



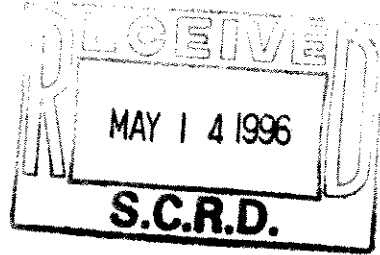
DAYTON & KNIGHT LTD.

Consulting Engineers

P.O. BOX 91247, (612 CLYDE AVENUE), WEST VANCOUVER, BRITISH COLUMBIA, CANADA V7V 3N9
TELEPHONE: (604) 922-3255 FAX: (604) 922-3253

May 9, 1996

Mr. Dennis Barlow
Waste Management Technician
B.C. Environment
Environmental Protection
15326 - 103 A Avenue
Surrey, B.C. V3R 7A2



Dear Mr. Barlow:

Re: **Sunshine Coast Regional District**
Gibsons Landfill Closure Plan

On behalf of the Sunshine Coast Regional District, we are pleased to submit 3 (three) copies of the Gibsons Landfill Closure Plan.

Yours truly,

Dayton & Knight Ltd.

Daryl J. Sinclair

djs
28.158
encl.

cc: Mr. S. K. Lehmann, Sunshine Coast Regional District
Ms. C. Kenny, Sunshine Coast Regional District

**SUNSHINE COAST REGIONAL DISTRICT
GIBSONS LANDFILL
CLOSURE PLAN**

1.0 Introduction

This Closure Plan outlines the background and existing conditions (as of December 1995) of the Gibsons Landfill, as well as recommended closure works to protect health and the environment. End use of the site is also addressed.

2.0 Background

The Gibsons Landfill is located on Stewart Road, north of the Town of Gibsons in the Sunshine Coast Regional District (see Figure 1). The landfill site is situated on the southern half of Lots 3 and 4 of D. L. 1507, Group 1, NWD., Plan 3795.

The Gibsons Landfill began operations in the early 1970's and was used for the disposal of municipal solid waste from Electoral Areas D (Roberts Creek), E (Elphinstone) and F (West Howe Sound) and the Town of Gibsons. Permit No. PR-2548 was issued on December 11, 1973 by the Ministry of Environment to the Sunshine Coast Regional District for the operation of the landfill. The authorised rate of discharge was 11.5 m³/day.

The landfill is located in an undeveloped area and occupies approximately 1 to 1.5 ha. A small drainage course runs in a north-south direction immediately to the east of the site.

The landfill operation was generally uncontrolled in which waste was simply dumped and burned. The burn residue was then spread out by machine. Burning of waste at the site was discontinued after 1980. Cover material was obtained from an area adjacent to the site.

