions caused by landfill-derived methane. However, most of the gas produced within a landfill eventually escapes vertically to the atmosphere, either directly through a landfill's cover soil or after migrating a short distance laterally through surrounding soils.

Any activity that makes the landfill cover less permeable will increase the tendency for lateral migration. The use of geomembrane or low permeability soil covers for landfill closure will inhibit the landfill's natural ability to vent gas through the cover. Pavement or slab foundations can also contribute to lateral migration, as does irrigation, rainfall, snow, frost, or any condition that can fill the voids normally present in the surface soils, thereby decreasing the permeability.

Lateral movement of landfill gas is also influenced by the local geology. Landfill gases tend to migrate laterally if the surrounding soils are porous sands or gravels, or if there are cracks or fissures through which the gas can easily pass. Conversely, fine silts or clay, as well as saturated surrounding soils can influence the lateral and/or vertical movement of gas.

The migration of landfill gas can also be affected by atmospheric conditions. Changes in barometric pressure, temperature, and precipitation can influence lateral gas movement. For instance, variations in barometric pressure can affect the internal conditions of a landfill by either increasing or decreasing the surface pressure exerted on the landfill surface. As the surface pressure changes, it directly affects the amount of effort it takes for the pressure inside the landfill to overcome this external pressure, resulting in changes to the inside "driving force" behind gas migration.

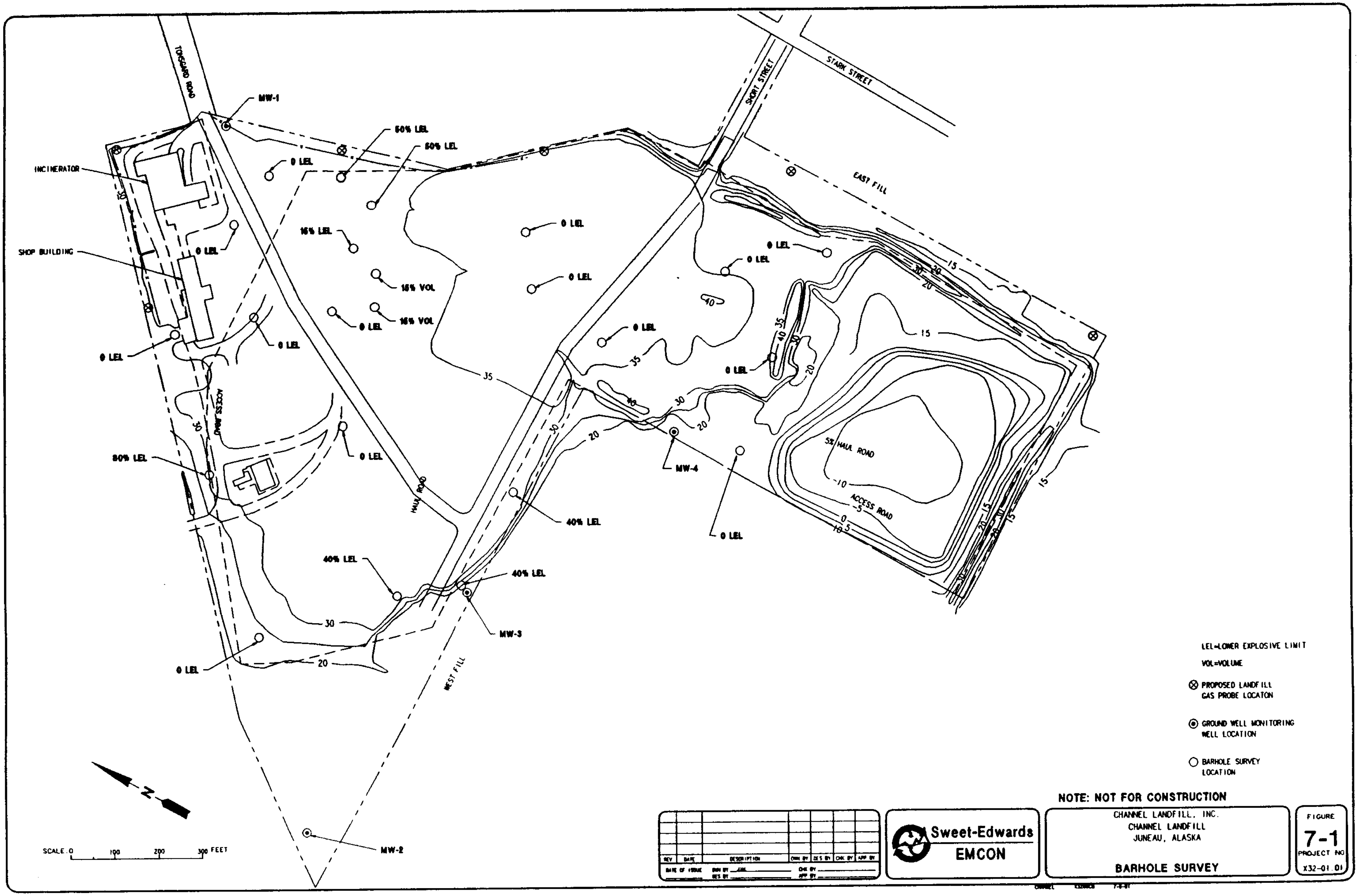
The location of underground utilities near a landfill can provide a conduit for landfill gas migration. Pipe bedding, and/or backfill can facilitate gas movement if the permeability of these materials is greater than that of the surrounding soils. The design of underground utilities near landfills, as well as procedures used in their construction, should therefore consider the potential for gas migration through pipe bedding, trench backfill, and the conduit itself.

The Juneau sewer utility has detected explosive gas in a manhole on Tongard Court. The manhole was fitted with a vent, and the sewer utility reports no further problems. The source of the gas may be the landfill. Some retrofitting of water and sewer services may be required at the Channel Landfill to address potential landfill gas migration. A routine program of gas monitoring should be established to evaluate the need for further action and provide information for design of facilities.

7.4 Barhole Survey

A barhole survey was conducted at the locations shown on Figure 7-1 to determine if combustible gas was detectable in the shallow soils. An "M-PACT-O" tool manufactured by Engineers Tool Co. (Lake City, Iowa) was driven 3 to 4 feet into the ground at each location to create a sampling hole. The tool is 0.5 inch in diameter and is driven by dropping a weighted metal tube that is sleeved over the upper end of the barhole tool. The sleeve is repeatedly raised and dropped, driving the tool into the ground. Once the tool is driven to the desired depth, it is pulled out of the ground and an intake tube attached to a combustible gas/oxygen detector is placed in the hole to monitor for oxygen and combustible gas.

Monitoring of gas concentrations was performed using a GasTech Model 1939-OX combustible gas/oxygen detector. The 1939-OX detector is a three-channel instrument capable of measuring combustible gas on two scales: 0 to 100 percent of the lower explosive limit (LEL) and 0 to 100 percent gas by volume. The instrument was calibrated using methane and oxygen standards before use.


TOMSGARD ROAD
STARK STREET
SHORT STREET
EAST FILL
WEST FILL
INCINERATOR
SHOP BUILDING
MW-1
MW-2
MW-3
MW-4
0 LEL
50% LEL
50% LEL
16% LEL
16% VOL
16% VOL
80% LEL
40% LEL
40% LEL
40% LEL
ACCESS ROAD
HAUL ROAD
5% HAUL ROAD
SCALE 0 100 200 300 FEET
N
LEL=LOWER EXPLOSIVE LIMIT
VOL=VOLUME
PROPOSED LANDFILL GAS PROBE LOCATION
GROUND WELL MONITORING WELL LOCATION
BARHOLE SURVEY LOCATION
NOTE: NOT FOR CONSTRUCTION
Sweet-Edwards EMCON
CHANNEL LANDFILL, INC.
CHANNEL LANDFILL
JUNEAU, ALASKA
BARHOLE SURVEY
FIGURE
7-1
PROJECT NO
X32-01.01

The results of the barhole survey indicate that landfill gas is present in concentrations up to 5 percent methane by volume in the cover soils on the landfill. However, no detectable levels of gas were found in on-site structures. This information indicates that the landfill is producing landfill gas and since gas is present, the potential for off-site migration exists. It is recommended that permanent gas probes be installed prior to detailed design of major construction at the Channel Landfill to more thoroughly evaluate the potential for off-site migration and provide information required for design. Typical gas probes are illustrated in Drawing 4. Typical gas locations for gas probe placement are illustrated in Figure 7-1.

7.5 Regulatory Requirements

Criteria for controlling landfill gas are described in 18 AAC 60.045(a)(6) and are as follows:

> gases generated by decomposition of solid waste are controlled or vented so as not to exceed the explosive limit concentration, and to prevent other health or safety hazards;

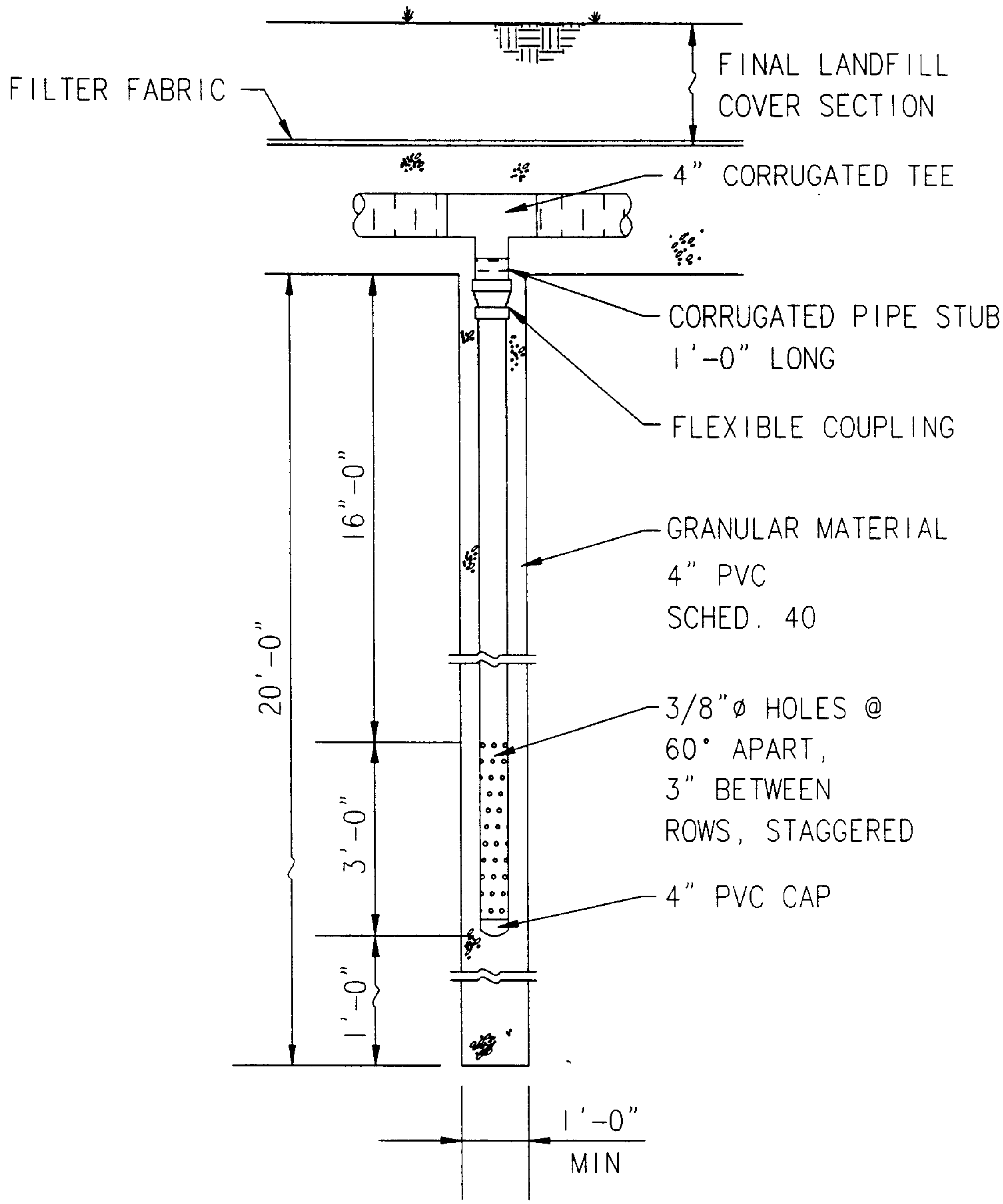
It is logical to assume that the intent of these regulations is to not allow methane to exceed the lower explosive limit at the landfill property boundary, since it is technically unfeasible to prevent the exceedance of the lower explosive limit within the landfill itself.

Therefore, the following section on the landfill gas control system was based on this assumption.

7.6 Landfill Gas Control System

The landfill gas control system should include installation of gas monitoring probes along the property boundary to determine the extent of any off-site migration and monitor the performance of other components of the landfill gas control system. The conceptual locations of the probes are shown on Drawing 1. These locations are based on the limited geologic information available and should be refined as more information becomes available.

At least two other gas control measures should be implemented in conjunction with final closure at the landfill to prevent gas pressure buildup. First, a permeable granular layer should be placed under the landfill cover at closure so gas can be collected from immediately under the geomembrane. Second, a passive gas collection system should be installed in conjunction with placement of the final cover system. The vertical gas wells and gas collectors should be spaced close enough to influence all areas under the cover. A typical gas well and collector are shown in Figures 7-2 and 7-3, respectively.



NOTE: NOT FOR CONSTRUCTION

Sweet-Edwards **EMCON**	DATE 6-91 DWN. JIM APPR. PROJECT NO. X320101	Figure 7-2 CHANNEL LANDFILL **TYPICAL GAS WELL AND COLLECTOR**

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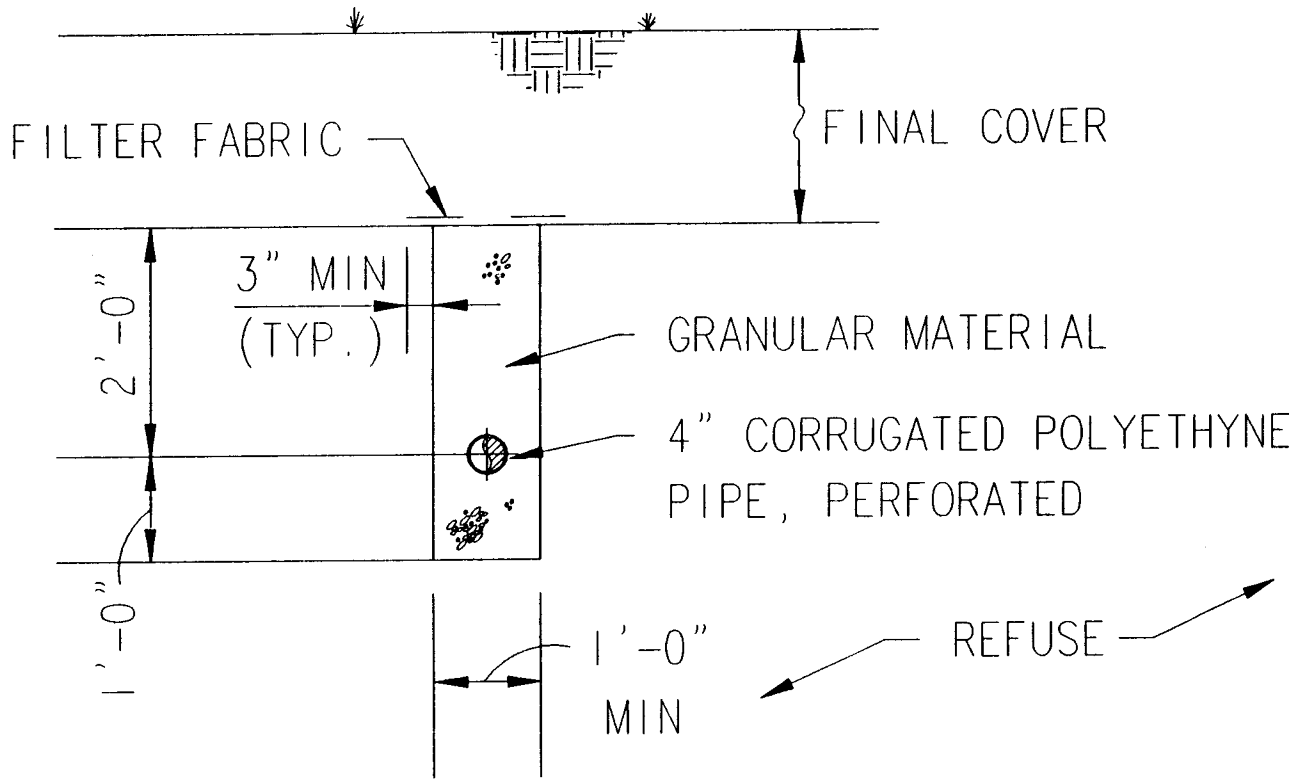

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Figure 7-3
CHANNEL LANDFILL

TYPICAL GAS COLLECTOR

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8 SURFACE WATER MANAGEMENT

8.1 General

The Juneau region receives from 55 inches of precipitation at the airport, to 76 inches in the Mendenhall Valley, to 80 inches downtown. The area receives approximately 100 inches of snowfall annually. The landfill is located in a tidally influenced area within the 100-year flood plain of Lemon Creek. Solid waste management regulations require that surface water run-on be controlled. These regulations also require that the landfill be protected from the 100-year flood.

Proposed storm water runoff control consists of drainage ditches along the perimeter and the haul road on top of the landfill. The overland flow distance on top of the landfill will range from 200 to 300 feet before a drainage ditch is encountered. Since the majority of the top slope will be five percent, surface erosion is not expected, but a large amount of rainfall may infiltrate the cover soil and accumulate in the drainage layer on top of the geomembrane. Water travelling in the drainage layer may be intercepted at the ditch by a perforated underdrain pipe.

8.2 Drainage Ditches

The storm water system essentially consists of conveyance ditches and a set of sedimentation basins (refer to Drawing 1). The system is intended to collect the runoff from the landfill and to discharge it after settling out the suspended solids.

The ditches are located throughout the landfill, alongside the access roads, and around the perimeter. These should be designed to carry runoff from the 25-year, 24-hour storm. The ditches will typically be "V" shaped with 50 percent (2:1) side slopes. Figure 8-1 illustrates a drainage ditch along a typical haul road over municipal solid waste and ash fill. Figure 8-2 illustrates a drainage ditch along a typical perimeter road around the landfill.

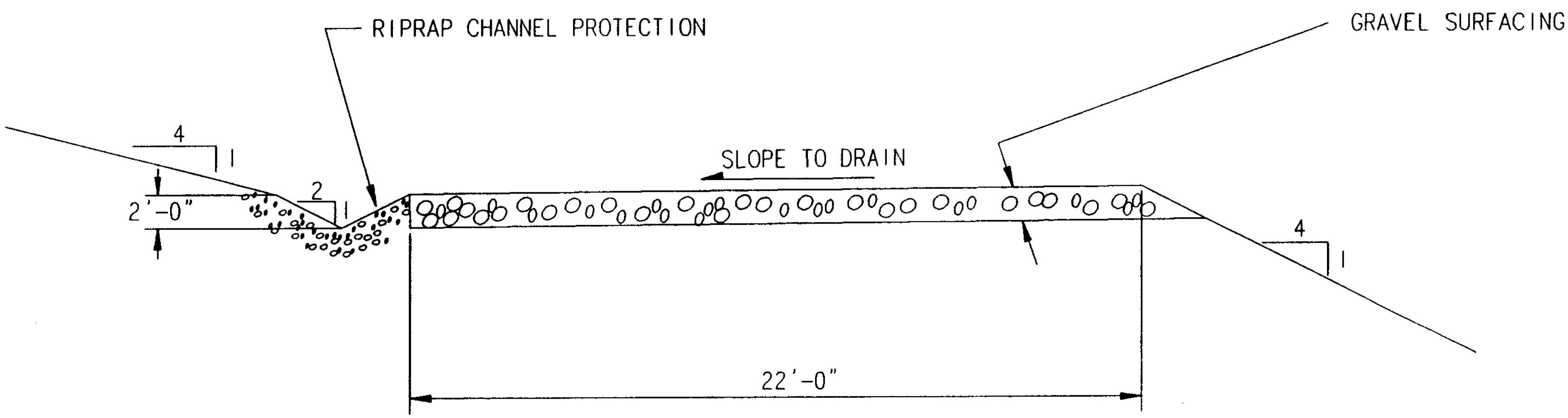

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Figure 8-1
CHANNEL LANDFILL

TYPICAL HAUL ROAD ON FILL

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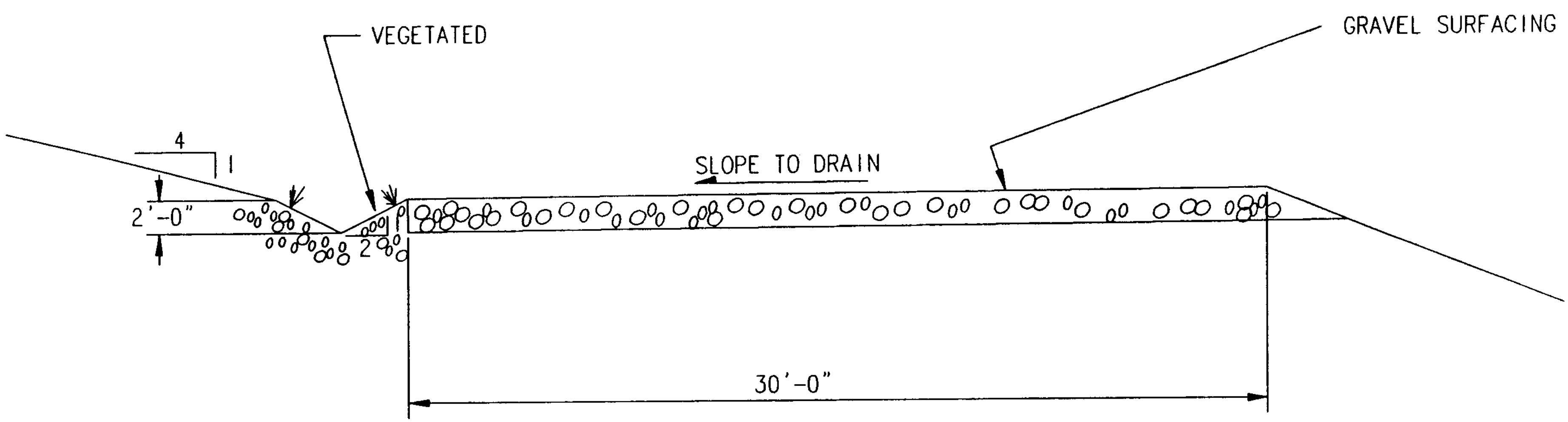

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Figure 8-2
CHANNEL LANDFILL

TYPICAL PERIMETER ROAD AROUND LANDFILL

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8.3 Sedimentation Basins

A series of existing perimeter drainage ditches currently conveys rainfall runoff to Gastineau Channel. The site plan shows the perimeter drainage ditches conveying rainfall runoff to two sedimentation basins prior to discharge into Gastineau Channel. The proposed locations for the basins are illustrated in Drawing 1.

The proposed sedimentation basins are sized based on the quantity of sediment expected to settle out of the runoff water. The Soil Conservation Service advises using a basin volume of 67 cubic yards per acre of drainage area. Based on previous sedimentation basin designs and in order to be conservative, a value of 80 cubic yards per acre was used. This results in a sedimentation storage volume of approximately 1,200 cubic yards. In addition 2 feet of freeboard (space between the design water surface elevation and the top of the basin) and 1 foot of dead water storage (standing water that remains in the basin) was added to each basin, resulting in a total volume of 2,000 cubic yards for each basin.

The final basin design should incorporate an emergency overflow spillway set at 2 feet from the top and an overflow pipe structure. The emergency spillway should be sized to release the 100-year, 24-hour storm event without significant erosion. The overflow pipe structure should be designed to retain the 25-year, 24-hour storm and should be installed with a set of orifice holes allowing the basin contents to slowly drain to within 1 foot of the basin bottom or at the level of the dead storage (water that does not drain).

8.4 Underdrain Pipe

A perforated underdrain pipe is typically located in the granular drainage layer in the landfill cover to provide adequate drainage of the vegetative layer above the low permeability layer. Underdrains typically discharge to the perimeter drainage ditch.

8.5 Culverts

Several culverts will be required under the access roads to direct rainfall runoff from the drainage ditches into the perimeter ditch system. The culverts should be sized to carry the estimated flow from the 25-year, 24-hour storm. The culverts should be installed above the geomembrane cover.

9 GROUND WATER/LEACHATE MANAGEMENT

Leachate is formed when solid waste comes in contact with water and contaminants are dissolved or suspended in the water. At Channel Landfill the source of water includes moisture in the refuse delivered directly to the landfill, quench water used on the incinerator ash, ground water seeping into the landfill, rainfall percolating into the landfill, surface water percolating into the landfill, and snow melt percolating into the landfill. The impacts of leachate upon ground water and surface water are functions of the quantity and quality of the leachate reaching the aquifer, aquifer parameters, the potential for degradation or binding of the contaminants, and the ultimate pathways and receptors of leachate-impacted ground water.

At present, there is no low-permeability cap on refuse at the Channel Landfill and refuse has been deposited below the water table in some areas of the site. Leachate seeps have been observed on the slopes of the west and east pits adjacent to the landfill. No leachate collection system is currently in place. Leachate is therefore entering both surface and ground water at or adjacent to the site and is probably ultimately discharging into the Gastineau Channel.

The potential quantity of leachate generated from the landfill is significantly influenced by precipitation that falls upon the landfill. The soils used for cover have been gravelly sands and silts which permit rapid infiltration into the fill. Infiltrated precipitation will percolate through refuse (becoming leachate) and then continue into the ground water or surface water. The EPA-recommended model, Hydrologic Evaluation of Landfill Performance (HELP), was used to provide information to compare ground water and leachate management strategies. The landfill was modelled without consideration of ground water underflow. Ground water underflow is a source of leachate generation but is not expected to be as significant a source as precipitation. The results of the HELP model are presented in Table 9-1. Under existing conditions the estimated annual movement of leachate from the landfill to the ground water is 45 million gallons per year. The quality of the leachate is unknown, but will be a function of the types of solid waste deposited at the landfill. The leachate would be expected to have elevated levels of VOCs, iron, manganese, nitrate, sulfate, organic carbon, and trace metals such as lead, zinc, nickel, and cadmium.

Table 9-1
HELP Model Estimates

Condition Modelled	Volume of Leachate Discharged to Ground Water (million gallons/year)	Volume of Leachate Collected (million gallons/year)
Existing Conditions	45	Not collected
Final Closure with Geomembrane	0.4	Not Collected
Final Closure with Bentonite-Amended Soil	0.9	Not Collected
Cover/Liner Over 12 Acres	30	13
Cover/Liner Over Entire Landfill	1	35

A measure of the impact of leachate on ground water is a comparison of water quality between the upgradient well MW-1 and the downgradient wells MW-2, MW-3, and MW-4. These impacts are described in Section 4.5.2. Concentrations of VOCs, trace metals, and inorganic compounds increase in the samples of the ground water between MW-1 and MW-3/MW-4, evidence of landfill impacts. If no barriers to downward percolation of precipitation or leachate are installed, this impact will continue and likely increase with increased landfilling. At present, there is one exceedance of a water quality standard (benzene) in a sample from a downgradient well.

It is recommended that further monitoring of ground water and surface water be conducted to further evaluate the potential impacts from landfill operations, tidal influences, and seasonal fluctuations. Additional monitoring wells could improve the understanding of ground water flow and direction and potential sources of contaminants.

Borings to locate the extent of refuse and monitoring wells on adjacent property could be used to identify upgradient or background ground water quality, the potential sources of contaminants, and the extent of contaminant migration through the ground. A study of the sediments in the tide flats and at the confluence of Lemon Creek and Gastineau Channel could help identify potential impacts, if any, to fish, shellfish, and other estuarian organisms.

Final Cover

One strategy for managing leachate and ground water is to continue current filling operations until final grades are achieved and then construct a final closure cover. At first, the weight of the final closure cover may squeeze some leachate out of the landfill into the ground water. However, the closure cover will minimize infiltration of precipitation and as the refuse begins to dewater, less leachate will move into the ground water. Using the geomembrane cover section discussed in Chapter 6, the estimated annual movement of leachate from the landfill to the ground water is 0.4 million gallons per year. Using the bentonite-amended soil cover section discussed in Chapter 6, the estimated annual movement of leachate from the landfill to the ground water is 0.9 million gallons per year. These results illustrate the advantage of using a geomembrane cover section and the potential improvement a closure cover can provide in reducing landfill impacts to ground water. However, the remaining capacity of the landfill is expected to provide over 20 years of service life under baseline waste generation conditions. During that time a substantial amount of leachate is expected to move from the landfill to ground water.

Liner/Cover

An alternative strategy for managing leachate and ground water is to construct a liner/cover over all, or a portion, of the landfill. The liner/cover can reduce the infiltration of precipitation into the older solid waste while providing a liner upon which to collect leachate from future solid waste. By placing a liner/cover over the approximately 12 acres of the southeast fill area, the estimated annual movement of leachate from the landfill to the ground water is reduced to 30 million gallons per year. By placing a liner/cover over the entire landfill, the estimated movement of leachate from the landfill to the ground water is 1 million gallons per year. The estimated quantity of leachate collected on the liner/cover that must be treated is a minimum of 13 million gallons per year, if only 12 acres is covered and a minimum of 35 million gallons per year, if the entire landfill is covered with a liner/cover. The estimated cost to treat leachate that is collected is included in the post-closure cost estimate presented in Section 10.

This strategy does not include collecting leachate from solid waste that is already in place. It is expected that this leachate will be fairly dilute and impractical to pump out of the ground and treat. Continued monitoring of the ground water will provide the information needed to fully evaluate the need for a pump-and-treat system.

10 FINAL CLOSURE PLAN AND PRELIMINARY COST ESTIMATE

10.1 General Criteria

The final closure configuration of the Channel Landfill is controlled by the surrounding topography, refuse settlement, slope stability considerations, and minimum gradients to ensure adequate drainage of the completed fill. Two primary capping alternatives are discussed in this report, and each is designed to achieve the desired end result of minimizing leachate production.

All the alternative cover plans were developed in conformance with the following criteria:

- Final landfill slopes - no steeper than 25 percent (4:1) and no flatter than 5 percent (20:1). Slopes in critical perimeter zones are adjusted to avoid thin layers of fill that are difficult to place and to ensure proper drainage after settlement has occurred.
- Height - limited to elevations required to achieve final slopes. The height of the northwest area is proposed to be approximately 50 feet above the surrounding landscape. The height of the southeast area is proposed to be approximately 30 feet. The maximum elevation is shown as 85 feet above sea-level at the time of closure.
- Topography - a two-mound configuration on existing refuse fill.
- Surface water - runoff diverted around the landfill in lined drainage ditches until sufficiently distant from fill area.

The alternatives were evaluated assuming the landfill will continue to operate and that the normal waste volume of ash, bypass solid waste, and inert material will achieve the base for the final grading due to the nature of the operations at the site.

10.2 Comparative Analysis of Alternatives

Implementing either of the alternatives described in Section 6 would entail closure of between 30 and 40 acres of surface area. The final grading plan for the closure alternatives is shown on Drawing 1. Generalized sections and details for the alternatives are shown on the figures in Section 6.

The efficiency of any of the cover alternatives will be many orders of magnitude better than the present cover system. The following discussion demonstrates the differences between the soil cover alternative and the geomembrane cover alternative.

The use of a low-permeability soil cover, as in one of the soil profiles discussed previously, will result in a significant reduction in the infiltration of precipitation.

One disadvantage of a low-permeability (bentonite clay amended) soil cover system is that the permeability is greater than a geomembrane, thus allowing more infiltration into the refuse. A second disadvantage of a bentonite clay amended soil cover system is that cracks in the cover system may result from settlement of the waste over time requiring greater maintenance. The third and most significant disadvantage of a low-permeability soil cover is the lack of locally developed sources of silt or clay, while transportation cost of bentonite clay is significant.

While there are several disadvantages of a geomembrane cover discussed in Section 6, there are several significant advantages. The most significant advantage of a geomembrane cover is its low-permeability. It also requires less maintenance than a low-permeability soil cover.

10.3 Landfill Closure Recommendation

The geomembrane cover is recommended for use in the final closure of the Channel Landfill based on the considerations discussed above and in Section 6. Regardless of the cover selected, a significant reduction in leachate discharges will occur. It is difficult to quantitatively evaluate the difference or variation in potential leachate discharge from each of the design alternatives due to the differential loading of the soil profiles, and the resultant squeezing effect on the saturated refuse.

Planning level estimates of the costs for closure under the two final closure alternatives are presented in 1991 dollars in Tables 10-1 and 10-2. Several major assumptions were made in preparing the cost estimates. For estimating purposes it is assumed that 35 acres will require a closure cover.

Table 10-1

Geomembrane Cover
Closure Cost Estimate

Closure Cap	Unit Cost	Unit	Quantity	Price
12-inch Foundation Layer	$6.00	CY	56,500	$ 339,000
60-mil HDPE Geomembrane	8.50	SY	169,400	1,440,000
12-inch Granular Layer	14.00	CY	56,500	790,000
Geotextile	2.50	SY	169,400	424,000
12-inch Vegetative layer	40.00	CY	56,500	2,260,000
Hydroseed	1,500.00	AC	35	53,000
Sediment Basin Excavation (2)	3.25	CY	4,000	13,000
Sediment Basin Outlet Structures	1,000.00	EA	2	2,000
Perimeter and Roadside ditches	15.00	LF	6,600	99,000
Gas Collection Trenches	20.00	LF	9,800	196,000
Gas Flare	25,000.00	EA	1	25,000
Subtotal				$5,641,000
Engineering @8%				451,000
Services During Construction @ 10%				564,000
Contingency @ 20%				1,128,000
Total				$7,784,000

NOTES: CY = cubic yard
SY = square yard
AC = acre
EA = each
LF = linear foot

Table 10-2

Soil Cover
Closure Cost Estimate

Closure Cap	Unit Cost	Units	Quantity	Price
12-inch Foundation Layer	$6.00	CY	56,500	$ 339,000
Geotextile	2.50	SY	338,800	847,000
24-inch Bentonite Amended Soil	90.00	CY	113,000	10,000,000
12-inch Granular Layer	14.00	CY	56,500	790,000
12-inch Vegetative Layer	40.00	CY	56,500	2,260,000
Hydroseed	1,500.00	AC	35	53,000
Sediment Basin Excavation (2)	3.25	CY	4,000	13,000
Sediment Basin Outlet Structures	1,000.00	EA	2	2,000
Perimeter and Roadside Ditches	15.00	LF	6,600	99,000
Gas Collection Trenches	20.00	LF	9,800	196,000
Gas Flare	25,000.00	EA	1	25,000
Subtotal				14,624,000
Engineering @ 8%				585,000
Services During Construction @ 8%				731,000
Contingency @ 20%				2,925,000
Total				$18,865,000

NOTES: CY = cubic yard
SY = square yard
AC = acre
EA = each
LF = linear foot

It is further assumed that 35 acres will encompass the areas on-site and off-site that have received solid waste in the past. Both alternatives include a 12-inch foundation layer of soil acquired locally, a 12-inch granular layer of soil acquired locally, and a 12-inch vegetative layer of soil acquired locally. Both alternatives also include two sedimentation basins, drainage ditches, gas collection trenches, and a gas flare. These cost estimates also assume the final land form will be achieved through solid waste fill, and imported soils will not be required for random earth fill. Vegetative soil is produced locally; however, this cost could be lowered by manufacturing the vegetative soil using municipal sewage sludge.

For the soil cover alternative, the cost estimate assumes clay or bentonite must be imported and blended with silt. A source for silt must be developed. The cost for silt is highly variable, depending on the location of the silt source and the costs of development. For the geomembrane alternative, the cost estimate assumes installation of 60-mil high density polyethylene (HDPE). This cost could be reduced somewhat by specifying an alternative material. Geomembrane is not manufactured locally and would be imported from another state.

10.4 Post-Closure Cost Estimate

The post-closure land use of the site will be consistent with that of the existing surrounding terrain. The closed site can be maintained as a grassy open space or developed for more intense uses.

