New Zealand Aluminium Smelters Limited

Interdepartmental Committee Annual Report 2011

Report to Environment Southland and the Interdepartmental Committee on consent monitoring and environmental effects of the Tiwai Aluminium Smelter for the year ending 31 December 2011

VERSION 3

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Summary

Introduction

This report contains the results of consent monitoring and environmental effects of the New Zealand Aluminium Smelter for the year ending 31 December 2011.

Main Stack

Main Stack discharges to air were within permit standards during 2011.

Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2011.

Dust Collector Discharges

Sixteen dust collectors were tested during 2011. There were two dust collectors that required action to be taken when measurements indicated that the consent action level of 100 mg/Sm^3 was exceeded. There were no breaches of the consent limit of 250 mg/Sm^3.

Dispersion

Wind speeds and direction were generally similar to previous years.

Monthly rainfall for 2011 was variable with the annual total of 1122mm being greater than usual. The long term annual average is 1107 mm.

Ambient Air

All sites were within permit standards.

Atmospheric Deposition

All permit guidelines were met during 2011.

Vegetation

The fluoride concentrations of ungrazed grass sites were similar to the concentrations measured in 2011.

Fluoride in *Pinus radiata* needles were within permit guidelines during 2011.

The fluoride concentrations of grazed grass for all monitoring farms were within permit standards during 2011 and similar to previous years. Cattle urine on GMF4 during 2011 was within the guideline.

Water Take

Water take from the aquifer was within permit standards for 2011. A problem developed with a bypass valve during December and the daily water take was under recorded by approximately 280m3/day. It is believed that the daily water take was still well within the consent limit.

Liquid Discharges

Discharges from the, South, and West drains and of Treated Effluent and their effect on the environment were within permit standards during 2011. There was one occasion in July 2011 that the North Drain discharge was outside the consent limits

All permit standards were met for Treated Sewage discharges during 2011.

Groundwater monitoring results from the upstream sewage monitoring bore showed a high result for phosphorous. The results for south downstream bore are similar to those previously reported.

Groundwater

Groundwater monitoring around the SCL storage shed and underneath the storage shed showed no significant changes of analytes during 2011. The cathode pad stockpile groundwater showed a spike in contaminant levels in the shallow bores close to the stockpile.

Landfill

Monitoring of groundwater near the NZAS landfill during 2011 showed some variation in the analyte concentrations in the bores but generally analyte levels have stabilised.

Greenhouse Gas Discharges

There was a decrease in absolute carbon dioxide emissions during 2011. The emission rate in 2011 was 1.87 t CO2-e / per tonne of aluminium produced. This was the lowest rate ever recorded in NZAS history.

Part A - Environmental Management

Introduction

This report summarises NZAS' environmental performance during 2011 and includes results, summaries and comments on discharge permit monitoring. It includes data from some reports forwarded to Environment Southland during the year with additional sections including discharges to air, dispersion conditions, liquid discharges etc. to cover NZAS' discharges to, and effects on, the environment.

The data is provided in tables, summaries, maps and where appropriate as graphs. Analysis of trends and other comments are included where appropriate.

The NZAS Laboratory Services team provides much of the data within this report. A comprehensive auditing programme conducted by Environment Southland verifies the validity of this data.

The NZAS system for environmental management is certified as meeting the ISO 14001 requirements. In addition, NZAS' Laboratory has maintained accreditation to NZS/ISO/IEC 17025 "General Competence of Calibration and Testing Laboratories". The scope of the accreditation includes Quality Systems to ensure the accuracy of data. Where samples are forwarded to external laboratories for analysis, these laboratories have accreditation to NZS/ISO/IEC 17025

Environmental Improvements

Environmental improvement work continued in 2011. This included:

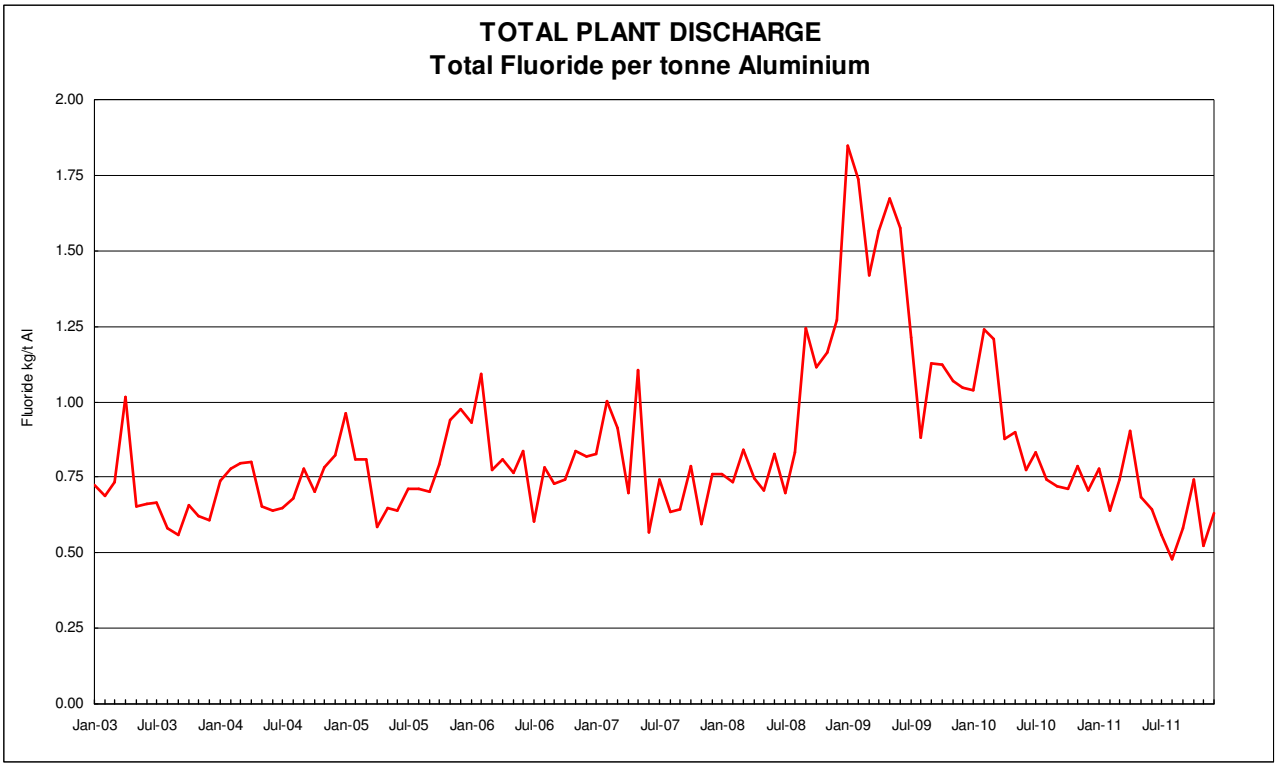
Opening of the Taha Asia Pacific Dross Recycling Facility