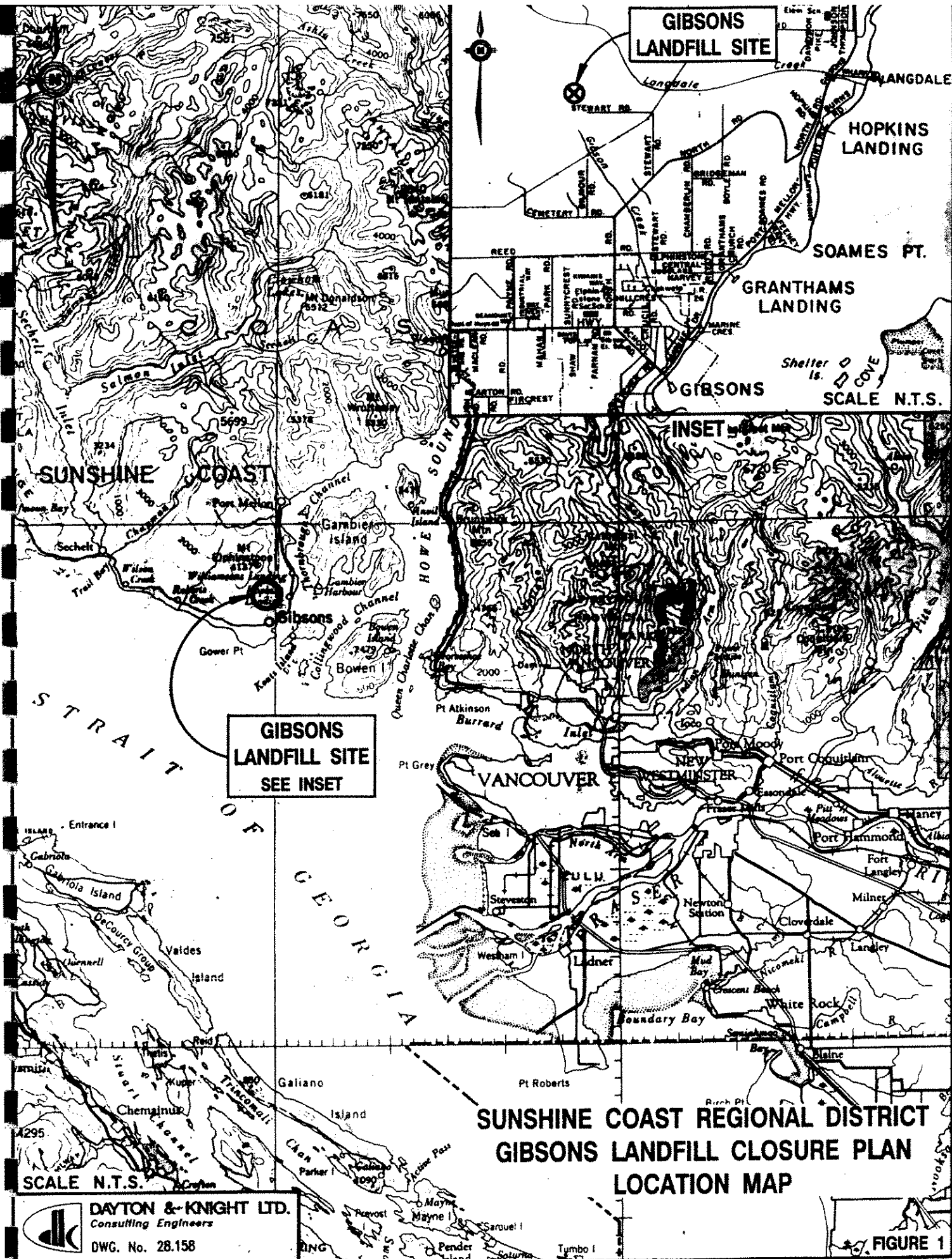
Between 1980 and 1986, the site was restricted to the landfilling of stumps and non-putrescible waste and was only operated seasonally. The landfill was closed in 1986.

Figure 2 shows the present landfill.

3.0 Present Conditions

The top surface of the landfill is fairly flat compared to surrounding topography and has been stripped of almost all trees. A trail runs along the northern edge of the landfill which is used by cyclists. The site is also used as a picnic area (benches and a picnic table have been placed at the site), especially by cyclists, and some grading has been done to facilitate use of the site for recreational uses.

The entrance to the site is restricted to discourage vehicle access and illegal dumping and a sign has been posted to identify the site and warn against unauthorised use of the