A post-closure maintenance program should be instituted at the landfill to verify that monitoring facilities retain their integrity. Surface drainage control facilities, flood control dikes, final vegetated soil cover areas, ground water monitoring facilities, gas control facilities, and access roads should be inspected on a monthly basis. Cracks in the final closure should be sealed and any erosion damage which may occur as a result of extremely heavy rainfall should be repaired. Temporary berms, ditches, and straw mulch should be used to prevent further erosion damage of soil cover areas until weather conditions permit replacement of eroded soil and reseeding. The sedimentation basins should be cleaned at least annually or when the volume of sediment accumulated interferes with proper operation of the basin. Damage to the flood control berms should be repaired immediately. A program of preventative maintenance should be established for the gas control facilities.

The landfill gas, surface water, and ground water monitoring will continue after the landfill is closed. State regulations currently require monitoring for at least 5 years after closure of the facility. If federal or state regulations are implemented during the active life of the landfill development which call for a longer monitoring period, funds to perform the additional monitoring should be accumulated through tip fees during the active operation. At this time proposed federal regulations are under consideration to lengthen the post-closure monitoring period to at least 30 years after landfill closure.

A cost estimate in 1991 dollars for post-closure maintenance is presented on Table 10-3. The cost estimate includes post-closure site inspections on a monthly basis and with increased frequency during periods of heavy or prolonged rainfall. A total of 18 inspections per year was assumed. The hourly cost of inspections could be reduced if a properly trained employee conducts the inspections incidental to other duties in the vicinity. The cost estimate also includes quarterly surface water and ground water sampling and laboratory analysis. More frequent sampling and analysis may be required by state or federal regulations in the future. The quality of the surface water and ground water, the use of the site, the use of adjacent properties, and the use of adjacent Lemon Creek and Gastineau Channel will form the basis for administration of state and federal regulations.

The estimated cost to treat leachate that might be collected on a liner/cover as described in Sections 5 and 9 was based on discussions with the sewage treatment plant operator. The sewage treatment plant appears to have capacity to treat this volume of leachate if metered slowly into the plant. The cost to treat it is approximately 5¢ per gallon. Prior to construction of the liner/cover, an agreement with the sewer utility should be arranged, confirming the ability to treat the leachate and the cost to do so.

10.5 End-Use Considerations

The end use of the Channel Landfill site has not yet been determined. However, low-intensity uses, such as open space or parking, should be considered. Interim use of inactive areas of the property can be accommodated while the landfill is in operation. Final end-use determinations could be made after the site has stabilized, in approximately 20 to 30 years after final grading and closure.

Since the landfill is located in an industrial area, a more intensive end use of the site may be desired. If there is a desire to put the site to a more intensive interim or final end use, a different approach to the final grading plan may be required. Depending upon the depth of waste placement, settlement and landfill gas could be factors in striking a balance between maximizing landfill capacity and maximizing the end use of the property. Certain areas could be set aside for future facilities and limit the amount of refuse placed in those areas.

Table 10-3

Annual Post-Closure Maintenance Estimate

Activity	Unit Cost	Unit	Quantity	Price
Final Cover Maintenance				
Annual mowing, fertilizer, ditch cleaning, and culvert cleaning	$1,000	AC	35	35,000
Cover Repair and sediment pond cleaning	5,000	EA	1	5,000
				40,000
Monthly Inspection				
16 hours/month	100	HRS	192	19,200
Quarterly Water Sampling and Testing				
Surface Water Sampling	100	HRS	64	6,400
Ground Water Sampling	100	HRS	128	12,800
Water Quality Analysis	1,500	EA	28	42,000
Report Preparation	2,800	EA	4	11,200
				72,400
LF Gas System Operations and Maintenance				
8 hrs/week @$100/hr				
$2,500/year parts				44,000
Annual Subtotal				$176,400
Contingency @ 20%				35,120
Annual Total				$210,720

NOTES: Under the cover/liner alternative for expansion, between 13 million and 35 million gallons of leachate per year will require treatment, at an estimated additional cost of between $650,000 and $1,750,000 annually.
AC = acre
EA = each
HRS = hours

11 RECOMMENDATIONS AND IMPLEMENTATION SCHEDULE

11.1 General

This closure study identified several recommendations with significant costs associated with implementation. These include environmental monitoring, permitting landfill expansion, landfill closure, and post-closure maintenance. Figure 11-1 presents an implementation schedule during the service life of the landfill and the post-closure maintenance period.

11.2 Environmental Monitoring

The monitoring wells that were installed as a part of this study can be sampled and used to comply with ground water monitoring required under the Alaska Solid Waste Management regulations and Permit 8511 BA 016. ADEC officials indicated a preference for additional monitoring wells. For the purposes of this implementation schedule, four additional wells are assumed. Data from sampling can be used to evaluate the expansion alternatives and closure alternatives presented in this study. A program of quarterly sampling of these monitoring wells and laboratory analysis for the parameters analyzed in this study is recommended. After a 2-year period, the sampling and analysis program should be evaluated in light of the data collected, and revised as appropriate.

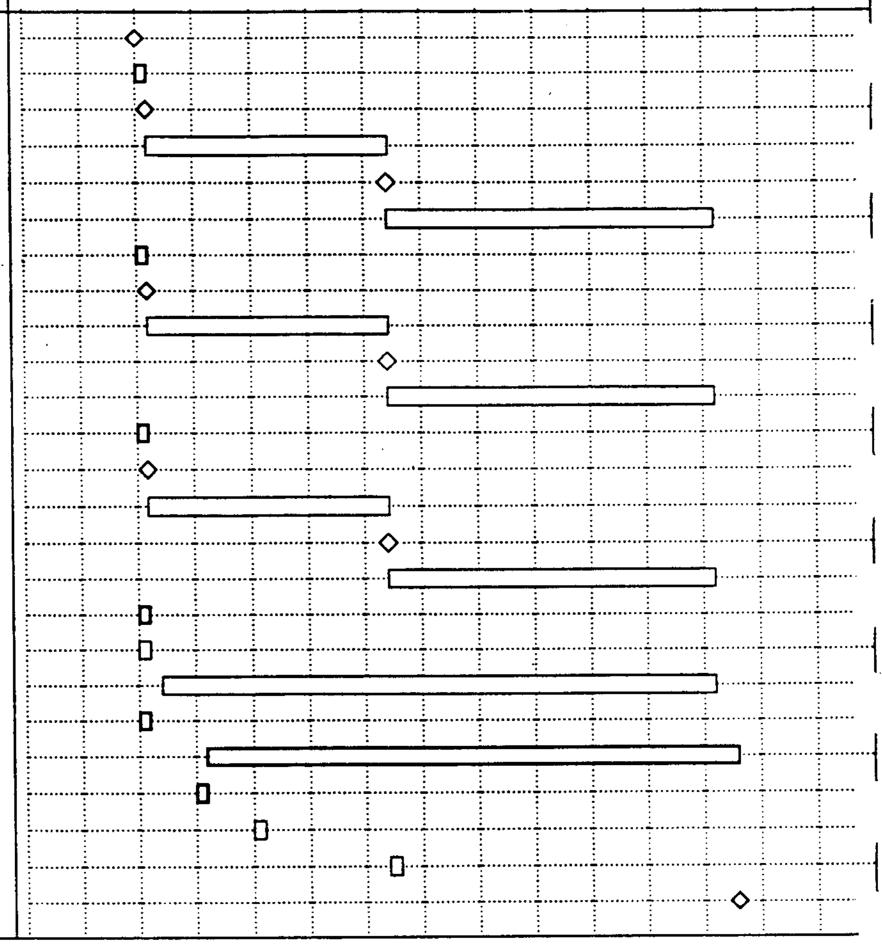
It is recommended that surface water sampling and analysis continue on a quarterly basis at the locations sampled historically. The parameters analyzed in this study should be analyzed. Data from the sampling and analysis program can be used to evaluate expansion alternatives and closure alternatives. After a 1-year period, the program should be evaluated in light of the data collected, and revised as appropriate.

It is recommended that an explosive gas monitoring program be implemented. Gas probes similar to those discussed in Section 7 should be installed. The probes, on-site structures, and selected off-site structures should be monitored for explosive gas on a monthly basis during periods of low or falling barometric pressure. Structures should be monitored more

PROJECT: Channel Landfill
CURRENT DATE: 07/10/91

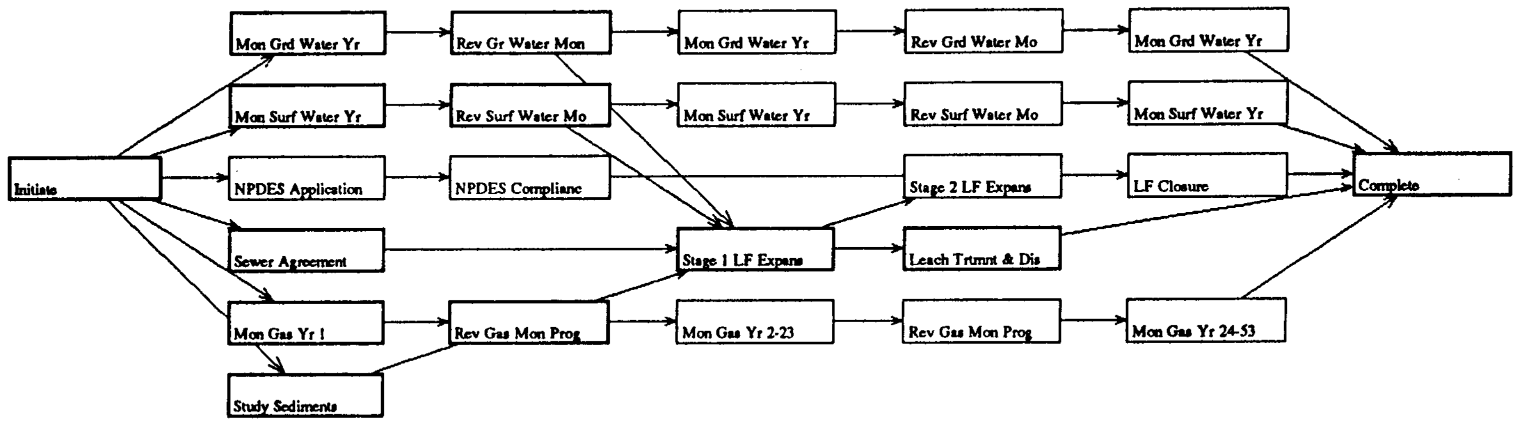
SCHEDULE FIGURE 11-1

Job#	Name
1	Initiate
2	Mon Grd Water Yr 1
3	Rev Gr Water Mon Program
4	Mon Grd Water Yr 2-23
5	Rev Grd Water Mon Program
6	Mon Grd Water Yr 24-53
7	Mon Surf Water Yr 1
8	Rev Surf Water Mon Program
9	Mon Surf Water Yr 2-23
10	Rev Surf Water Mon Program
11	Mon Surf Water Yr 24-53
12	Mon Gas Yr 1
13	Rev Gas Mon Program
14	Mon Gas Yr 2-23
15	Rev Gas Mon Program
16	Mon Gas Yr 24-53
17	Study Sediments
18	NPDES Application
19	NPDES Compliance
20	Sewer Agreement
21	Leach Trtmnt & Disposal
22	Stage 1 LF Expansion
23	Stage 2 LF Expansion
24	LF Closure
25	Complete



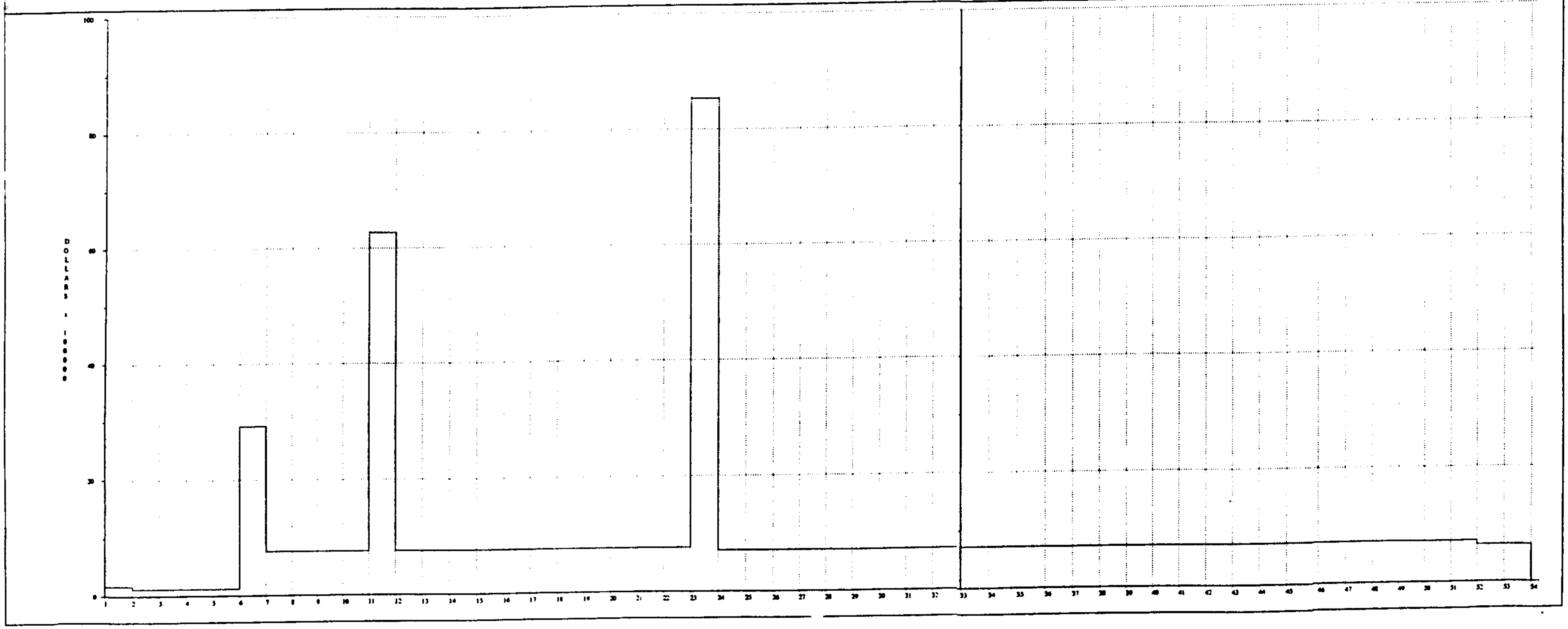
PROJECT: Channel Landfill
CURRENT DATE: 07/10/91

NETWORK FIGURE 11-2



PROJECT : Channel Landfill
CURRENT DATE: 07/30/91

COSTS FIGURE 11-3



frequently if levels of gas near the lower explosive limit concentration are found in those structures. Data from the gas monitoring program can be used to evaluate gas control techniques to be used with the selected expansion alternative. At the time of selection and design of the closure alternative, the data can be used to evaluate gas control techniques to be used with the selected closure alternative.

A study of the sediments of the tide flats and the confluence of Lemon Creek and Gastineau Channel is recommended to evaluate the impact of landfill operations on fish, shellfish, and other estuarian organisms. Data from this study can be used to revise the surface water and ground water monitoring programs, to evaluate expansion alternatives, and to evaluate closure alternatives.

It is recommended that samples of the incinerator ash be tested for hazard characteristics using the Toxicity Characteristics Leaching Procedure (TCLP) instead of the EPTox that is currently used. Data from the TCLP can be used to revise ash disposal procedures or apply to have the ash exempted from being considered a hazardous waste. A comparison of EPTox and TCLP is presented in Table 11-1.

11.3 Permitting

Recently adopted federal regulations require a permit application for a National Pollutant Discharge Elimination System (NPDES) storm water discharge permit. There are two options open to the Channel Landfill to submit a permit application. The first option is an individual application. This must be submitted to the Environmental Protection Agency (EPA) by November 18, 1991. The second option is a group application. The first part of this application must be submitted to EPA by September 30, 1991. The second part must be submitted by May 18, 1992. It is expected that ongoing storm water quality monitoring will be a requirement of the permit, whichever application process is chosen.

A permit or contract with the sewer utility will be required if the liner/cover expansion alternative is selected. It is recommended that these negotiations begin soon. Information from these negotiations can be used to evaluate feasibility of the expansion alternatives.

11.4 Landfill Expansion

It is recommended that the liner/cover alternative be implemented in a phased approach. Firstly, negotiate with ADEC to continue current operations for a period of time, such as 5 years. During that time funds can

Table 11-1
Toxicity Characteristic
Maximum Concentration of Contaminants

Compound	Regulatory Level (mg/l)
Metals	
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Organics	
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
Benzene	0.5
Carbon Tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
o-Cresol	200.0[1]
m-Cresol	200.0[1]
p-Cresol	200.0[1]
Cresol (total)	200.0[1]
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
Endrin	0.02
Heptachlor (and its hydroxide)	0.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lindane	0.4
Methyl ethyl ketone	200.0
Methoxychlor	10.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Tetrachloroethylene	0.7
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
Toxaphene	0.5
Vinyl chloride	0.2

[1] If o-, m-, and p-cresol concentrations cannot be differentiated, the total cresol concentration of 200 mg/l is used.

be accumulated to pay for the liner/cover. In the fifth year, construct a liner/cover over 12 acres, if monitoring data and regulations at the time allow. Then begin filling over the lined area. At that time, the expense of leachate treatment and disposal and gas system operation would begin to be incurred. After approximately five more years of operation over a lined area, and accumulation of funds, the second lined area can be constructed. Landfill operations would continue over the lined area until closure elevations were reached.

11.5 Landfill Closure

It is recommended that the geomembrane closure alternative be implemented. Funds to pay for construction of this alternative and post-closure maintenance can be accumulated over the remaining life of the landfill. At the time of closure, this alternative should be evaluated in light of accumulated monitoring data and current regulations.

11.6 Post-Closure Maintenance

After closure of the landfill, post-closure maintenance and monitoring is recommended. For the purposes of estimating an implementation schedule, the baseline service life of 23 years was used. The 30-year monitoring period proposed under Title 40 CFR 257 and 258 was also used for the purposes of this implementation schedule.

Appendix 1

REFERENCES

REFERENCES

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Appendix 2

GLOSSARY

GLOSSARY

AEROBIC - composting environment characterized by bacteria active in the presence of oxygen (aerobes); generates more heat and is a faster process than anaerobic composting.

ANAEROBIC - composting environment characterized by bacteria active in the absence of oxygen (anaerobes); generates methane and carbon dioxide.

AQUIFER - a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs. A confined aquifer is under pressure. An unconfined aquifer is not under pressure.

BACKGROUND - characteristics of the existing area, without the impacts of the site under study.

BENTONITE - an aluminum silicate clay with a high swelling capacity and very low permeability.

BTEX - BENZENE, TOLUENE, ETHYLBENZENE, TOTAL XYLENES - Major constituents of petroleum products.

BULKY WASTE - large items of refuse including, but not limited to, appliances, furniture, large auto parts, non-hazardous construction and demolition materials, trees, branches, and stumps that cannot be handled by normal solid waste processing, collection, and disposal methods.

COD - CHEMICAL OXYGEN DEMAND - measure of the oxygen equivalent of the organic matter susceptible to oxidation by a strong chemical oxidant.

COMPOUNDS - a substance consisting of atoms of two or more different elements in definite proportions and usually having properties unlike those of its constituent elements.

CONDUCTIVITY - a measure of the ability of water to transmit or conduct electricity.

DAILY COVER - soil or other material used to cover the working face of a landfill at the close of each working day or at the completion of a cell.

DECOMPOSITION - conversion of organic matter as a result of microbial and/or enzymatic interactions.

DISPOSAL - the discharge, deposit, injection, dumping, leaking, or placing of any solid waste into or on any land or water.

DOWNGRADIENT - referring to a slope or grade, a descriptive term meaning downhill, below a specified elevation, or below a specified potential energy.

FIELD METHOD BLANK - laboratory distilled water sample that checks for the presence of contamination and whose result should be "no detection." This blank checks field sampling equipment for decontamination procedures.

FLUIVAL ESTUARINE ENVIRONMENT - area of a widened tidal mouth of a river valley or river where fresh water comes into contact with seawater and where tidal effects are evident.

GARBAGE - unwanted animal and vegetable wastes and animal and vegetable wastes resulting from the handling, preparation, cooking and consumption of food, swill and carcasses of dead animals, and of such a character and proportion as to be capable of attracting or providing food for vectors, except sewage and sewage sludge.

HAZARDOUS WASTE - includes all dangerous and extremely hazardous waste, including substances composed of both radioactive and hazardous components.

HEAVY METALS - elements regulated because of their potential for human, plant, or animal toxicity, including cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn).

HIGH DENSITY POLYETHYLENE (HDPE) - a plastic material that can be formed into containers, pipes, and sheets. In sheet form HDPE is used as a geomembrane for landfill covers and liners.

HOLDING TIMES - amount of time set by the EPA, allowed between collection of the sample and analysis of the sample before analyses become invalid.

HYDRAULIC CONDUCTIVITY - a measure of the ability of a geologic formation to transmit water.

INCINERATION - a process of reducing the volume of solid waste operating under federal and state environmental laws and regulations by use of an enclosed device using controlled flame combustion.

INCINERATOR ASH - the remnants of solid waste after combustion, including non-combustibles (e.g., metals) and soot.

INCINERATOR - facility in ;which the combustion of solid waste takes place.

INERT WASTES - noncombustible, nondangerous solid wastes that are likely to retain their physical and chemical structure under expected conditions of disposal, including resistance to biological attack and chemical attack from acidic water.

LANDFILL - a disposal facility or part of a facility at which solid waste is permanently placed in or on land.

LEACHATE - water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases therefrom.

LINER - a continuous layer of natural or man-made materials, beneath or on the sides of a surface impoundment, landfill, or landfill cell, which restricts the downward or lateral escape of solid waste or leachate.

MATRIX SPIKE - procedure used to check the accuracy of the analytical system. Compounds are added to duplicate samples and compared to samples of the same origin without the compounds added.

MCL - MAXIMUM CONTAMINANT LEVEL. Maximum permissible level of a contaminant in a water which is delivered to a free-flowing outlet of the ultimate user of a public water system.

METHANE - an odorless, colorless, flammable, and explosive gas produced where organic waste such as municipal solid waste undergo anaerobic decomposition. Methane is emitted from municipal solid waste landfills and anaerobic compost processes.

MICROORGANISMS - small living organisms only visible with a microscope.

MUNICIPAL SOLID WASTE (MSW) - consists of residential, commercial, institutional, and industrial solid waste.

ORGANIC CONTAMINANTS - include pesticides and polychlorinated biphenols (PCBs), fuels, solvents, resins, etc.

PARAMETERS - delineates boundaries that determine specific characteristics of water.

PCBs - polychlorinated biphenyl; a class of chlorinated aromatic hydrocarbons representing a mixture of specific biphenyl hydrocarbons which are thermally and chemically very stable.

PERMEABILITY - a characteristic that indicates how well liquid or gas pass through a material.

pH - a measure of the acidity or alkalinity of a substance.

QA/QC - QUALITY ASSURANCE/QUALITY CONTROL - check of each extraction form the field to assure the quality of the methods and procedures used to collect samples and analyze samples. Duplicates of samples are made to check against each other for accuracy. Field method blanks check for contamination; trip blanks check the cleanliness of the bottle batch. Matrix spikes check that laboratory equipment is clean and in good working order.

RECYCLING - transforming or remanufacturing waste materials into usable or marketable materials for use other than landfill or incineration.

SANITARY LANDFILL - solid waste disposal site that is located, design, and operated to minimize pollution from runoff leaching and landfill gas. Waste is spread in layers, compacted, and covered with a fresh layer of soil each day to minimize pests, disease, air pollution, and water pollution problems.

SCRAP - discarded or rejected industrial waste material often suitable for recycling.

SEPTAGE - a semisolid consisting of settled sewage solids combined with varying amounts of water and dissolved materials generated from a septic tank system.

SEWAGE SLUDGE - the accumulated semi-solid suspension of solids deposited from wastewater from municipal or private sewage treatment plants.

SOIL AMENDMENT - soil additive which stabilizes the soil, improves resistance to erosion, permeability to air and water, improves texture and resistance of its surface to crusting, eases cultivation or otherwise improves its quality.

SPECIAL WASTE - items that require special or separate handling, such as household hazardous wastes, bulky wastes, and junk vehicles.

SURROGATE RECOVERIES - Analysis used as a basis to check the cleanliness of each individual extraction from its source.

TDS - TOTAL DISSOLVED SOLIDS - Residue left after evaporation of a sample of water or wastewater and subsequent drying in an oven.

UPGRADIENT - referring to a slope or grade, a descriptive term meaning uphill, above a specified elevation, or above a specified potential energy level.

VECTOR - animal or insect that transmits a disease-producing organism, including rats, mice, and mosquitos.

VOC - VOLATILE ORGANIC COMPOUNDS. Organic compounds that readily evaporate when exposed to air.

WATER TABLE - level below the earth's surface at which the ground becomes saturated with water.

Appendix 3

DOCUMENTS AND RECORDS REVIEWED

EMPS
ENGINEERING
P.O. Box 2317, Juneau, Alaska 99803 Phone (907)789-2152

Project #749

October 28, 1985

Channel Landfill
P.O. Box 1267
Juneau, Alaska 99802

Attn: Mr. Jerry Wilson
General Manager

Re: Disposal of Incinerator Residue

Dear Mr. Wilson:

In accordance with your request of August 9, 1985, attached is a short report describing the situation at the landfill and a plan for disposal of the incinerator residue at the site.

The report concludes that neither the pond waters nor ground waters in the landfill vicinity are used or will be used for domestic uses. Analyses show the minor effect the landfill has had on receiving waters.

The report recommends that a pit adjacent to land filling operations and enclosed by an existing dike be used for Phase I ash disposal. The report also recommends for Phase II ash disposal that an isolated and diked lagoon be filled in next to North Pond.

Sincerely yours,

EMPS ENGINEERING

Ronald G. Hansen

Ronald G. Hansen, P.E.
Sanitary Engineer

RGH:pd

Enclosure

This report will describe the physical situation at the landfill, including topography, hydrology, geology, and water quality. In addition, the existing landfill operation will be discussed. Finally a preliminary plan will be presented for the disposal of incinerator ash at the site.

A. Topography: The Channel Landfill disposal area is located on the tidal flats adjacent to Lemon Creek about 5 miles northwesterly of downtown Juneau and about 3 miles easterly of the Juneau Airport. The landfill is in the center of Lemon Creek Valley. Gastineau Channel is adjacent to the tide flats and on high tides (19+) flood tide approaches the toe of the deposited materials at one point at the northeast corner. Otherwise the deposited materials abut several ponds on the southerly side of the landfill. The ponds are protected by tide gates and the pond water levels stand about 4-5 feet below a 19 foot tide. The upper part of the landfill is always above tide levels; Natural ground is about elevation 32. Solid wastes and fill materials have been stored about 10 to 15 feet above natural ground. Drainage of the site is southwesterly toward Gastineau Channel.

B. Geology: An extensive report by the Soil Conservation Service (Soils of the Juneau Area, August 1974) describes the surface soils on the lower boundaries of the landfill area as "Tidal flats". At the northern portion of the landfill area the soils are a silty loam.

Observation of the gravel extraction operations indicate a deposit of silty clays has been intercepted above the gravels. The silty clays and the organic rich surface soils of the tide flats have been side cast into mounds here and there and also extensively used to construct the dikes. The dikes are substantially impermeable and this was dramatically evident at a 19+ tide when water was standing 4-5 feet deep on the outer toe of the dike at the westerly point of the dike. Inside the upstream toe of the dike where there were sandy soils adjacent to Lemon Creek, the water was boiling up out of the ground creating a quick-sand condition. The water traveled through the ground taking a longer path than through the more direct, but less permeable silty clays.

Reference is made to the report, "Hydrologic Data of the Juneau Borough, Alaska" by U.S. Geological Survey, dated 1969. That report tabulates about a dozen well logs in this area indicating extensive sand and gravel deposits to depths of 100 feet. Some soil and muskeg was typically reported in these well logs generally in the surface few feet. A few well logs reported blue clay at about 20 feet or at 80 depth. Generally, however, most of the well logs reported alternating strata of sand and gravel to depths of 80-100 feet.

Reference is made to the report for Channel Landfill, "Limited Subsurface Exploration and Geotechnical Engineering Study - Proposed Incinerator Building", by Rittenhouse-Zeman and Associates (RZA) dated June 1984. Test holes about 100 yards from the incinerator site discovered about 15 feet of deposted trash was underlain by "medium to coarse SAND with some gravel and fine to coarse sand GRAVEL, and "gravelly, medium to coarse SAND with some cobbles." These are extremely permeable materials, and ground waters can be expected to flow through these materials with velocities about 10 feet per day, versus about 5 feet per second in Lemon Creek, and about 10 feet per year in silty materials.

C. Hydrology: The following is a discussion of the surface water and ground water hydrology in the area.

1. Surface Water Hydrology: The overland flow on the landfill site is southwesterly toward Gastineau Channel as was the overland flow at the site before landfill operations. Lemon Creek, which drains the valley, runs parallel to and about 500 feet away from the westerly edge of the deposited materials. Natural tide channels exist on the tide flats, which channels are periodically innundated at extreme tides.

   A dike has been constructed around the lower edge of the property on the tide flats. Gravel extraction operations have left several pits 30-40 feet deep into the tide flats. These pits are interconnected, expept for one. The result is that there are in effect 2 ponds within the diked area. See Figure No. 1. At low tides both ponds drain through culverts through the dike. The northerly pond drains directly to Lemon Creek at the pond's westerly edge. The southerly pond drains directly to the tide flats. At a +19.3 foot tide observed on September 17, 1985, both culverts on the tide flats side of the dike were innundated about 4 feet beneath sea water and water was backed up in Lemon Creek. Tide gates protected both ponds so their levels at a 19.3 foot tide were about 5 ft. below tide level. In both cases the tide gates leaked to some extent, so there was a small flow of sea water into both ponds during high water period. Measurements of pond surface levels between high and low tides indicated the North pond fluctuated 5" and the South pond fluctuated 1".

   Reference is made to the report "Water Resources of the City and Borough of Juneau, Alaska", by U.S. Geological Survey, dated December, 1971. That report describes the surface and ground water hydrology in the Juneau area including Lemon Creek. Lemon Creek typically has its highest flows in August and lowest flows in mid winter.

2. Ground Water Hydrology: Ground water in the upper part of Lemon Creek Valley generally flows toward Lemon Creek. In that area the creek level would represent the lowest elevation of ground water surface. In the Lemon Creek Valley in the vicinity of the tide flats, the ground water flows generally toward Lemon Creek and southerly directly toward Gastineau Channel.

   As described in the geology section of this report, the subsurface strata consists of layers of sand and gravel. One could conclude with a good level of confidence that there is one ground water body in the land fill area - no artesian aquifers separated by extensive layers of impermeable depostis. The ground water is all inter-connected.

Tidal fluctions in Gastineau Channel and affecting Lemon Creek themselves directly affect levels of ground water. Extreme high tides of 19 feet will back up local surface water and to some extent ground water, but generally the free water table slopes beneath the surface of Lemon Creek Valley do intercept the ground surface at the tide flats. This means that ground water flows out of the ground water body onto the flats and into the creeks and ponds south to the landfill, and into Gastineau Channel.

The report "Hydrologic Data of the Juneau Borough" indicated measured depths to ground water of 3 to 10 feet. Before the City water distribution system was built and put into use in the Lemon Creek Valley in 1984, most users of ground water depended on wells with suction pumps. Use of such pumps indicates that the water table was no more than 25 feet below ground surface. Recent experience and problems with water distribution facilities north of Lemon Creek (Pinewood Park Area) indicates water tables about 5' below ground. However south of Lemon Creek the water tables are generally much lower, possibly influenced by the upstream gravel pits. The recent installation of a water distribution system with water imported from outside the basin will displace the use of ground water formerly used. This decreased ground water use will increase ground water levels, and increasing slopes to the ground water table. This latter effect will result in increased velocities and flow through the ground water body.

The pit dug for the incinerator building detected ground water about 15 feet below the surface, or at about elevation 17. The geologic testing by RZA about 100 yards southerly of the incinerator site indicated ground water at 14 feet and at 16 feet in two test holes.

D. Water Quality: This section describes the surface and ground water quality in Lemon Creek Valley and in the land fill area.

1. Surface Water Quality: The report "Water Resources of the City and Borough of Juneau" gives a general discussion of surface waters in the area. Most of the water in the area is a Calcium-Bicarbonate type of water with a low concentration of total dissolved solids - ranging from 7 to 296 mg/l. Lemon Creek exhibited extensive glacial turbidity during the summer months; during the winter it is clear.

The report "Hydrologic Data of the Juneau Borough" includes 2 analyses of Lemon Creek. The following table gives some of the analyses.

SURFACE WATER ANALYSES

Date	Source	Fe mg/l	Na mg/l	Ca mg/l	Cl mg/l	TDS mg/l	Total Hardness mg/l	pH
Nov. 66	Lemon Creek	0.03	---	10	3.2	47	30	7.3
Jan. 68	Lemon Creek	0.61	0.4	4.1	0.4	17	11	6.5

These waters are extremely good quality waters. The June sample did however, have a high iron content. The pH value of this surface water is essentially neutral.

Other analyses collected by DEC on surface waters is included in Appendix B. Analyses of water supplied to Switzer Village indicated organic materials exceeding drinking water standards and concentrations of color, iron, lead and manganese also exceeding drinking water standards. One should conclude that - as compared to drinking water standards - surface waters are generally of high quality, although they can have several constituents exceeding established standards.

On September 17, 1985, samples were taken from the North Pond, South Pond and Outflow from the North Pond. The field testing data from those samples is tabulated below and the mineral analyses are included in Appendix C.

Quality of Pond Surface Waters

Sample Description	pH	Turbidity (NTU's)	Conductivity
North Pond	7.1	120	5750
South Pond	6.8	3.8	8200
Outflow from North Pond to Lemon Creek	7.2	27	5400

Mineral analyses in Appendix C are compared to drinking water (!), and the only trace of heavy metal of concern is iron. Iron concentrations are less than some natural ground waters in the area.

The South Pond is an isolated gravel pit not connected to the North Pit. It is clear, as indicated by the low turbidity, whereas the North Pond receives gravel washing wastes from a sand and gravel operation and has a muddy appearance. The surface of South Pond stands 6" to 1' above the surface of North Pond. During a 19 foot tide on 9-17-85, both tidegates were leaking and salt water was flowing into the ponds, but to a greater extent at South Pond. The fact that more salt water gets into South Pond is attested to by the elevation of the water surface and the conductivity. The North Pond, adjacent to the landfill has pH values on the basic side of neutral. The surface water dissolved oxygens noted in Appendix C vary from 6.7 mg/l to 11.7 mg/l. Other indicators (fish) confirm that the dissolved oxygen concentrations support fish life.

Attached to this report as Appendix B is a listing of unpublished data collected by Alaska Department of Environmental Conservation during an investigation in May 1984. Surface waters were collected at 2 places in Lemon Creek, the discharge from "Lagoon #2" (termed North Pond in this report), and from depths of 1 foot and 6 feet in "Lagoon #1" and "Lagoon #2" (both now part of North Pond). The majority of the analyses were for organics, and nothing of significance was found, except for a trace of benzene on the surface of "Lagoon #1" (North Pond). The physical analyses indicated dissolved oxygen concentrations from 10 to 14 mg/l, concentrations approaching saturation. The depth samples in the lagoons were just above the bottom and showed oxygen concentrations only slightly depressed below surface D.O. levels. Samples collected on October 23, 1985 and analyzed for D.O. confirm these results.

Results of analyses for trace elements from samples taken from the ponds and outflow from the ponds are attached to this report in Appendix C as are D.O. analyses collected on October 23, 1985.

Surface waters in the vicinity of the landfill are in the process of discharging into the saline Gastineau Channel. These waters are not and will not be used for drinking purposes, so any comparison with standards must be done with standards for uses at or below the vicinity of the land fill or compared directly with the concentration of materials in the saline Gastineau Channel.

2. Ground Water Quality: As expected ground water quality is substantially the same as surface water. The report "Water Resources of the City and Borough of Juneau" indicates that ground waters in general are Calcuim-Bicarbonate type like surface water. There is a trend shown in that report that indicates ground waters tend to have more sodium than surface waters and slightly less sulfate and nitrate. Ground water has more bicarbonate and carbonate than surface waters and because of this one would expect higher pH values.