In 2011 the Taha dross recycling facility was formally opened for business. All dross arising from NZAS production activities is now reprocessed in the Taha facility. The process uses mechanical separation techniques to remove aluminium metal from the dross solids. The metal is returned to NZAS and recycled through normal production processes. The remaining "aluminium depleted dross" will be sent to the Taha facility in Invercargill where it will be further treated to render it inert. This inert material has valuable properties which enable it to be easily converted into fertiliser. There are no waste products arising from this process.

In addition to taking all dross arising from current production, Taha have also started to recycle the dross material stored in the NZAS Landfill. Approximately 40,000 tonnes of dross is stored at the Landfill and it is anticipated that all this material will be removed by 2016.

Fluoride Emissions Management

As reported in the 2010 IDC annual report, a specialist group had been set up at NZAS to review fluoride emission levels and to propose improvement projects to reduce emissions as far as reasonably practicable given current economic circumstances. NZAS is pleased to report that this group has been very successful in reducing emissions. 2011 saw record low levels of emissions achieved since increased high purity production commenced in 2004.



Biodiversity Review

NZAS called upon the expertise of Rio Tinto's biodiversity group to undertake a biodiversity review for the NZAS site and its immediate surrounds. The review identified 51 priority 'biodiversity features' and recommended actions to ensure the continuing presence of these species on the Tiwai Peninsula. During 2012 NZAS intends to prepare an action plan in response to the Report. Copies of the 2011 Biodiversity Report are available on request.

Peninsula Pest Management

In consultation with the Department of Conservation, an enhanced pest management programme has been implemented on the Tiwai Peninsula. The objective of the programme is to reduce the numbers of a wide range of pest predators on the Peninsula, including some not previously targeted by NZAS programmes.

Stoat trapping is one such example. Working with DOC and NZAS's pest management contractor, the entire Peninsula is now ringed with stoat traps set 200m apart. The picture below shows the number and location of the traps.

The intention is to reduce pest animal numbers as low as reasonably practicable so that indigenous wildlife is encouraged to return to the Peninsula in greater numbers than previously seen.

Environmental Incidents

Incidents Involving Consent Violations

There were one environmental consent violations reported to Environment Southland in 2011.

As reported on 13th July to Environment Southland, during routine sampling of the North Drain on the 8th July during heavy rain and strong on-shore winds, the fluoride concentration in the seawater control site (100m upstream) of the exit of the Drain was determined to be 5.6 g F/m^3. NZAS interprets this result as a breach of Consent 203373 Section 4(b) in that a seawater sample collected exceeded a concentration of 5.0 g F/m^3. This is because differentiation between the control and the seawater site (50m downstream of the drain exit) was difficult due to rough sea conditions. The Consent does not specify limits on analytes at the seawater control site. No adverse impacts were observed on the seawater environment.

Audit Programme
Auditing conducted by Environment Southland (ES) during 2011 included:

Audit Sample Type		Sites	Date	Issues
Ambient Air	1km Hut	1	February	Gaseous fluoride result for 1 sample – not resolved due to the delay in receiving results.
		1	May	1 gaseous fluoride and 1 particulate fluoride for the same week. Both results were below limit for consent so no further action.
	Bluff	1	November	None
Ungrazed Pasture		8	November	All low level samples (<25 mg/kg) outside agreed limits. No samples exceeded consent limits.
Atmospheric Deposition		2	February	None
		2	July	None
Drains	North	3	March	Fluoride and suspended solids.
	South	3	March	Suspended solids
	West	3	March	Fluoride and conductivity.
Treated Effluent		1	May	None
			October	None

Reports to Environment Southland

NZAS 2010 Waituna Wetlands Report

The Air Discharge Consent 203378 issued by Environment Southland in June 2006; Section D14 requires that:

> *"The consent holder shall repeat the investigation of the water quality in a fresh water body within the Waituna Wetland to establish the impact of smelter discharges. The site and extent of the investigation shall be to the satisfaction of the Director of Environmental Management. The investigation shall be completed by the end of 2011."*

This investigation was undertaken in August and October 2011. The attached file details the investigation which was completed on the behalf of NZAS by NIWA. The Report concludes that:

> *"Total aluminium and fluoride levels in the Waituna wetland ponds in wet season samples collected in 2011 were lower than those recorded in 1994 and 2011. A similar trend was observed when comparing dry season data from 1996, 2001 and 2011."*

Part B - Discharges into Air

Introduction

Discharges into air from the smelter and wharf were covered by Air Discharge Permit Number 93566 prior to June 2006. A new Air Discharge Permit Number 203378 was issued on the 6th June 2006.