**GIBSONS
LANDFILL SITE**

**GIBSONS
LANDFILL SITE
SEE INSET**

**SUNSHINE COAST REGIONAL DISTRICT
GIBSONS LANDFILL CLOSURE PLAN
LOCATION MAP**

DAYTON & KNIGHT LTD.
Consulting Engineers
DWG. No. 28.158

FIGURE 1

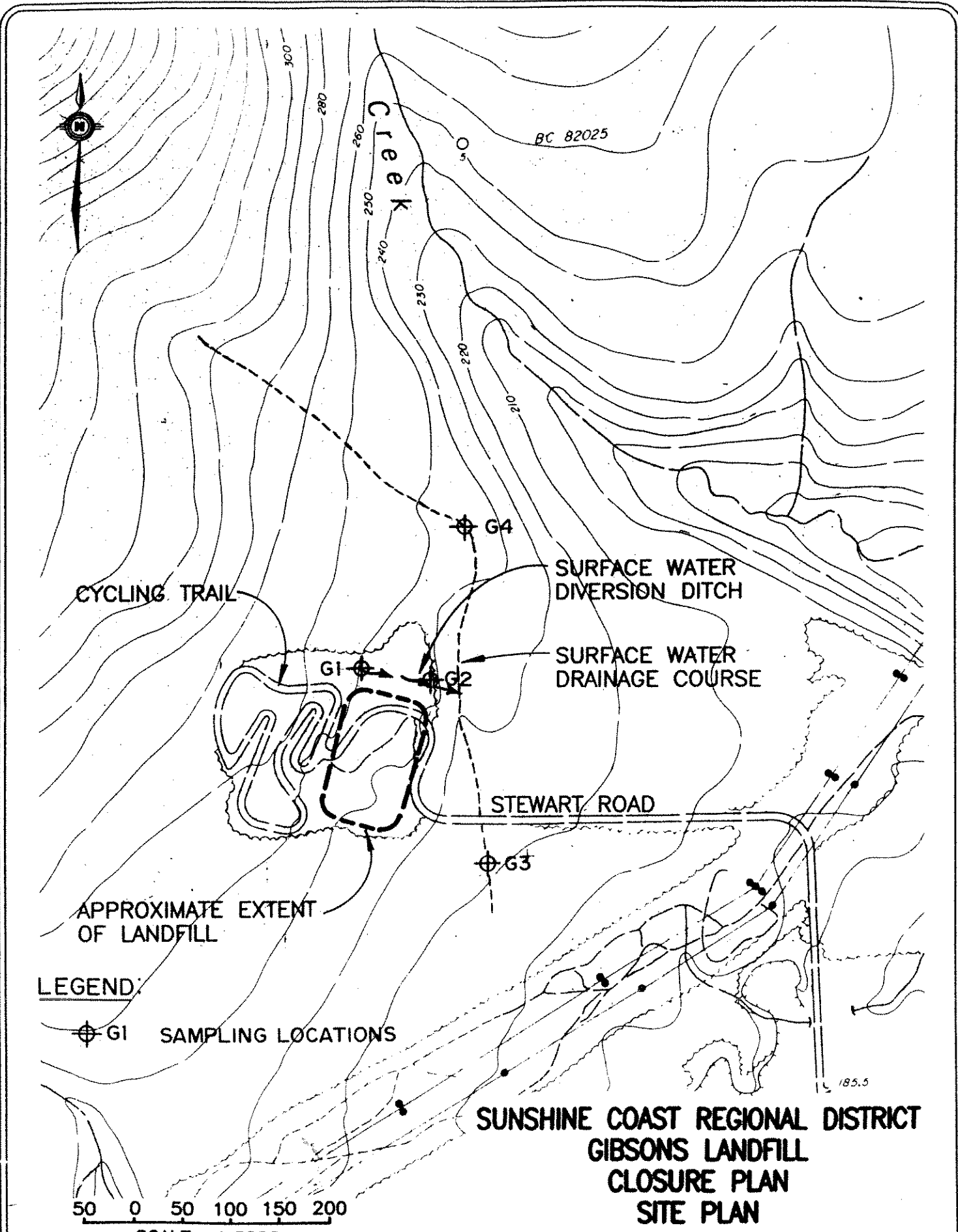


FIGURE 2

site. There are no other restrictions to access to the site apart from natural topography and vegetation.

Exposed waste is visible along the slopes of the landfill. The top surface of the landfill appears to have a soil cover and very little waste is exposed. Although the top surface has been stripped of trees, a mix of natural vegetation has been established outside graded areas.

Figure 3 illustrates the existing topography of the site (as of January 5, 1996).

4.0 Environmental Monitoring

4.1 Previous Investigation

In February 1991, Dayton & Knight inspected the landfill and found surface water (ditched) flow along the toe of the uppermost lift of the landfill (reference Dayton & Knight Ltd. letter to the Sunshine Coast Regional District dated March 12, 1991). It was concluded that the source of the flow was primarily run-on from areas adjacent to the landfill. It was also observed that surface water runoff had passed through a portion of the landfill and seepage through that embankment appeared to discharge as leachate into the ditched flow, based on colourisation of the water.