   The report provides 9 mineral analyses of ground waters collected in 1968. Some typical and extreme values of ground water analyses are listed in the following table sequentially by depth.

GROUND WATER ANALYSES

Depth	Fe mg/l	Na mg/l	Ca mg/l	Cl mg/l	TDS mg/l	Hardness mg/l	pH
36	2.8	10	12	5	84	51	6.9
38	1.2	12	17	4	100	52	6.8
52	2.0	2.1	9.8	0.7	75	34	7.3
60	0.08	1.2	5.0	0.9	38	16	6.8
86	0.6	111	43	186	470	160	8.4
120	7.2	312	3.0	220	817	20	8.9

If one can generalize from such an array of almost random samples in the Lemon Creek area, one could conclude that the waters are of very good quality, except for the iron concentration. The iron concentration is many times over the drinking water standard, nevertheless is typical in Southeastern Alaska ground waters. The table is listed in order of depth of the wells. It is readily apparent that sodium and chloride increase with depth, and as to be expected with increases in sodium, the calcium concentration decreases with depth. This is an identical pattern with ground waters in Mendenhall Valley 4 miles to the north. Intruding saline waters from Gastineau Channel or ancient marine waters present at the time of receeding glaciers are present below the less dense ground waters at shallow depths. The pH of the ground waters are generally basic to neutral, but some of the ground waters are just to the acid side of neutrality.

Attached to this report as Appendix B is a listing of unpublished data collected by Alaska Department of Environmental Conservation. Ground water samples were collected from wells at Old Charlies Marina, J D Telephone, Liquor Barrel, and Mark N' Pak. Most of the analyses were for organic constituents. Contrary to most of the results of analyses on surface waters, some unusual constituents were discovered. Benzene was discovered in minute quantities in ground water at Mark N' Pak and Charlies Marina. The well drilled at the latter site was reported to have been driven through car bodies and other deposited refuse. Chlorobenzene, Ethylbenzene, and Trans-1,2-Dichloroethylene were also discovered at this well. It is unlikely that these conditions were caused by operations of the Channel Landfill, because surface ditches separate Channel Landfill from the location of these wells in both instances. It does point out that ground waters have been somewhat degraded in the past by waste disposal operations.

Other analyses of ground waters for mineral and organics materials in the Lemon Creek Valley are included in Appendix B. These indicate that iron and color in excess of the drinking water standards are common constituents in ground water in the area.

Because of the slope of the ground water table, the ground waters in the vicinity of the landfill are in the process of discharging into tidal and tidally influenced surface waters in the vicinity of the landfill and directly into the saline Gastineau Channel. These waters are not and will not be used for drinking purposes. The only "use" of ground waters in this area can be considered to be the recharging of surface waters in the area, including tidal and marine waters. Any comparison with standards for uses at or below the vicinity of the landfill must be done with standards for uses at or below the landfill or compared directly with the concentration of materials in marine waters.

E. Landfill Operations: Land filling operations have been conducted at the site for about 20 years. The rate of current waste disposal at the site is about 70 tons/day. Over the years the site has been built up with refuse and cover materials so that in places it is over 20 feet above the tide lands. As described previously, concurrent gravel extraction operations have left a series of ponds 30-40 feet deep at the southern boundary of the deposited materials but northerly of a dike constructed at the periphery of the Channel Landfill's property.

The type of waste deposited at this site for almost a generation has been general municipal refuse from Juneau. This waste is the typical refuse in Southeastern Alaskan communities, characterized by a complete lack of any industrial wastes, higher than normal (considering U.S. average) content of paper and packing materials, a much lower than average content of grass, garden clippings and leaves. Reference is made to a report entitled "Southeast Alaska Solid Waste Management Study" by Finite Resources, Inc. dated August, 1980. That report contains a discussion of volumes and content of refuse collected.

In regard to heavy metals or trace elements in the refuse, this refuse contains much less than the normal, since Juneau is non-industrialized. The major metals which have been in the refuse are mainly ferrous materials with minor amounts of aluminum, copper, zinc, chrome, and lead. Collection stations exist in Juneau for aluminum wastes and high priced scrap materials like copper, brass and lead. It is expected that these collection and export ventures will continue. Because of the non industrialized nature of Juneau and the collection efforts by the scrap metal ventures, it is highly likely that the metals content of wastes disposed of at the landfill is significantly below the national average.

The refuse in Southeast Alaska is wetter after deposition in a landfill than a typical landfill in the southwest U.S., mainly because of the rainfall, approximating 80 inches annually which falls on the landfill. This excess moisture in the deposited materials contributes to a rapid decay and decomposition of the deposited refuse, with a concurrent rapid emmission of methane and other gasses and much earlier than normal depletion of these gasses than would be the case in a "normal" landfill in a more arid climate.

The 20 years of more of operation of this landfill has not caused a problem to surface or ground waters in the the area. The turbid nature of the North Pond is due, to some extent, from runoff from the landfill but a considerable effect is directly induced by the waste discharge of the gravel washing operation located on the landfill. Recent observations by Alaska Department of Fish and Game have noted jumping Cohos in North Pond and Chum fry using North Pond for short term rearing. Salmon Creek is itself a very turbid stream due to glacial silt. But it has good runs of Dolly Varden, Coho salmon and possibly has some Cut-throat Trout. The salmon migrate up the silty Lemon Creek to some clear water tributaries (upstream of the developed area) for spawning. The easterly side of the landfill deposit is drained by a tributary to Vanderbilt Creek, which is itself only 50 feet from the property at the southerly corner. Vanderbilt Creek is not a turbid or glacial stream. It has excellent populations of Cut-throat Trout and good runs of Dolly Varden, and Pink, Chum, and Coho salmon. The flats and the ponds are frequented by ducks, geese, eagles and other birds. In general this landfill operation has been a success, attested to by the abundant fish and fowl in the area.

F. <u>Future Incinerator Operations:</u> At the present time the incinerators are being assembled in the incinerator building. These are 2 each 35 tons/day units. The incinerators will take all the wastes presently being discharged to the landfill, with the exception of large items like stumps, and inert, non-combustible materials, such as brick and other demolition materials. These latter materials will be disposed of at the landfill without incineration, and disposed of as previously done. In addition, the landfill will no longer accept metals for disposal because of the physical limitations of the landfill area. therefore such items as washers, dryers, stoves, occasional car bodies, etc., will not be adding to the iron concentration of any leachates as was formerly the case.

The ash from the incinerators will be dumped into a quench pit at the incinerator floor. A hopper building adjacent to the incinerators will be subdrained and the drained-off quench water recycled to the incinerators' quench pit. This ash will then be disposed of at the landfill. It will contain the same metal content as has been disposed of at the site for more than 20 years, the organics having been burned off and discharged as gasses to the atmosphere. Any solids collected at air pollution control facilities at the incinerators will be disposed of at the landfill. These are the same type of solids that have been discharged for the past 20 years or so, but after incineration are now minus organics and volatile constituents. Several metal oxides and hydroxides, especially iron and alumimum are strong adsorbants for lead and cadmium. These oxides, especially iron oxide, are a major component of the incinerator wastes and may be available for adsorption.

The ash would be deposited in unsaturated ground water conditions, and in Phase II saturated surface and unsaturated ground water conditions. Natural ground water and water in the ponds is essentially basic, with some few analyses indicating a pH just under neutrality. Except for iron, leachate of soluble metals from the ash is not expected to be a problem. Furthermore, any metals leached out would be greatly attenuated by adsorption on soil particles before they could move via ground water into surface water systems. As in the past it is not expected that disposal of this material at the site would cause a problem.

Reference is made to a paper "Fly Ash Disposal in a Limestone Quarry: Hydrogeochemical Considerations" by Leonard, Unites, and Kebe, and presented at the Seventh Annual Madison Waste Conference in September, 1984. In that paper the authors tried to simulate leachate from fly ash disposal by lab extractions. The ash was to be innundated in a limestone quarry. Although fly ash is not the same as ash from municipal refuse, it may give some indication of the concentration of constituents in an "ash". After 89 hours of leaching the following concentrations were found of selected constituents.

Constituent	Concentration in mg/l
Arsenic	0.0240
Cadmium	0.0013
Chromium	<0.15
Iron	<0.13
Lead	<0.0061
Mercury	<0.0002
Molybdenum	0.89
Selenium	0.236
Silver	<0.06

Reference is made to a paper "Sources of Metals in Municipal Incinerator Emission", by Stephen L. Law of U.S. Bureau of Mines and Glen E. Gordon of the Department of Chemistry at the University of Maryland. This paper not only discussed "fly ash", but "bottom ash" or those solids from the quench tank normally disposed of by landfilling. The averages were from the industrialized areas of Eastern and Central United States. The following table provides some metals concentration in dried fine (less than 3 mm) bottom ash from municipal incinerators.

Element	Concentration in Fine Bottom Ash (ppm)
Silver (Ag)	38 ± 8
Aluminum (Al)	49000 ± 800
Cadmium (Cd)	41 ± 15
Cobalt (Co)	70 ± 10
Chromium (Cr)	520 ± 240
Copper (Cu)	450 ± 190
Iron (Fe)	16000 ± 6000
Mercury (Hg)	0.4
Lead (Pb)	1700 ± 800
Tin (Sn)	400
Zinc (Zn)	550 ± 1500

Other metals larger than 3 mm are not included in the above table. These data will give some idea of concentrations in "bottom ash" in some U.S. cities. It is not anticapated that Juneau's bottom ash will contain the amount of heavy metals shown above. A fact to keep in mind is that Juneau's waste has been deposited at this location for 20 years with little of any expression of problems resulting from trace or heavy metals.

G. Proposed Ash Disposal Operations: It is proposed to dispose of ash in two phases. Phase I incinerator ash disposal will be to two pits. At the west end of the landfill the south and west sides of the pit are an existing dike and the north and east sides consist of active land fill deposits. The base of the pit is above ground water elevation and above the surface elevation of the adjacent North Pond. At the east end of the landfill an area above ground water elevation will be diked and that "pit" brought up to grade. The pit locations are shown on Fiqure 1 and the relation between pit bottom and water table elevation is shown on Figure 2. Phase II incinerator ash disposal will be into the isolated lagoon in West Pit of North Pond after the incomplete dike has been completed, then that area will be brought up to the grade of the top of the landfill.

Adequate sampling point locations exist for monitoring both Phase I and Phase II operations to determine if there are any effects on surface waters and to measure the amount of any effect.

H. Conclusions: As a result of this study the following conclusions have been reached.

1. Wastes have been deposited here for 20 years.

2. The amount of trace and heavy metals in Juneau's refuse is very much less than the national average, because of the non-industrialized nature of the community.

3. It is expected that metals in the ash to be disposed of in the future will have less metals waste than previously disposed of at this site, because of separate metals collection.

4. No surface or ground water quality problem exists after about 20 years of operation of the landfill, and since the same or better quality wastes will be disposed of at this site, it is not expected that there will be a problem.

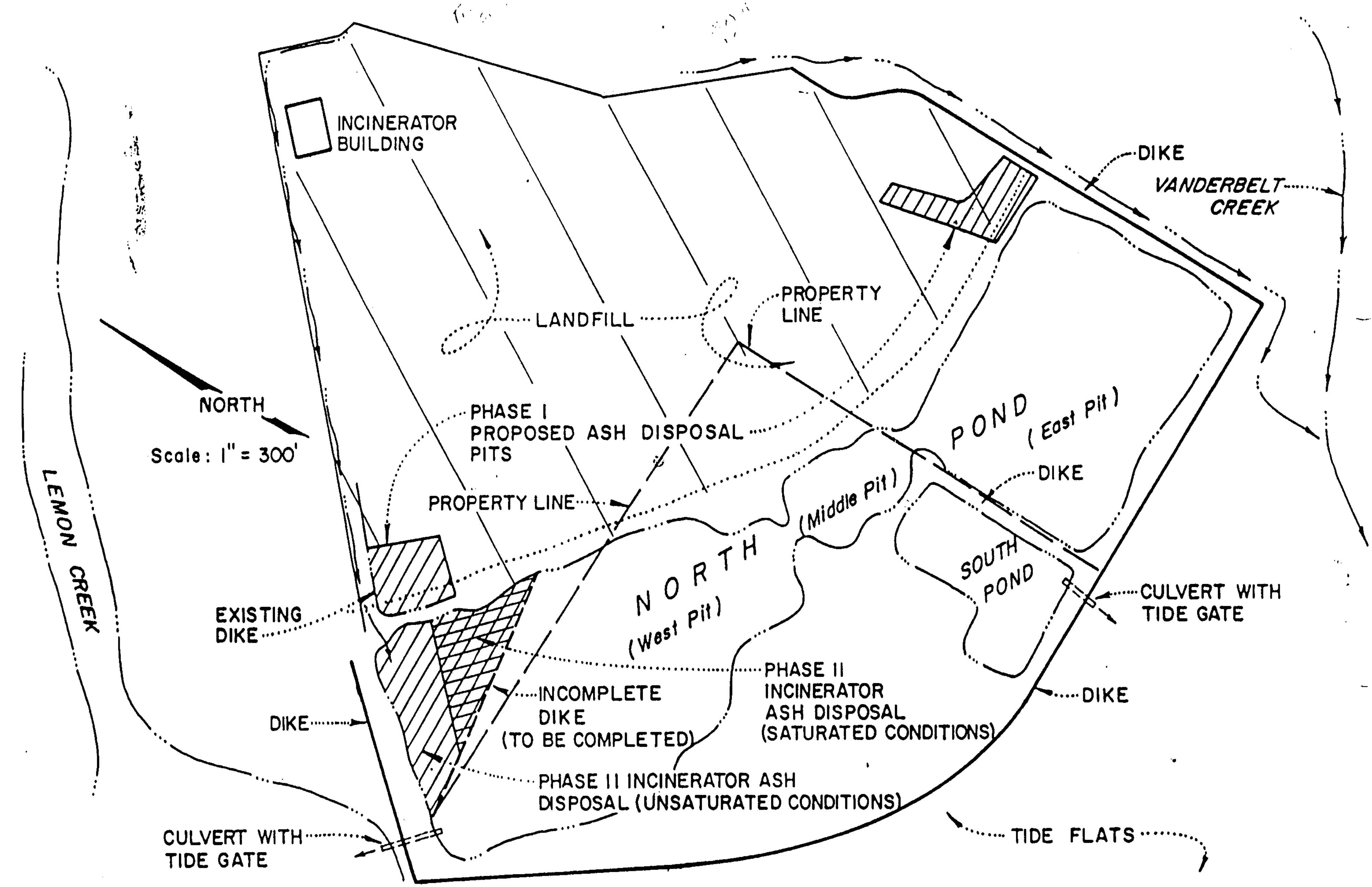
5. Neither surface nor ground waters in the vicinity or downstream of the landfill are used for domestic purposes. The only uses made of those waters are for fish and wildlife migration, not spawning, and for fry rearing.

I. Recommendations: As a result of this study the following recommendations are made to Channel Landfill, Inc.

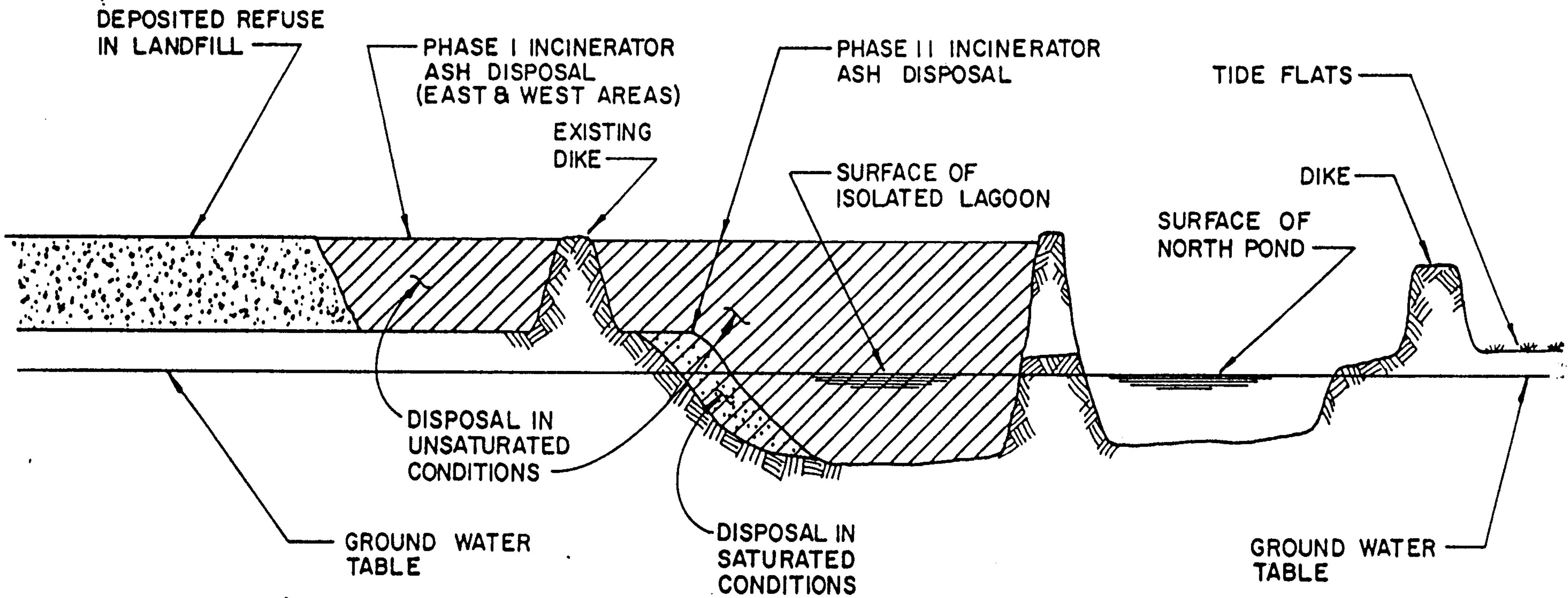
1. Dispose of ash in two phases. Phase I ash disposal should be to a pit at the west end of the landfill and a pit to be created at

the east end of the landfill, both above the elevation of ground waters. Phase II ash disposal should be to an isolated lagoon in the West Pit of North Pond and eventually that Phase II area brought up to the grade of the top of the landfill.

2. Conduct periodic surface and ground water analyses to determine if there is any effect, so possible remedial action can be taken.



EMPS ENGINEERING	SKETCH MAP Showing EXISTING and PROPOSED FACILITIES at CHANNEL LANDFILL	FIGURE NO. 1



NOT TO SCALE

EMPS ENGINEERING	SCHEMATIC PROPOSE ASH DISPOSAL PLAN	FIGURE NO. 2

APPENDIX A

Photographs of Channel Landfill Operations

(Originals of aerials and prints

submitted separately)


CK - SWITZER CK
9.8.84
1"=500
4-7

APPENDIX B

Unpublished Data

collected by

Alaska Department of Environmental Conservation

CHF ON CR OONS- ALAS 1984

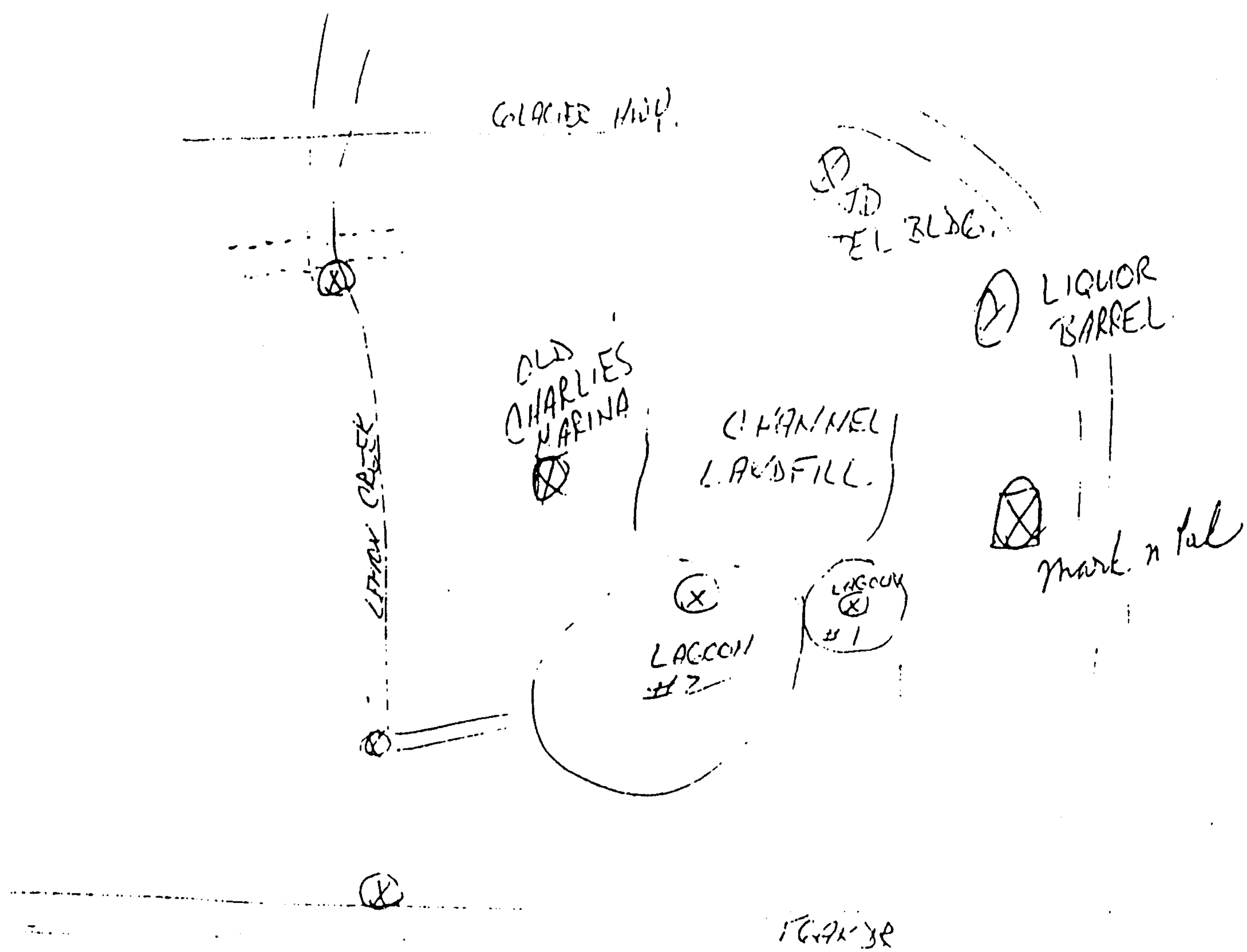
STATION I.D.	LAGOON 1	LAGOON 1	LAGOON 2	LAGOON 2	LEMON CREEK BELOW OLD GLACIER HWY.	LEMON CREEK LAGOON PIPE TERMINUS	LEMON CREEK ABOVE EGAN DR. BRIDGE	30 FT. WELL @ PARK N PAK	60 FT. WELL @ LIQUOR BARREL	WELL @ JUNEAU DOUGLAS PHONE BUILDING	WELL @ OLD CHARLIE'S MARINA BLDG.
LABORATORY NUMBER	84051701	84051702	84051703	84051704	84051705	84051706	84051707	84051801	84051802	84051803	84051804
PARAMETERS											
PHYSICAL											
Date	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984	MAY 16, 1984
Time(Military)	1130	1140	1230	1240	1440	1455	1500	1100	1130	1030	1000
Depth(Feet)	1	6	1	6	1	1	1	30	60-70	UNKNOWN	37
Temperature(Deg. C)	12.5	10	16	12.5	7.5	11	9	NA	NA	NA	NA
Dissolved Oxygen(mg./l)	12.2	10.5	14.3	12.2	10.4	10.7	10.3	NA	NA	NA	NA
Conductivity(umhos/cm @ 25 Deg. C)	2110	2330	2190	2320	49	5860	4650	NA	NA	NA	NA
Salinity(o/oo)	12	13	12.5	13	0	1	2.2	NA	NA	NA	NA
MICROBIOLOGICAL-colonies/100ml											
Fecal Coliform	NA	NA	NA	NA	0	1	0	NA	NA	NA	NA
ORGANICS-ug/l											
ACID EXTRACTABLES											
2,4,6,-Trichlorophenol	(2.	(2.	(2.	(2.	NA	NA	NA	NA	NA	NA	NA
Parachlorometacresol	(2.	(2.	(2.	(2.	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	(2.	(2.	(2.	(2.	NA	NA	NA	NA	NA	NA	NA
2,4,-Dichlorophenol	(2.	(2.	(2.	(2.	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	(5.	(5.	(5.	(5.	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	(5.	(5.	(5.	(5.	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	(5.	(5.	(5.	(5.	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	(15.	(15.	(15.	(15.	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-o-cresol	(10.	(10.	(10.	(10.	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	(5.	(5.	(5.	(5.	NA	NA	NA	NA	NA	NA	NA
Phenol	(2.	(2.	(2.	(2.	NA	NA	NA	NA	NA	NA	NA
MISCELLANEOUS											
Bis(chloromethyl)ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,7,8-Tetrachlorodibenzodioxin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Molecular sulfur	NA	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOLATILE ORGANICS											
Acrolein	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	2	(1	(1	(1	(1	(1	(1	1.4	(1	(1	1.8
Carbon Tetrachloride	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Chlorobenzene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	1.6
1,2-Dichloroethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
1,1,1-Trichloroethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
1,1,-Dichloroethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
1,1,2-Trichloroethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
1,1,2,2-Tetrachloroethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
1,1-Dichloroethylene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Trans-1,2-Dichloroethylene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	2.4
1,2-Dichloropropane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Cis-1,3-Dichloroporpane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Trans-1,3-Dichloroethylene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Ethylbenzene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	1.3 INCLUDES XYLENES
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Bromide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Bromodichloromethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Trichlorofluoromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Tetrachloroethylene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Toluene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Trichloroethylene	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1	(1
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloroethyl Vinyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BASE NEUTRAL EXTRACTABLES											
Acenapthene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
[illegible]	(20	(20	(20	(20	NA	NA	NA	NA	NA	NA	NA

CHANNEL SANITATION-LEMON CREEK LAGOONS-JUNEAU, ALASKA-MAY, 1984

STATION I.D.	LAGOON 1	LAGOON 1	LAGOON 2	LAGOON 2	LEMON CREEK BELOW OLD GLACIER HWY.	LEMON CREEK LAGOON PIPE TERMINUS	LEMON CREEK ABOVE EGAN DR. BRIDGE	30 FT. WELL @ MARK N PAK	60 FT. WELL @ LIQUOR BARREL	WELL @ JUNEAU DOUGLAS PHONE BUILDING	WELL @ OLD CHARLIE'S MARINA BLDG.
LABORATORY NUMBER	84051701	84051702	84051703	84051704	84051705	84051706	84051707	84051801	84051802	84051803	84051804
PARAMETERS											
Bis(2-chloroethyl)ether	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
2-Chloronapthalene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	(5.0	(5.0	(5.0	(5.0	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
1,2-Diphenylhydrazine(b)	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenylphenylether	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
4-Bromophenylphenylether	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroisopropyl)ether	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethozy)methane	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	(10.0	(10.0	(10.0	(10.0	NA	NA	NA	NA	NA	NA	NA
Isophorone	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Napthalene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine(a)	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-proplyamine	(5.0	(5.0	(5.0	(5.0	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphtalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
3,4-Benzofluoranthrene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthrene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Chrysene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Acenapthylene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Anthracene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i0perylene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Fluorene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-c,d)pyrene	(2.0	(2.0	(2.0	(2.0	NA	NA	NA	NA	NA	NA	NA
Pyrene	(2.0	(2.0	(2.0	(2.0							

POLY BOTTLE(1)		TYPE OF SAMPLE BOTTLE	NONE	NONE	NONE	NONE	NONE	POLY BEAKER	LIT(1) AMB GLASS(2)	POLY BOTTLE(1)
						PARAMETERS				
FECAL COLIFORM COLONIES/100 ML	SAMPLE LOCATIONS	SAMPLE STATIONS	SAMPLE DEPTHS	TEMPERATURE DEGREES C	SALINITY PPT	DISSOLVED OXYGEN MG/L	CONDUCTIVITY uMHOS/CM DEGREES C(@25)	pH UNITS	PRIORITY POLLUTANT SCREEN FOR PURGEABLES EXTRACTABLES TRACE METALS	FECAL COLIFORM COLONIES/100 ML.
0	LAGOON	NORTH END	SURFACE	1	1	1	1	1	1	0
0			BOTTOM- FT.	1	1	1	1	1	1	0
0	LAGOON	SOUTH END	SURFACE	1	1	1	1	1	1	0
1			BOTTOM- FT.	1	1	1	1	1	1	1
1	LEMON CREEK	ABOVE DISCHARGE-100 FT.	MID- FT.	1	1	1	1	1	1	1
1	LEMON CREEK	AT DISCHARGE	MID- FT.	1	1	1	1	1	1	1
1	LEMON CREEK	BELOW DISCHARGE-200 FT.	MID- FT.	1	1	1	1	1	1	1
0	DRINKING WATER WELL	LANDFILL	TAP- FT.	0	0	0	0	0	1	0
0	DRINKING WATER WELL	MARK N PAK	TAP- FT.	0	0	0	0	0	1	0
0	DRINKING WATER WELL	?	TAP- FT.	0	0	0	0	0	1	0
0	DRINKING WATER WELL	?	TAP- FT.	0	0	0	0	0	1	0
4		TOTALS=		7	7	7	7	7	11	4
MEMBRANE FILTER		INSTRUMENTS EMPLOYED FOR ANALYSIS	CABLE	YSI MODEL 33 S-C-T	YSI MODEL 33 S-C-T	YSI MODEL 57 D.O.	YSI MODEL 33 S-C-T	ORION MODEL 407A pH METER	FINNIGAN GC/MS VARIAN	MEMBRANE FILTER
J.D. TREATMENT PLANT		CONDUCTED IN:	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	DOUGLAS LAB	J.D. TREATMENT PLANT
GRAB VAN DORN AT DEPTH		SAMPLE METHOD	DIRECT READ	IN SITU	IN SITU	IN SITU	IN SITU	ON SITE GRAB/VAN DORN@DEPTH	GRAB VAN DORN AT DEPTH	GRAB VAN DORN AT DEPTH
ICE		PRESERVATION TECHNIQUE	NONE	NONE	NONE	NONE	NONE	NONE	ICE	ICE
POLY BOTTLE(1) STP 250ML		TYPE OF SAMPLE BOTTLE	NONE	NONE	NONE	NONE	NONE	POLY BEAKER	LIT(1) AMB GLASS(2) TOT TRIHALO VIALS(3)	POLY BOTTLE(1) STP 250ML

SKETCH OF SAMPLE LOCATIONS



Ⓧ = SAMPLE SITE

Surface Water Analyses

S T A T E O F A L A S K A
Department of Environmental
Conservation, EQM&LO

750 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

RECEIVED
JUL 19 1984
Department of Environmental Conservation
Southeast Regional Office

Rw

PUBLIC DRINKING WATER SUPPLY
Analytical Report

SAMPLE NUMBER	84AK001	LABORATORY NUMBER	84050902
Date Collected	5-9-84	Time Collected	1030

INORGANICS

Recoverable Trace Metals: sample preserved, heated at 60°C for 24 hours

Parameter	Value ug/l	Limit ug/l	Parameter	Value mg/l	Limit mg/l
Silver	**	(50)	Barium	**	(1.0)
Arsenic	**	(50)	Iron	**	(0.3)
Cadmium	**	(10)	Sodium	**	(250)
Chromium	**	(50)			
Mercury	**	(2)			
Manganese	**	(50)			
Lead	**	(50)	Fluoride	<0.2	(2.4)
Selenium	**	(10)	Nitrate-N	<0.5	(10.0)
Color	25.	15 PCU			
Turbidity	0.21	1.0 NTU			
*Gross Alpha	**	15 pCi/l			

*When found in excess of 5 pCi/l, resample for Radium 226 is required.
**Note: Results for these parameters will be reported separately.

ORGANICS

Parameter	Value ug/l	Limit ug/l
Total Trihalomethanes	31.	(100)
Max. Trihalomethane Potential	66.	(100)
Total Purgeable Aromatics	see below	

Benzene = <1.0 ug/l
Toluene = <1.0 ug/l
Ethylbenzene = <1.0 ug/l
Xylenes = <1.0 ug/l

Values below the level of quantitation are expressed as < (less than).
All analyses included Quality Control. Methods and Q.C. data are available on request.

1 gram = 10^3mg (milligrams) = 10^6ug (micrograms)
1 mg/l = 1 ppm (parts per million)
1 ug/l = 1 ppb (parts per billion)

7-16-84	T. C. Tinke	7-16-84
Date Completed	Chief, EQMLO	Date Reported

STATE OF ALASKA
Department of Environmental Conservation

Environmental Quality Monitoring
and Laboratory Operations
750 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

REQUEST FOR LABORATORY SERVICES
(Instructions on Reverse)

SAMPLE NUMBER 84AK001 ~~[illegible]~~ | LABORATORY NUMBER 84050902

DATE SAMPLED 5-9-84 TIME SAMPLED 10:30 am

SAMPLE LOCATION: (fill out as completely as possible)
At [ ] or near [X] population center or geographic feature JUNEAU
Address or exact location SWEDISH VILLAGE

Meridian ______ Township ______ Range ______ Section ______
Quad title or Chart number ______
Latitude ______ Longitude ______
PDWS number ______ Storet number ______

SAMPLER
agency/address KEGLER
SERO-ADEC
789-3151
Phone number ______

Send Results to:
KEGLER
SERO-ADEC
Phone number 789-3151

SAMPLE TYPE:
[ ] SOIL [ ] Other ______
[ ] SEDIMENT
[ ] BIOTA
[X] WATER
[ ] Ground [ ] Treated
[ ] Surface [ ] Untreated
[ ] Effluent [ ] Grab
[ ] Marine [ ] Composite
[ ] Receiving [ ] ______
Sediment present: [ ] yes [ ] no
Depth of Well ______
Flow Rate ______

ON SITE ANALYSIS:
Air Temp ______
Water Temp ______
pH ______
Conductivity (@25°C) ______
Dissolved Oxygen ______
Free Chlorine Residual ______
Turbidity ______
Color ______
Taste ______
Odor ______
Comments: ______
Preservatives: ______

PURPOSE:
[X] Public Drinking Water Supply

[ ] Village Safe Water

[ ] Special Purpose ______

ANALYSIS REQUESTED:
[ ] Only HEAVY METALS
C, I, F, N. [X] All

[ ] Only PURGEABLES AROMATIC [ ] All
~~[illegible]~~

POTENTIAL THM
TOTAL THM

Follow-up of LABORATORY NUMBER (if applicable) ______

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DRINKING WATER ANALYSIS

INORGANIC, ORGANIC, PHYSICAL AND RADIOCHEMICAL CONTAMINANTS

TO BE COMPLETED BY PUBLIC WATER SUPPLIER - Public Water System & Sample Description

Identification Number:	Collected By: R. McGee	
Public Water System Name: Miller Residence	Sample Location: Kitchen tap - unboiled	
Address (Street or P. O. Box): Switzer Village		Sample Date: 14 Jan 82
City: Juneau AK	State: AK	Zip Code: 99801

Check the box to the left of the contaminants listed below for the analysis desired:

☐ Surface Water ☐ Treated Water ☐ Routine Sample
☐ Ground Water ☐ Untreated Water ☐ Special Purpose Sample

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name: State of Alaska	Sample Number: 01BJM82 ~~02B~~	Station Number:
Address (Street or P.O. Box): Dept. of Environmental Conservation, Monitoring and Lab Operations	Laboratory Analysis Number: 82011809	
City, State and Zip Code: 1015 St. Ann's Ave. Douglas, AK 99824	Received By: Josie Lunasan	Date: 1-18-82

INORGANICS

	LIMIT	Mg/l
☑ Arsenic	(0.05)	0.005
☑ Barium	(1.)	TR
☑ Cadmium	(0.010)	ND
☑ Chromium	(0.05)	ND
~~☐ Fluoride~~	(2.4)	
☑ Iron	(0.3)	0.37
☑ Lead	(0.05)	0.009
☑ Manganese	(0.05)	1.9
☑ Mercury	(0.002)	ND
~~☐ Nitrate~~	(10.)	
☑ Selenium	(0.01)	ND
☑ Silver	(0.05)	ND
☑ Sodium	(250	6.9
☐		
☐		

ORGANICS

	LIMIT	Mg/l
☐ Endrin	(0.0002)	
☐ Lindane	(0.004)	
☐ Methoxychlor	(0.1)	
☐ Toxaphene	(0.005)	
☐ 2,4,-D	(0.1)	
☐ 2,4,5 - TP Silvex	(0.01)	
☐ Total Trihalomethanes	(0.1)	
☐ Max. Trihalomethane Pot.	(0.1)	
☐		
☐		

PHYSICAL

	LIMIT		
~~☐ Color~~	(15)		PCU
~~☐ Turbidity~~	(1.)		NTU
☐			
☐			

RADIOACTIVITY

	LIMIT	pCi/l
☐ Gross Alpha*	(15)	
☐ Radium 226 & 228	(5)	
☐ Gross Beta	(50)	
☐ Strontium-90	(8)	
☐ Tritium	(20,000)	

*When found in excess of 5 pCi/l, analysis for Radium 226 is required.