This Chapter covers:

- Main Stack discharges,
- Potline Roof Louvre discharges,
- Fluoride discharges into air,
- Dust Collector discharges,
- Main Stack smoke discharges, and
- Sulphur contents of raw materials and fuels used in the aluminium smelting process.

Main Stack Discharges

Monitoring results

The following tables show the main stack monitoring results for 2011.

The following shows the running twelve monthly averages of the monthly test results.

Parameter	Units	Running 12 month average	
		Permit Limit	2011
Gas flow rate	Sm^3/ min	-	63,800
Total particulate	kg/min	1.70	0.48
Gaseous fluoride	kg/min	0.50	0.20
Particulate fluoride	kg/min	0.20	0.01
Sulphur dioxide	kg/min	21.4	12.6
Total condensable hydrocarbons	kg/min	-	0.08
Polycyclic aromatic hydrocarbons	kg/min	-	0.025

The following table shows the monthly maximum values. Discharges of these contaminants shall not exceed the following maximum values in eleven out of 12 months.

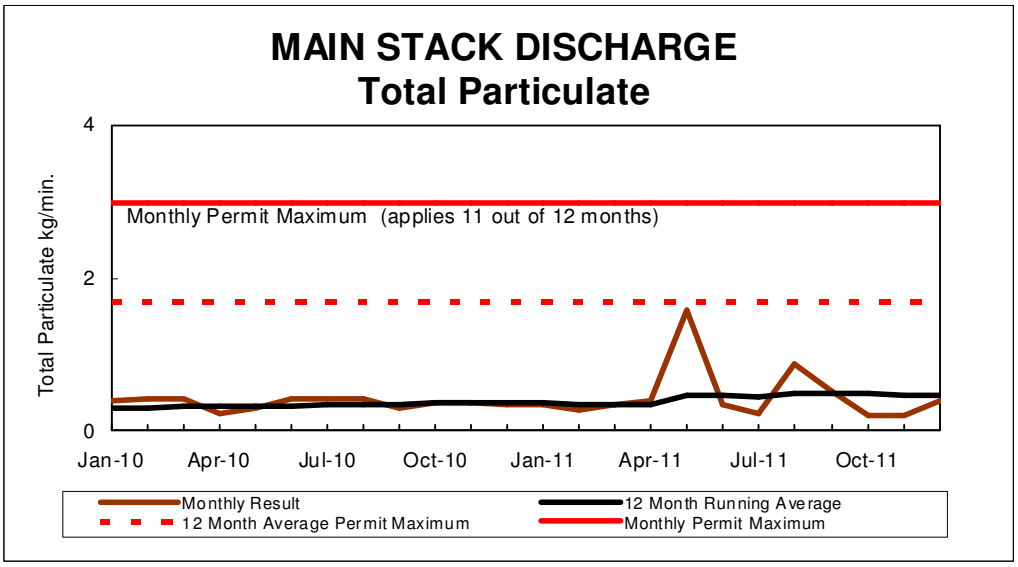
Parameter	Units	Monthly Results Limit applies 11 out of 12 Months		
		Permit Limit	Maximum	Number of times > Limit
Total particulate	kg/min	3.00	1.59	0
Gaseous fluoride	kg/min	0.65	0.31	0
Sulphur dioxide	kg/min	23.0	13.5	0

Main Stack Discharges, continued

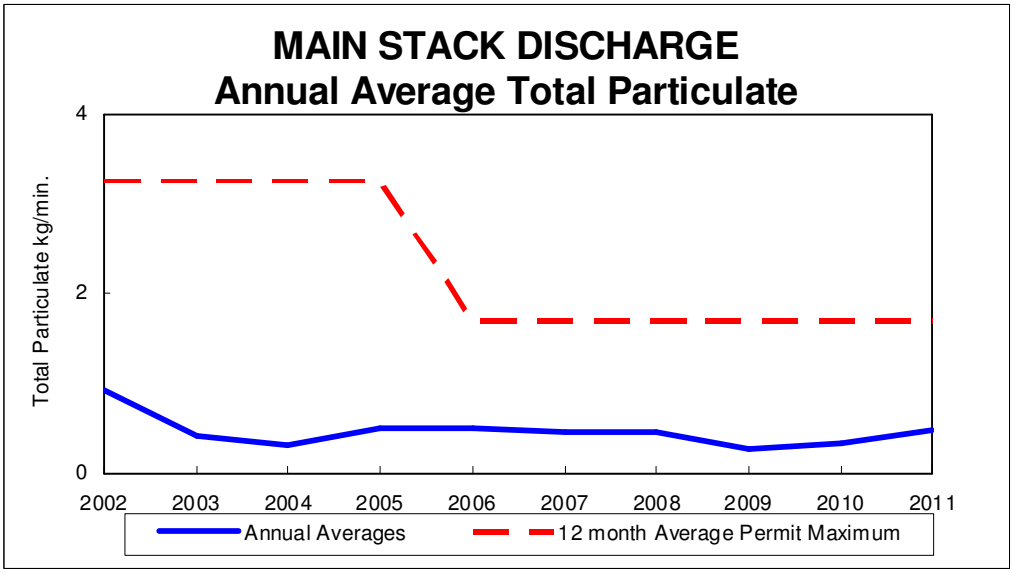
Total particulate

Permit: 12 month running average not to exceed 1.7 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack total particulate discharge during 2010 and 2011.



The following graph shows the annual average main stack total particulate discharge.