In March 1991, two water samples were collected from the ditched flow, upstream and downstream from the suspected leachate breakout discussed above. Comparing upstream to downstream sampling results revealed the following:

- No increase in Chemical or Biochemical Oxygen Demand;
- Very little increase in pH, Total Solids, Specific Conductivity, Total Hardness, Total Kjeldahl Nitrogen and Ammonia; and
- An appreciable increase in Iron from 0.14 mg/L in the upstream sample to 6.06 mg/L in the downstream sample.

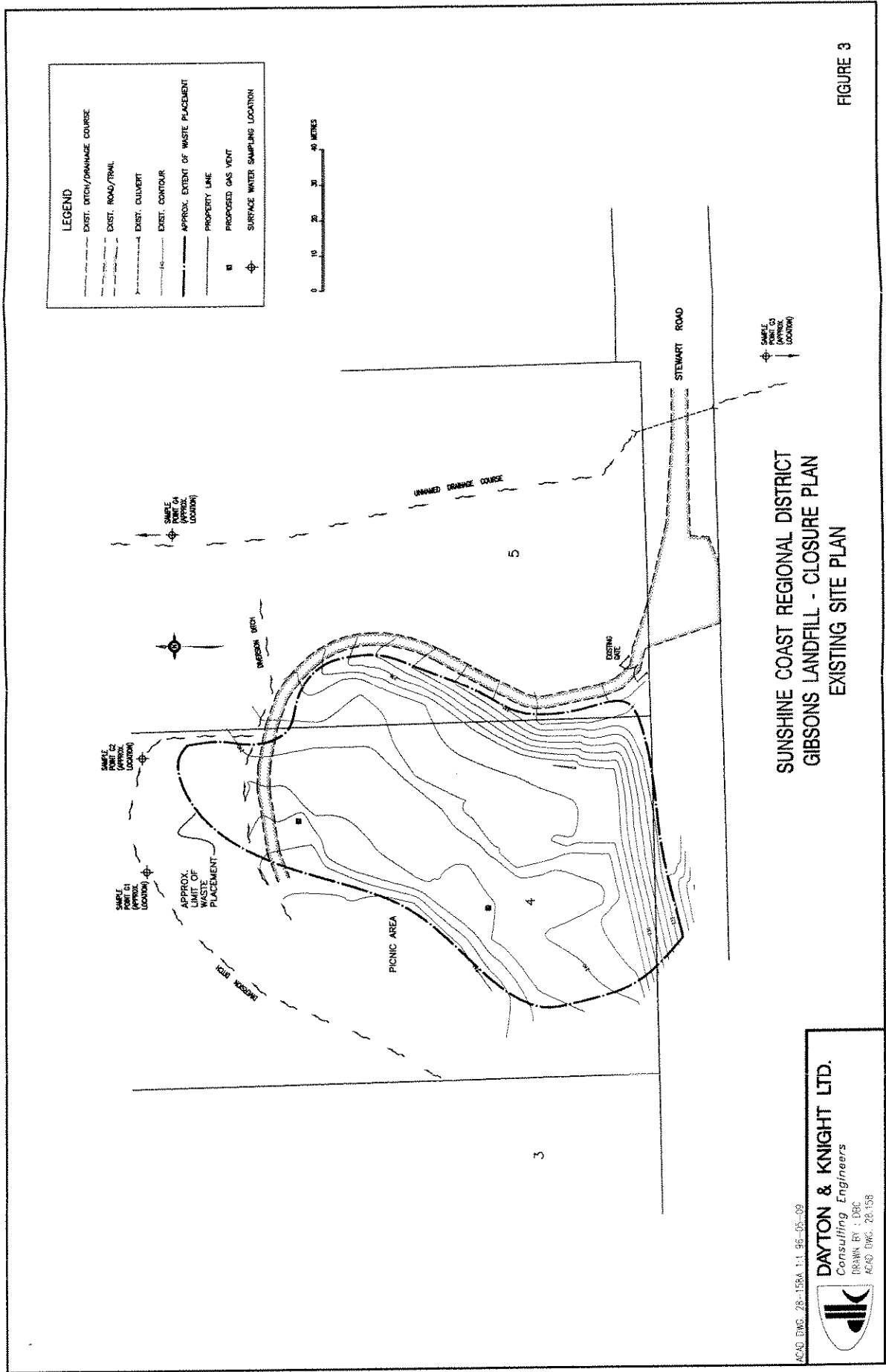
These results indicated some migration of leachate, however, the impact on water quality was minor. The results also show that the landfill is old and has limited presence of leachable materials.