TR - Indicates Trace Detected
ND - Indicates Not Detected
NCRD - Indicates No Confirmable Resdiue Detected

Date Analysis Completed	Signature of Laboratory Supervisor	Date Reported
2-10-82	T. T. O. Taller	2-10-82

18-2001 (Rev. 1/81)

Surface Water

STATE OF ALASKA
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DRINKING WATER ANALYSIS
INORGANIC, ORGANIC, PHYSICAL AND RADIOCHEMICAL CONTAMINANTS

TO BE COMPLETED BY PUBLIC WATER SUPPLIER - Public Water System & Sample Description

Identification Number:	Collected By: AL KEGLER
Public Water System Name:	Sample Location: LEMON CREEK MANOR -- Juneau
Address (Street or P. O. Box):	Sample Date: 2-4-82
City: Juneau / State: Ak	Zip Code:

Check the box to the left of the contaminants listed below for the analysis desired:

- ☐ Surface Water
- ☒ Ground Water
- ☒ Treated Water
- ☐ Untreated Water
- ☐ Routine Sample
- ☐ Special Purpose Sample

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name: State of Alaska	Sample Number: 82AK003/004 / Station Number:
Address (Street or P. O. Box): Dept. of Environmental Conservation, Monitoring and Lab Operations	Laboratory Analysis Number: 82020402
City, State and Zip Code: 750 St. Ann's Ave. Douglas, AK 99824	Received By: Josie Lunasin / Date: 2-4-82

INORGANICS

	LIMIT	Mg/l
☒ Arsenic	(0.05)	ND
☒ Barium	(1.)	TR
☒ Cadmium	(0.010)	TR
☒ Chromium	(0.05)	ND
☒ Fluoride	(2.4)	ND
☒ Iron	(0.3)	0.66
☒ Lead	(0.05)	ND
☒ Manganese	(0.05)	1.6
☒ Mercury	(0.002)	ND
☒ Nitrate (as N)	(10.)	TR
☒ Selenium	(0.01)	ND
☒ Silver	(0.05)	ND
☒ Sodium	(250	6.5
☐		
☐		

PHYSICAL

	LIMIT	
☐ Color	(15)	PCU
☐ Turbidity	(1.)	NTU
☐		
☐		

ORGANICS

	LIMIT	Mg/l
☐ Endrin	(0.0002)	
☐ Lindane	(0.004)	
☐ Methoxychlor	(0.1)	
☐ Toxaphene	(0.005)	
☐ 2,4,-D	(0.1)	
☐ 2,4,5 - TP Silvex	(0.01)	
☐ Total Trihalomethanes	(0.1)	
☐ Max. Trihalomethane Pot.	(0.1)	
☐		
☐		

RADIOACTIVITY

	LIMIT	pCi/l
☐ Gross Alpha*	(15)	
☐ Radium 226 & 228	(5)	
☐ Gross Beta	(50)	
☐ Strontium-90	(8)	
☐ Tritium	(20,000)	

*When found in excess of 5 pCi/l, analysis for Radium 226 is required.

TR - Indicates Trace Detected
ND - Indicates Not Detected
NCRD - Indicates No Confirmable Resdiue Detected

Date Analysis Completed	Signature of Laboratory Supervisor	Date Reported
4-6-82	T. C. Tre[illegible]	4-12-82

-2001 (Rev. 1/81)

Ground Water Analyses

Rw√

Jenner 2K

STATE OF ALASKA
Department of Environmental
Conservation, EQM&LO

750 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

PUBLIC DRINKING WATER SUPPLY
Analytical Report

SAMPLE NUMBER 84AK1112 LABORATORY NUMBER 84111502
Date Collected 11-14-84 Time Collected 1200

INORGANICS RADIOCHEMICALS AND PHYSICALS

Recoverable Trace Metals: sample preserved, heated at 60°C for 24 hours

Parameter	Value ug/l	MCL ug/l	MDL ug/l	Parameter	Value mg/l	MCL mg/l	MDL mg/l
Silver	<5	(50)	(5)	Barium	0.059	(1)	(0.005)
Arsenic	<5.	(50)	(5)	Iron	0.010	(0.3)	(0.005)
Cadmium	<5.	(10)	(5)	Sodium	1.5	(250)	(0.040)
Chromium	<5.	(50)	(5)				
Mercury	<1.	(2)	(1)				
Manganese	11.	(50)	(5)				
Lead	<5.	(50)	(5)	Fluoride	<0.2	(2.4)	(0.2)
Selenium	<2.	(10)	(2)	Nitrate-N	1.0	(10)	(0.5)
Color	--	(15 PCU)	(5)				
Turbidity	--	(1.0 NTU)	(0.2)				
*Gross Alpha	--	(15 pCi/l)	(1)				

*When found in excess of 5 pCi/l, resample for Radium 226 is required.

VOLATILE ORGANICS

Parameter	Value ug/l	MCL ug/l	MDL ug/l
Total Trihalomethanes	--	(100)	(0.2)
Max. Trihalomethane Potential	--	(100)	(0.2)
1,1,2,2 Tetrachloroethane	--		
Total Purgeable Aromatics	see below		(1.0)

Benzene = -- ug/l Ethylbenzene = -- ug/l
Toluene = -- ug/l m,p,& o-Xylenes = -- ug/l

Values below the level of quantitation are expressed as < (less than).
All analyses included Quality Control. Methods and Q.C. data are available on request.

MCL = Maximum contaminant limit for public water supplies
MDL = Method detection limit
1 gram = 10^3 mg (milligrams) = 10^6 ug (micrograms)
1 mg/l = 1 ppm (parts per million)
1 ug/l = 1 ppb (parts per billion)

12-13-84
Date Completed

T. O. Tale
Chief, EQMLO

12-18-84
Date Reported

S T A T E O F A L A S K A
Department of Environmental
Conservation, EQM&LO

7?0 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

PUBLIC DRINKING WATER SUPPLY
Analytical Report

SAMPLE NUMBER 84AK1112
Date Collected 11-14-84

LABORATORY NUMBER 84111502
Time Collected 1200

The following analyses are provided as an adjunct to the primary drinking water standards:

****

PARAMETER	VALUE (mg/l)	MCL (mg/l)	MDL (mg/l)
Aluminum	<0.040		(0.040)
Antimony	--		
Beryllium	<0.005		(0.005)
Calcium	7.1		(0.005)
Cobalt	--		
Copper	0.012	(1.0)	(0.005)
Magnesium	0.72		(0.005)
Molybdenum	--		
Phosphorus	--		
Nickel	<0.010		(0.010)
Potassium	0.93		(0.10)
Silicon	--		
Sulfur	--		
Thallium	--		
Tin	--		
Titanium	--		
Tungsten	--		
Vanadium	--		
Zinc	<0.005	(5.0)	(0.005)

All above analyses conducted by ICP - Emission Spectrometry.

Values found below the limit of quantitation (method detection limit) are expressed as < (less than). All analyses included Quality Control. Methods and Q.C. data are available on request.

MCL = Maximum Contaminant Limit
MDL = Method Detection Limit
1 gram = 10^3 mg (milligrams) = 10^6 ug (micrograms)
1 mg/l = 1 ppm (parts per million)
1 ug/l = 1 ppb (parts per billion)

11-29-84
Date Completed

T. R. Tulle
Chief, EQMLO

11-30-84
Date Reported

STATE OF ALASKA
Department of Environmental Conservation

Environmental Quality Monitoring
and Laboratory Operations
750 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

REQUEST FOR LABORATORY SERVICES
(Instructions on Reverse)

SAMPLE NUMBER 84AK 1112 | LABORATORY NUMBER 84111502

DATE SAMPLED Nov. 14, 1984 TIME SAMPLED NOON

SAMPLE LOCATION: (fill out as completely as possible)
At[ ] or near [X] population center or geographic feature JUNEAU
Address or exact location LEMON CREEK
VALLEY COURT

Meridian ______ Township ______ Range ______ Section ______
Quad title or Chart number ______
Latitude ______ Longitude ______
PDWS number ______ Storet number ______

SAMPLER WARREN / KEGLER
agency/address ADEC - SERO
Phone number 789-3151

Send Results to: WARREN
KEGLER
SERO
Phone number 789-3151

SAMPLE TYPE:
[] SOIL [] Other ______
[] SEDIMENT
[] BIOTA
[] WATER
[] Ground [] Treated
[] Surface [] Untreated
[] Effluent [] Grab
[] Marine [] Composite
[] Receiving []
Sediment present: [] yes [] no
Depth of Well ______
Flow Rate ______

ON SITE ANALYSIS:
Air Temp ______
Water Temp ______
pH ______
Conductivity (@25°C) ______
Dissolved Oxygen ______
Free Chlorine Residual ______
Turbidity ______
Color ______
Taste ______
Odor ______
Comments: ______
Preservatives: ______

PURPOSE:
[X] Public Drinking Water Supply

[] Village Safe Water

[X] Special Purpose ______

ANALYSIS REQUESTED:
[] Only HEAVY METALS [] All
FLOURIDE
NITRATE
[] Only ______ [] All

Follow-up of LABORATORY NUMBER (if applicable) ______

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DRINKING WATER ANALYSIS

INORGANIC, ORGANIC, PHYSICAL AND RADIOCHEMICAL CONTAMINANTS

TO BE COMPLETED BY PUBLIC WATER SUPPLIER - Public Water System & Sample Description

Identification Number:	Collected By: Al Kegler
Public Water System Name: Scott Sneed	Sample Location:
Address (Street or P. O. Box): 4410 McGinnis Dr Lemon Creek	Sample Date: 15 November 1981
City: Juneau; State: AK	Zip Code:

Check the box to the left of the contaminants listed below for the analysis desired:

- ☐ Surface Water ☐ Treated Water ☐ Routine Sample
- ☒ Ground Water ☒ Untreated Water ☒ Special Purpose Sample

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name: State of Alaska	Sample Number: 07 RJM81	Station Number:
Address (Street or P. O. Box): Dept. of Environmental Conservation, Monitoring and Lab Operations	Laboratory Analysis Number: 8112 1721	
City, State and Zip Code: 750 St. Ann's Ave. Douglas, AK 99824	Received By: Josie Lunasin	Date: 12-17-81

INORGANICS

	Contaminant	LIMIT	Mg/l
☒	Arsenic	(0.05)	ND
☒	Barium	(1.)	TR
☒	Cadmium	(0.010)	TR
☒	Chromium	(0.05)	ND
☐	Fluoride	(2.4)	
☒	Iron	(0.3)	5.8
☒	Lead	(0.05)	TR
☒	Manganese	(0.05)	1.4
☒	Mercury	(0.002)	0.0011
☐	Nitrate (as N)	(10.)	
☒	Selenium	(0.01)	ND
☒	Silver	(0.05)	ND
☒	Sodium	(250	TR
☐			
☐			

ORGANICS

	Contaminant	LIMIT	Mg/l
☐	Endrin	(0.0002)	
☐	Lindane	(0.004)	
☐	Methoxychlor	(0.1)	
☐	Toxaphene	(0.005)	
☐	2,4,-D	(0.1)	
☐	2,4,5 - TP Silvex	(0.01)	
☐	Total Trihalomethanes	(0.1)	
☐	Max. Trihalomethane Pot.	(0.1)	
☐			
☐			

PHYSICAL

	Parameter	LIMIT	Result	Unit
☐	Color	(15)		PCU
☐	Turbidity	(1.)		NTU
☐				
☐				

RADIOACTIVITY

	Contaminant	LIMIT	pCi/l
☐	Gross Alpha*	(15)	
☐	Radium 226 & 228	(5)	
☐	Gross Beta	(50)	
☐	Strontium-90	(8)	
☐	Tritium	(20,000)	

*When found in excess of 5 pCi/l, analysis for Radium 226 is required.

TR - Indicates Trace Detected
ND - Indicates Not Detected
NCRD - Indicates No Confirmable Resdiue Detected

Date Analysis Completed	Signature of Laboratory Supervisor	Date Reported
2-2-82	T. C. Trella	2-2-82

18-2001 (Rev. 1/81)

Drinking Water Analysis Report for Inorganic, Organic, and Radiochemical Contaminants

TO BE COMPLETED BY PUBLIC WATER SUPPLIER

PUBLIC WATER SYSTEM:

I.D. NO. ______

TONSGAARD
Public Water System Name

Address

City - State Zip Code

Note: Check box to left of contaminants listed below for the analyses desired.

SAMPLE DESCRIPTION:

Collected By ALAN KEGLER

SHOP HOSE
Sample Location

Source Type ☐ Surface Water ☒ Ground Water

Sample Date 01 Mo. 06 Day 81 Year

☐ Routine Sample ☒ Untreated Water
☒ Special Purpose Sample ☐ Treated Water

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name State of Alaska
Dept. of Environmental Conservation
~~Monitoring and Lab Operations~~
Address 750 St. Ann's Ave.
Douglas, Alaska 99824
State Zip Code

069AK81 011AK81
010AK81 012AK81
Sample No. Station No.

81010603
Laboratory Analysis No.

Received by Wendy J. Whelan Date 1/6/81

INORGANICS

	Limit	Mg/l
☒ Arsenic	(0.05)	0.005
☒ Barium	(1.)	0.20
☒ Cadmium	(0.010)	ND
☒ Chromium	(0.05)	ND
☒ Fluoride	(2.4)	TR
☒ Iron	(0.3)	16.4
☒ Lead	(0.05)	ND
☒ Manganese	(0.05)	0.75
☒ Mercury	(0.002)	ND
☒ Nitrate (as N)	(10.)	ND
☒ Selenium	(0.01)	TR
☒ Silver	(0.05)	ND
☒ Sodium	(250)	14.5
☒ Color		40 PCU
☒ Turbidity		19 NTU
☐		

ND Indicates Not Detected
NCRD Indicates No Confirmable Residue Detected

ORGANICS

☒ ~~ALL~~

	Limit	Mg/l
☒ Endrin	(0.0002)	NCRD
☒ Lindane	(0.004)	NCRD
☒ Methoxychlor	(0.1)	NCRD
☒ Toxaphene	(0.005)	NCRD
☒ 2, 4-D	(0.1)	NCRD
☒ 2,4,5 - TP Silvex	(0.01)	NCRD
☐		
☐		

RADIOACTIVITY

	Limit	pCi/l
☒ Gross Alpha*	(15)	ND
☐ Radium 226 & 228	(5)	
☒ ~~Gross Beta~~	(50)	
☐ Strontium - 90	(8)	
☐ Tritium	(20,000)	
☐		
☐		

*When found in excess of 5 Ci/l analysis for radium 226° is required

2/9/81
Date Analysis Completed

T. C. Tolle
Signature of Laboratory Supervisor

2/10/81
Date reported

Drinking Water Analysis Report for Inorganic, Organic, and Radiochemical Contaminants

TO BE COMPLETED BY PUBLIC WATER SUPPLIER

PUBLIC WATER SYSTEM:

I.D. NO. [ ]

PHONE COMPANY
Public Water System Name

Address

City State Zip Code

Note: Check box to left of contaminants listed below for the analyses desired.

SAMPLE DESCRIPTION:

Collected By ALAN KELLER

WELL ROOM SINK
Sample Location

Source Type ☐ Surface Water ☒ Ground Water

Sample Date 01 (Mo.) 06 (Day) 81 (Year)

☐ Routine Sample ☐ Untreated Water
☒ Special Purpose Sample ☒ Treated Water

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name State of Alaska
Dept. of Environmental Conservation
~~Monitoring and Lab Operations~~
Address 750 St. Ann's Ave.
City Douglas, Alaska 99824
State Zip Code

013,014,015,016 AK 81
Sample No. Station No.

~~80~~ 81010604
Laboratory Analysis No.

Wendy J. Whelan 1/6/81
Received by Date

* Notified SERO of high Se 1/12/81
* Notified SERO of high Ba 1/29/81

INORGANICS

	Limit	Mg/l
☒ Arsenic	(0.05)	0.006
☒ Barium	(1.)	2.7
☒ Cadmium	(0.010)	ND
☒ Chromium	(0.05)	ND
☒ Fluoride	(2.4)	0.60
☒ Iron	(0.3)	.20
☒ Lead	(0.05)	ND
☒ Manganese	(0.05)	0.018
☒ Mercury	(0.002)	TR
☒ Nitrate (as N)	(10.)	ND
☒ Selenium	(0.01)	0.025
☒ Silver	(0.05)	ND
☒ Sodium	(250)	1100.
☒ COLOR		10 PCU
☒ TURBIDITY		0.8 NTU
☐		

ND Indicates Not Detected
NCRD Indicates No Confirmable Residue Detected

ORGANICS

~~☒ All~~

	Limit	Mg/l
☒ Endrin	(0.0002)	NCRD
☒ Lindane	(0.004)	NCRD
☒ Methoxychlor	(0.1)	NCRD
☒ Toxaphene	(0.005)	NCRD
☒ 2, 4-D	(0.1)	NCRD
☒ 2,4,5 - TP Silvex	(0.01)	NCRD
☐		
☐		

RADIOACTIVITY

	Limit	pCi/l
☒ Gross Alpha*	(15)	3
☐ Radium 226 & 228	(5)	
☒ ~~Gross Beta~~	(50)	
☐ Strontium - 90	(8)	
☐ Tritium	(20,000)	
☐		
☐		

*When found in excess of 5 Ci/l analysis for radium 226° is required

2/9/81
Date Analysis Completed

T. C. Trelle
Signature of Laboratory Supervisor

2/10/81
Date reported

Form No. 18-715 (R... 2/79)

Drinking Water Analysis Report for Inorganic, Organic, and Radiochemical Contaminants

TO BE COMPLETED BY PUBLIC WATER SUPPLIER

PUBLIC WATER SYSTEM:

I.D. NO. [ ]

Public Water System Name: CHARLIE'S MARINE

Address:

City: State: Zip Code:

Note: Check box to left of contaminants listed below for the analyses desired.

SAMPLE DESCRIPTION:

Collected By: ALAN KEGLER

Sample Location: SHOP TAP

Source Type: ☐ Surface Water ☒ Ground Water

Sample Date: Mo. 01 Day 06 Year 81

☐ Routine Sample ☒ Special Purpose Sample

☒ Untreated Water ☐ Treated Water

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name: State of Alaska
Dept. of Environmental Conservation
Monitoring and Lab Operations

Address: 750 St. Ann's Ave.

City: Douglas, Alaska 99824 State Zip Code

Sample No.: 017,018,019,020 Station No.: AK81

Laboratory Analysis No.: 81010605

Received by: Wendy J. Whelan Date: 1/6/81

* Notified SERO of high Se 1/12/81

INORGANICS

	Limit	Mg/l
☒ Arsenic	(0.05)	TR
☒ Barium	(1.)	ND
☒ Cadmium	(0.010)	ND
☒ Chromium	(0.05)	TR
☒ Fluoride	(2.4)	0.64
☒ Iron	(0.3)	97.
☒ Lead	(0.05)	
☒ Manganese	(0.05)	ND
☒ Mercury	(0.002)	1.6
☒ Nitrate (as N)	(10.)	TR
☒ Selenium	(0.01)	ND
☒ Silver	(0.05)	0.014
☒ Sodium	(250)	ND
COLOR		45.
☒ TURBIDITY		25 PCU
		460 NTU

ND Indicates Not Detected
NCRD Indicates No Confirmable Residue Detected

ORGANICS

~~All~~

	Limit	Mg/l
☒ Endrin	(0.0002)	NCRD
☒ Lindane	(0.004)	NCRD
☒ Methoxychlor	(0.1)	NCRD
☒ Toxaphene	(0.005)	NCRD
☒ 2, 4-D	(0.1)	NCRD
☒ 2,4,5 - TP Silvex	(0.01)	NCRD
☐		
☐		

RADIOACTIVITY

	Limit	pCi/l
☒ Gross Alpha*	(15)	2
☐ Radium 226 & 228	(5)	
~~☒ Gross Beta~~	(50)	
☐ Strontium - 90	(8)	
☐ Tritium	(20,000)	
☐		
☐		

*When found in excess of 5 Ci/l analysis for radium 226ᵖ is required

Date Analysis Completed: 2/9/81

Signature of Laboratory Supervisor: T. C. Trelle

Date reported: 2/10/81

Form No. 18-316 (Rev. 9/79)

Drinking Water Analysis Report for Inorganic, Organic, and Radiochemical Contaminants

TO BE COMPLETED BY PUBLIC WATER SUPPLIER

PUBLIC WATER SYSTEM:

I.D. NO. [ ]

Public Water System Name: MARK & PACK

Address:

City: JUNO State: AK Zip Code:

Note: Check box to left of contaminants listed below for the analyses desired.

SAMPLE DESCRIPTION:

Collected By: ALAN KEGLER

Sample Location: PRODUCE SINK

Source Type ☐ Surface Water ☒ Ground Water

Sample Date: Mo. 01 Day 06 Year 80

☐ Routine Sample ☒ Untreated Water

☒ Special Purpose Sample ☐ Treated Water

* Notified SERO of high Se 1/12/81

* Notified SERO of high F 1/30/81

TO BE COMPLETED BY CERTIFIED LABORATORY

Laboratory Name: State of Alaska

Address: Dept. of Environmental Conservation

~~Monitoring and Lab Operations~~

750 St. Ann's Ave.

Douglas, Alaska 99824

City State Zip Code

Sample No.: 001 AK 80, 002 AK 80, 003 AK 80, 004 AK 81 Station No.

Laboratory Analysis No.: 8101060 1

Received by: Wendy J. Whelan Date: 1/6/81

INORGANICS

	Limit	Mg/l
☒ Arsenic	(0.05)	TR
☒ Barium	(1.)	TR
☒ Cadmium	(0.010)	TR
☒ Chromium	(0.05)	TR
* ☒ Fluoride	(2.4)	7.0
☒ Iron	(0.3)	0.25
☒ Lead	(0.05)	ND
☒ Manganese	(0.05)	0.026
☒ Mercury	(0.002)	TR
☒ Nitrate (as N)	(10.)	2.4
* ☒ Selenium	(0.01)	0.023
☒ Silver	(0.05)	TR
☒ Sodium	(250)	1200.
☒ Color		20 PCU
☒ Turbidity		4.0 NTU
☐		

ND Indicates Not Detected

NCRD Indicates No Confirmable Residue Detected

ORGANICS

~~☒ All~~

	Limit	Mg/l
☐ Endrin	(0.0002)	NCRD
☐ Lindane	(0.004)	NCRD
☐ Methoxychlor	(0.1)	NCRD
☐ Toxaphene	(0.005)	NCRD
☐ 2, 4-D	(0.1)	NCRD
☐ 2,4,5 - TP Silvex	(0.01)	NCRD
☐		
☐		

RADIOACTIVITY

	Limit	pCi/l
☒ Gross Alpha*	(15)	2
☐ Radium 226 & 228	(5)	
~~☒ Gross Beta~~	(50)	
☐ Strontium - 90	(8)	
☐ Tritium	(20,000)	
☐		
☐		

*When found in excess of 5 Ci/l analysis for radium 226° is required

Date Analysis Completed: 2/9/81

Signature of Laboratory Supervisor: T. O. Trollie

Date reported: 2/10/81

STATE OF ALASKA
Department of Environmental Conservation

Environmental Quality Monitoring and Laboratory Services
750 St. Ann's Avenue
Douglas, Alaska 99824
Tel. No. 364-2155

Lemon Cr. Jail

ANALYTICAL REPORT
Public Drinking Water Supply

SAMPLE NUMBER 24GM82 & 25GM82 LABORATORY NUMBER 82080501
Date Collected 8-05-82 Time Collected 10:00AM

INORGANICS

Parameter	Result µg/l	Limit µg/l	Parameter	Result mg/l	Limit mg/l
Silver	<5	(50)	Barium	<0.2	(1.0)
Arsenic	<5	(50)	Iron	2.8	(0.3)
Cadmium	<2	(10)	Sodium	<10	(250)
Chromium	<5	(50)			
Mercury	<1	(2)			
Manganese	2200	(50)			
Lead	<5	(50)	Fluoride	<0.2	(2.4)
Selenium	<2	(10)	Nitrate-N	<1	(10.0)

Color	-----	15 PCU
Turbidity	-----	1.0 NTU
*Gross Alpha	<1	15 pCi/l

*When found in excess of 5 pCi/l, resample for Radium 226 is required.

ORGANICS

Parameter	Result µg/l	Limit µg/l
Total Trihalomethanes	---	(100)
Max. Trihalomethane Potential	---	(100)
Total Purgeable Aromatics	---	

Results below the level of quantitation are expressed as < (less than).
All analyses included Quality Control. Methods and Q.C. data are available on request.

1 gram = 10^3mg (milligrams) = 10^6µg (micrograms)
1 mg/l = 1 ppm (parts per million)
1 µg/l = 1 ppb (parts per billion)

10-27-82
Date Completed

T. Q. Tnle
Chief, EQMLO

10-29-82
Date Reported

APPENDIX C

Mineral Analyses of Surface Waters in Ponds and Dissolved Oxygen Concentration in Surface Waters

NEW LONDON, N.H. 03257

Test
CORPORATION

WATER ANALYSIS REPORT

Customer	Water source
EMPS ENGINEERING	CHANNEL SANITATION I
ATTN: RON HANSEN	
PO BOX 3217	
JUNEAU	
AK 99803	

OUTFLOW FROM "UPPER POND" (= flow from Middle Pit to W. Pit of N. Pond)

Date sampled : 17 SEP 85 Sample number: 263033

The following test parameters were found to be outside the Maximum Contaminant Levels (MCL) set by the Safe Drinking Water Act (SDWA) or WaterTest's recommended limits:

Chloride	Iron	Manganese
Sodium	Hardness	Sulfate
TDS		

Any parameter outside these limits will be marked with a double asterisk on either side of the result -- for example, **0.014**. The WaterTest manual -- THE WATER YOU DRINK -- is an integral part of this report and should be read in conjunction with the analysis. Please note that the medical hazards of certain levels of contamination are often a function of the individual water consumer's health, diet, age and physical and mental condition.

Parameter	MCL		YOUR RESULTS		Parameter	MCL		YOUR RESULTS	
Arsenic	0.050	<	0.010		Barium	1.00		0.56	
Cadmium	0.010	<	0.005		Chromium	0.050	<	0.030	
pH	8.5		6.5		Mercury	0.002	<	0.0005	
Nitrate	10.00	<	0.01		Selenium	0.010	<	0.005	
Silver	0.050	<	0.030		Fluoride	2.40		0.44	
Chloride	250.0	**	>250.0	**	Iron	0.300	**	0.390	**
Manganese	0.050	**	0.751	**	Sodium	100.	**	272.	**
Hardness	250.	**	>400.	**	Zinc	5.00	<	0.50	
Lead	0.050	<	0.010		Nickel		<	0.50	
Copper	1.000		0.120		Magnesium		>	40.0	
Potassium			55.5		Alkalinity			184.	
Sulfate	250.0	**	275.7	**	TDS	500.0	**	>999.0	**
Calcium		>	60.0						

All results are in milligrams/liter
except pH and Coliform counts.
< means "less than".
> means "greater than".

NEW LONDON, N.H. 03257

Test CORPORATION

OCT 7 1985

WATER ANALYSIS REPORT

Customer
EMPS ENGINEERING
ATTN: RON HANSEN
PO BOX 2317
JUNEAU
AK 99803
OUTFLOW FROM LAST POND (= Discharge to Lemon Cr.)

Water source
CHANNEL SANITATION I

Date sampled : 17 SEP 85

Sample number: 263032

The following test parameters were found to be outside the Maximum Contaminant Levels (MCL) set by the Safe Drinking Water Act (SDWA) or WaterTest's recommended limits:

pH	Chloride	Iron
Manganese	Sodium	Hardness
Sulfate	TDS	

Any parameter outside these limits will be marked with a double asterisk on either side of the result -- for example, **0.014**. The WaterTest manual -- THE WATER YOU DRINK -- is an integral part of this report and should be read in conjunction with the analysis. Please note that the medical hazards of certain levels of contamination are often a function of the individual water consumer's health, diet, age and physical and mental condition.

Parameter	MCL	YOUR RESULTS
Arsenic	0.050	< 0.010
Cadmium	0.010	< 0.005
pH	8.5	** 6.4 **
Nitrate	10.00	< 0.01
Silver	0.050	< 0.030
Chloride	250.0	**>250.0 **
Manganese	0.050	** 0.804 **
Hardness	250.	**>400. **
Lead	0.050	< 0.010
Copper	1.000	0.122
Potassium		56.0
Sulfate	250.0	** 283.1 **
Calcium		> 60.0

Parameter	MCL	YOUR RESULTS
Barium	1.00	0.44
Chromium	0.050	< 0.030
Mercury	0.002	< 0.0005
Selenium	0.010	< 0.005
Fluoride	2.40	0.30
Iron	0.300	** 0.363 **
Sodium	100.	** 260. **
Zinc	5.00	< 0.50
Nickel		< 0.50
Magnesium		> 40.0
Alkalinity		65.
TDS	500.0	**>999.0 **

All results are in milligrams/liter except pH and Coliform counts.
< means "less than".
> means "greater than".

NEW LONDON, N.H. 03257

Test CORPORATION

WATER ANALYSIS REPORT

Customer	Water source
SEA WATER QUALITY	CHANNEL SANITATION I
ATT:JOHN STONE	
P.O.BOX 2014	
JUNEAU	
AK 99801	
GRAVEL PIT POND (= South Pond)	

Date sampled : 17 SEP 85 Sample number: 263034

The following test parameters were found to be outside the Maximum Contaminant Levels (MCL) set by the Safe Drinking Water Act (SDWA) or WaterTest's recommended limits:

pH	Chloride	Manganese
Sodium	Hardness	Sulfate
TDS		

Any parameter outside these limits will be marked with a double asterisk on either side of the result -- for example, **0.014**. The WaterTest manual -- THE WATER YOU DRINK -- is an integral part of this report and should be read in conjunction with the analysis. Please note that the medical hazards of certain levels of contamination are often a function of the individual water consumer's health, diet, age and physical and mental condition.

Parameter	MCL	YOUR RESULTS	Parameter	MCL	YOUR RESULTS
Arsenic	0.050	0.020	Barium	1.00	< 0.10
Cadmium	0.010	< 0.005	Chromium	0.050	< 0.030
pH	8.5	** 5.5 **	Mercury	0.002	< 0.0005
Nitrate	10.00	< 0.01	Selenium	0.010	0.008
Silver	0.050	< 0.030	Fluoride	2.40	0.57
Chloride	250.0	**>250.0 **	Iron	0.300	< 0.100
Manganese	0.050	** 0.520 **	Sodium	100.	**>300. **
Hardness	250.	**>400. **	Zinc	5.00	< 0.50
Lead	0.050	< 0.010	Nickel		< 0.50
Copper	1.000	0.165	Magnesium		> 40.0
Potassium		89.6	Alkalinity		109.
Sulfate	250.0	**>300.0 **	TDS	500.0	**>999.0 **
Calcium		> 60.0			

All results are in milligrams/liter except pH and Coliform counts.
< means "less than".
> means "greater than".

DISSOLVED OXYGEN IN SURFACE WATERS

Sampling date: October 23, 1985

Sampling Point Description	Field Temp degrees F.	Dissolved Oxygen % Sat *	Remarks
Vanderbilt Creek above Glacier Hwy bridge	38	10.3 mg/l 76.6 %	clear 0855 h Q=1.5cfs
Creek trib to Vandrebilt at landfill at Short St. extended	35.5	6.7 mg/l 48.5 %	Sl yellow 0905 h Q=0.04cfs
East side of East Pit in North Pond	34	10.2 mg/l 71.9 %	Cloudy Sheen on surface Q=0cfs Sl yellow 0920 h
South side of Middle Pit in North Pond	40	9.4 mg/l 71.8 %	Very muddy Sl sheen V=1fps W. 0934 h
west side of West Pit near outflow culvert	38.5	8.5 mg/l 64.4%	Sl yellow Sl turbid Some Q in to pond. 0943 h
Lemon Creek near N. Pond culvert	36	11.7 mg/l 90.1 %	Clear foam on surface. Flood tide. 0947 h

* Note: The % Saturation for Dissolved Oxygen corrected for temperature and salinity, with salinity approximated for the Lemon Creek sample.

CHANNEL CORPORATIONS

CHANNEL SANITATION CORPORATION
CHANNEL EQUIPMENT RENTAL INCORPORATED
CHANNEL LANDFILL, INC.

ORIGINALS IN PROJECT FILING

RECEIVED

May 31, 1991

Mr. Peter Moon
Sweet Edwards/ECON
18912 North Creek Parkway
Ste 210
Bothell, WA 98011

RE: Water and Ash Reports

Dear Mr. Moon:

Please find enclosed a copy of all water and ash reports to date that you have requested. Due to our weather conditions, there have been times we could not take samples. Two of these are noted, but I'm not aware of any others.

Should you have any questions, please contact myself or Mr. Jerry Wilson. Thank you.

Very truly,

Judy Kennedy
Judy Kennedy
Admin. Asst.