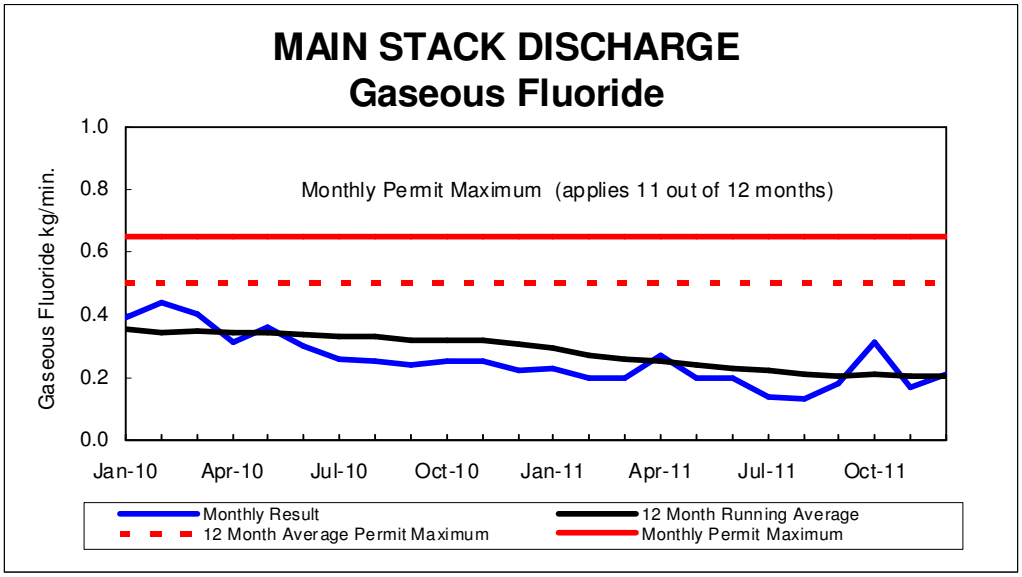


Main Stack Discharges, continued

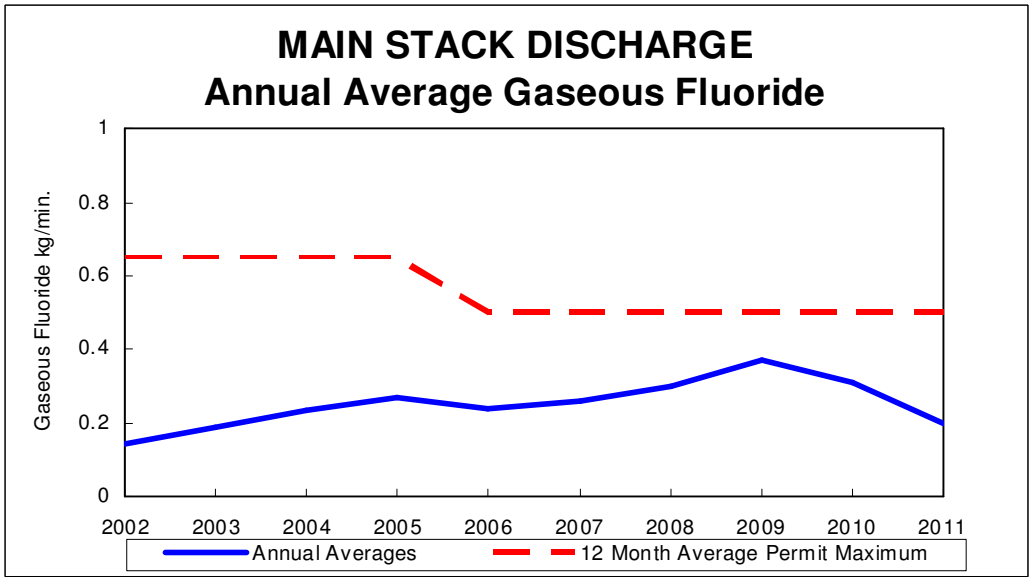
Gaseous fluoride

Permit: 12 month running average not to exceed 0.5 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack gaseous fluoride discharge during 2010 and 2011.



The following graph shows the annual average main stack gaseous fluoride discharge.