As a result of this investigation, it was recommended that surface water run-on be diverted away from the landfill and that the surface of the landfill be vegetated.

Surface water diversion ditches were subsequently excavated along the upper slopes of the site to divert surface run-on around the landfill.

4.2 1995 Monitoring

On two separate occasions, November 22, 1995 and December 13, 1995, samples were collected from two surface water drainage courses in the vicinity of the site; a diversion ditch upslope from the landfill and the surface water drainage course which runs east of



SUNSHINE COAST REGIONAL DISTRICT
 GIBSONS LANDFILL - CLOSURE PLAN
 EXISTING SITE PLAN

45402 DWG. 28-1534-1-1 25-05-09

DAYTON & KNIGHT LTD.
 Consulting Engineers
 BRANKY RD., DBC
 4540 DWG. 28-153



FIGURE 3

the site. Both upstream and downstream samples were collected from the two drainage courses.

The samples were analysed for the following parameters:

- pH;
- Specific Conductance;
- Chemical Oxygen Demand;
- Dissolved Chloride;
- Nitrites plus Nitrates; and
- Dissolved Iron.

Comparing the sampling results in the diversion ditch indicates that there was little difference between upstream and downstream water quality in the samples collected on November 22, 1995. In the samples collected on December 13, 1995, the downstream water quality (Sample Point G2) was slightly changed compared to the upstream water quality (Sample Point G1) as evidenced by higher levels of COD (55 mg/L vs. <10 mg/L, respectively) and Nitrates (0.31 mg/L vs. 0.09 mg/L, respectively).

Comparing the sampling results in the surface water drainage course indicates that there was little difference between upstream and downstream water quality during both sampling events.

The laboratory analytical reports are presented in the Appendix.

From this sampling event, it appears that the landfill is not having an adverse impact on the local environment.

5.0 Closure Plan

The landfill does not appear threatening to health or the environment based on the observations and investigations conducted to date.

The recommendations for closure are given below:

- Place additional cover material as required over the top surface of the landfill to ensure a 4% (minimum) slope is provided for surface water drainage. Upon review of the existing topography of the landfill it is apparent that in general, the top of the landfill is sloped at a grade exceeding 4%. Therefore, it is recommended that only depressions on the surface be filled. The fill material should preferably be a silty or clayey soil, with minimal gravel or larger rocks or other material, having low permeability (less than 1×10^{-5} cm/sec). This material can be obtained from on-site.
- Install two passive landfill gas vents at high points in the cover consisting of 2 metre by 2 metre sand pits extending down into the waste.
- Remove exposed waste located on the slopes of the landfill and dispose either on-site or at the Sechelt Landfill (for large waste items such as white goods or automobiles). Additional cover material should be placed in disturbed areas.

- Place additional signs at the site to identify the site as a former landfill, warn against illegal dumping, list restrictions to use of the site, and list potential hazards posed by the landfill.
- Install permanent barriers (steel posts) to vehicular access from Stewart Road to discourage illegal dumping.
- In addition, areas of the landfill which are disturbed by filling or waste removal, as described above, should be vegetated to prevent erosion. Natural vegetation would be acceptable. Existing trees and other vegetation should be retained.

Environmental monitoring, hydrogeological investigations or landfill gas assessments would only be required as part of a remedial response to significant leachate migration or similar health or environmental threats.