/jak
cc: file
Enclosure

P.O. Box 21267 Juneau, Alaska 99802-1267 (907) 780-4288

		9/25/90	6/12/90							
rsenic	*0.050	.002	.010							
ium	*1.000	.073	.041			#1				
admium	*0.010	.003	.002							
alcium	None	32.364	28.312							
rromium	*0.050	.018	.003							
opper	*1.000	.039	.012							
ron	*0.300	9.586	2.862							
ead	*0.050	.042	.037							
anganese	*0.050	.540	.080							
agnesium	None	13.179	35.023							
ercury	*0.002	.00050	.00050							
ckel	None	.050	.050							
elenium	*0.010	.002	<.002							
ilver	*0.050	.002	.002							
odium	None	67.815	292.760							
inc	*5.000	.313	.073							
itrate	*10.000	.560	1.20							
luoride	*4.000	.100	1.130							
lkalinity	None	95.850	65.850							
hloride	*250.000	72.350	612.900							
arndess	*250.000	135.083	214.919							
PH	*8.500	7.130	7.420							
Corrosivity	None	.0851	<.782							
Sulfate	*250.000	52.890	106.200							
S.Conductance	*700.0	492.00	2146.0							

#2 Stream South of Property

		3/23/90	6/12/90
rsenic	*0.050	.002	<.010
rium	*1.000	.025	.018
dmium	*0.010	.002	<.002
Calcium	None	17.402	32.596
hromium	*0.050	.013	<.002
opper	*1.000	.005	<.005
ron	*0.300	1.176	.810
Lead	*0.050	.010	<.010
manganese	*0.050	.120	.053
agnesium	None	14.077	62.576
ercury	*0.002	.00050	<.00050
Nickel	None	.050	<.050
Selenium	*0.010	.002	<.002
ilver	*0.050	.002	<.002
odium	None	109.128	505.823
Zinc	*5.000	0.019	<.010
Nitrate	*10.000	0.500	1.0
luoride	*4.000	0.100	<.100
lkalinity	None	52.410	54.250
Chloride	*250.000	165.410	1264.90
Harndess	*250.000	121.423	339.079
PH	*8.500	7.700	7.430
Corrosivity	None	[illegible]	<.795
Sulfate	*250.000	[illegible]	168.100
[illegible]			3709.0

		3/23/90	6/12/90
Arsenic	*0.050	.002	.010
arium	*1.000	.033	.050
Cadmium	*0.010	.002	.002
Calcium	None	30.526	42.203
Chromium	*0.050	.009	.002
Copper	*1.000	.013	.005
Iron	*0.300	1.196	.654
Lead	*0.050	.014	.010
Manganese	*0.050	.154	.107
Magnesium	None	6.847	19.247
Mercury	*0.002	.00050	.00050
Nickel	None	.050	.050
Selenium	*0.010	.002	.002
Silver	*0.050	.002	.002
Sodium	None	49.123	156.72
Zinc	*5.000	.130	.036
Nitrate	*10.000	500	1.400
Fluoride	*4.000	.100	.160
Alkalinity	None	55.910	100.910
Chloride	*250.000	62.420	[illegible]
Harndess	*250.000	79.450	194.727
PH	*8.500	7.710	7.[illegible]
Corrosivity	None	.703	-.06
Sulfate	*250.000	[illegible]	[illegible]
[illegible]			

		3/22/90								
senic	*0.050	.002								
rium	*1.000	.075		#7						
Cadmium	*0.010	.002	Discontinued 3/90							
Calcium	None	32.867								
romium	*0.050	.016								
pper	*1.000	.030								
Iron	*0.300	4.904								
Lead	*0.050	.029								
anganese	*0.050	.454								
agnesium	None	6.982								
Mercury	*0.002	.00050								
Nickel	None	.050								
elenium	*0.010	.002								
ilver	*0.050	.002								
Sodium	None	51.570								
Zinc	*5.000	.146								
Nitrate	*10.000	.500								
luoride	*4.000	.100								
lkalinity	None	102.680								
Chloride	*250.000	39.140								
Harndess	*250.000	110.820								
PH	*8.500	7.490								
Corrosivity	None	.454								
Sulfate	*250.000	32.400								
S. Conductance*700.0		[illegible]								

#4D below #6 Stream on Hilare Slide

		6/12/90								
Arsenic	*0.050	.010								
Barium	*1.000	.046								
Cadmium	*0.010	.002								
Calcium	None	49.962								
Chromium	*0.050	.002								
Copper	*1.000	.005								
Iron	*0.300	69.419								
Lead	*0.050	.012								
Manganese	*0.050	4.060								
Magnesium	None	11.707								
Mercury	*0.002	.00050								
Nickel	None	.050								
Selenium	*0.010	.002								
Silver	*0.050	.002								
Sodium	None	29.025								
Zinc	*5.000	.021								
Nitrate	*10.000	.500								
Fluoride	*4.000	—								
Alkalinity	None	—								
Chloride	*250.000	52.710								
Harndess	*250.000	172.963								
PH	*8.500	—								
Corrosivity	None	—								
Sulfate	*250.000	—								
[illegible]										

		5/23/90	6/12/90						
rsenic	*0.050	.002	.010						
arium	*1.000	.114	.051						
Cadmium	*0.010	.002	.002						
alcium	None	63.480	65.466						
hromium	*0.050	.022	.002						
opper	*1.000	.015	.005						
Iron	*0.300	10.132	69.358						
ead	*0.050	.019	.018						
anganese	*0.050	.920	1.205						
agnesium	None	5.745	15.275						
Mercury	*0.002	.00050	.00050						
ickel	None	.050	.050						
Selenium	*0.010	—	.002						
Silver	*0.050	.002	.002						
Sodium	None	11.008	12.[illegible]3						
Zinc	*5.000	.133	.023						
Nitrate	*10.000	.500	.500						
Fluoride	*4.000	.200	—						
Alkalinity	None	137.630	—						
Chloride	*250.000	10.0	10.0						
Harndess	*250.000	182.169	226.371						
PH	*8.500	7.37	—						
Corrosivity	None	.161	—						
Sulfate	*250.000	39.470	—						
S. Conductance *600.0		[illegible]	[illegible]						

		5/22/90	6/12/90							
Arsenic	*0.050	.005	.010							
Barium	*1.000	.061	.043							
Cadmium	*0.010	.002	.002							
Calcium	None	15.132	5.474							
Chromium	*0.050	.013	.002							
Copper	*1.000	.009	.005							
Iron	*0.300	.652	1.319							
Lead	*0.050	.010	.010							
Manganese	*0.050	.067	.024							
Magnesium	None	4.607	1.677							
Mercury	*0.002	.00050	.00050							
Nickel	None	.050	.050							
Selenium	*0.010	.002	.002							
Silver	*0.050	.002	.002							
Sodium	None	29.256	11.744							
Zinc	*5.000	.035	.021							
Nitrate	*10.000	.500	.500							
Fluoride	*4.000	.100	.100							
Alkalinity	None	34.560	20.0							
Chloride	*250.000	33.820	16.610							
Harndess	*250.000	56.759	50.0							
PH	*8.500	7.910	7.60							
Corrosivity	None	.844	1.833							
Sulfate	*250.000	12 130	5.0							
S.Conductance	*700.0	[illegible]	[illegible]							

Shop Building

A senic	*0.050									
rium	*1.000									
Cadmium	*0.010									
Calcium	None									
C romium	*0.050									
C pper	*1.000									
Iron	*0.300									
Lead	*0.050									
M nganese	*0.050									
M gnesium	None									
Mercury	*0.002									
ickel	None									
elenium	*0.010									
lver	*0.050									
odium	None									
Zinc	*5.000									
itrate	*10.000									
luoride	*4.000									
lkalinity	None									
Chloride	*250.000									
narndess	*250.000									
H	*8.500									
orrosivity	None									
Sulfate	*250.000									
S.Conductance	*700.0									

D

#1 STREAM MARK + PAK

RAMETER	MCL*	3/7/88	12/13/88	3/13/89	7/7/89	7/19/89			
rsenic	0.050	<0.010	<0.010		<0.002	<0.002			
admium	0.010	<0.002	<0.002		<0.002	<0.002			
H	8.5	7.1	7.3		7.600	6.580			
itrate	10.00	<1.00	<1.00		<0.500	<0.500			
ilver	0.050	<0.020	<0.020		<0.002	<0.002			
hloride	250.0	79.9	79.0		332.050	307.270			
anganese	0.050	0.321	0.582		0.245	0.518			
ardness	250.	70.	79.70		752.872	268.292			
ead	0.010 ~~0.050~~	<0.005	0.007		0.014	<0.010			
pper	1.000	<0.20	<0.20		0.019	<0.005			
otassium									
ulfate	250.0	24.3	29.3		265.900	146.900			
alcium		16.0	18.4		53.765	50.079			
arium	1.00	<0.50	<0.05		0.058	0.075			
hromium	0.050	<0.020	<0.020		<0.002	0.002			
ercury	0.002	<0.0005	<0.0005		>0.0020	<0.0020			
elenium	0.010	<0.005				<0.002			
luoride	2.40	<0.50	<0.050		0.300	0.180			
ron	0.300	3.795	10.200		>2.000	>2.000			
odium	NONE ~~100.~~	52.	75		>200.00	>200.00			
Zinc	5.00	<0.50	0.09		0.058	0.328			
Nickel		<0.50	0.17		<0.050	0.050			
Magnesium		7.4	8.2		>100.000	11.785			
Alkalinity	NONE	42	<20.00		57.970	110.240			

(3/13/89 column, written vertically: Well Frozen)

#2 STREAM SOUTH OF PROPERTY

RAMETER	MCL*	3/7/88	12/13/88	3/13/89	7/7/89	9/19/89
Arsenic	0.050	<0.010	<0.010	<0.010	<0.002	<0.002
dmium	0.010	<0.002	<0.002	<0.002	<0.002	<0.002
l	8.5	7.0	7.5	7.4	7.690	7.040
Nitrate	10.00	1.50	<1.00	<1.00	<0.500	<0.500
ilver	0.050	<0.020	<0.020	<0.004	<0.002	<0.002
loride	250.0	847.9	392.5	361.4	333.350	421.040
nganese	0.050	0.138	0.138	0.087	0.079	0.122
Hardness	250.	371.	137.90	>1000.00	1172.556	351.727
ead	0.010 ~~0.050~~	<0.005	0.018	<0.010	<0.010	<0.010
opper	1.000	<0.20	<0.20	<0.20	0.022	<0.005
otassium						
Sulfate	250.0	158.8	64.7	480.3	419.200	143.100
alcium	none	33.4	18.8	78.4	76.459	34.142
arium	1.00	<0.50	<0.05	<0.05	0.026	0.029
hromium	0.050	<0.020	<0.020	<0.002	<0.002	<0.002
Mercury	0.002	<0.0005	<0.0005		<0.00020	<0.00020
elenium	0.010	<0.005				<0.002
luoride	2.40	<0.50	<0.50	<0.50	0.200	<0.100
ron	0.300	7.768	2.800	0.994	0.834	1.107
odium	NONE ~~100.~~	607.0	365	243	>200.00	>200.00
Zinc	5.00	<0.50	<0.05	<0.05	0.013	0.034
Nickel	none	<0.50	0.13	<0.10	<0.050	<0.050
Magnesium	none	69.7	22.1	211.4	>100.00	64.710
Alkalinity		24.	64.07	59.10	54.210	20.770

#3. GRAVEL POND - S.E. SIDE

ARAMETER	MCL*	3/7/88	12/13/88	3/13/89	7/7/89	9/19/89		
Arsenic	0.050	<0.010	<0.010	<0.010	<0.002	<0.002		
Cadmium	0.010	<0.002	<0.002	<0.002	<0.002	<0.002		
pH	8.5	7.2	7.8	8.0	8.130	7.820		
Nitrate	10.00	<1.00	<1.00	<1.00	0.560	<0.500		
Silver	0.050	<0.020	<0.020	<0.004	<0.002	<0.002		
Chloride	250.0	20.8	712.4	290.9	298.480	425.040		
Manganese	0.050	1.027	1.260	0.605	0.333	0.277		
Hardness	250.	165	588.50	498.20	336.403	325.660		
Lead 0.010	~~0.050~~	0.055	0.006	<0.010	<0.010	<0.010		
Copper	1.000	<0.20	<0.20	<0.20	<0.005	<0.005		
Potassium								
Sulfate	250.0	123.5	140.9	72.5	60.290	16.330		
Calcium		52.0	137.4	115.3	77.080	70.081		
Barium	1.00	<0.50	0.22	0.13	0.105	0.135		
Chromium	0.050	<0.020	<0.020	<0.002	<0.002	<0.002		
Mercury	0.002	<0.0005	<0.0005		<0.00020	<0.00020		
Selenium	0.010	<0.005				<0.002		
Fluoride	2.40	<0.50	0.50	<0.50	0.200	0.170		
Iron	0.300	12.505	6.880	2.821	0.656	>2.000		
Sodium NONE ~~100.~~		42.	707	414	>200.00	>200.00		
Zinc	5.00	<0.50	0.27	0.68	0.054	0.379		
Nickel		<0.50	0.31	<0.10	<0.050	<0.050		
Magnesium		8.5	59.6	51.1	34.953	36.588		
Alkalinity	NONE	6.8	[illegible]	[illegible]	[illegible]	[illegible]		

MAXIMUM CONTAMINANT LEVELS

#4A GRAVEL + ASH POND S.W. SIDE

PARAMETER	MCL*	3/7/88	12/13/88	3/13/89	5/5/89	7/7/89	9/19/89	
Arsenic	0.050	<0.010	<0.010		<0.010	<0.002	<0.002	
Cadmium	0.010	<0.002	<0.002		<0.002	<0.002	<0.002	
pH	8.5	7.0	7.6		7.9	8.070	7.640	
Nitrate	10.00	<1.00	<1.00		<1.00	1.200	<0.500	
Silver	0.050	<0.020	<0.020		<0.004	<0.002	<0.002	
Chloride	250.0	412.8	119.0		53.6	287.300	197.870	
Manganese	0.050	0.354	0.458		0.226	0.464	0.405	
Hardness	250.	187.	99.10		98.00	293.872	208.203	
Lead	0.010 ~~0.050~~	0.024	0.022	Water Frozen	0.016	0.012	0.014	
Copper	1.000	<0.20	<0.20		<0.20	0.028	0.005	
Potassium								
Sulfate	250.0	70.9	3.0		23.4	73.230	57.450	
Calcium		28.4	23.7		27.6	59.921	53.979	
Barium	1.00	<0.50	<0.05		<0.05	0.114	0.095	
Chromium	0.050	<0.020	<0.020		<0.002	0.003	0.003	
Mercury	0.002	<0.0005	<0.0005		<0.0005	<0.00020	<0.00020	
Selenium	0.010	<0.005					<0.002	
Fluoride	2.40	<0.50	<0.50		<0.50	0.200	0.120	
Iron	0.300	9.034	7.400		1.400	1.413	72.000	
Sodium	NONE ~~100.~~	253	104		49	7200.00	142.366	
Zinc	5.00	<0.50	0.10		0.07	0.027	0.065	
Nickel		<0.50	0.34		<0.10	0.050	<0.050	
Magnesium		28.2	9.7		6.3	35.029	17.829	
Alkalinity		38.	<30.00		59.32	270.300	130.700	

#6 STREAM ON HILDRE SIDE OF ASHPIT

ARAMETER	MCL*	3/7/88	12/13/88	3/13/89	7/7/89	9/19/89		
Arsenic	0.050	<0.010	<0.010			<0.002		
Cadmium	0.010	0.002	<0.002			<0.002		
pH	8.5	7.3	7.5			7.100		
Nitrate	10.00	<1.00	<1.00			<0.500		
Silver	0.050	<0.020	<0.020			<0.002		
Chloride	250.0	<10.0	<10.0			<10.00		
Manganese	0.050	0.429	0.462			0.502		
Hardness	250.	62.	78.00			137.104		
Lead	0.050	0.031	<0.003			0.013		
Copper	1.000	<0.20	<0.20			0.012		
Potassium				No Water	Not Done			
Sulfate	250.0	26.6	18.7			54.570		
Calcium		19.1	27.3			48.242		
Barium	1.00	<0.50	0.09			0.103		
Chromium	0.050	<0.020	<0.020			0.003		
Mercury	0.002	<0.0005	<0.0005					
Selenium	0.010	<0.005						
Fluoride	2.40	<0.50	<0.50			0.100		
Iron	0.300	12.289	10.800			72.000		
Sodium	NONE ~~100.~~	<10.	9			7.868		
Zinc	5.00	<0.50	0.17			0.114		
Nickel		<0.50	0.14			<0.050		
Magnesium		3.5	2.4			11.041		
Alkalinity		<20.	<20.00			65.200		

7 LEMON CREEK - 100 YDS. UPSTREAM FROM EGAN Drive

ARAMETER	MCL*	3/7/88	12/13/88	3/13/89	7/7/89	9/19/89		
...senic	0.050	<0.010	<0.010	<0.010	<0.002	<0.002		
..dmium	0.010	<0.002	<0.002	<0.002	<0.002	<0.002		
pH	8.5	7.1	7.6	7.3	7.620	7.040		
Nitrate	10.00	<1.00	<1.00	<1.00	<0.500	<0.500		
S lver	0.050	<0.020	<0.020	<0.004	<0.002	<0.002		
C loride	250.0	794.0	112.9	312.7	<10.000	25.220		
langanese	0.050	0.083	0.091	0.084	0.018	0.023		
lardness	250.	312.	65.24	319.16	<50.00	<50.000		
..ad	0.050	<0.005	<0.003	<0.010	<0.010	<0.010		
..pper	1.000	<0.20	<0.20	<0.20	<0.005	<0.005		
otassium								
ulfate	250.0	136.2	19.5	128.4	<5.000	<5.000		
.. clum		32.1	13.1	32.8	4.051	6.776		
.. ium	1.00	<0.50	<0.05	0.05	0.040	0.045		
hromium	0.050	<0.020	<0.020	<0.002	<0.002	<0.002		
ercury	0.002	<0.0005	<0.0005		<0.00020	<0.00020		
..enium	0.010	<0.005				<0.002		
..oride	2.40	<0.50	<0.50	<0.50	<0.100	<0.100		
..on	0.300	0.768	2.290	0.326	0.742	0.994		
..dium	NONE ~~100.~~	537.	120	446	8.648	18.244		
:	5.00	<0.50	<0.05	<0.05	0.015	<0.010		
..kel		<0.50	0.21	<0.10	<0.050	<0.050		
gnesium		56.3	7.9	57.6	1.030	2.923		
..alinity		25.	<20.00	35.50	<20.00	<20.00		

Precipitator & Bottom Ash

*Maximun Concentration Levels

PARAMETER	MCL*	4/86	8/86	3/88	3/87	12/87	3/88	12/88	3/89	7/89	12/89	3/90	6/90
Arsenic	5.0	.01	.01	.067	.01	.003	.067	.070	.020	<.005	<.05	<.2	<.2
Barium	100.0	.46	.13	.13	.23	—	.13	2.4	.24	.92	.15	.3	.38
Cadmium	1.0	<.005	<.01	2.3	<.01	<.003	2.3	.25	2.0	.21	.98	.28	.14
Chromium	5.0	<.01	<.01	.025	<.01	<.014	.025	.95	.097	<.014	<.05	<.05	<.05
Lead	5.0	<.01	<.01	5.2	<.01	<.02	5.2	8.4	8.0	1.0	<.05	7.1	.58
Mercury	0.2	<.001	<.001	<.002	<.005	—	<.002	<.0002	<.002	<.002	<.002	<.002	<.002
Selenium	1.0	.03	<.005	<.001	.01	.013	<.001	<.001	<.010	<.005	<.01	<.2	<.2
Silver	5.0	<.01	<.01	<.005	<.01	<.005	<.005	<.005	<.005	<.005	<.01	<.01	.02

MEMO

TO: Jerry Wilson
President

FROM: Loren Randolph *LR*

DATE: December 21, 1990

RE: Water Tests

This is to advise you that due to the ground being frozen, I am unable to perform the quarterly water tests at the test points. I'm not sure how the first quarter of 1991 will be as it depends on the weather.

JUNEAU LANDFILL
AKD-980495568
CERCLA Site Inspection Report

Submitted to:

Department of Environmental Conservation
Juneau, Alaska

Submitted by:

Tryck, Nyman & Hayes
Anchorage, Alaska

Shannon & Wilson, Inc.
Anchorage, Alaska

Science Applications International Corporation
Bellevue, Washington

December, 1987

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Juneau Landfill (a.k.a. Channel Landfill) is a sanitary landfill located northwest of Juneau, Alaska. The facility has received commercial and domestic wastes since at least 1972 and possibly the 1960s. Other wastes received in the landfill included low-level radioactive scintillation media and possibly some sewage sludge and waste oils. There are no records that can document the disposal of the sludges or oils in this site, but their presence has been men- tioned in letters written by the state agency personnel.

Currently, only nonputrescible material, construction and demolition debris and ash/incinerator residue are landfilled. Putrescible material and burnable solid wastes are incinerated. The disposal of the radioactive scintillation media by Auke Bay Laboratories occurred from 1977 to 1979. At that time, these wastes were required to be disposed in a licensed hazardous waste landfill or on the premises of the licensee [Auke Bay]. In 1981, however, amendments to 10 CFR Part 20, the NRC rules concerning biomedical waste disposal, were approved. The new regulations permit the disposal of these same wastes in a sanitary landfill such as the Juneau Landfill because they do not pose human health and safety risks.

The total **volume** of toluene disposed of in the past as part of the scintillation media would not exceed current RCRA restrictions for a conditionally-exempt hazardous waste generator.

Monitoring records of surface water or ash examined up to April, 1986 have not indicated a violation of federal drinking water standards for hazardous constituents. Sampling to date has proven inconclusive as to whether the site is a source of hazardous organic compounds. Benzene has been detected on-site and in a nearby well, but the source of the contamination has not been identified and may be associated with adjacent land use activities.

Due to the available information concerning the nature of wastes disposed in this faciltiy and on the potential for human exposure to these wastes, there appears to be little risk to human health. There is no information which indicates that the site is or is not a source of toxic or explosive landfill gases such as methane. Environmental contamination from the generation and migration of leachate appears to be a greater possibility and may pose localized water quality impacts. The landfill is not lined. In the event of improper waste disposal, it could be difficult to contain and reclaim any undesirable material.

1.0 INTRODUCTION

The State of Alaska's Department of Environmental Conservation (DEC) is evaluating the potential for release of hazardous wastes from several suspected uncontrolled hazardous waste sites throughout the state under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C 9601) [CERCLA Superfund]. CERCLA, recently reauthorized as the Superfund Amendments and Reauthorization Act of 1986 [SARA], authorizes EPA to respond to known or potential releases of hazardous substances to the environment which present an imminent or substantial danger to public health, welfare, or the environment.

Under the CERCLA Program, DEC has been authorized by EPA to perform site inspections at suspected hazardous waste sites in the state of Alaska in order to determine whether or not further investigative or remedial action is warranted. The scope of the Alaska site inspections as developed by the Tryck, Nyman & Hayes team for DEC involves a two-phased process: Phase 1 - a records search and data synthesis in an attempt to provide a data base sufficient to apply the EPA Hazard Ranking System (HRS) and; Phase 2 - an optional on-site inspection to close data gaps, confirm or document site conditions, and/or to collect and analyze environmental samples in order to complete HRS scoring and satisfy the overall site inspection objectives.

This report represents an evaluation of the Juneau Landfill (a.k.a. Channel Landfill). The information presented was gathered through a review of existing agency files, personal interviews, and a brief site reconnaissance. The files reviewed included those of the EPA Region 10's Superfund Program and open files at DEC's Central Office and Southeast Regional Office. Interviews were conducted with Dick Stokes, Steven Haavig, Al Kegler, and Roy Warren (all of DEC-Southeast), Sid Weldon, and Jim Beeson (City/Borough of Juneau), Stan Rice (National Marine Fisheries Service [NMFS] Auke Bay Laboratory), and Gerald Wilson (Channel Sanitation Corporation). A visual site inspection was performed on July 10, 1986 by members of the Tryck, Nyman & Hayes (TNH), site investigation team.

Section 2.0 of this report provides a description of the Juneau Landfill including available information on location, site history, waste management practices, and past permitting and regulatory activity. Section 3.0 describes the environmental setting including geology, geohydrology, and surface water resources. Monitoring activities conducted regarding the landfill are discussed in Section 4.0. Section 5.0 contains a discussion of major study findings. Finally, Section 6.0 provides conclusions and recommendations.

2.0 FACILITY DESCRIPTION

2.1 LOCATION AND SITE PLAN

The Juneau Landfill is located on the tidal flats of Lemon Creek, at the confluence of the creek with Gastineau Channel in Juneau, Alaska (see Figure 1). It is on the north side of Egan Drive, and accessible by an entry road at mile 5.5 of the Old Glacier Highway. The site is located in the southern one-half of Section 34 in T40S and R66E of the Copper River Meridian.

The landfill occupies approximately 20 acres (see Figure 2). An office building, weigh station, and two incinerators occupy the northern portion of the site. The southern portion of the property is covered by two ponds, 30 to 40 feet in depth, resulting from gravel extraction operations. Much of the perimeter of the site is surrounded by a dike which prevents inundation by Lemon Creek, drainages associated with Vanderbelt Creek, and the Gastineau Channel.

2.2 SURROUNDING LAND USE

The site is located along the north shore of Gastineau Channel, 4 miles northwest of downtown Juneau and 2.5 miles east of the Juneau Airport (Figure 2). Much of the land in the general site vicinity is mountainous and undeveloped. With the exception of the lower elevations bordering Gastineau Channel, much of the surrounding area is part of the Tongass National Forest. Residential areas including a trailer park and small commercial establishments are located about 0.5 miles north and east of the site. Hildre Sand and Gravel Company operates a gravel mining and asphalt manufacturing operation adjacent to and north of the landfill site. The firm has previously operated south of the Channel property and still owns property in that area. The permanent resident population within 3 miles of the site is approximately 3,000 (Tetra Tech, 1984).

2.3 SITE HISTORY

The date of initial waste disposal at the site is unclear. One document (Brewer, 1972) indicates that the facility was in operation in 1972, and another report (EMPS, 1985) states that it has been operating since about

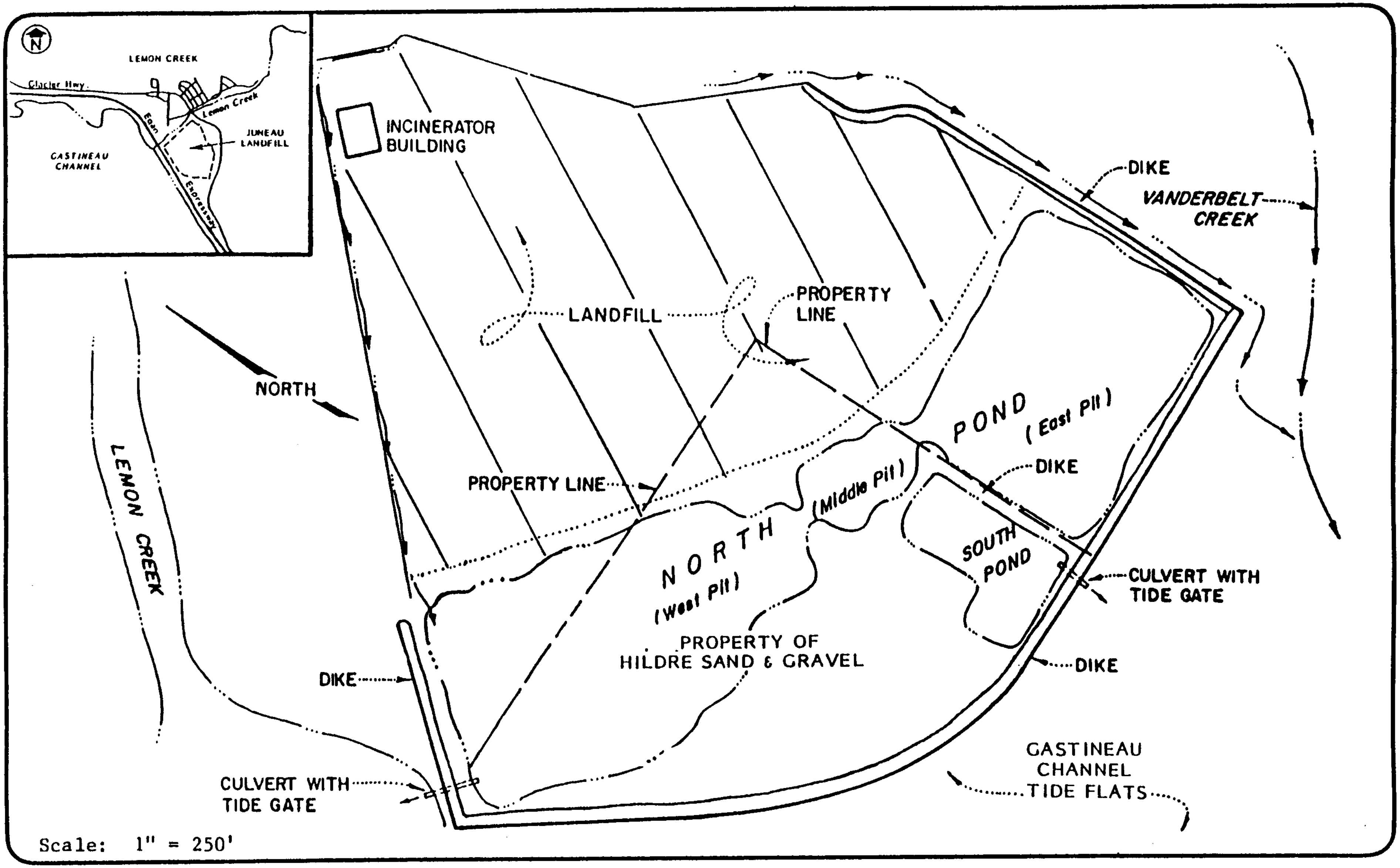


Figure 1

JUNEAU LANDFILL SITE PLAN
Source: Adapted from EMPS, 1985

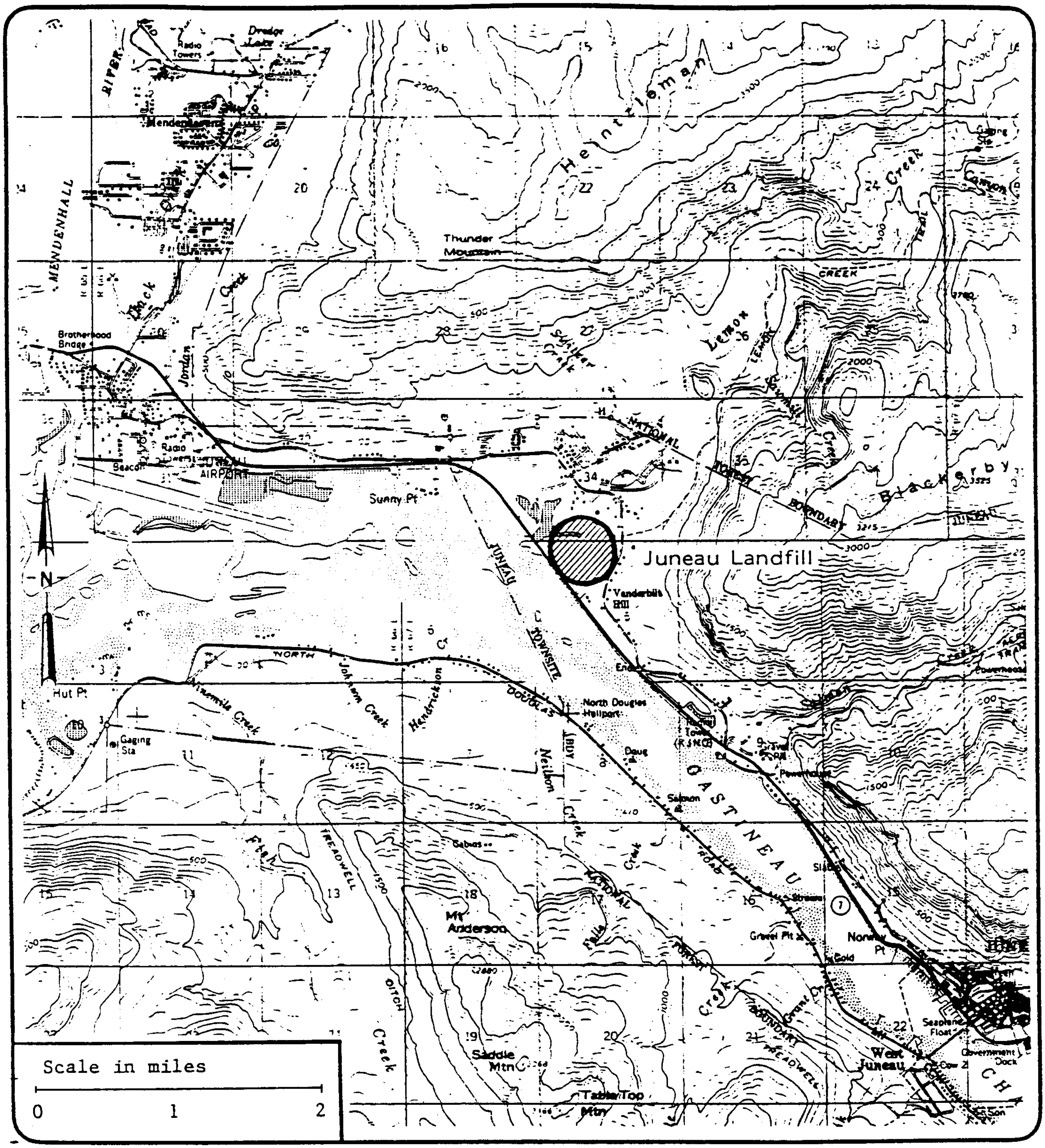


Figure 2

LOCATION OF JUNEAU LANDFILL SITE
Source: USGS Juneau (B-2) Topo. Map, 1962

1965. As of 1972, the facility was operated as an unpermitted landfill by Acme Disposal Service. In May 1974, DEC issued Solid Waste Management Permit SER 1-74 to the facility. A second permit (SE 5-76) was issued in January, 1977. During the years of operation of the site by Acme Disposal Service, DEC files indicated repeated problems with odors, failure to keep wastes within specified areas, and failure to apply cover material as required by permit. At some point between 1977 and 1979, the facility was purchased by Channel Sanitation Corporation, and a permit to operate the site (SE 4-80) was issued by DEC in January, 1980. Channel Sanitation is currently authorized to operate the Juneau sanitary landfill for the disposal of incinerated and unincinerated solid waste under Solid Waste Management Permit No. 8511-BA016. A notice of violation of this permit was issued on May 30, 1986 for deposition of ash below the water table (DEC, 1986d). The solid waste permit was reissued in January, 1987 and expires in December, 1988.

2.4 SITE OPERATIONS AND WASTE CHARACTERISTICS

The facility receives approximately 70 tons of waste per day from the greater Juneau area. Since there is little or no industry in the area, as was noted by the inspector during the file search in Juneau, the wastes received at the facility have been largely limited to domestic and commercial refuse. These two waste sources make up 96 percent of the wastes placed in the landfill. Seafood processing wastes, construction wastes, demolition debris, and ash/incinerator residue each comprise an additional one percent of wastes received (Channel Sanitation Corp., 1985). Some documents (Brewer, 1972; DEC, 1977) suggest that waste oil and sewage sludge may have been accepted at the site during the early periods of facility operation, but such disposal was not a routine practice (Brewer, 1974). No other records or files documented oil disposal practices.

Between the years 1977 and 1979 the National Marine Fisheries Service (NMFS), Auke Bay Laboratory disposed of liquid scintillation media containing tracer levels of ^{3}H (tritium) or ^{14}C (carbon 14) in the Juneau Landfill. The scintillation media was combined with an organic solvent (toluene) in 10 ml glass vials. The waste vials were then packed in 55-gallon drums with vermiculite. According to Dr. Stanley Rice, Habitat Program Manager for the laboratory, the vermiculite accounted for approximately 65% of the drum's volume. He estimated that eighteen drums were disposed in 10 different shipments during this period of time. Each shipment and burial included 1 to 2 drums. The drums were buried by the landfill operator (at that time Acme Disposal Service) in holes approximately 7 feet in depth. The drums were then covered to grade with fill materials and garbage (Rice, 1986). The location of these drums was not documented and would not be easily determined today (G. Wilson, pers. comm. 7/86). Based on conversations with Dr. Rice, it has been calculated that the total number of vials disposed was approximately 11,800. Assuming that each vial contained a full 10 ml of scintillation media it can be estimated that a total of 118 liters (approximately 31 gallons) of toluene wastes were disposed over a 2.4 year period. The laboratory estimates that the total activity of these wastes would not exceed 0.15 millicuries ^{14}C and 0.05 millicuries ^{3}H (Rice, 1986).

The amount of radioactive material used by the Auke Bay Laboratory during this period was 15 millicuries ^{14}C and 37 millieuries ^{3}H. Most of this material was lost via the laboratory drains as part of the flow through experiments (Rice, 1986).

The facility has traditionally been operated as a sanitary landfill: depositing wastes within discrete cells, compacting the material, and periodically covering the refuse with clean fill. The landfill is not lined and has no leachate collection or treatment system. Likewise, the facility is not designed to collect landfill gases such as methane (G. Wilson, pers. comm 7/7/86). In 1985, two incinerators were installed on-site, each with 35 tons/ day capacity. All combustible material is now incinerated. Incinerator ash is required by permit to be landfilled at least two feet above the saturated zone (DEC, 1986b), but the facility has received a notice of violation for placement of the ash within the flooded gravel pits (DEC 1986d). The facility's permit does not restrict the disposal of nonputrescible wastes (e.g., stumps, demolition debris, refrigerators, waste metals) in flooded gravel pits as was observed on the southern portion of the property in July, 1986.

The facility still maintains areas for stockpiling recyclable/salvageable materials. Scrap steel is stockpiled in the southern area and is shipped out-of-state about every six months (Tonsgard, 1982). Junk cars are now being landfilled.

3.0 ENVIRONMENTAL SETTING

3.1 CLIMATE

Juneau lies within a maritime climate, typified by mild temperatures, high humidity, high precipitation, considerable cloudiness, and an average temperature of 40°F. Temperatures range from 44°F to 64°F in summer, and 18°F to 34°F in winter. Moderate to heavy precipitation occurs year-round. Storms are more frequent and precipitation is heavier from November to January. The mean annual precipitation is 53 inches (NWS, 1986). This includes 107 inches of snow (Alaska Regional Profiles, undated). The Juneau Weather Station at the airport reports approximately 102 inches of snowfall annually. Prevailing winds are from the southeast (Channel Sanitation Corp., 1981).