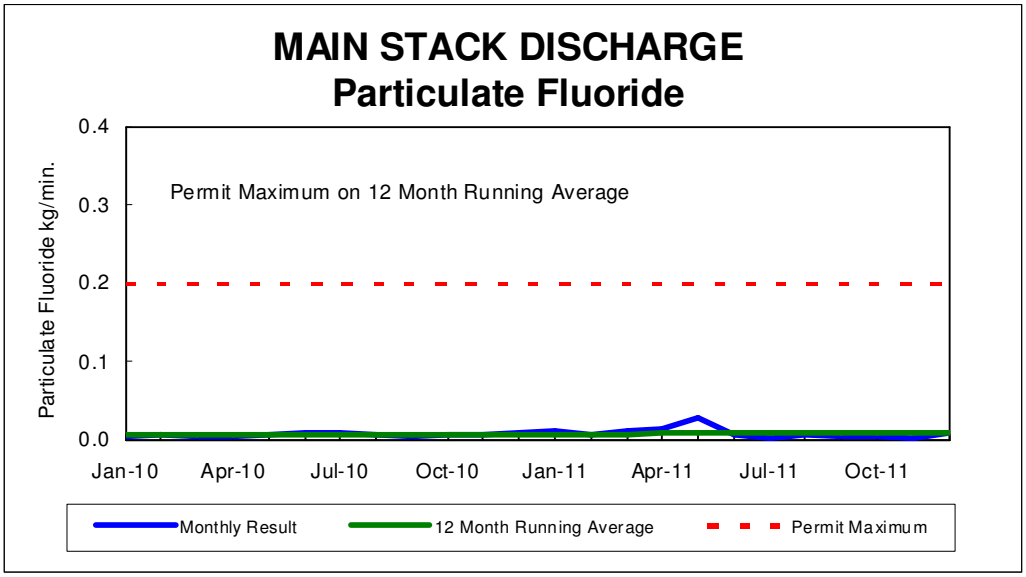


Main Stack Discharges, continued

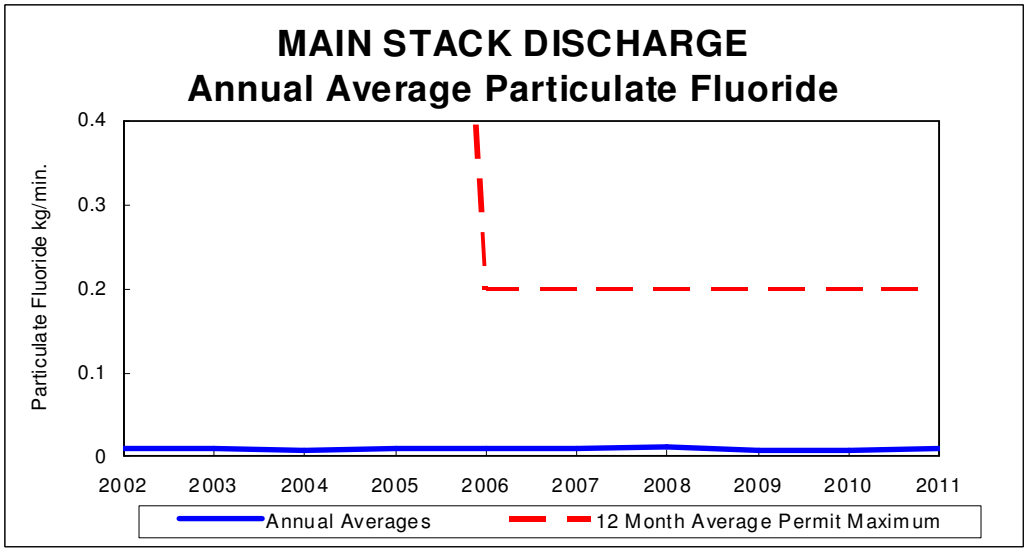
Particulate fluoride

Permit: 12 month running average not to exceed 0.2 kg/min.

The following graph shows both the average monthly and the 12 monthly running average main stack particulate fluoride discharge during 2010 and 2011.



The following graph shows the annual average main stack particulate fluoride discharge.