As discussed above, the site is used for recreational purposes, specifically for cyclists. The site can continue to be used this way following closure, however, it is imperative that users are aware that the site is a former landfill. This requires the posting of signs which clearly identify the site, potential hazards (in particular, fires) and restrictions to use. With respect to restrictions, use or development of the site must not result in damage to the final cover, diversion drainage ditches or vegetative cover, and intrusive work must be prohibited. It is also important that users are warned against starting fires.

Although vehicular access to the site must be restricted, it is important that access to the cycling trail which runs adjacent to the landfill be maintained. The installation of locked steel posts at the end of Stewart Road would prevent unauthorised vehicle entry to the site but permit bicycle access. The need for fencing to discourage unauthorised use or illegal dumping at site may be considered in future if problems arise.

Any proposed development of the site related to the current use of the site for recreational purposes must be reviewed and approved by the Regional District.

6.0 Post-Closure Care

The landfill should be inspected by the Regional District on an annual or semi-annual basis to ensure that the final cover, vegetative cover, signs, gates and diversion ditches are in good condition; to inspect for illegal dumping; to examine the site for potential leachate breakouts; and that use of the site has not affected closure works. In addition, the need for additional improvements to the landfill to protect health and the environment can be identified as conditions warrant.

In addition, samples from the unnamed drainage course which runs east of the landfill should be monitored twice per year for the following parameters:

- pH;
- Specific Conductance;
- Chemical Oxygen Demand;
- Dissolved Chloride;

- Nitrites plus Nitrates; and
- Dissolved Iron.

Inspection and monitoring information should be compiled into an annual report.

7.0 Closure and Post-Closure Costs

7.1 Closure Capital Costs

The anticipated capital costs for closure of the landfill are estimated below:

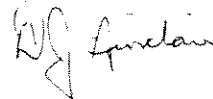
• Removal of Exposed Waste:		\$ 5,000
- on-site disposal or transport to Sechelt Landfill		
• Site Grading:		10,000
- filling depressions with on-site fill for surface drainage		
- filling areas from which exposed waste was removed		
- filling excavations for disposal of exposed waste		
• Re-Vegetation of Disturbed Areas:		1,000
• 2 Passive Gas Vents:		500
• Signs:		300
• Access Barriers (steel posts):		500
	Subtotal	\$ 17,300
	Contingencies @ 10%	\$ 1,730
	Subtotal	\$ 19,030
	GST @ 7%	\$ 1,332
	TOTAL	\$ 20,262

The estimated capital costs (1996 dollars) for closure of the landfill is approximately \$20,300.

7.2 Annual Post-Closure Operating Costs

The annual post closure operating costs related to site inspections, monitoring and reporting are estimated to be \$1,000, including GST (1996 dollars).

Dayton & Knight Ltd.



Daryl J. Sinclair

djs
28.158

**SUNSHINE COAST REGIONAL DISTRICT
GIBSONS LANDFILL CLOSURE PLAN**

APPENDIX

Water Sampling - Laboratory Reports

SUNSHINE COAST REGIONAL DISTRICT

Box 800 (5477 Wharf Road), Sechelt, BC V0N 3A0

GIBSONS LANDFILLSURFACE WATER SAMPLES

Taken by CATHY KENNY on November 22, 1995

- SAMPLE G1** - Beginning of Diversion Ditch
- taken at 9:45 a.m.
- water shallow (approx 2 inches deep); rinsed litre sample bottle & lid; filled bottle using small metal sample bottle; filled metal sample bottle; sample was difficult to get; some sediment in ditch was disturbed during sampling
- SAMPLE G2** - Diversion Ditch Above Culvert
- taken at 9:50 am
- water shallow (approx 2.5 inches deep); rinsed litre sample bottle & lid; filled bottle using small metal sample bottle; filled metal sample bottle; sample was difficult to get; some sediment in ditch was disturbed during sampling
- SAMPLE G3** - Unnamed Drainage Course Below Culvert
- taken at 10:00 am
- good water flow; rinsed litre sample bottle & lid & filled; filled metal sample bottle
- SAMPLE G4** - Unnamed Drainage Course Upstream
- taken at 10:10 am
- good water flow; rinsed litre sample bottle & lid & filled; filled metal sample bottle

Samples are to be analyzed for:

- pH
- specific conductivity, umhos/cm
- chemical oxygen demand, mg/L
- chloride (dissolved), mg/L
- nitrate and nitrite nitrogen (dissolved NO₃+NO₂), mg/L
- nitrate nitrogen (dissolved NO₃), mg/L
- nitrite nitrogen (dissolved NO₂)
- iron (dissolved), mg/L



8577 Commerce Court
Burnaby, B.C.
Canada V5A 4N5
Tel 604 444 4808
Fax 604 444 4511

01-Dec-95
Page 1 of 2

ZENON ENVIRONMENTAL LABORATORIES
Certificate of Analysis

Reported To :

SUNSHINE COAST REG. DIST.

Client Code WS

5477 WHARF ROAD
BOX 800
SECHELT, BC
V0N 3A0

Attention : CATHY KENNY
Phone : (604) 885-2261
FAX : (604) 885-7909

Project Information :

Project ID : GIBSONS LANDFILL
Submitted By : CATHY KENNY

Requisition Forms :

Form 06106710 received on 23-Nov-95 completed on 1-Dec-95

Remarks :

- ☞ All organic data is blank corrected except for PCDD/F, Hi-res MS and CLP volatile analyses
- ☞ 'MDC' = Minimum Detectable Concentration, '<' = Less than MDC, '---' = Not analyzed
- ☞ Solids results are based on dry weight except Biota Analyses & Special Waste Oil & Grease
- ☞ Organic analyses are not corrected for extraction recovery standards except for Isotope Dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by Zenon are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', 18th Edition, published by the American Public Health Association, or on US EPA protocols found in the 'Test Methods For Evaluating Solid Waste, Physical/Chemical Method, SW846', 3rd Edition. Other procedures are based on methodologies accepted by the B.C. Ministry of Environment.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied.
Your samples will be retained at Zenon for a period of 30 days from receipt of data or as per contract.

ZENON Project Manager: Carolyn Nelson



**ANALYTICAL REPORT
Form 06106710**

01-Dec-95
Page 2 of 2

Client : SUNSHINE COAST REG. DIST.
Project : GIBSONS LANDFILL

Zenon ID :	95034965	95034966	95034967	95034968
Client ID :	G1	G2	G3	G4

Sparcode	Parameter	Unit	MDC				
PHYSICAL							
00041220	pH	pH units	0.1	5.7	5.7	5.4	5.3
00111160	Specific Conductance	uS/cm	1	14	23	18	15
GENERAL INORGANICS							
01160500	Chemical Oxygen Demand	mg/L	10	43	23	25	20
ANIONS							
11041330	Chloride Dissolved	mg/L	0.5	1.9	1.6	2.0	2.1
NITROGEN							
11091350	Nitrate+Nitrite (N)	mg/L	0.02	0.05	0.35	0.58	0.25
1110CALC	Nitrate Nitrogen Dissolved	mg/L		0.05	0.35	0.58	0.25
11111354	Nitrite Nitrogen	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
METALS DISSOLVED							
Fe-D0031	Iron Dissolved	mg/L	0.003	0.114	0.038	0.009	< 0.003
			Matrix :	Fresh Water	Fresh Water	Fresh Water	Fresh Water
			Sampled on:	95/11/22	95/11/22	95/11/22	95/11/22

SUNSHINE COAST REGIONAL DISTRICT

Box 800 (5477 Wharf Road), Sechelt, BC V0N 3A0

GIBSONS LANDFILL SURFACE WATER SAMPLES

Taken by CATHY KENNY on December 12, 1995

- SAMPLE G1** - Beginning of Diversion Ditch
- taken at 12:50 pm
- water shallow (approx 2 inches deep); rinsed litre sample bottle & lid; filled bottle using small metal sample bottle; filled metal sample bottle; sample was difficult to get; some sediment in ditch was disturbed during sampling
- SAMPLE G2** - Diversion Ditch Above Culvert
- taken at 12:53 pm
- water shallow (approx 2.5 inches deep); rinsed litre sample bottle & lid; filled bottle using small metal sample bottle; filled metal sample bottle; sample was difficult to get; some sediment in ditch was disturbed during sampling
- SAMPLE G3** - Unnamed Drainage Course Below Culvert
- taken at 12:55 pm
- good water flow; rinsed litre sample bottle & lid & filled; filled metal sample bottle
- SAMPLE G4** - Unnamed Drainage Course Upstream
- taken at 1:00 pm
- good water flow; rinsed litre sample bottle & lid & filled; filled metal sample bottle