Net precipitation and lake evaporation data are not available for this area. As a consequence, the estimated net precipitation value cited for this area (34") and later used for HRS scoring purposes is the potential evapotranspiration value developed by the U.S. Department of Agriculture (Patric & Black, 1968).

3.2 TOPOGRAPHY AND SURFACE WATER CHARACTERISTICS

3.2.1 Topography

The Juneau Landfill is located on the tidal flats of Lemon Creek, at the confluence of the creek with Gastineau Channel. The southern boundary of the site adjoins tide flats of the Gastineau Channel. To the north and east of the site are Heintzlman and Blackerby Ridges, respectively. These ridges on the mainland rise to 3000-3500 feet within approximately two miles of the site. Across Gastineau Channel is Douglas Island which rises less steeply to elevations approaching 3000 feet.

Because of the low lying elevation of the landfill, earthen dikes have been constructed along the borders of the site in order to prevent inundation of the site during high tide. At high tides (+ 19 feet) the ponds on the site are 4 to 5 feet below sea level. Culverts with tide gates prevent flooding of the site during high tides, but allow drainage of the ponds at low tidal stages. The higher portions of the landfill (approximately 30 feet in elevation) are always above sea level (EMPS,1985).

3.2.2 Surface Water Characteristics

The Juneau Landfill is bounded by surface water on all but its northern border. Lemon Creek flows 500 feet to the west of the site and Vanderbelt Creek flows less than one-half mile to the east. Both creeks are freshwater, although mixing with saltwater could be expected in their lower reaches during high tide. High flows of these creeks occur in August and low flows occur in mid-winter. Egan Drive separates the landfill from the tide flats adjacent to Gastineau Channel. Gastineau Channel is a marine water body used for navigation. The channel is over 15 miles long, and is over 25 fathoms deep in some places southeast of downtown Juneau. Near the Juneau Landfill, the channel has been filled in by silt from the Mendenhall Glacier, and is five to ten feet deep.

An engineered leachate collection and treatment system does not exist on the Juneau Landfill. Two ponds situated across the southern half of the landfill (see Figure 1), receive on-site surface water drainage. Surface runoff is primarily to the southwest towards either of the two ponds which were created by previous gravel mining operations. The water in these ponds is a composite of groundwater, surface runoff, and marine water infiltrating under the dikes or leaking through the tide gates during high tides. Water exits these ponds during low tidal stages through tide gates to both Gastineau Channel and Lemon Creek (EMPS, 1985; Stokes, 1985).

3.2.3 Surface Water Use

There is no use of surface water for drinking supplies within three miles downstream of the landfill site. Drinking water for the Lemon Creek Valley is supplied by a gravity flow distribution line from the Salmon Creek Penstock located approximately 2.5 miles east of the facility. Both streams provide spawning, rearing or migration habitat for anadromous fishes including trout and salmon (Hall, 1983). Gastineau Channel is a major transportation channel particularly for recreational tour ships. It also provides wildlife habitat.

3.3 SOILS AND GEOLOGY

The surficial geology of the lands encompassing Juneau Landfill include the broad, alluvium filled valley of Lemon Creek and a topographic bench bordering Gastineau Channel formed by the deposition of subaqueous sediments (USGS, 1972). Characteristic soils in this area include manmade fill, silty loam, and muskeg or peat. The northern portion of the landfill is comprised of silty loam, a very fine organic rich soil. On the lower portions of the site, soils are characterized as the Lemon Creek/Gastineau Channel tidal flats (EMPS 1985). These soils are typically one foot or less in thickness.

Subsurface depositional information specific to the landfill site is limited. Boring logs from wells completed in the area indicate that the site is underlain primarily by first a muskeg or peat of varying organic content and then primarily medium to coarse sand, fine to coarse gravel, and cobbles at depths up to 100 feet. A few wells reported to have intercepted layers of blue clay at depths of 20 and 80 feet, but this deposit is not known to be continuous or extensive (EMPS, 1985; Channel Sanitation Corp., 1981; Well logs for Stotz, Carlson, Schaefer, & Lotchansky). Generally, bedrock of slate or schist is encountered at depths of 100 feet.

A study of unconsolidated material in the Juneau area suggests that sediments found at the landfill are products of mass-wasting of the surrounding mountains.

These Quaternary deposits include colluvium, talus, debris-flow deposits, rockslide-avalanche deposits, undifferentiated landslides and colluvial diamicton (USGS, 1972).

3.4 AQUIFER/GROUNDWATER DATA

Groundwater in the landfill has been reported to occur at a depth of about seven feet beneath the natural ground surface (Channel Sanitation Corp, 1981). Borings taken in the northern portion of the facility indicate a depth to groundwater of approximately 15 feet. This would suggest that local gradients may be somewhat high, particularly with little impermeable material to impede flow. A review of the literature has not shown the presence of more than one water bearing unit. If there is more than one water bearing unit, a substantial vertical distance is probably necessary to prevent hydraulic communication between the units. Groundwater is believed to discharge to Lemon Creek, which is located approximately 500 feet west of the site, as it is the lowest surface groundwater expression. Some groundwater probably discharges into Gastineau Channel as well. Groundwater flow direction is believed to be in a southwesterly direction across the facility. Most likely, hydraulic conductivities are probably in the range of 10^{-3} to 10^{-5} cm/sec (Freeze and Cherry, 1979), these values are typical of the range of this type of unconsolidated material. Tidal fluctuations do exert some influence on groundwater levels, possibly causing some local mounding of groundwater. However, this phenomenon is probably temporary. Of more importance is flooding due to very high tides, as the possibility would exist to carry undesirable landfill material into Lemon Creek and Gastineau Channel.

A review of USGS well files has identified 24 wells within three miles of the site: 18 households, 2 businesses, 1 institutional establishment, and 3 public wells. The three public supply wells serve the Super-8 Motel, Juneau Airport, and Shop 'n Cart. All of these wells are upgradient and seven are on the other side of the Gastineau Channel. The number of wells identified in the USGS files may underestimate the number actually present since the DEC has sampled four other wells adjacent to the site (DEC, 1986a) which were not listed in USGS files. However, recent upgrades to the Juneau City/Borough water utility has resulted in hooking up most if not all of the residences and commercial establishments in this area. For HRS Scoring purposes, it is estimated that 100 persons or less use private wells for potable supplies. This estimate was provided by the City/Borough of Juneau (S. Weldon pers. comm., 6/87). The incinerator cooling water is provided by well. This well is not used for potable supplies as Channel Sanitation has tied into the public water supply. The City/Borough municipal supply wells are located five miles southeast of the site. A private surface water supply source is the Switzer Creek system which serves the trailer park near the landfill. The intake of this system is upgradient of the site and greater than three miles from it (S. Weldon, pers. comm., 6/87).

4.0 RECORDS SEARCH AND SITE INSPECTION

4.1 PHASE 1: INFORMATION RETRIEVAL

On July 10 and 11, 1986 project staff traveled to Juneau, Alaska and performed a visual site inspection of the landfill, reviewed the regional and state DEC files pertaining to the site, and interviewed DEC and landfill operating staff to obtain additional information concerning the Juneau Landfill.

The EPA Region 10 CERCLIS files were reviewed during the week of July 21, 1986. Computerized USGS well inventory data were reviewed to identify all recorded groundwater withdrawals on or near the site. Additional research was performed to obtain characteristic regional and local climatological, hydrologic, and geologic information.

The following summarizes the information obtained regarding the Juneau Landfill:

DEC Central Office

- Files or records pertaining to the Juneau Landfill located in the DEC headquarters were limited to the RCRA 3012 Preliminary Assessment (Tetra Tech, 1984) and to a surface and groundwater monitoring study conducted in May, 1984 (DEC 1986a). Specific landfill records are maintained in the Southeast Regional office of DEC.

  The Preliminary Assessment assigned a priority score of "low" to the site due to the disposal of radioactive scintillation wastes from the Auke Bay laboratories (Tetra Tech, 1984). The surface and groundwater monitoring study concluded there was no evidence that either Lemon Creek or the ponds onsite were contaminated by organic chemicals. The study further concluded that reasonable evidence was available that indicated volatile organic chemical contamination, presumably from fuels, was present in two wells adjacent to the landfill. The source of this contamination was not determined and not necessarily associated to the landfill as one of the wells was located at a boat marina and repair facility which regularly handled fuels (DEC,1986a).

DEC Southeast Regional Office

- Information retrieved from the Southeast Regional Office included landfill operating records, solid waste disposal permit applications and permit authorizations, water quality monitoring results, inspection memoranda, and a copy of a report prepared by EMPS Engineering for Channel Sanitation regarding disposal of incinerator residue dated October 28, 1985 (EMPS, 1985).

- Discussions with DEC regional staff (Stokes, Haavig, Kegler, and Warren) regarding the landfill did not yield additional information beyond that retrieved from the files and presented herein.

EPA Region 10 CERCLIS Files

- CERCLIS files from EPA included the RCRA 3012 Preliminary Assessment mentioned previously.

City/Borough of Juneau

- Mr. Jim Beeson, Utility Superintendant; and Sid Weldon, Assistant Utility Superintendant provided several records describing the City/Borough's Water Department and the water collection and distribution system. These records included schematics of the system and water quality monitoring data.

Channel Sanitation

- A visual site inspection of the landfill was performed on July 10, 1986. Mr. Gerald Wilson, General Manager for Channel Sanitation provided a description of the current landfill's operating practices and submitted a copy of a recent surface water and ash analysis report.

4.2 PHASE 2: FINAL SITE INVESTIGATION EFFORT

At the conclusion of the Phase 1 records review, a preliminary HRS score was calculated for the site. The TNH preliminary score of the Juneau Landfill was calculated as $S_m = 6.64$. The overall low score was a result of the lack of groundwater or surface water users in the area near the site and the small quantities of wastes (31 gallons of toluene) attributable to the facility. Information from the City/Borough of Juneau indicated that the number of private water supply wells remaining in use was very minimal (<100). Because of the tidal nature of local groundwater and surface water as well as the natural occurance of manganese, total dissolved solids, and iron in localized water supplies there is limited use of this water for potable supplies. As a result most businesses and residences near the site are either connected to the local municipal system or the Switzer Creek source (S. Weldon, Pers. Comm., 6/87).

The Juneau landfill does not reflect a history of industrial and/or hazardous waste disposal or associated contamination problems. As a consequence of the preliminary HRS score and because it was not clear whether or not radioactive materials such as those reportedly disposed in the landfill were regulated under CERCLA, it was decided by the state DEC that the site inspection should be concluded without environmental sampling. Instead, the field team conducted a separate research effort to review the recent (January, 1987) joint EPA/NRC Guidance on the definition and identification of commercial mixed low-level radioactive and hazardous wastes and separate NRC and EPA requirements regarding disposal of low-level mixed wastes in order to determine regulatory applicability of the disposal of Auke Bay scintillation wastes to the Juneau Landfill.

5.0 DISCUSSION

Chemical analytical determinations of wastes accepted for disposal in the Juneau Landfill are not available. Information retrieved during the Phase 1 Records Search indicate that the landfill accepted seafood processing wastes, putrescible domestic wastes, construction wastes, demolition debris, and ash/ incinerator residues. Personal communications with the General Manager of Channel Sanitation during the July site visit did not indicate that any other wastes were accepted that are hazardous in nature with the exception of household wastes that may contain hazardous constituents (i.e., occasional paint cans, waste motor oil). At one time, the landfill accepted lead batteries although these were usually recycled. It is conceivable that a few batteries were landfilled. The landfill reportedly received the shipments of Auke Bay mixed wastes in drums with the approval of DEC. The General Manager did not believe that retrieval of these drums was feasible because of the lack of records indicating a precise burial location in the landfill (G. Wilson, pers. comm., 7/10/86).

The city of Juneau has little industry and consequently is not a likely source of industrial hazardous wastes. When the landfill buried all its wastes, equipment operators would screen the waste contents before burial (G. Wilson, pers. comm., 7/10/86).

5.1 LANDFILL MONITORING HISTORY

Despite the lack of landfill waste characterization, there have been several past monitoring efforts of both surface and groundwater in the vicinity of the site primarily by staff of DEC. These investigations are summarized below:

- Samples were taken from Lemon Creek on December 22, 1980, and analyzed for a variety of heavy metals (DEC, 1981a). Available files do not indicate the sampling locations on Lemon Creek, thus no assessment of results is possible. The analytical results, however did not indicate any contamination in excess of federal drinking water standards.

- Groundwater samples were collected from wells north and east of the site on January 6, 1981. No pesticides or radioactivity were detected. Some well samples exceeded drinking water standards for barium, selenium, iron, and managanese. The only well potentially downgradient of the facility (Charlie's Marina) had the highest concentrations of iron (97.5 mg/L versus 0.2 to 1.7 mg/L upgradient). The on-site well sample had 16.4 mg/L iron and 0.75 mg/L manganese. The levels of selenium ranged from 0.014 to 0.060 mg/L in wells offsite; selenium was not detected in the landfill well (DEC, 1981b). The presence of selenium in groundwater near the site has not been reported in subsequent DEC or landfill monitoring reports.

- Surface water sampling conducted in or around May, 1981, detected low dissolved oxygen concentrations in the on-site borrow pits and in Lemon Creek adjacent to the site. Dissolved oxygen ranged from 0.3 to 3.1 mg/L and BOD_5 ranged from 5.3 to 41 mg/L (DEC, 1981c).

- Surface water samples were collected on the site and from adjacent waters on June 9, 1981. Analyses for D.O., pH, salinity, and conductivity revealed no contamination of concern (DEC, 1981d).

- Surface water samples from Lemon Creek were collected on May 9 or 16, 1984, from sites upstream and downstream from the point of discharge from the on-site ponds. Samples were analyzed for a variety of organic solvents and none were detected. During the same period, groundwater samples were taken from wells north, east, and west of the site, and the samples analyzed primarily for organic solvents. Benzene was detected in a well east of the facility. Benzene, chlorobenzene, trans-1,2-dichloroethylene, and ethylbenzene were detected at Charlie's Marina, west of the facility. A sample of one of the on-site ponds also had detectable concentrations of benzene, but it was not possible to determine whether contamination of off- site wells was attributable to the facilty or from an offsite source such as the boat marina and its parking lot (DEC, 1986a).

- On December 18, 1985, a contractor for the landfill operator sampled surface water in the on-site gravel pits and surface drainages adjacent to the site. Manganese and iron showed evidence of elevated concentrations in the gravel pits. Consistently low pH values (5-6.6) were reported, but these values are not unusual of surface and shallow groundwater found, within peat deposits. Other metals were either below detection limits or demonstrated no gradient attributable to site operations (EMPS, 1986a).

- The current facility waste disposal permit (8511-BA106) requires the operator to sample surface water in the on-site gravel pits on a quarterly basis for conductivity, COD, pH, alkalinity, salinity, arsenic, and a variety of heavy metals. Analytical results for the December, 1985, and March, 1986, sampling effort indicate that iron and manganese exceeded drinking water standards during both periods in all samples and that pH, sodium, chloride, hardness, total dissolved solids, and sulfate exceeded standards in several samples. In no sample was a RCRA or CERCLA regulated material in excess of state and/or federal drinking water standards (EMPS, 1986b).

- The facility's waste disposal permit also requires quarterly analysis of the incinerator ash using the extracable procedure (EP) toxicity testing methodology. In April, 1986, the analysis of the landfill's ash samples did not indicate concentrations of heavy metals in excess of the federal primary drinking water standards (EMPS, 1986b).

5.2 LOW-LEVEL RADIOACTIVE WASTE DISPOSAL

Between the years 1977 and 1979 the National Marine Fisheries Service, Auke Bay Laboratory reportedly disposed of liquid scintillation media containing trace levels of ^{3}H (tritium) or ^{14}C in the Juneau Landfill. Disposal of this material was approved by the DEC in 1977 (Rice, 1986). However, the Lab was required by NRC as a licensee to dispose of these items in one of the following ways:

- by sending them to a radioactive waste disposal site;
- by dispersing them through a sanitary sewerage system;
- or by evaporation, distillation, burning, or burial on the licensee's facility (10 CFR 30.41 and 20.301).

Based on the above, it is clear that the scintillation wastes should not have been disposed at the Juneau landfill because it was not a NRC licensed facility. These same materials, however, may have been approved for disposal by NRC on the Auke Bay facility because the overall activity was considered low and would not pose a threat to humans or the environment (Rice, 1986). Radionuclide tracers are commonly used in biomedical research. The laboratory used them in flow through seawater systems, hence the majority of scintillation media was flushed with the lab's wastewater down the drain. Such disposal was acceptable by the NRC. Only samples withdrawn for water and tissue analyses were disposed within the landfill (Rice, 1986).

In March, 1981, NRC regulations regarding the disposal of biomedical wastes were amended to allow for disposal of liquid scintillation media at facilities not regulated by the NRC. Specifically, CFR §20.306 states that liquid scintillation wastes, [like those found at the Juneau Landfill], may be disposed of "without regard to radioactivity" when 0.05 microcuries or less of ^{3}H or ^{14}C are contained in each gram of medium. This change was considered appropriate by the NRC because the amendments would not pose an unreasonable risk to the health and safety of the public, the transport and disposal of these wastes was expensive without benefit commensurate to the expense, and these wastes consumed a significant portion of the limited radioactive waste burial sites. The new disposal amendments, however, did not exempt the licensee from complying with other applicable federal, state, and local regulations governing other toxic or hazardous properties of these wastes (10CFR§20.306 [d]).

On August 19, 1986, a memo was submitted by the NMFS Auke Bay Lab to SAIC estimating the ^{3}H and ^{14}C concentration levels of the disposed scintillation wastes. Through a series of back calculations, an attempt was made to estimate these concentrations based on the total number of experiments that were conducted and of the resultant disposed wastes. This was necessary because the lab apparently failed to keep accurate records of what the actual concentrations of radioactive constituents were in the packed drums. Based on the lab's estimates a total activity of 0.2 millicuries (200 microcuries) ^{14}C and 0.05 millicuries (50 microcuries) ^{3}H were disposed in approximately 31 gallons of toluene (Rice, 1986). Based on these values, and on the specific gravity of toluene (0.8669) the total radioactivity of the scintillation media disposed was approximately 0.002 microcuries per gram. This quantity would be permissible for disposal in the Juneau Landfill today.

The imprecise recordkeeping by the lab suggests that 10 CFR §30.51 record keeping requirements may have been violated. Under §30.51(3) the lab is required to maintain records showing the receipt, transfer and disposal of this material for 5 years after the transfer occurs.

In a joint memo released on January 8, 1987 by EPA and the NRC, guidance is provided on identification of low-level hazardous waste. On page 3 of Directive Number 9432.00-2, the policy states that when the NRC finds that the radioactive content of the wastes is below NRC's regulatory concern, licensees are not relieved from compliance with other federal and state laws. As mentioned above, RCRA requirements can apply. The presence of the organic chemical toluene in the wastes could trigger RCRA requirements. In fact, the hazardous nature of the solvents used to carry radioactive tracers may pose a greater threat to human health and the environment than the presence of either ^{3}H or ^{14}C. However, based on the total estimated quantity of toluene disposed (31 gallons) in several shipments (10) over 2.4 years, it is quite likely that no single drum contained more than 25 gallons of liquid wastes. Generators of 25 gallons or less of hazardous wastes in any calendar month are conditionally exempted small quantity generators under current RCRA regulations. Conditionally exempt generators are only required to identify all hazardous wastes and send this waste to an approved hazardous waste or municipal landfill (40 CFR §261 and §262). Based on this, there would have been no apparent RCRA violations associated with the disposal of Auke Bay wastes in the Juneau Landfill.

There are no records that indicate air releases from hazardous wastes can be attributed to this facility. Likewise, there is no indication that a fire and/or explosive threat are present. It should be pointed out however, that the landfill is not designed with a landfill gas recovery or vent system for collecting or igniting gaseous materials common to sanitary landfills such as methane. Because of the saturated conditions that occur in portions of this site, and due to the shallow depth to groundwater it is probable that methane generation is occurring. Whether or not this generation is a problem has not been determined. The reviewer therefore should not assume that landfill gases do not occur in the Juneau Landfill and do not pose potential explosivity problems.

This site evaluation and HRS is based on the reported disposal of approximately 31 gallons of toluene as a component of the low-level mixed scintillation wastes from Auke Bay Labs. Toluene is the only known documented hazardous material disposed in the Juneau Landfill.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The Juneau Landfill (a.k.a. Channel Landfill) is a sanitary landfill located northwest of Juneau, Alaska. The facility has received commercial and domestic wastes since at least 1972 and possibly the 1960s. Other wastes received in the landfill include low-level radioactive scintillation media and possibly some sewage sludge and waste oils. There are no records that can precisely document the disposal of the sludges or oils in this site, although references in correspondence suggest such materials may have been disposed there prior to 1972 (Brewer, 1972).

In at least ten separate shipments over a 2.4 year period, NMFS Auke Bay Laboratories disposed of a total of 18 drums of ^{3}H and ^{14}C scintillation wastes with toluene. At the time disposal took place, burial of radioactive wastes of this type and quantity in an off-site landfill was not an option to NRC licensees; however, based on the 1981 amendments to 10 CFR Part 20, and the NRC rules concerning biomedical waste disposal, the Auke Bay Laboratory wastes could now be disposed in a site such as the Juneau Landfill. Furthermore, the total volume of toluene disposed with these wastes does not exceed RCRA requirements for a conditionally-exempt hazardous waste generator.

Monitoring records of surface water or ash examined up to April, 1986, and performed by DEC or the landfill operator, Channel Sanitation, has not indicated a violation of federal drinking water standards for hazardous constituents. Some nonhazardous metals (e.g. iron and manganese) have been reported in excess of drinking water standards. Sampling to date has proven inconclusive as to whether the site is a source of hazardous organic compounds. Benzene has been detected on-site and in a nearby well, but the source of the contamination has not been identified and may be associated with other adjacent land uses.

The TNH preliminary HRS Score for this facility is 6.64. The score is based on the disposal of 31 gallons of toluene in the landfill. Due to the available information concerning the nature of wastes disposed in this facility and on the potential for human exposure to these wastes, there appears to be little risk to human health. There is no information which indicates that the site is or is not a source of toxic or explosive landfill gases such as methane. Considering the saturated conditions that occur in portions of the site, this possibility should not be ignored. Environmental contamination from the generation and migration of leachate appears to be a greater possibility and may pose localized water quality impacts. The degree and magnitude of these potential impacts can not be estimated without routine monitoring, which is currently ongoing by the landfill operator. The landfill is not lined, consequently in the event of improper disposal it could be difficult to contain and reclaim any undesirable wastes.

6.2 RECOMMENDATIONS

The recommendations in this section are measures which may further define and assess the potential for environmental contamination due to past or continuing activities at the Juneau Landfill:

- The facility should carefully characterize the direction and rate of groundwater movement, particularly during ebb tide in order to better predict the potential effects, if any of buried wastes on local and surface groundwaters.

- Continue quarterly monitoring the landfill's ponds, adjacent surface waters, and incinerator ash for hazardous constituents, in particular heavy metals and volatile organic chemicals.

- If the on-site groundwater well is accessible conduct sampling on a quarterly basis for heavy metals and volatile organic chemicals.

- Conduct a combustible gas survey of the landfill to determine the potential for organic vapors and gases present in the atmosphere.

- It would be advisable to construct a lined and bermed disposal area to dispose incinerator ash. At the present time there are no federal limits on the disposal of incinerator ash based on the presence of toxic metals, however this disposal in sanitary landfills is being reported as a significant source of metals contamination (Environmental Reporter, 1987).

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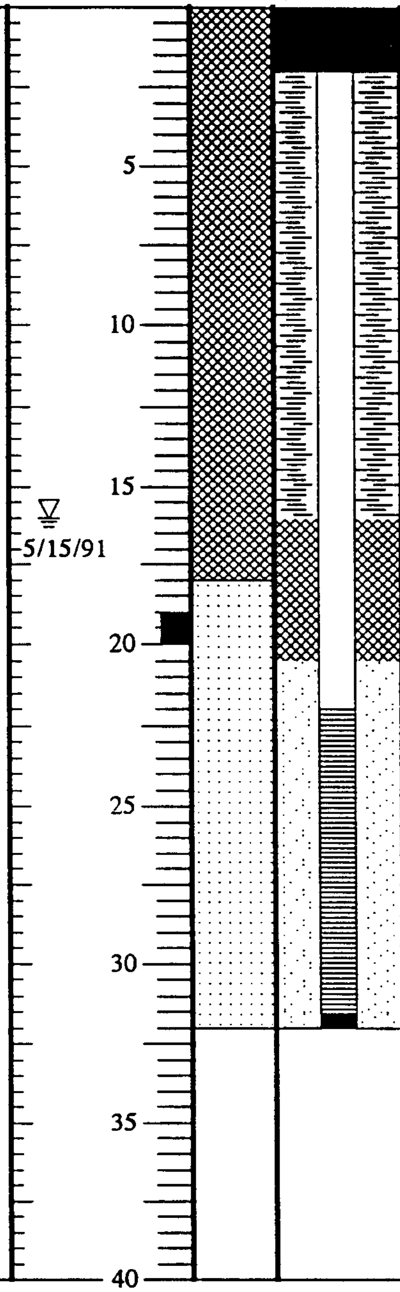
Appendix 4

SOIL BORING AND MONITORING WELL LOGS

LOG OF EXPLORATORY BORING

PROJECT NAME	Channel Corporation	BORING NO.	MW- 1
LOCATION	Juneau Landfill	PAGE	1 OF 1
DRILLED BY	Wink Int'l Geotech	REFERENCE ELEV.	
DRILL METHOD	H.S.Auger	TOTAL DEPTH	32.00'
LOGGED BY	Steve Nelson	DATE COMPLETED	5/13/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS/S-1	10/10/-	20%						



0 - 18.0 feet: REFUSE; black, mixture of paper, plastic, wood and metal, with layers of gravelly sand, wet below 16 feet. (FILL)

18.0 - 32.0 feet: SAND (SP); brown, fine to coarse, few fine to subround gravel, few fines, dense, wet. (ALLUVIUM)

Well Completion Details

0 - 2 feet: concrete.
2 - 16.0 feet: bentonite-cement grout.
16 - 20.5 feet: bentonite slurry
20.5 - 32 feet: 8 x 12 Colorado silica sand.

+ 2 - 22 feet: 2-inch-diameter PVC schedule 40 blank riser.
22 - 31.8 feet: 2-inch-diameter PVC Schedule 40 0.020-inch slot screen.
31.8 - 32 feet: 2-inch-diameter PVC slip-on end-cap w/s.s. screws.

Bottom of boring at 32.0 feet.

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch 10 Hollow Stem Auger

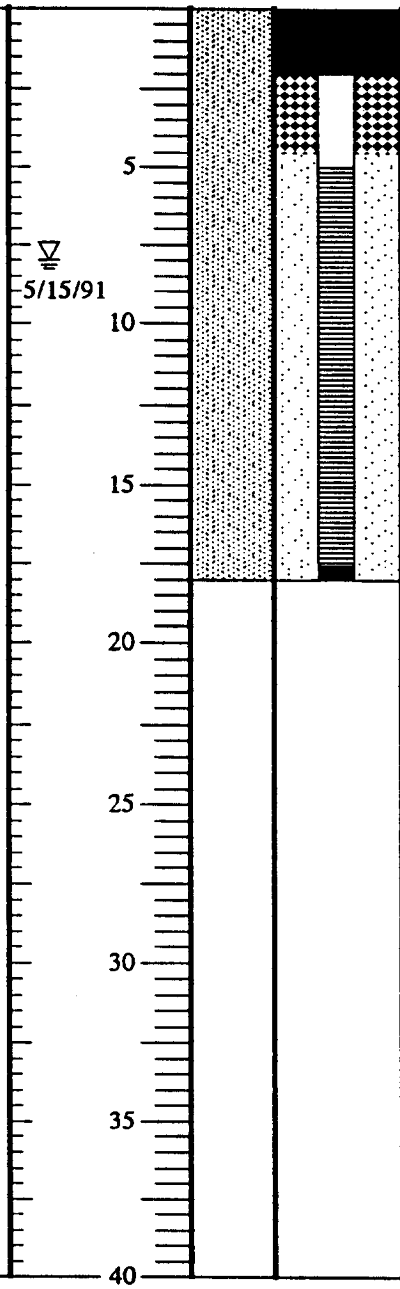
SWEET-EDWARDS/EMCON

X32-01.01.CHAN1.26/sd:3.6/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Channel Corporation	BORING NO.	MW- 2
LOCATION	Juneau Landfill	PAGE	1 OF 1
DRILLED BY	Wink Int'l Geotech	REFERENCE ELEV.	
DRILL METHOD	H.S.Auger	TOTAL DEPTH	18.00'
LOGGED BY	Steve Nelson	DATE COMPLETED	5/8/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION



0 - 18.0 feet: GRAVELLY SAND (SW); light brown, fine to coarse, fine to medium subround gravel, dense, wet below 11 feet. (ALLUVIUM)

Well Completion Details

0 - 2 feet: concrete.
2 - 4.5 feet: bentonite pellets (hydrated).
4.5 - 18 feet: 8 x 12 Colorado silica sand.

+2 - 5 feet: 2-inch-diameter PVC schedule 40 blank riser.
5 - 17.5 feet: 2-inch-diameter PVC schedule 40 0.020 in slot screen.
17.5 - 18 feet: 2-inch-diameter PVC slip-on end-cap with S.S. screws.

Bottom of boring at 18.0 feet on 5-8-91.

REMARKS

Borings completed with 6-inch O.D./3 1/2-inch 10 Hollow Stem Auger.

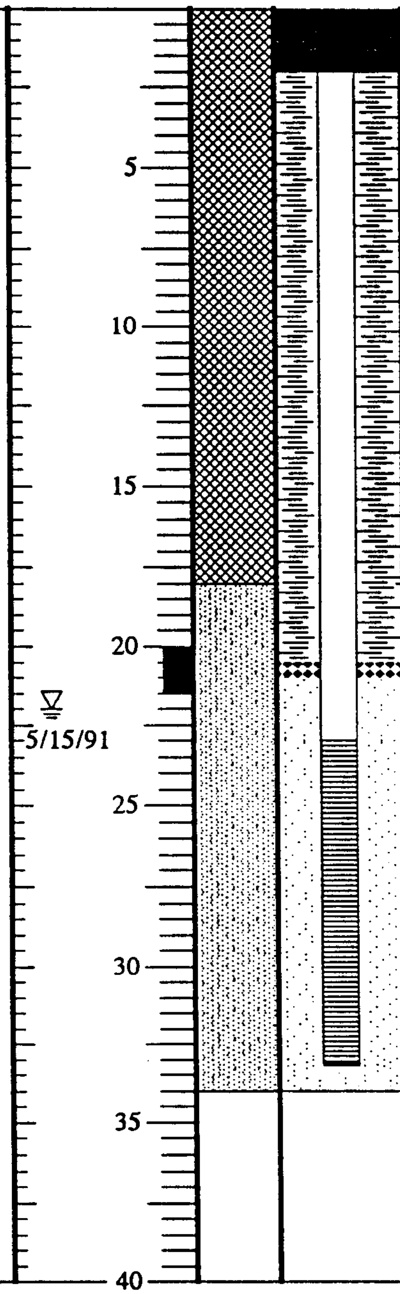
SWEET-EDWARDS/EMCON

X32-01.01.CHAN1.26/sd:3.6/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Channel Corporation	BORING NO.	MW- 3
LOCATION	Juneau Landfill	PAGE	1 OF 1
DRILLED BY	Wink Int'l Geotech	REFERENCE ELEV.	
DRILL METHOD	H.S.Auger	TOTAL DEPTH	34.00'
LOGGED BY	Steve Nelson	DATE COMPLETED	5/9/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS / DEPTH IN FT. / SAMPLES / LITHOLOGIC COLUMN / WELL DETAILS	LITHOLOGIC DESCRIPTION
				0 - 18.0 feet: REFUSE; black, mixture of incinerator ash and metal with layers of gravelly sand, wet below 20 feet. (FILL)
SS-1	8/10/10	10%		18.0 - 34.0 feet: GRAVELLY SAND with silt (SW); greenish -gray, fine to coarse, fine subround gravel, non-plastic fines, dense, wet. (ALLUVIUM)



Well Completion Details

0 - 2 feet: concrete.
2 - 20.5 feet: bentonite-cement grout.
20.5 - 21 feet: bentonite pellets.
21.0 - 33 feet: 8 x 12 Colorado silica sand.

+ 2 - 23 feet: 2-inch-diameter PVC schedule 40 blank riser.
23 - 33 feet: 2-inch-diameter PVC Schedule 40 0.020-inch slot screen.
33 - 33.2 feet: 2-inch-diameter PVC threaded end-cap.

Bottom of boring at 34.0 feet.

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch 10 Hollow Stem Auger.

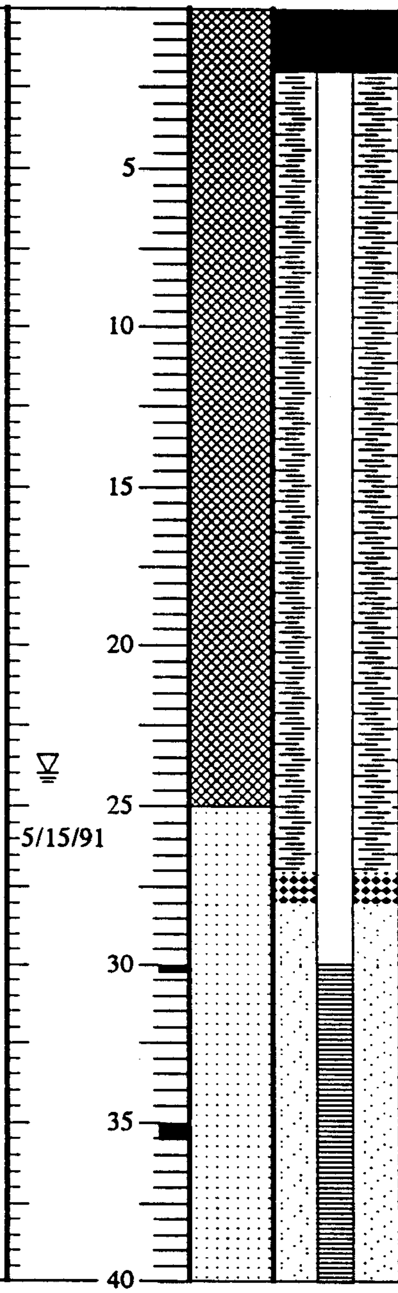
SWEET-EDWARDS/EMCON

X32-01.01.CHAN1.26/sd:3.6/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	**Channel Corporation**	BORING NO.	MW- 4
LOCATION	**Juneau Landfill**	PAGE	1 OF 2
DRILLED BY	**Wink Int'l Geotech**	REFERENCE ELEV.	
DRILL METHOD	**H.S.Auger**	TOTAL DEPTH	41.50'
LOGGED BY	**Steve Nelson**	DATE COMPLETED	5/11/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								0 - 25 feet: REFUSE; black, mixture of paper, wood, plastic and metal with layers of gravelly sand, wet below 24 feet. (FIL L)
								25.0 - 41.5 feet: SAND (SP); brown, fine with trace fines, dense, wet. (ALLUVIUM - DELTAIC SEDIMENTS)
SS-1	50/-/-	0						
SS-2	20/-/-	0						



Well Completion Details

0 - 2 feet: concrete.
2 - 27 feet: bentonite-cement grout.
27 - 28 feet: bentonite pellets
28 - 40 feet: 8 x 12 Colorado silica sand.
40 - 41.5 feet: caved native sediments

\+ 2 - 30 feet: 2-inch-diameter PVC schedule 40 blank riser.

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch 10 Hollow Stem Auger.