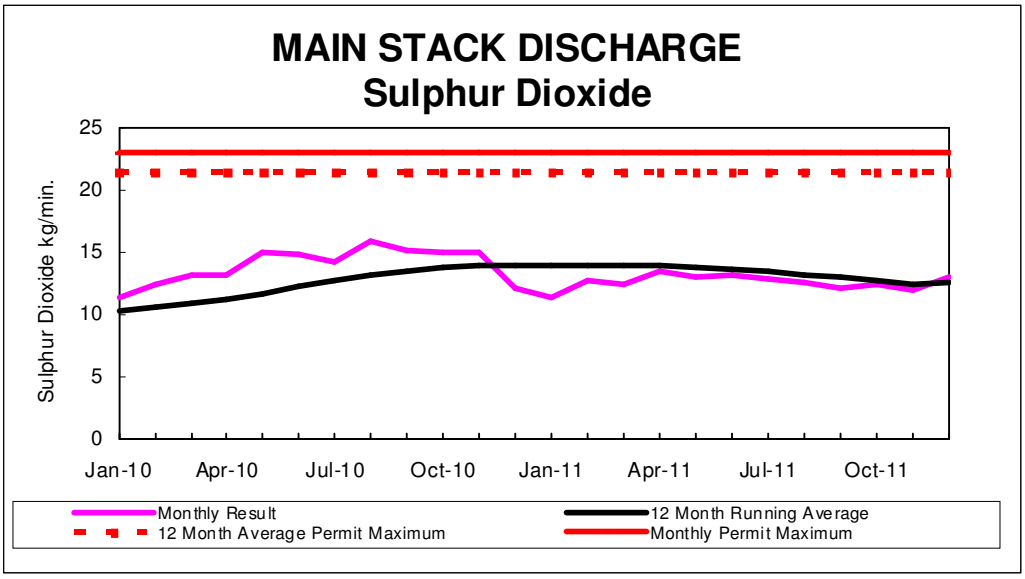


Main Stack Discharges, continued

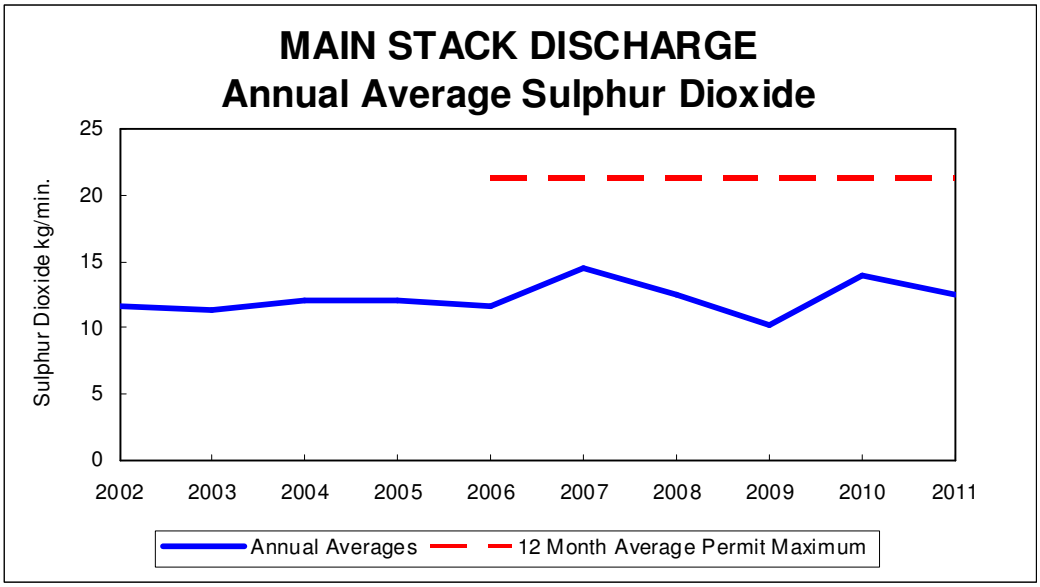
Sulphur Dioxide

Permit: 12 month running average not to exceed 21.4 kg/min.

The following graph shows both the average monthly and 12 monthly running average main stack sulphur dioxide discharge during 2010 and 2011.



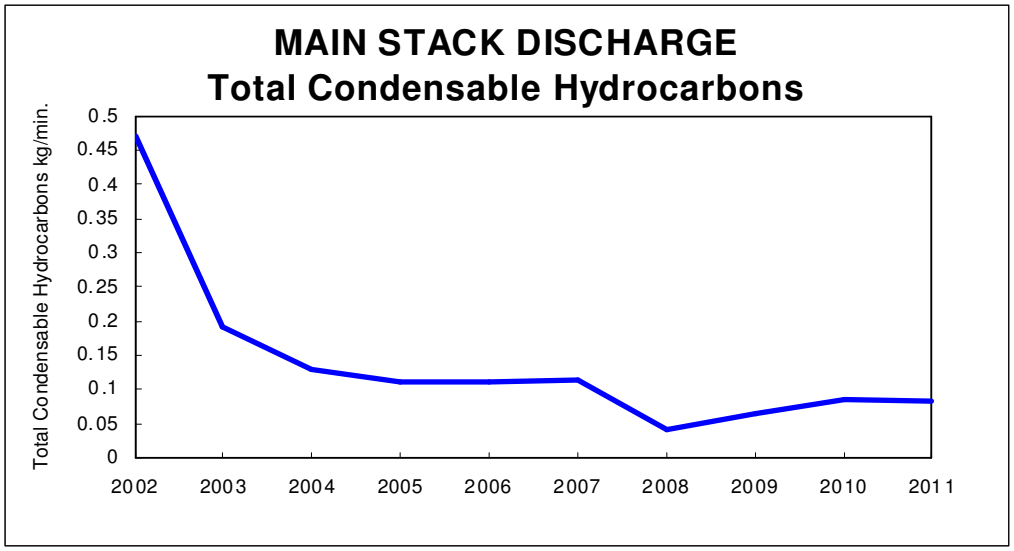
The following graph shows the annual average main stack sulphur dioxide discharge.



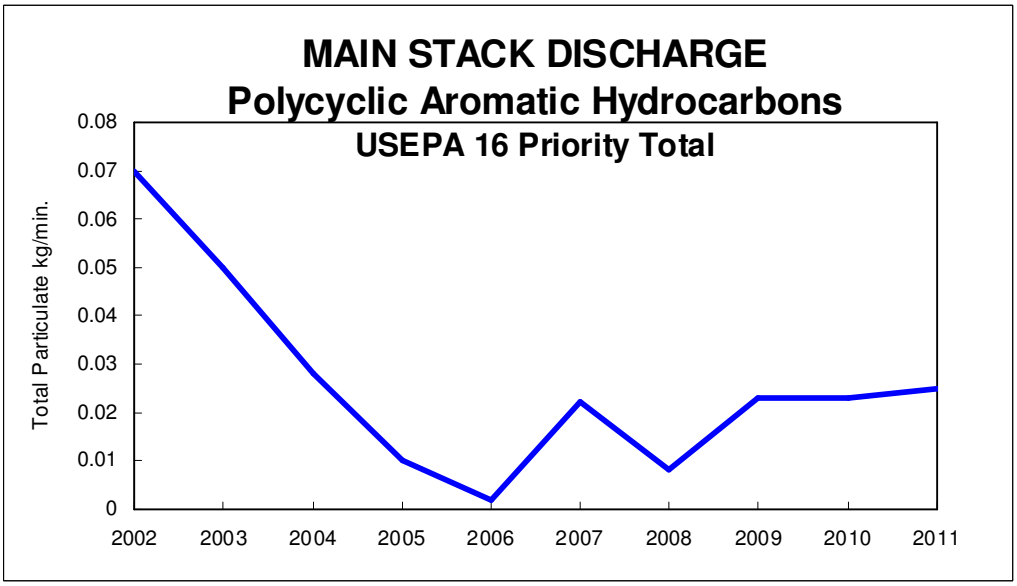
Main Stack Discharges, continued

Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons

The annual analysis for total condensable hydrocarbons and 16 USEPA priority PAH was carried out during September 2011. The following graph shows the annual Total Condensable Hydrocarbons discharges.



The following graph shows the annual result for 16 Priority USEPA polycyclic hydrocarbons.



Main Stack Discharges, continued

Comments

Discharges of total particulate, gaseous fluoride and particulate fluoride from the main stack were within the permit standards throughout 2011.