Samples are to be analyzed for:

- pH
- specific conductivity, umhos/cm
- chemical oxygen demand, mg/L
- chloride (dissolved), mg/L
- nitrate and nitrite nitrogen (dissolved NO₃+NO₂), mg/L
- nitrate nitrogen (dissolved NO₃), mg/L
- nitrite nitrogen (dissolved NO₂)
- iron (dissolved), mg/L

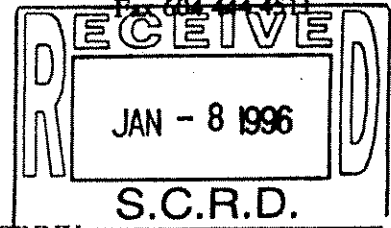


to accounting
→

19-Dec-95
Page 1 of 2

ZENON ENVIRONMENTAL LABORATORIES
Certificate of Analysis

8577 Commerce Court
Burnaby, B.C.
Canada V5A 4N5
Tel 604 444 4808
Fax 604 444 4511



Reported To :

SUNSHINE COAST REG. DIST.

Client Code WS

5477 WHARF ROAD
BOX 800
SECHELT, BC
V0N 3A0

Attention : CATHY KENNY
Phone : (604) 885-2261
FAX : (604) 885-7909

Project Information :

Project ID : GIBSONS LANDFILL
Submitted By : CATHY KENNY

Requisition Forms :

Form 06106706 received on 13-Dec-95 completed on 19-Dec-95

Remarks :

- ☞ All organic data is blank corrected except for PCDD/F, Hi-res MS and CLP volatile analyses
- ☞ 'MDC' = Minimum Detectable Concentration, '<' = Less than MDC, '—' = Not analyzed
- ☞ Solids results are based on dry weight except Biota Analyses & Special Waste Oil & Grease
- ☞ Organic analyses are not corrected for extraction recovery standards except for Isotope Dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by Zenon are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', 18th Edition, published by the American Public Health Association, or on US EPA protocols found in the 'Test Methods For Evaluating Solid Waste, Physical/Chemical Method, SW846', 3rd Edition. Other procedures are based on methodologies accepted by the B.C. Ministry of Environment.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at Zenon for a period of 30 days from receipt of data or as per contract.

ZENON Project Manager: Carolyn Nelson



ANALYTICAL REPORT
Form 06106706

19-Dec-95
Page 2 of 2

Client : SUNSHINE COAST REG. DIST.
Project : GIBSONS LANDFILL

Zenon ID : 95037023 95037024 95037025 95037026
Client ID : G1 G2 G3 G4

Sparcode	Parameter	Unit	MDC				
PHYSICAL							
00041220	pH	pH units	0.1	5.9	5.9	5.6	5.4
00111160	Specific Conductance	uS/cm	1	6	15	16	11
GENERAL INORGANICS							
01160500	Chemical Oxygen Demand	mg/L	10	< 10	55	< 10	37
ANIONS							
11041330	Chloride Dissolved	mg/L	0.5	1.1	1.4	2.2	1.8
NITROGEN							
11091350	Nitrate+Nitrite (N)	mg/L	0.02	0.09	0.31	0.30	0.20
1110CALC	Nitrate Nitrogen Dissolved	mg/L		0.08	0.31	0.30	0.20
11111354	Nitrite Nitrogen	mg/L	0.005	0.006	0.005	< 0.005	< 0.005
METALS DISSOLVED							
Fe-D0031	Iron Dissolved	mg/L	0.003	0.095	0.084	0.008	< 0.003
				Matrix : Fresh Water	Fresh Water	Fresh Water	Fresh Water
				Sampled on: 95/12/13	95/12/13	95/12/13	95/12/13