SWEET-EDWARDS/EMCON

X32-01.01.CHAN1.26/sd:3.6/12/91

LOG OF EXPLORATORY BORING

PROJECT NAME	Channel Corporation	BORING NO.	MW- 4
LOCATION	Juneau Landfill	PAGE	2 OF 2
DRILLED BY	Wink Int'l Geotech	REFERENCE ELEV.	
DRILL METHOD	H.S.Auger	TOTAL DEPTH	41.50'
LOGGED BY	Steve Nelson	DATE COMPLETED	5/11/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
SS-3	4/4/4	5						30 - 40 feet: 2-inch-diameter PVC Schedule 40 0.020-inch slot screen wrapped with polyester filter sock and s.s. clamps. 40 - 40.2 feet: 2-inch-diameter PVC threaded end-cap.
				45				Bottom of boring at 41.5 feet.
				50				
				55				
				60				
				65				
				70				
				75				
				80				

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch 10 Hollow Stem Auger.

LOG OF EXPLORATORY BORING

PROJECT NAME	Channel Corporation	BORING NO.	SB- 1
LOCATION	Juneau Landfill	PAGE	1 OF 2
DRILLED BY	Wink Int'l Geotech	REFERENCE ELEV.	
DRILL METHOD	H.S.Auger	TOTAL DEPTH	41.50'
LOGGED BY	Steve Nelson	DATE COMPLETED	5/14/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	LITHOLOGIC DESCRIPTION
				0	0 - 24.0 feet: REFUSE; paper, metal, plastic, wood, and layers of gravelly sand, moist, wet below 18 feet. (FILL)
				5	
SS-1	6/6/6	0		10	
				15	
			▽ 5/7/91	18	
				20	
SS-2	2/2/1	80%		25	24.0 - 38.0 feet: SILT (ML); dark brown, low to moderate plasticity, soft, wet. (TIDEFLAT)
				30	
				35	
				38	38.0 - 41.5 feet: SILTY SAND with gravel (SM); dark gray, fine to medium, non-plastic fines, fine subround
				40	

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch Hollow Stem Auger.

SWEET-EDWARDS/EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Channel Corporation**	BORING NO.	SB- 1
LOCATION	**Juneau Landfill**	PAGE	2 OF 2
DRILLED BY	**Wink Int'l Geotech**	REFERENCE ELEV.	
DRILL METHOD	**H.S.Auger**	TOTAL DEPTH	41.50'
LOGGED BY	**Steve Nelson**	DATE COMPLETED	5/14/91

SAMPLING METHOD AND NUMBER	BLOWS PER 6 INCHES	PERCENTAGE RECOVERY	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
SS-3	10/10/10	20%					gravel, dense, moist to dry. (TILL)
							Boring was abandoned with bentonite pellets, bentonite -cement slurry and sealed at surface with cement.
				45			
				50			
				55			
				60			
				65			
				70			
				75			
				80			

REMARKS
Borings completed with 6-inch O.D./3 1/2-inch Hollow Stem Auger.

SWEET-EDWARDS/EMCON

Sweet-Edwards/EMCON, Inc.
18912 N. Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS: Chornd
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: MW-1
Sample Designation: MW-1
Date, Time: 5-15 8^30
Weather: cloudy

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
16.94		5-15 8^30	
16.91		5-~~16~~15 14^00	

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
7.5	3	B		

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes/no)	Preservative	Iced (yes/no)
VOC	5-15 8^30	B	40	glass		no	HCl	yes
INORG	|	|	1000	P			—	
Metals	|	|	500	|			HNO3	
Metals	|	|	|	|				
CN	|	|	|	|			NaOH	
OC							H2SO4	

Sample Cleaning Method: (circled) Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh
0	5.80	674	8	
1	6.01	710	8	
2	6.12	710	8	
3	6.14	710	8	

NOTES:

cloudy no odor

Total # of Bottles: 7

Signature: [signature]

SEA-400-01

Sweet-Edwards/EMCON, Inc.
18912 N. Creek Parkway, Suite 210 • Bothell, WA 98011
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Field Sampling Data

LOCATION/ADDRESS: Channel
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: MW-2
Sample Designation: MW-2
Date, Time: 5-15, 5-16
Weather: Cloudy

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
9.70		5-15 14[15]	
9.32		5-16 10[40]	

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
8	4	B		

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes, no)	Preservative	Iced (yes, no)
VOC	5-15 / 5-16	B	40	g		no (circled)	HCl	yes (circled)
Inorg			1000	p			—	
Metals			500				—	
"							HNO_3	
CN							NaOH	
OC							H_2SO_4	

Sample Cleaning Method: (circled) Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity		Temp	Eh
0	6.74	5870	6200	8 8	
1	6.55	7080	~~7770~~		
2	6.83	7360	9860		
3	6.88	7910	9900		
4	6.85	7860	9810		

NOTES:

Two samples taken
~~[illegible]~~ near hi tide 5-15, low tide 5-16

Total # of Bottles: 14

Signature: [signature]

Sweet-Edwards/EMCON, Inc.
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Field Sampling Data

LOCATION/ADDRESS: Channel
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: MW-3
Sample Designation: MW-3-1, MW-3-2
Date, Time: 5-15 1330 1335
Weather:

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
23.54		5-15 1350	
~~[illegible]~~		~~[illegible]~~	

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
6	3	B		

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preserva-tive	Iced (yes,no)
VOC	5-15 1350	B	40	g		no	HCl	yes
IN	|	|	1000	Poly			—	
Metals	|	|	500	|			—	
"	|	|	|	|			HNO_3	
CN	|	|	|	|			NaOH	
OC							H_2SO_4	

Sample Cleaning Method: Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse (circled: Distilled H2O rinse)

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh
0	6.15	2700	9	
1	6.31	2870	|	
2	6.39	2890	|	
3	6.33	2850	|	

NOTES:

Duplicate sample taken
cloudy, Fe-staining?

Total # of Bottles: 14

Signature: [signature]

SEA-400-01

Sweet-Edwards/EMCON, Inc.
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Field Sampling Data

Well or Surface Site Number: MW-4
Sample Designation: MW-4
Date, Time: 5-15 15⁰
Weather: Cloudy

LOCATION/ADDRESS ______
PROJECT NAME ______ # ______
CLIENT/CONTACT ______

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)
~~[illegible]~~ 26.42		5-15 15⁵⁰	
~~[illegible]~~ 26.40		5-15 9⁴⁰	

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time
7.5	3	B		

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes, no)	Preservative	Iced (yes, no)
VOC	5-15 10¹⁵ ~~15⁰~~	B	40	g			HCl	
IN	|	|	1000	P			–	
Metals	|	|	500	|			–	
–	|	|		|			HNO₃	
CN	|	|	|	|			NaOH	
OC	|	|	|	|			H₂SO₄	

Field Filtered: no (circled). Iced: yes (circled).

Sample Cleaning Method: (circled) Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh				
0	6.44	3040						
1	6.54	3590						
2	6.61	4210						
3	6.50	4460						

NOTES:

Cloudy reddish brown color

Total # of Bottles: 7

Signature: [signature]

SEA-400-01

Sweet-Edwards / EMCON, Inc.

Kelso, WA (206) 423-3580
Bothell, WA (206) 485-5000

Chain of Custody / Laboratory Analysis Request

DATE [illegible] PAGE ____ OF ____

PROJECT ____ # ____
CLIENT INFO. CONTACT ____
ADDRESS ____
TELEPHONE# ____
SAMPLERS NAME ____ PHONE# ____
SAMPLERS SIGNATURE ____

ANALYSIS REQUESTED — GENERAL CHEMISTRY (Specify) — OTHER (Specify)

	SAMPLE I.D.	DATE	TIME	LAB I.D.	TYPE	BASE/NEU/ACID ORGAN. GC/MS/625/8270	VOLATILE ORGANICS GC/MS/624/8240	HALOGENATED VOLATILE ORGANICS 601/8010	PHENOLICS 604/8040	POLYNUCLEAR AROMATIC 610/8310	TOTAL ORGANIC CARBON (TOC) 415/9060	TOTAL ORGANIC HALIDE (TOX) 9020	EP TOX/TCLP METALS (Circle One)	METALS (TOTAL) (See Special Inst.)	TCLP ORGANICS	pH, COND ALK	NO_3/NO_2, Cl SO_4	Ca, Mg, Na, K							NUMBER OF CONTAINERS
1.	[illegible]	[illegible]	[illegible]				X							X		X	X	X	X	X	X	X	X		
2.	[illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		
3.																									
4.																									
5.																									
6.																									
7.																									
8.																									

Relinquished By Sweet, Edwards & Assoc.	Relinquished By	Relinquished By	PROJECT INFORMATION	SAMPLE RECEIPT
Signature	Signature	Signature	Shipping I.D. No.	Total No. of Containers
Printed Name	Printed Name	Printed Name	VIA	Chain of Custody Seals
Firm	Firm	Firm	Project	Received in good condition
Date/Time	Date/Time	Date/Time		LAB NO.

Received By	Received By	Received By	SPECIAL INSTRUCTIONS/COMMENTS
Signature	Signature	Signature	
Printed Name	Printed Name	Printed Name	
Firm	Firm	Firm	
Date/Time	Date/Time	Date/Time	

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator.

S-E/E 400-05

Sweet-Edwards / EMCON, Inc.

Kelso, WA (206) 423-3580
Bothell, WA (206) 485-5000

Chain of Custody / Laboratory Analysis Request

DATE [illegible] PAGE 1 OF 2

PROJECT [illegible] # [illegible]
CLIENT INFO.
CONTACT
ADDRESS
TELEPHONE#
SAMPLERS NAME PHONE#
SAMPLERS SIGNATURE

ANALYSIS REQUESTED — GENERAL CHEMISTRY (Specify) — OTHER (Specify)

SAMPLE I.D.	DATE	TIME	LAB I.D.	TYPE	BASE/NEU/ACID ORGAN. GC/MS/625/8270	VOLATILE ORGANICS GC/MS/624/8240	HALOGENATED VOLATILE ORGANICS 601/8010	PHENOLICS 604/8040	POLYNUCLEAR AROMATIC 610/8310	TOTAL ORGANIC CARBON (TOC) 415/9060	TOTAL ORGANIC HALIDE (TOX) 9020	EP TOX/TCLP METALS (Circle One)	METALS (TOTAL) (See Special Inst.)	TCLP ORGANICS	pH, COND, ALK	NO_3/NO_2, Cl, SO_4	Ca, Mg, Na, K, Fe	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		NUMBER OF CONTAINERS
1. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
2. [illegible] (X)	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
3. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
4. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
5. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
6. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
7. [illegible]	5-16	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]
8. [illegible]	[illegible]	[illegible]		[illegible]		X							X		X	X	X	X	X	X	X	X		[illegible]

Relinquished By Sweet, Edwards & Assoc.	Relinquished By	Relinquished By
Signature [illegible]	Signature	Signature
Printed Name [illegible]	Printed Name	Printed Name
Firm [illegible]	Firm	Firm
Date/Time	Date/Time	Date/Time

Received By	Received By	Received By
Signature	Signature	Signature
Printed Name	Printed Name	Printed Name
Firm	Firm	Firm
Date/Time	Date/Time	Date/Time

PROJECT INFORMATION
Shipping I.D. No.
VIA
Project

SAMPLE RECEIPT
Total No. of Containers
Chain of Custody Seals
Received in good condition
LAB NO.

SPECIAL INSTRUCTIONS/COMMENTS
[illegible] Filt[illegible]
Metals: As, Ba, Cd, Cr, Pb, Hg, Se, Ag
(X) Two [illegible] bottles; [illegible] [illegible]
[illegible] 5-20 [illegible]
[illegible]
[illegible]

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator.

S-E/E 400-05

Sweet-Edwards/EMCON, Inc.

18912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS: Chornel
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: ~~L~~ Lemon Creek Upstream ~~[illegible]~~
Sample Designation: LCU-1
Date, Time
Weather

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time

Surface Water Flow Speed: ? Measurement Method: Date, Time:

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes, no)	Preserva-tive	Iced (yes, no)
VOC	5-16 8:00	Grab	40	g		no	HCl	yes
IN			1000	P			—	
metals			500				—	
"							HNO3	
CN							NaOH	
OC							H2SO4	

Sampler Cleaning Method: ~~Non-Phosphatic detergent wash, H2O rinse, MeOH rinse, Distilled H2O rinse~~

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh				
	7.02	320	6					

NOTES:

upstream of Tidal culvert

Total # of Bottles: 7 Signature: [signature]

SEA-400-01

Sweet-Edwards/EMCON, Inc.

18912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS Channel

PROJECT NAME # X320101

CLIENT/CONTACT

Well or Surface Site Number Lemon Creek Downstream

Sample Designation LCD-1

Date, Time 5-16 9:15

Weather cloudy

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes/no)	Preservative	Iced (yes/no)
VOC	5-16 9:15	Grab	90	g		no	HCl	yes
IN.			1000	p			—	
metals			500				—	
"							HNO3	
CN							NaOH	
OC							H2SO4	

Sample Cleaning Method: ~~Non-Phosphatic detergent wash H2O rinse MeOH rinse Distilled H2O rinse~~

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh				
	7.41	1180	6					

NOTES:

Downstream of tidal gate stream

Total # of Bottles: 7

Signature: [signature]

SEA-400-01

Sweet-Edwards/EMCON, Inc.
18912 North Creek Parkway, Suite 210 • Bothell, WA 98011
Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS: Channel
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: Tidal Flat TF-1
Sample Designation: TF-1
Date, Time: 5-15 1500
Weather: cloudy

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time

Surface Water Flow Speed: ______ Measurement Method: ______ Date, Time: ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes/no)	Preservative	Iced (yes/no)
VOC	5-15 1500	B	40	g			HCl	
IN		|	1000	p			–	
metals		|	500	|			–	
"		|	|	|			HNO_3	
CN		|	|	|			NaOH	
OC		|					H_2SO_4	

Field Filtered: (yes/no) — no circled. Iced: (yes/no) — yes and no circled.

Sampler Cleaning Method: ~~Non-Phosphatic detergent wash~~ ~~H2O rinse~~ ~~MeOH rinse~~ ~~Distilled H2O rinse~~

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh				
	7.24	13800	14					

NOTES:

Taken at high tide

Total # of Bottles: 7
Signature: [signature]

SEA-400-01

Sweet-Edwards/EMCON, Inc.
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Office (206) 485-5000 • FAX (206) 486-9766

Field Sampling Data

LOCATION/ADDRESS: Chorned
PROJECT NAME: # X320101
CLIENT/CONTACT:

Well or Surface Site Number: East Pond EP-1
Sample Designation: EP-1
Date, Time: 5-16 8'5
Weather: Cloudy

HYDROLOGY MEASUREMENTS:

(Nearest .01 ft.)	Elevation	Date, Time	Method Used (M-Scope Number or Other)

WELL EVACUATION:

Gallons	Pore Volumes	Method Used	Rinse Method	Date, Time

Surface Water Flow Speed ______ Measurement Method ______ Date, Time ______

SAMPLING:

Sample	Date, Time	Method	Volume (ml)	Container Type	Depth Taken (feet)	Field Filtered (yes,no)	Preserva-tive	Iced (yes,no)	Sample: Cleaning Method
VOC									Non-Phosphatic detergent wash
IN									H2O rinse
metals									MeOH rinse
"									Distilled H2O
CN									rinse

FIELD WATER QUALITY TESTS:

Pore Vol. Number	pH	Conductivity	Temp	Eh				
	7.09	1170	15					

NOTES:

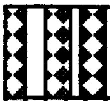
Sample taken from N E shore near active face

Total # of Bottles: 7

Signature: [signature]

SEA-400-01

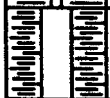
SYMBOL ID	Fill Style	Description
AS	None	
BCH2&1GP	29	Bentoniite chip seal: 2" pipe and one gas probe
BCH2&2GP	29	Bentoniite chip seal: 2" pipe and two gas probes
BCH2NOGP	29	Bentoniite chip seal: 2" pipe, no gas probes shown
BENTCMNT	None	
BNP2SNCT	29	Bentonite chips; slotted; no gps shown, central.
BNT2SNCT	29	Bentonite chips; slotted; no gps shown, central.
BNTCHP	29	Bentonite Chip Bottom Seal
BNTCHP1"	29	Bentonite Chip Seal; solid; 1" pipe
BNTCHP2"	29	Bentonite chip seal: solid; 2" pipe
BNTCHP21	29	Bentonite chip seal; solid; 2 pipe group; 1 pipe
BNTCHP22	29	Bentonite chip seal; solid; 2 pipe group; 2 pipes
BNTCHP31	29	Bentonite chip seal; solid; 3 pipe group; 1 pipe
BNTCHP32	29	Bentonite chip seal;solid; 3 pipe group; 2 pipes
BNTCHP33	29	Bentonite chip seal; soild; 3 pipe grop; 3 pipes
BNTCHP4"	29	Bentonite chip seal: solid; 4" pipe
BNTCHP41	29	Bentonite Chip Seal; solid; 4 pipe gp; 1 pipe
BNTCHP42	29	Bentonite Chip Seal; solid; 4 pipe gp; 2 pipes
BNTCHP43	29	Bentonite Chip Seal; solid; 4 pipe gp; 3 pipes
BNTCHP44	29	Bentonite Chip Seal; solid; 4 pipe gp; 4 pipes

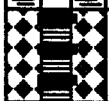

BNTCHPPZ 29
Bentonite chip seal; well and piezometer.

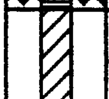

BNTCMN22 None
Bent/Cement; slotted; 2 pipe group; 2 pipes

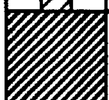

BNTCMNT None
Bentonite-Cement Grout.


BNTCMNT1 None
1" pipe; Bentonite-Cement Grout.

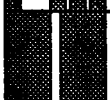

BNTCMNT2 None
Bentonite-Cement Grout.


BNTSCNT 29
Granular backfill layer; slotted; 1 pipe w/central

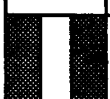

BOTT2 3
Underreamed well bottom packed w/ imperm. mat'l.

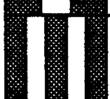

BOTT3 1
Well bottom packing.

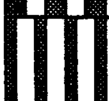

CNC2&2GP 4
Concrete surface seal; 1 2" pipe & two gas probes

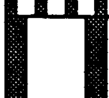

CONC1" 4
Concrete surface seal; solid; 1 pipe

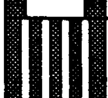
CONC2 None

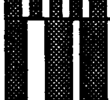

CONC2" 4
Concrete surface seal; solid; 1 pipe

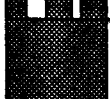

CONC22 4
Concrete surface seal; solid; 2pipe group; 2 pipes


CONC33 4
Concrete surface seal; soild; 3 pipe grop; 3 pipes

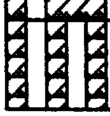

CONC4" 4
4" Concrete surface seal; solid; 1 pipe

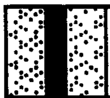

CONC44 4
Concrete surface seal; solid; 4pipe group; 4 pipes

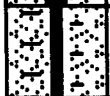

CONCPIEZ 4
Concrete surface seal; well and piezometer.

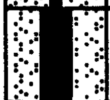

CONCRETE 4
Concrete seal.

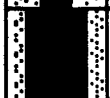

CVSEAL21 27
Native cave & bentinote seal; 2 pipe group; 1 pipe

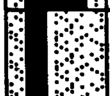

CVSEAL22 27
Native cave & bentinote seal; 2 pipe group; 2 pipe

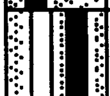

END-CAP 0
1" pipe, End Cap packed in sand.

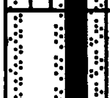

END-CAP1 0
1" pipe, End Cap packed in sand.

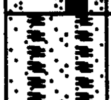

END-CAP2 0
End Cap packed in sand.

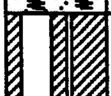

END-CAP4 0
4" End Cap packed in sand.

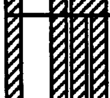

ENDCAP21 0
1" pipe, End Cap packed in sand; 2 pipe group.

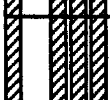

ENDCAP22 0
1" pipe, End Cap packed in sand; 2 pipe group.

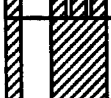

ENDCAP23 0
1" pipe, End Cap packed in sand; 2 pipe group.

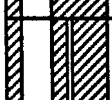

FILL None
Using well graphics for a 2nd lithologic section.


GBF2&1GP 2
Granular backfill; 1 pipe with one gas probe

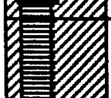

GBF2&1SG 2
Granular backfill; 1 pipe, 2 gas probes, 1 slotted


GBF2&2GP 2
Granular backfill; 1 pipe with two gas probes

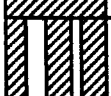

GBF2&NGP 2
Granular backfill; 1 pipe, no gas probes shown

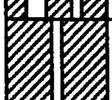

GBF2&SGP 2
Granular backfill; 1 pipe w/one slotted gas probe

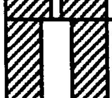

GBF2SNCT 2
Granular backfill; slotted; no gps shown, central.

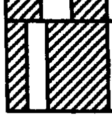

GBF2STNG 2
Granular backfill; slotted; no gas probes shown

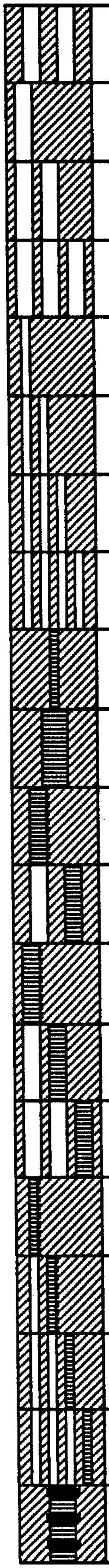

GBFILL 2
Granular backfill solid


GBFPIEZ 2
Granular backfill; well and piezometer.


GBFSLD1" 2
Granular backfill layer; solid; 1 pipe


GBFSLD2" 2
Granular backfill layer; solid; 1 pipe


GBFSLD21 2
Granular backfill; solid; 2 pipe group; 1 pipe



GBFSLD22 2
Granular backfill; solid; 2 pipe group; 2 pipes

GBFSLD31 2
Granular backfill; solid; 3 pipe group; 1 pipe

GBFSLD32 2
Granular backfill; solid; 3 pipe group; 2 pipes

GBFSLD33 2
Granular backfill; solid; 3 pipe group; 3 pipes

GBFSLD41 2
Granular backfill; solid; 4 pipe group; 1 pipe

GBFSLD42 2
Granular backfill; solid; 4 pipe group; 2 pipes

GBFSLD43 2
Granular backfill; solid; 4 pipe group; 3 pipes

GBFSLD44 2
Granular backfill; solid; 4 pipe group; 4 pipes

GBFSLT1" 2
Granular backfill layer; slotted; 1 pipe

GBFSLT2" 2
Granular backfill layer; slotted; 1 pipe

GBFSLT21 2
Granular backfill; slotted; 2 pipe group; 1 pipe

GBFSLT22 2
Granular backfill; slotted; 2 pipe group; 2 pipes

GBFSLT31 2
Granular backfill; slotted; 3 pipe group; 1 pipe

GBFSLT32 2
Granular backfill; slotted; 3 pipe group; 2 pipes

GBFSLT33 2
Granular backfill; slotted; 3 pipe group; 3 pipes

GBFSLT41 2
Granular backfill; solid; 4 pipe group; 1 pipe

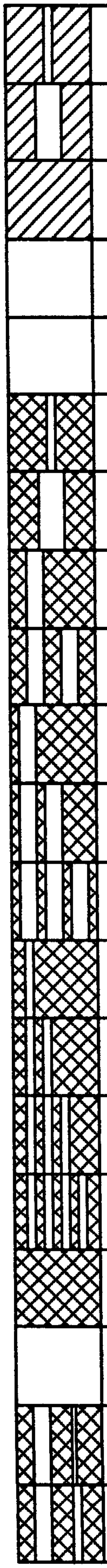
GBFSLT42 2
Granular backfill; solid; 4 pipe group; 2 pipes

GBFSLT43 2
Granular backfill; solid; 4 pipe group; 3 pipes

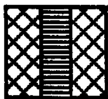
GBFSLT44 2
Granular backfill; solid; 4 pipe group; 4 pipes

GBFSLTCT 2
Granular backfill layer; slotted; 1 pipe w/central

SYMBOL ID	Fill Style	Description
GRAVEL	None	Gravel Backfill.
GVLSLD1"	None	Gravel backfill; solid; 1 pipe.
GVLSLD2"	None	Gravel backfill; solid; 1 pipe.
GVLSLD33	None	Gravel Backfill; solid; 3 pipe group; 3 pipes.
GVLSLT1"	None	Gravel backfill; slotted; 1 pipe
GVLSLT2"	None	Gravel backfill; slotted; 1 pipe.
GVSDNOGP	None	Gravel backfill; 2" pipe and two gas probes w/slat
GW	None	Native Sandy/Gravelly Sand
GWSLD1"	None	Gravelly sand; solid; 1 pipe
GWSLD2"	None	Gravelly sand, solid; 1 pipe
GWSLD21	None	Native Sandy/Gravelly Sand; 2 pipe group; 1 pipe
GWSLD22	None	Native Sandy/Gravelly Sand; 2 pipe group; 2 pipes
GWSLT1"	None	Gravelly sand; slotted; 1 pipe
GWSLT2"	None	Gravelly sand, slotted; 1 pipe
JUSTPIEZ	None	Slotted pipe showing no backfill.
OPEN1"	None	1" Well Casing with no backfill.
OPEN2"	None	2" Well Casing with no backfill.
PACKBOTT	None	
PACKPIPE	None	
PIPE	None	



SYMBOL ID	Fill Style	Description
PIPE1"	3	Solid pipe above screen. Packed in random mat'l.
PIPE2"	3	Solid pipe above screen. Packed in random mat'l.
PIPENONE	3	Random material; no pipe showing.
REF	None	
SEAL	None	
SEAL1"	6	Bentonite Seal (slurry); 1 pipe
SEAL2"	6	Bentonite Seal (slurry); 1 pipe
SEAL21	6	Bentonite Seal (slurry); 2 pipe group; 1 pipe
SEAL22	6	Bentonite Seal (slurry); 2 pipe group; 2 pipes
SEAL31	6	Bentonite Seal (slurry); 3 pipe group; 1 pipes
SEAL32	6	Bentonite Seal (slurry); 3 pipe group; 2 pipes
SEAL33	6	Bentonite Seal (slurry); 3 pipe group; 3 pipes
SEAL41	6	Bentonite Seal (slurry); 4 pipe group; 1 pipe
SEAL42	6	Bentonite Seal (slurry); 4 pipe group; 2 pipes
SEAL43	6	Bentonite Seal (slurry); 4 pipe group; 3 pipes
SEAL44	6	Bentonite Seal (slurry); 4 pipe group; 4 pipes
SEALBOTT	6	Bentonite Bottom Seal
SEALCASE	None	
SEALGP	6	Bentonite Seal; well and gas probe.
SEALPIEZ	6	Bentonite Seal; well and piezometer.


SEALSLT2 6
Bentonite Seal (slurry); Slotted; 1 pipe

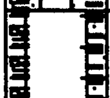

SEALSNCT 6
Granular backfill layer; slotted; 1 pipe w/central


SL-X 6
Bentonite Seal (slurry); 1 pipe - ABANDON

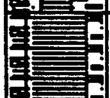

SLF 30
Slough


SLFSLD1" 30
Slough; Solid; 1" pipe


SLFSLD2" 30
Slough; Solid; 1 pipe


SLFSLD4" 30
Slough; Solid; one 4" pipe


SLFSLT2" 30
Slough; Slotted; 1 pipe

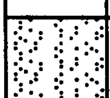

SLFSLT4" None
Slough; Slotted; 1 2-inch pipe

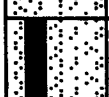
SLOTPIPE None

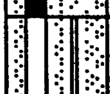
SLSLT-X None

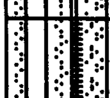

SLSLT2-X 6
Bentonite Seal (slurry); Slotted; 1 pipe - ABANDON

SLST-X None

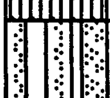

SND None
sand pack without casing

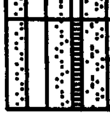

SNDCAP21 0
End cap; 2 pipe group; 1 pipe


SNDGP None
Sand pack; well and gas probe.

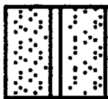

SNDGPSLT None
Sand pack; well and screened gas probe.

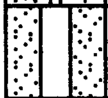

SNDMAT 12
Silty sands, sand-silt mixtures (no pipe)

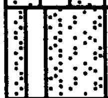

SNDPIEZ None
Sand pack; well and piezometer.

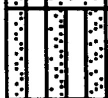

SNDPZSLT None
Sand pack; well and screened piezometer.

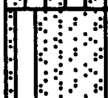
SYMBOL ID Fill Style
Description

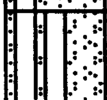

SNDSLD1" None
Solid pipe packed in sand.


SNDSLD2" None
Solid pipe packed in sand.

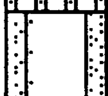

SNDSLD21 None
sand pack; 2 pipe group; 1 pipe

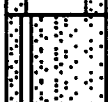

SNDSLD22 None
sand pack; 2 pipe group; 2 pipes

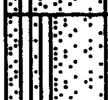

SNDSLD31 None
Sand pack; 3 pipe group; 1 pipe.

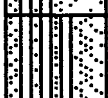

SNDSLD32 None
Sand pack; 3 pipe group; 2 pipes.

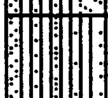

SNDSLD33 None
Sand pack; 3 pipe group; 3 pipes.

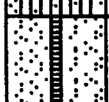

SNDSLD4" None
4" Solid pipe packed in sand.

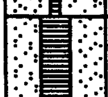

SNDSLD41 None
Sand pack; 4 pipe group; 1 pipe.

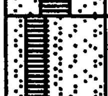

SNDSLD42 None
Sand pack; 4 pipe group; 2 pipes.

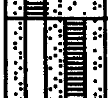

SNDSLD43 None
Sand pack; 4 pipe group; 3 pipes.

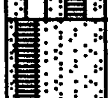

SNDSLD44 None
Sand pack; 4 pipe group; 4 pipes.

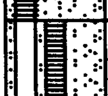

SNDSLT1" None
Slotted pipe packed in sand.

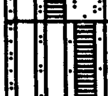

SNDSLT2" None
Slotted pipe packed in sand.

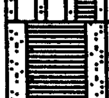

SNDSLT21 None
sand pack; slotted; 2 pipe group; 1 pipe

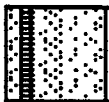

SNDSLT22 None
sand pack; slotted; 2 pipe group; 2 pipes


SNDSLT31 None
Sand pack; slotted; 3 pipe group; 1 pipe.

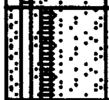

SNDSLT32 None
Sand pack; slotted; 3 pipe group; 2 pipes.


SNDSLT33 None
Sand pack;slotted; 3 pipe group; 3 pipes.

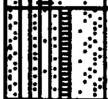

SNDSLT4" None
4" Slotted pipe packed in sand.



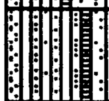
SNDSLT41 None
Sand pack; slotted; 4 pipe group; 1 pipe.



SNDSLT42 None
Sand pack; slotted; 4 pipe group; 2 pipes.

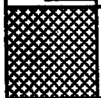
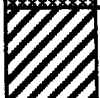
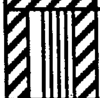
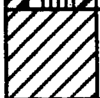
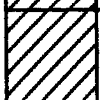
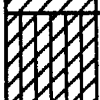
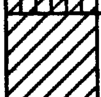
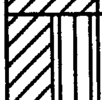
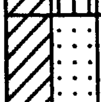
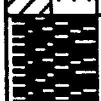
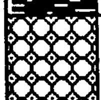
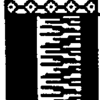
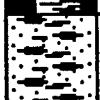
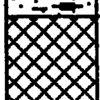
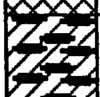
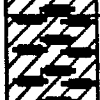
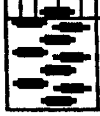


SNDSLT43 None
Sand pack; slotted; 4 pipe group; 3 pipes.



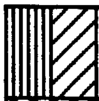
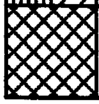
SNDSLT44 None
Sand pack; slotted; 4 pipe group; 4 pipes.

TC None
Using well graphics for 2nd lithologic section.

	SYMBOL ID	Fill Style	Description
	AS	0	Asphalt
	BREC	None	Breccia
	BSLT	5	Basalt
	CH	31	Clay, high plasticity
	CH/OH	31	Clay and organic clay, interbedded
	CL	3	Lean clay, low to medium plasticity
	CL-CH	3	field classification, may be either CL or CH
	CL-ML	3	Clayey silt to silty clay, dual classification
	CL-SC	3	field classification, may be either CL or SC
	CL/ML	3	Clayey silt and silty clay, interbedded
	CL/SP	3	Clay and sand, interbedded
	CLST	None	Claystone
	CNGLM	13	Conglomerate
	COAL	0	Coal
	CON	None	Concrete
	FILL	6	Fill, nonspecific
	GC	3	Clayey gravel, gravel-sand-clay mixtures
	GC-GM	3	field classification, may be either GC or GM
	GM	None	Silty gravel, gravel-sand-silt mixtures
	GP	None	Poorly graded gravels, or gravel-sand mixtures

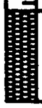
SYMBOL ID	Fill Style	Description
GP-GM	None	
GP-OL	23	Poorly graded gravels with organic silts
GW	None	Well graded gravels or gravel-sand mixtures
GW-ML	None	Silt(~50%), with gravel(~25%), & sand(~25%)
LMST	None	Limestone
LS/SH	None	Limestone and shale, interbedded
LW	14	Lime Waste, gray-white, fine, soft, saturated
MDST	None	Mudstone
MH	0	Elastic silt
MH/CL	0	Elastic silt & lean clay, interbedded
ML	None	Silt, low to non-plastic silt.
ML-GM	None	GRAVELLY SILT AND SILTY GRAVEL INTERBEDS
ML/CL	3	SILT AND CLAY-INTERBEDDED
NONE	None	
OH	27	Organic clay, medium to high plasticity
OL	23	Organic silts and silty clays, low plasticity
PT	None	Peat or other highly organic soils
RECON	None	Reinforced Concrete
REF	None	Refuse
SC	3	Clayey sand, sand-clay mixtures

SYMBOL ID	Fill Style	Description
SC/CL	3	Clayey sand and lean clay, interbedded
SC/GC	2	Clayey sand and gravelly sand, interbedded
SERP	None	Serpentinite
SH	None	Shale
SLST	None	Siltstone
SM	12	Silty sands, sand-silt mixtures
SM-ML	12	Field classification, may be either SM or ML
SM-SP	12	field classification, silty sand to sand
SM-SW	18	field classification, silty sand to sand
SM/ML	None	Silty sand and sandy silt, interbedded
SM/SC	2	Silty sand and clayey sand, interbedded
SM/SP	12	Silty sand and p-graded sand, interbedded
SP	12	Sand, poorly graded or gravelly sand
SP/GP	12	Poorly graded gravels, gravelly sand
SP/ML	12	sand and sandy silt, interbedded
SS	None	Sandstone
SS/CS	None	Sandstone and claystone, interbedded
SS/SL	None	Sandstone and siltstone, interbedded
SW	17	Sand, well graded, or gravelly sand
SW-SM	18	field classification, silty sand to sand

	TEMP 3 Elastic silt & lean clay, interbedded
	TS 6 Topsoil

SYMBOL ID	Fill Style	Description
*SS	None	
A	None	Auger cuttings
AS	None	
AU	4	Auger Sample
BK	None	
BLANK	None	
BULK	6	Bulk sample
C	0	CALIFORNIA SAMPLER
CL	None	
CN	0	Continuous Sample
CON	None	
CP	None	
CR	None	
CS	None	
D	6	
DBLCORE	None	Double tube core barrel
DR	None	
GRAB	None	Hand taken sample either from cuttings or surface
HANDRIV	None	
HANDRIVE	None	3' HANDRIVEN SANPLING BARREL EQUIPPED WITH RINGS

SYMBOL ID	Fill Style	Description
MC	0	Modified CA sampler (driven)
MCD	None	Modified California, solid diagonal
MCP	None	Modified CA sampler (pushed)
NO	None	
NONE	None	
NQ	None	NQ core barrel
NX	None	NX core barrel
O	3	Other samplers.
P	None	Pitcher sampler
PB	None	Pitcher barrel.
R-	6	
RD	None	Rotary drill with mud circulation.
RX	0	Rock Core
S	None	2" O.D. 1.38" I.D. tube sample
S3	None	3 inch split spoon sampler.
SHELBY	None	Thin walled Shelby sampler
SHELBY2	None	Shelby, diagonal line, upper right to lower left
SM	10	Silty sand
SP-	0	
SPT	None	Standard split spoon sampler

	SYMBOL ID / Description	Fill Style
	SS Standard split spoon sampler	0
	ST Shelby tube	0
	TW	None
	U 3" O.D. 2.42" I.D. tube sample	None
	UNSMP	None
	VANESHR Down hole vane shear	None
	WA Wash Sample	None

Appendix 5

WATER QUALITY LABORATORY RESULTS

Columbia Analytical Services Inc.