Substantial work was carried out during 2011 to decrease emissions from the main stack. Six of the thirteen dry scrubbers had full filter bag replacements. To further increase scrubbing efficiency, one of the six dry scrubbers (N1) had a new type of filter bag with a higher surface area fitted. This has proved successful and led to a significant drop in outlet emissions from this dry scrubber. Another trial using an alumina injection system in dry scrubber N2 is also showing promise as a future emission control option.

The 2011 average total condensable hydrocarbons and concentration of 16 USEPA priority PAH's were similar to the levels seen in 2010.

Potline Roof Louvre Discharges

Monitoring results

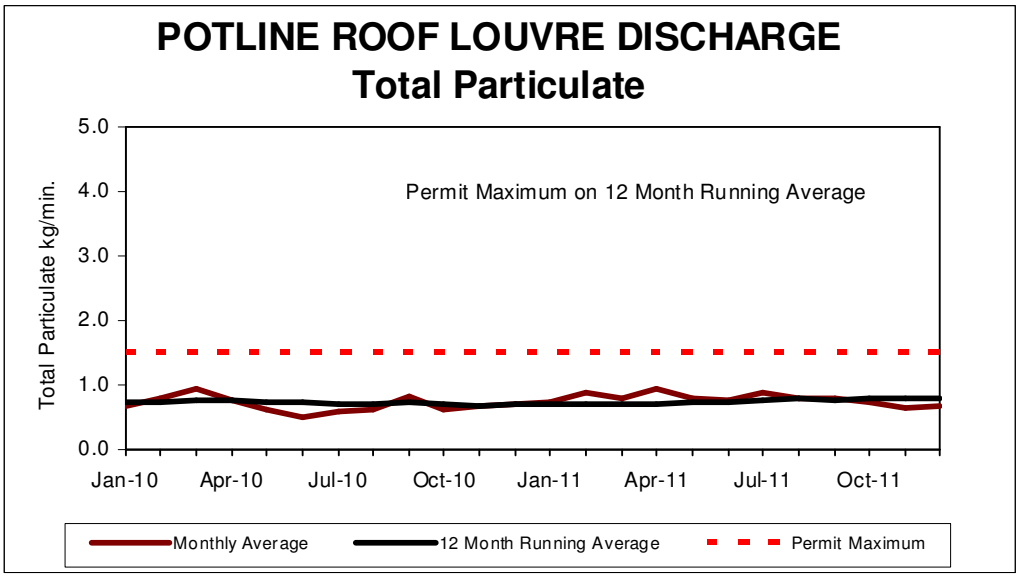
The table below shows the Potline roof louvre monitoring results for 2011. The permit limits are for 12 month running averages. There is no permit limit on maximum emissions in any given month.

Parameter	Units	Running 12 month average		
		Permit Limit	2011	Maximum for any month
Total particulate	kg/min	1.50	0.78	0.93
Gaseous fluoride	kg/min	0.21	0.10	0.15
Particulate fluoride	kg/min	0.30	0.14	0.18
Sulphur dioxide	kg/min	0.55	0.27	0.45

Total particulate

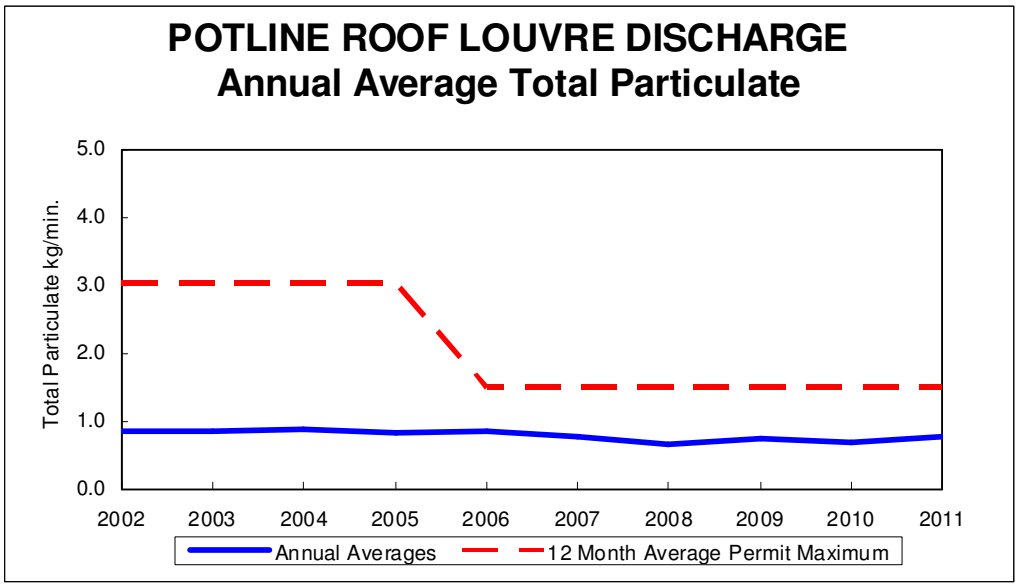
Permit: 12 month running average not to exceed 1.50 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre total particulate discharge during 2010 and 2011.