JUN 20 1991
SE/E - PORTLAND

COPY

June 18, 1991

RECEIVED
'91

Steve Nelson
Sweet-Edwards/EMCON, Inc.
15055 SW Sequoia Parkway
Suite 140
P.O. Box 231269
Portland, OR 97224

Re: **Channel/Project #X3201.01**

Dear Steve:

Enclosed are the results of the samples submitted to our lab on May 20, 1991. Preliminary results were transmitted via facsimile on June 4, 7 and 13, 1991. For your reference, our service request number for this work is K912737.

All analyses were performed in accordance with the laboratory's quality assurance program.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Cheryl Noone-Fisher
Cheryl Noone-Fisher
Project Chemist

CNF/das

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-1068

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Inorganic Parameters
mg/L (ppm)

		Sample Name:	MW-1	MW-2
		Lab Code:	K2737-1	K2737-2
Analyte	**Method**	**MRL**		
pH	150.1	--	6.31	6.63
Bicarbonate as $CaCO_3$	310.1	20	185	68
Chloride	300.0	0.2	17.6	2,430
Chemical Oxygen Demand (COD)	410.2	5	189	82
Cyanide	335.3	0.01	ND	ND
Nitrogen, Ammonia	350.3	0.05	3.88	0.24
Nitrogen, Nitrate & Nitrite	353.2	0.2	ND	0.3
Solids, Total Dissolved (TDS)	160.1	5	229	5,160
Solids, Total Suspended (TSS)	160.2	5	1,040	3,200
Sulfate	300.0	0.2	2.3	380
Total Organic Carbon (TOC)	415.1	0.5	11.9	4.1

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman, [illegible] Date 6/19/91

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-106

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Inorganic Parameters
mg/L (ppm)

	Sample Name:		MW-3-1	MW-3-2	MW-4
	Lab Code:		K2737-4	K2737-5	K2737-6
Analyte	**Method**	**MRL**			
pH	150.1	--	6.68	6.67	6.80
Bicarbonate as $CaCO_3$	310.1	20	1,002	918	1,270
Chloride	300.0	0.2	386	377	541
Chemical Oxygen Demand (COD)	410.2	5	248	297	591
Cyanide	335.3	0.01	ND	ND	ND
Nitrogen, Ammonia	350.3	0.05	5.33	5.59	67.0
Nitrogen, Nitrate & Nitrite	353.2	0.2	ND	ND	ND
Solids, Total Dissolved (TDS)	160.1	5	1,850	1,820	2,270
Solids, Total Suspended (TSS)	160.2	5	848	856	252
Sulfate	300.0	0.2	5.0	5.0	107
Total Organic Carbon (TOC)	415.1	0.5	73.9	70.2	184

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman / Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Inorganic Parameters
mg/L (ppm)

		Sample Name:	FB-1	LCU-1	LCD-1
		Lab Code:	K2737-7	K2737-8	K2737-9
Analyte	**Method**	**MRL**			
pH	150.1	--	6.08	7.33	7.36
Bicarbonate as $CaCO_3$	310.1	20	ND	ND	ND
Chloride	300.0	0.2	ND	59.4	368
Chemical Oxygen Demand (COD)	410.2	5	ND	ND	11
Cyanide	335.3	0.01	ND	ND	ND
Nitrogen, Ammonia	350.3	0.05	ND	ND	ND
Nitrogen, Nitrate & Nitrite	353.2	0.2	ND	0.2	0.2
Solids, Total Dissolved (TDS)	160.1	5	ND	111	697
Solids, Total Suspended (TSS)	160.2	5	ND	ND	ND
Sulfate	300.0	0.2	ND	13.0	57.6
Total Organic Carbon (TOC)	415.1	0.5	ND	0.6	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Inorganic Parameters
mg/L (ppm)

			Sample Name:	EP-1	TF-1	Method Blank
			Lab Code:	K2737-10	K2737-11	K2737-MB
Analyte	**Method**	**MRL**				
pH	150.1	--		7.75	7.93	--
Bicarbonate as $CaCO_3$	310.1	20		139	62	ND
Chloride	300.0	0.2		168	3,860	ND
Chemical Oxygen Demand (COD)	410.2	5		30	215	ND
Cyanide	335.3	0.01		ND	ND	ND
Nitrogen, Ammonia	350.3	0.05		0.52	ND	ND
Nitrogen, Nitrate & Nitrite	353.2	0.2		ND	ND	ND
Solids, Total Dissolved (TDS)	160.1	5		526	9,425	ND
Solids, Total Suspended (TSS)	160.2	5		ND	12	ND
Sulfate	300.0	0.2		68.1	704	ND
Total Organic Carbon (TOC)	415.1	0.5		7.7	1.9	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman./ Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Dissolved Metals
mg/L (ppm)

Analyte	Method	MRL	MW-1 K2737-1	MW-2 K2737-2	MW-3-1 K2737-4
Arsenic	7060	0.005	ND	ND	ND
Barium	6010	0.005	0.111	0.096	0.314
Cadmium	6010	0.003	ND	0.004	ND
Chromium	6010	0.005	ND	ND	ND
Lead	7421	0.002	ND	ND	0.005
Manganese	6010	0.005	1.12	0.186	9.92
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	ND	ND	ND
Silver	6010	0.01	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehlers Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Dissolved Metals
mg/L (ppm)

	Sample Name:		MW-3-2	MW-4	FB-1
	Lab Code:		K2737-5	K2737-6	K2737-7
Analyte	**Method**	**MRL**			
Arsenic	7060	0.005	ND	ND	ND
Barium	6010	0.005	0.355	0.262	ND
Cadmium	6010	0.003	ND	ND	ND
Chromium	6010	0.005	ND	ND	ND
Lead	7421	0.002	ND	ND	0.007
Manganese	6010	0.005	10.2	1.77	ND
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	ND	ND	ND
Silver	6010	0.01	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Eldeman.A Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Dissolved Metals
mg/L (ppm)

		Sample Name:	LCU-1	LCD-1	EP-1
		Lab Code:	K2737-8	K2737-9	K2737-10
Analyte	**Method**	**MRL**			
Arsenic	7060	0.005	ND	ND	ND
Barium	6010	0.005	0.030	0.034	0.064
Cadmium	6010	0.003	ND	ND	ND
Chromium	6010	0.005	ND	ND	ND
Lead	7421	0.002	ND	ND	ND
Manganese	6010	0.005	0.009	0.013	0.230
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	ND	ND	ND
Silver	6010	0.01	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Dissolved Metals
mg/L (ppm)

	Sample Name: Lab Code:		TF-1 K2737-11	Method Blank K2737-MB
Analyte	**Method**	**MRL**		
Arsenic	7060	0.005	ND	ND
Barium	6010	0.005	0.024	ND
Cadmium	6010	0.003	ND	ND
Chromium	6010	0.005	ND	ND
Lead	7421	0.002	ND	ND
Manganese	6010	0.005	0.021	ND
Mercury	7470	0.0005	ND	ND
Selenium	7740	0.005	ND	ND
Silver	6010	0.01	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Total Metals
mg/L (ppm)

	Sample Name:		MW-1	MW-2	MW-3-1
	Lab Code:		K2737-1	K2737-2	K2737-4
Analyte	**Method**	**MRL**			
Barium	6010	0.005	0.746	1.50	1.11
Cadmium	6010	0.003	ND	ND	ND
Calcium	6010	0.05	52.7	74.0	164
Chromium	6010	0.005	0.086	0.212	0.075
Iron	6010	0.02	118	184	172
Magnesium	6010	0.01	31.1	188	82.3
Potassium	6010	2	15	85	63
Silver	6010	0.01	ND	ND	ND
Sodium	6010	0.1	20.6	1,460	332

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ele... Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Total Metals
mg/L (ppm)

		Sample Name:	MW-3-2	MW-4	FB-1
		Lab Code:	K2737-5	K2737-6	K2737-7
Analyte	**Method**	**MRL**			
Barium	6010	0.005	1.09	0.481	ND
Cadmium	6010	0.003	ND	ND	ND
Calcium	6010	0.05	159	144	ND
Chromium	6010	0.005	0.074	0.010	ND
Iron	6010	0.02	168	85.2	ND
Magnesium	6010	0.01	79.9	98.9	ND
Potassium	6010	2	61	113	ND
Silver	6010	0.01	ND	ND	ND
Sodium	6010	0.1	324	508	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehler .f Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Total Metals
mg/L (ppm)

	Sample Name:		LCU-1	LCD-1	EP-1
	Lab Code:		K2737-8	K2737-9	K2737-10
Analyte	**Method**	**MRL**			
Barium	6010	0.005	0.030	0.032	0.060
Cadmium	6010	0.003	ND	ND	ND
Calcium	6010	0.05	7.97	12.2	50.1
Chromium	6010	0.005	ND	ND	ND
Iron	6010	0.02	0.12	0.23	1.02
Magnesium	6010	0.01	4.09	18.0	16.8
Potassium	6010	2	3	7	11
Silver	6010	0.01	ND	ND	ND
Sodium	6010	0.1	31.6	138	110

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Eden[signature] Date 6/19/91

00011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Total Metals
mg/L (ppm)

	Sample Name:		TF-1	Method Blank
	Lab Code:		K2737-11	K2737-MB
Analyte	Method	MRL		
Barium	6010	0.005	0.022	ND
Cadmium	6010	0.003	ND	ND
Calcium	6010	0.05	106	ND
Chromium	6010	0.005	ND	ND
Iron	6010	0.02	0.23	ND
Magnesium	6010	0.01	327	ND
Potassium	6010	2	95	ND
Silver	6010	0.01	ND	ND
Sodium	6010	0.1	2,580	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edele.A Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

Total Metals
mg/L (ppm)

	Sample Name:		MW-1	MW-2	MW-3-1
	Lab Code:		K2737-1	K2737-2	K2737-4
Analyte	**Method**	**MRL**			
Arsenic	7060	0.005	0.052	0.049	0.028
Lead	7421	0.002	0.033	0.065	0.050
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	0.013	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edeler Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Total Metals
mg/L (ppm)

	Sample Name:		MW-3-2	MW-4	FB-1
	Lab Code:		K2737-5	K2737-6	K2737-7
Analyte	**Method**	**MRL**			
Arsenic	7060	0.005	0.031	0.018	ND
Lead	7421	0.002	0.033	0.008	ND
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehlen .A Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Total Metals
mg/L (ppm)

	Sample Name:		LCU-1	LCD-1	EP-1
	Lab Code:		K2737-8	K2737-9	K2737-10
Analyte	**Method**	**MRL**			
Arsenic	7060	0.005	ND	ND	ND
Lead	7421	0.002	ND	ND	ND
Mercury	7470	0.0005	ND	ND	ND
Selenium	7740	0.005	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ebel[illegible] Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Total Metals
mg/L (ppm)

	Sample Name:		TF-1	Method Blank
	Lab Code:		K2737-11	K2737-MB
Analyte	**Method**	**MRL**		
Arsenic	7060	0.005	ND	ND
Lead	7421	0.002	ND	ND
Mercury	7470	0.0005	ND	ND
Selenium	7740	0.005	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ebelen.j Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Volatile Organic Compounds
EPA Method 8240
μg/L (ppb)

Sample Name:		**MW-1**	**MW-2**	**MW-3-1**
Lab Code:		**K2737-1**	**K2737-2**	**K2737-4**
Date Analyzed:		**05/28/91**	**05/28/91**	**05/28/91**
Analyte	**MRL**			
Chloromethane	1	ND	ND	ND
Vinyl Chloride	1	ND	ND	ND
Bromomethane	1	ND	ND	ND
Chloroethane	1	ND	ND	4.2
Trichlorofluoromethane (Freon 11)	1	ND	ND	ND
Trichlorotrifluoroethane (Freon 113)	10	ND	ND	ND
1,1-Dichloroethene	1	ND	ND	ND
Acetone	20	ND	ND	105
Carbon Disulfide	1	ND	ND	ND
Methylene Chloride	10	ND	ND	ND
trans-1,2-Dichloroethene	1	ND	ND	ND
cis-1,2-Dichloroethene	1	ND	ND	ND
2-Butanone (MEK)	10	ND	ND	*234
1,1-Dichloroethane	1	ND	ND	ND
Chloroform	1	ND	ND	ND
1,1,1-Trichloroethane (TCA)	1	ND	ND	ND
Carbon Tetrachloride	1	ND	ND	ND
Benzene	1	ND	ND	ND
1,2-Dichloroethane	1	ND	ND	ND
Vinyl Acetate	10	ND	ND	ND
Trichloroethene (TCE)	1	ND	ND	ND
1,2-Dichloropropane	1	ND	ND	ND
Bromodichloromethane	1	ND	ND	ND
2-Chloroethyl Vinyl Ether	10	ND	ND	ND
trans-1,3-Dichloropropene	1	ND	ND	ND
2-Hexanone	10	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	10	ND	ND	ND
Toluene	1	ND	ND	24
cis-1,3-Dichloropropene	1	ND	ND	ND
1,1,2-Trichloroethane	1	ND	ND	ND
Tetrachloroethene (PCE)	1	ND	ND	ND
Dibromochloromethane	1	ND	ND	ND
Chlorobenzene	1	ND	ND	ND
Ethylbenzene	1	ND	ND	1.0
Styrene	1	ND	ND	ND
Total Xylenes	1	ND	ND	3.2
Bromoform	1	ND	ND	ND
1,1,2,2-Tetrachloroethane	1	ND	ND	ND
1,3-Dichlorobenzene	1	ND	ND	ND
1,4-Dichlorobenzene	1	ND	ND	ND
1,2-Dichlorobenzene	1	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
* Result from analysis of a diluted sample performed on May 29, 1991.

Approved by Dave Ehle Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Volatile Organic Compounds
EPA Method 8240
µg/L (ppb)

Sample Name:		**MW-3-2**	**MW-4**	**FB-1**
Lab Code:		**K2737-5**	**K2737-6**	**K2737-7**
Date Analyzed:		**05/28/91**	**05/28/91**	**05/28/91**
Analyte	**MRL**			
Chloromethane	1	ND	ND	ND
Vinyl Chloride	1	ND	ND	ND
Bromomethane	1	ND	ND	ND
Chloroethane	1	ND	ND	ND
Trichlorofluoromethane (Freon 11)	1	ND	*210	ND
Trichlorotrifluoroethane (Freon 113)	10	ND	ND	ND
1,1-Dichloroethene	1	ND	ND	ND
Acetone	20	107	68.9	ND
Carbon Disulfide	1	ND	ND	ND
Methylene Chloride	10	ND	ND	ND
trans-1,2-Dichloroethene	1	ND	ND	ND
cis-1,2-Dichloroethene	1	ND	ND	ND
2-Butanone (MEK)	10	*251	140	ND
1,1-Dichloroethane	1	ND	ND	ND
Chloroform	1	ND	ND	2.8
1,1,1-Trichloroethane (TCA)	1	ND	ND	ND
Carbon Tetrachloride	1	ND	ND	ND
Benzene	1	ND	6.9	ND
1,2-Dichloroethane	1	ND	ND	ND
Vinyl Acetate	10	ND	ND	ND
Trichloroethene (TCE)	1	ND	ND	ND
1,2-Dichloropropane	1	ND	ND	ND
Bromodichloromethane	1	ND	ND	ND
2-Chloroethyl Vinyl Ether	10	ND	ND	ND
trans-1,3-Dichloropropene	1	ND	ND	ND
2-Hexanone	10	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	10	ND	ND	ND
Toluene	1	22	ND	ND
cis-1,3-Dichloropropene	1	ND	ND	ND
1,1,2-Trichloroethane	1	ND	ND	ND
Tetrachloroethene (PCE)	1	ND	ND	ND
Dibromochloromethane	1	ND	ND	ND
Chlorobenzene	1	ND	ND	ND
Ethylbenzene	1	1.0	13.5	ND
Styrene	1	ND	ND	ND
Total Xylenes	1	3.1	66.8	ND
Bromoform	1	ND	ND	ND
1,1,2,2-Tetrachloroethane	1	ND	ND	ND
1,3-Dichlorobenzene	1	ND	ND	ND
1,4-Dichlorobenzene	1	ND	ND	ND
1,2-Dichlorobenzene	1	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
* Result from analysis of a diluted sample performed on May 29, 1991.

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Approved by Dave Edelman A Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Sweet-Edwards/EMCON, Inc. **Date Received:** 05/20/91
Project: Channel/#X3201.01 **Work Order #:** K912737
Sample Matrix: Water

Volatile Organic Compounds
EPA Method 8240
μg/L (ppb)

Sample Name:		LCU-1	LCD-1	EP-1
Lab Code:		K2737-8	K2737-9	K2737-10
Date Analyzed:		05/28/91	05/28/91	05/28/91
Analyte	**MRL**			
Chloromethane	1	ND	ND	ND
Vinyl Chloride	1	ND	ND	ND
Bromomethane	1	ND	ND	ND
Chloroethane	1	ND	ND	ND
Trichlorofluoromethane (Freon 11)	1	ND	ND	ND
Trichlorotrifluoroethane (Freon 113)	10	ND	ND	ND
1,1-Dichloroethene	1	ND	ND	ND
Acetone	20	ND	ND	22.1
Carbon Disulfide	1	ND	ND	ND
Methylene Chloride	10	ND	ND	ND
trans-1,2-Dichloroethene	1	ND	ND	ND
cis-1,2-Dichloroethene	1	ND	ND	ND
2-Butanone (MEK)	10	ND	ND	ND
1,1-Dichloroethane	1	ND	ND	ND
Chloroform	1	ND	ND	ND
1,1,1-Trichloroethane (TCA)	1	ND	ND	ND
Carbon Tetrachloride	1	ND	ND	ND
Benzene	1	ND	ND	ND
1,2-Dichloroethane	1	ND	ND	ND
Vinyl Acetate	10	ND	ND	ND
Trichloroethene (TCE)	1	ND	ND	ND
1,2-Dichloropropane	1	ND	ND	ND
Bromodichloromethane	1	ND	ND	ND
2-Chloroethyl Vinyl Ether	10	ND	ND	ND
trans-1,3-Dichloropropene	1	ND	ND	ND
2-Hexanone	10	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	10	ND	ND	ND
Toluene	1	ND	ND	2.6
cis-1,3-Dichloropropene	1	ND	ND	ND
1,1,2-Trichloroethane	1	ND	ND	ND
Tetrachloroethene (PCE)	1	ND	ND	ND
Dibromochloromethane	1	ND	ND	ND
Chlorobenzene	1	ND	ND	ND
Ethylbenzene	1	ND	ND	1.0
Styrene	1	ND	ND	ND
Total Xylenes	1	ND	ND	2.0
Bromoform	1	ND	ND	ND
1,1,2,2-Tetrachloroethane	1	ND	ND	ND
1,3-Dichlorobenzene	1	ND	ND	ND
1,4-Dichlorobenzene	1	ND	ND	ND
1,2-Dichlorobenzene	1	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

00019

Approved by Dave Edelman Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Volatile Organic Compounds
EPA Method 8240
µg/L (ppb)

Sample Name:		TF-1	Method Blank	Method Blank
Lab Code:		K2737-11	K2737-MB	K2737-MB
Date Analyzed:		05/28/91	05/28/91	05/29/91
Analyte	**MRL**			
Chloromethane	1	ND	ND	ND
Vinyl Chloride	1	ND	ND	ND
Bromomethane	1	ND	ND	ND
Chloroethane	1	ND	ND	ND
Trichlorofluoromethane (Freon 11)	1	ND	ND	ND
Trichlorotrifluoroethane (Freon 113)	10	ND	ND	ND
1,1-Dichloroethene	1	ND	ND	ND
Acetone	20	ND	ND	ND
Carbon Disulfide	1	ND	ND	ND
Methylene Chloride	10	ND	ND	ND
trans-1,2-Dichloroethene	1	ND	ND	ND
cis-1,2-Dichloroethene	1	ND	ND	ND
2-Butanone (MEK)	10	ND	ND	ND
1,1-Dichloroethane	1	ND	ND	ND
Chloroform	1	ND	ND	ND
1,1,1-Trichloroethane (TCA)	1	ND	ND	ND
Carbon Tetrachloride	1	ND	ND	ND
Benzene	1	ND	ND	ND
1,2-Dichloroethane	1	ND	ND	ND
Vinyl Acetate	10	ND	ND	ND
Trichloroethene (TCE)	1	ND	ND	ND
1,2-Dichloropropane	1	ND	ND	ND
Bromodichloromethane	1	ND	ND	ND
2-Chloroethyl Vinyl Ether	10	ND	ND	ND
trans-1,3-Dichloropropene	1	ND	ND	ND
2-Hexanone	10	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	10	ND	ND	ND
Toluene	1	ND	ND	ND
cis-1,3-Dichloropropene	1	ND	ND	ND
1,1,2-Trichloroethane	1	ND	ND	ND
Tetrachloroethene (PCE)	1	ND	ND	ND
Dibromochloromethane	1	ND	ND	ND
Chlorobenzene	1	ND	ND	ND
Ethylbenzene	1	ND	ND	ND
Styrene	1	ND	ND	ND
Total Xylenes	1	ND	ND	ND
Bromoform	1	ND	ND	ND
1,1,2,2-Tetrachloroethane	1	ND	ND	ND
1,3-Dichlorobenzene	1	ND	ND	ND
1,4-Dichlorobenzene	1	ND	ND	ND
1,2-Dichlorobenzene	1	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

00020

Approved by Dave Edelm... Date 6/19/91

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APPENDIX A

LABORATORY QC RESULTS

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

Inorganic Parameters
mg/L (ppm)

Analyte	**Method**	**Date Analyzed**
pH	150.1	05/21/91
Bicarbonate as $CaCO_3$	310.1	05/22/91
Chloride	300.0	06/04/91
Chemical Oxygen Demand (COD)	410.2	05/23/91
Cyanide	335.3	05/24/91
Nitrogen, Ammonia	350.3	06/10/91
Nitrogen, Nitrate & Nitrite	353.2	06/03/91
Solids, Total Dissolved (TDS)	160.1	05/22/91
Solids, Total Suspended (TSS)	160.2	05/21/91
Sulfate	300.0	06/04/91
Total Organic Carbon (TOC)	415.1	05/22/91

Approved by Dave Ed... Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Duplicate Summary
Inorganic Parameters
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
pH	150.1	-	6.31	6.34	6.32	<1
Bicarbonate as $CaCO_3$	310.1	20	185	177	181	4
Chloride	300.0	0.2	17.6	16.2	16.9	8
Chemical Oxygen Demand (COD)	410.2	5	189	192	190	2
Cyanide	335.3	0.01	ND	ND	ND	--
Nitrogen, Ammonia	350.3	0.05	3.88	3.57	3.72	8
Nitrogen, Nitrate & Nitrite	353.2	0.2	ND	ND	ND	--
Solids, Total Dissolved (TDS)	160.1	5	229	243	236	6
Solids, Total Suspended (TSS)	160.2	5	1,040	1,090	1,060	5
Sulfate	300.0	0.2	2.3	2.3	2.3	<1
Total Organic Carbon (TOC)	415.1	0.5	11.9	11.6	11.8	3

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehele..[signature] Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Matrix Spike Summary
Inorganic Parameters
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Chloride	300.0	0.2	20.0	17.6	37.9	102	85-115
Cyanide	335.2	0.01	0.10	ND	0.10	100	85-115
Nitrogen, Nitrate & Nitrite	353.2	0.2	2.0	ND	1.7	85	85-115
Sulfate	300.0	0.2	2.0	2.3	4.3	100	85-115
Total Organic Carbon (TOC)	415.1	0.5	24.9	11.9	36.7	100	85-115

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehle.. Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Duplicate Summary
Dissolved Metals
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Arsenic	7060	0.005	ND	ND	ND	--
Barium	6010	0.005	0.111	0.111	0.111	<1
Cadmium	6010	0.003	ND	ND	ND	--
Chromium	6010	0.005	ND	ND	ND	--
Lead	7421	0.002	ND	ND	ND	--
Manganese	6010	0.005	1.12	1.12	1.12	<1
Mercury	7470	0.0005	ND	ND	ND	--
Selenium	7740	0.005	ND	ND	ND	--
Silver	6010	0.01	ND	ND	ND	--

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Matrix Spike Summary
Dissolved Metals
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Arsenic	0.005	0.04	ND	0.042	105	75-125
Barium	0.005	2.0	0.111	2.02	95	75-125
Cadmium	0.003	0.05	ND	0.046	92	75-125
Chromium	0.005	0.2	ND	0.185	92	75-125
Lead	0.002	0.02	ND	0.022	110	75-125
Manganese	0.005	0.5	1.12	1.57	90	75-175
Mercury	0.0005	0.001	ND	0.0009	90	60-140
Selenium	0.005	0.01	ND	0.010	100	60-125
Silver	0.01	0.05	ND	0.049	98	75-125

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Skelen Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Duplicate Summary
Total Metals
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Barium	6010	0.005	0.746	0.813	0.780	9
Cadmium	6010	0.003	ND	ND	ND	--
Calcium	6010	0.05	52.7	53.5	53.1	2
Chromium	6010	0.005	0.086	0.097	0.092	12
Iron	6010	0.02	118	127	122	7
Magnesium	6010	0.01	31.1	33.0	32.0	6
Potassium	6010	2	15	16	16	6
Silver	6010	0.01	ND	ND	ND	--
Sodium	6010	0.1	20.6	21.1	20.8	2

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ekler, [illegible] Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Matrix Spike Summary
Total Metals
mg/L (ppm)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Barium	0.005	2.0	0.746	2.81	103	75-125
Cadmium	0.003	0.05	ND	0.052	104	75-125
Iron	0.02	1.0	118	124	NA	75-125

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
NA Not Applicable because of the sample matrix. Accuracy of spike value is reduced since the sample concentration was greater than four times the amount spiked.

Approved by Dave Ebelm, I Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Work Order #:**	K912737
Sample Matrix:	Water		

QA/QC Report
Duplicate Summary
Total Metals
mg/L (ppm)

Sample Name: FB-1
Lab Code: K2737-7

Analyte	**Method**	**MRL**	**Sample Result**	**Duplicate Sample Result**	**Average**	**Relative Percent Difference**
Arsenic	7060	0.005	ND	ND	ND	--
Lead	7421	0.002	ND	ND	ND	--
Mercury	7470	0.0005	ND	ND	ND	--
Selenium	7740	0.005	ND	ND	ND	--

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Eldon / Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client: Sweet-Edwards/EMCON, Inc.
Project: Channel/#X3201.01
Sample Matrix: Water

Date Received: 05/20/91
Work Order #: K912737

QA/QC Report
Matrix Spike Summary
Total Metals
mg/L (ppm)

Sample Name: FB-1
Lab Code: K2737-7

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Arsenic	0.005	0.04	ND	0.039	98	75-125
Lead	0.002	0.02	ND	0.017	85	75-125
Mercury	0.0005	0.001	ND	0.0008	80	60-140
Selenium	0.005	0.01	ND	0.010	100	60-125

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Dave Ehlen.A Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Date Analyzed:**	05/28/91
Sample Matrix:	Water	**Work Order #:**	K912737

QA/QC Report
Surrogate Recovery Summary
Volatile Organic Compounds
EPA Method 8240

Sample Name	**Lab Code**	Percent Recovery		
		1,2-Dichloroethane - D_4	Toluene - D_8	4-Bromofluorobenzene
MW-1	K2737-1	104	99.8	93.4
MW-2	K2737-2	104	99.8	93.2
MW-1	K2737-1MS	101	99.6	97.0
MW-1	K2737-1DMS	95.4	98.8	97.4
MW-3-1	K2737-4	101	100	92.6
MW-3-2	K2737-5	102	99.8	93.4
MW-4	K2737-6	104	99.0	91.6
FB-1	K2737-7	106	98.4	89.0
LCU-1	K2737-8	104	97.6	86.8
	EPA Acceptance Criteria	76-114	88-110	86-115

Approved by Dave Edelm... Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Date Analyzed:**	05/28/91
Sample Matrix:	Water	**Work Order #:**	K912737

QA/QC Report
Surrogate Recovery Summary
Volatile Organic Compounds
EPA Method 8240

Sample Name	Lab Code	Percent Recovery		
		1,2-Dichloroethane - D_4	Toluene - D_8	4-Bromofluorobenzene
LCD-1	K2737-9	103	97.6	86.4
EP-1	K2737-10	99.4	97.0	86.0
TF-1	K2737-11	101	97.2	86.0
Method Blank	K2737-MB	103	100	93.2
	EPA Acceptance Criteria	76-114	88-110	86-115

Approved by Dave Ebler, J Date 6/19/91

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COLUMBIA ANALYTICAL SERVICES, INC.

Client:	Sweet-Edwards/EMCON, Inc.	**Date Received:**	05/20/91
Project:	Channel/#X3201.01	**Date Analyzed:**	05/28/91
Sample Matrix:	Water	**Work Order #:**	K912737

QA/QC Report
Matrix Spike/Duplicate Matrix Spike Summary
Volatile Organic Compounds
EPA Method 8240
µg/L (ppb)

Sample Name: MW-1
Lab Code: K2737-1

Analyte	**Spike Level**	**Sample Result**	**Spike Result** MS	DMS	**Percent Recovery** MS	DMS	EPA Acceptance Criteria	**Relative Percent Difference**
1,1-Dichloroethene	50	ND	67.4	61.9	135	124	61-145	8.5
Trichloroethene	50	ND	59.0	55.5	118	111	71-120	6.1
Chlorobenzene	50	ND	55.8	53.4	112	107	75-130	4.4
Toluene	50	ND	52.0	47.3	104	94.6	76-125	9.5
Benzene	50	ND	57.8	54.4	116	109	76-127	6.1

ND None Detected at or above the method reporting limit

Approved by Dave Ebel.. Date 6/19/91

00033

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APPENDIX B

CHAIN OF CUSTODY INFORMATION

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-1068

Chain of Custody / Laboratory Analysis Request

Sweet-Edwards / EMCON, Inc.
Kelso, WA (206) 423-3580
Bothell, WA (206) 485-5000

K2737

DATE 5-17-91 PAGE 1 OF 2

PROJECT Channel # X320101
CLIENT INFO.
CONTACT
ADDRESS
TELEPHONE#
SAMPLERS NAME PHONE#
SAMPLERS SIGNATURE

ANALYSIS REQUESTED — GENERAL CHEMISTRY (Specify) — OTHER (Specify)

SAMPLE I.D.	DATE	TIME	LAB I.D.	TYPE	BASE/NEU/ACID ORGAN. GC/MS/625/8270	VOLATILE ORGANICS GC/MS/624/8240	HALOGENATED VOLATILE ORGANICS 601/8010	PHENOLICS 604/8040	POLYNUCLEAR AROMATIC 610/8310	TOTAL ORGANIC CARBON (TOC) 415/9060	TOTAL ORGANIC HALIDE (TOX) 9020	EP TOX/TCLP METALS (Circle One)	METALS (~~TOTAL~~) (Diss.) (See Special Inst.)	TCLP ORGANICS	(pH) ~~COND~~ ~~ALK~~	(NO3/NO2) (Cl) (SO4) (Nitrate N)	(Ca) (Mg) (Na) (K) (Fe)	HCO3	Mn dissolved	COD, TOC	TDS, TSS	CN		NUMBER OF CONTAINERS
1. MW-1	5-15	9^00		W		X							X		/	X	X	/	X	X	X	X		7
2. MW-2 (X)	5-16 / 5-15	10^00 / 19^30				X							X		X	X	X	X	X	X	X	X		14
3. MW-3-1	5-15	13^30				X							X		X	X	X	X	X	X	X	X		7
4. MW-3-2	5-15	13^45				X							X		X	X	X	X	X	X	X	X		7
5. MW-4	5-15	10^15				X							X		X	X	X	X	X	X	X	X		7
6. FB-1	5-15	13^00				X							X		X	X	X	X	X	X	X	X		7
7. LCU-1	5-16	8^50				X							X		X	X	X	X	X	X	X	X		7
8. LCD-1	5-16	9^15		W		X							X		X	X	/	X	X	X	X	X		7

Relinquished By Sweet, Edwards & Assoc.	Relinquished By	Relinquished By	PROJECT INFORMATION	SAMPLE RECEIPT
Signature: [signature] Steve Nelson	Signature	Signature	Shipping I.D. No.	Total No. of Containers
Printed Name: SE/E	Printed Name	Printed Name	VIA	Chain of Custody Seals
Firm: 5-17-91 1200	Firm	Firm	Project	Received in good condition
Date/Time	Date/Time	Date/Time		LAB NO.

Received By	Received By	Received By
Signature: [signature]	Signature	Signature
Printed Name: Fran Adair	Printed Name	Printed Name
Firm: CAS	Firm	Firm
Date/Time: 5/20/91 1100	Date/Time	Date/Time

SPECIAL INSTRUCTIONS/COMMENTS
Metals As Ba Cd Cr Pb Hg Se Ag (Filter in lab - dissolved)
(X) Two sets of bottles; analyze only one set. Steve Nelson will call on 5-20 AM to inform you as to which set to analyze.
Run pH even if past hold time per S. Nelson. Note which bottles here not be acidified. Analyze 5/20/91 CF 2, MW-2 5/16 Add MW-2 5/15

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator.

S-E/E 400-05

00035

Sweet-Edwards / EMCON, Inc.
Kelso, WA (206) 423-3580
Bothell, WA (206) 485-5000

Chain of Custody / Laboratory Analysis Request

K2237

DATE 5-17-91 PAGE 2 OF 2

PROJECT Channel # X320101

CLIENT INFO. CONTACT

ADDRESS

TELEPHONE#

SAMPLERS NAME Steve Nelson PHONE#

SAMPLERS SIGNATURE [signature]

	SAMPLE I.D.	DATE	TIME	LAB I.D.	TYPE	BASE/NEU/ACID ORGAN. GC/MS/625/8270	VOLATILE ORGANICS GC/MS/624/8240	HALOGENATED VOLATILE ORGANICS 601/8010	PHENOLICS 604/8040	POLYNUCLEAR AROMATIC 610/8310	TOTAL ORGANIC CARBON (TOC) 415/9060	TOTAL ORGANIC HALIDE (TOX) 9020	EP TOX/TCLP METALS (Circle One)	METALS ~~(TOTAL)~~ (DISS) (See Special Inst.)	TCLP ORGANICS	(pH) ~~COND~~ ~~ALK~~	NO3/NO2/Cl/SO4 (Nitrate N)	(Ca), (Mg), (Na), (K), (Fe)	HCO3	Mn dissolved	COD, TOC	TDS, TSS	CN		NUMBER OF CONTAINERS
1.	EP-1	5-16	8[15]		W		X							X		X	X	X	X	X	X	X	X		7
2.	TF-1	5-15	15[00]		W		X							X		X	X	X	X	\	X	X	X		7
3.																									
4.																									
5.																									
6.																									
7.																									
8.																									

Relinquished By Sweet, Edwards & Assoc.	Relinquished By	Relinquished By
Signature: [signature]	Signature:	Signature:
Printed Name: Steve Nelson	Printed Name:	Printed Name:
Firm: SE/E	Firm:	Firm:
Date/Time: 5/17/91 1300	Date/Time:	Date/Time:

Received By	Received By	Received By
Signature: [signature]	Signature:	Signature:
Printed Name: Fran Adair	Printed Name:	Printed Name:
Firm: CAS	Firm:	Firm:
Date/Time: 5/20/91 1100	Date/Time:	Date/Time:

PROJECT INFORMATION

Shipping I.D. No.

VIA

Project

SAMPLE RECEIPT

Total No. of Containers: 7 7

Chain of Custody Seals

Received in good condition

LAB NO.

SPECIAL INSTRUCTIONS/COMMENTS

Metals: As Ba Cd Cr Pb Hg Se Ag
Filter first Note which bottles have not been acidified

DISTRIBUTION: WHITE - return to originator; YELLOW - lab; PINK - retained by originator.

S-E/E 400-05