Potline Roof Louvre Discharges, continued

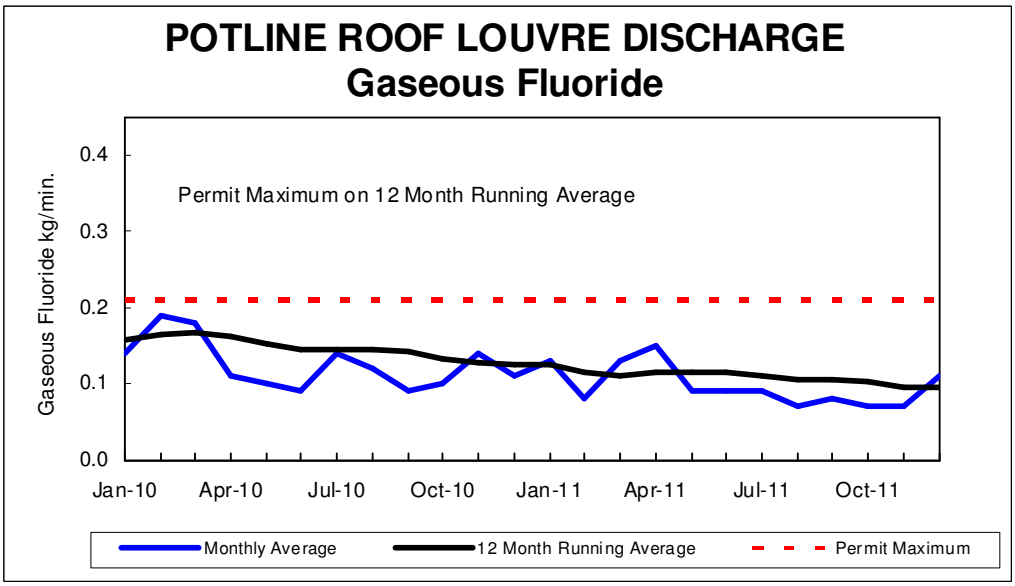
The following graph shows the annual average Potline roof louvre total particulate discharge.



Gaseous fluoride

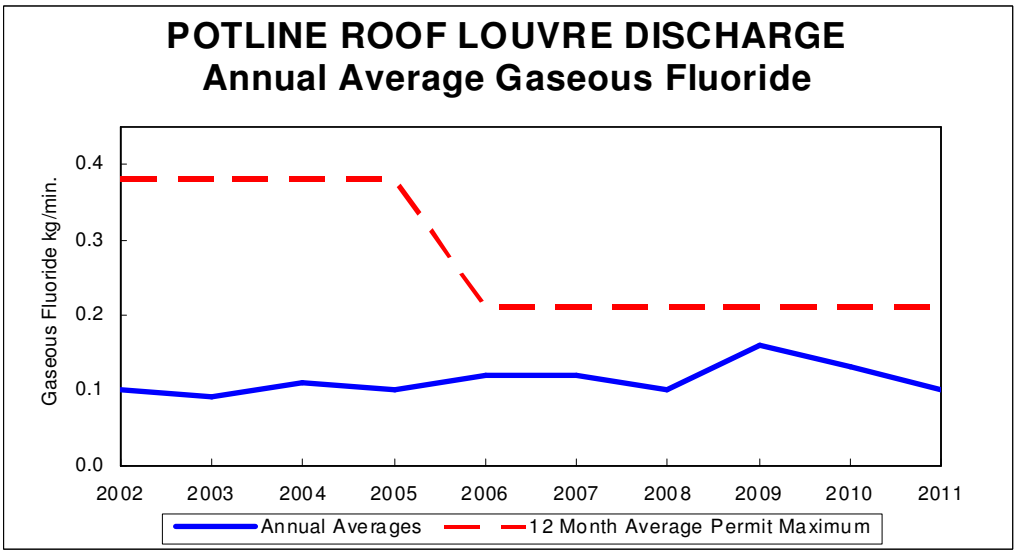
Permit: 12 month running average not to exceed 0.21 kg/min.

The following graph shows both the average monthly and 12 month running average Potline roof louvre gaseous fluoride discharge during 2010 and 2011.

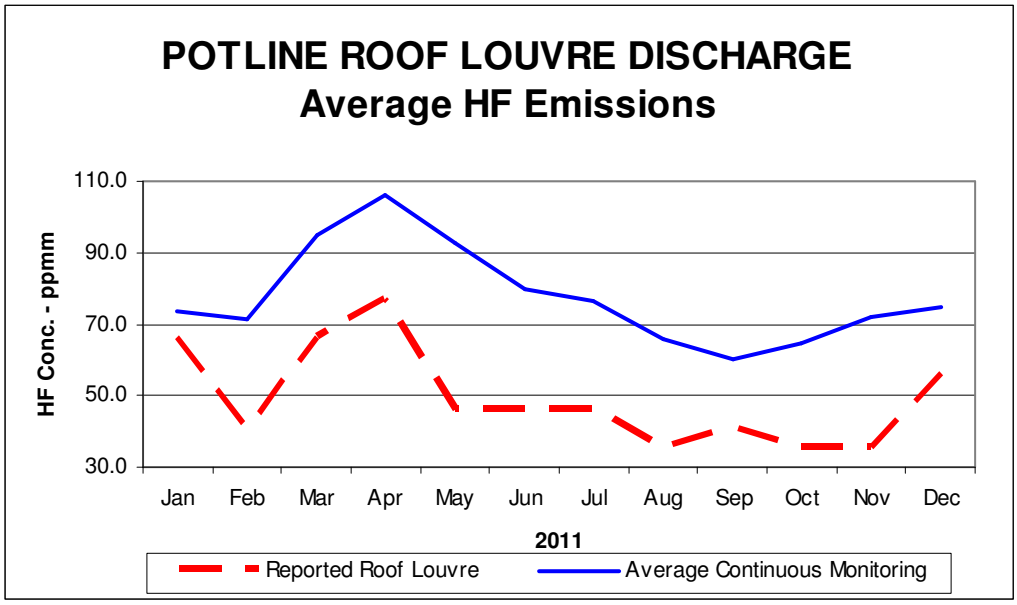


Potline Roof Louvre Discharges, continued

The following graph shows the annual average Potline roof louvre gaseous fluoride discharge.



The following graph shows the reported Potline Roof Louvre gaseous fluoride emissions in comparison to the Boreal continuous monitoring results.

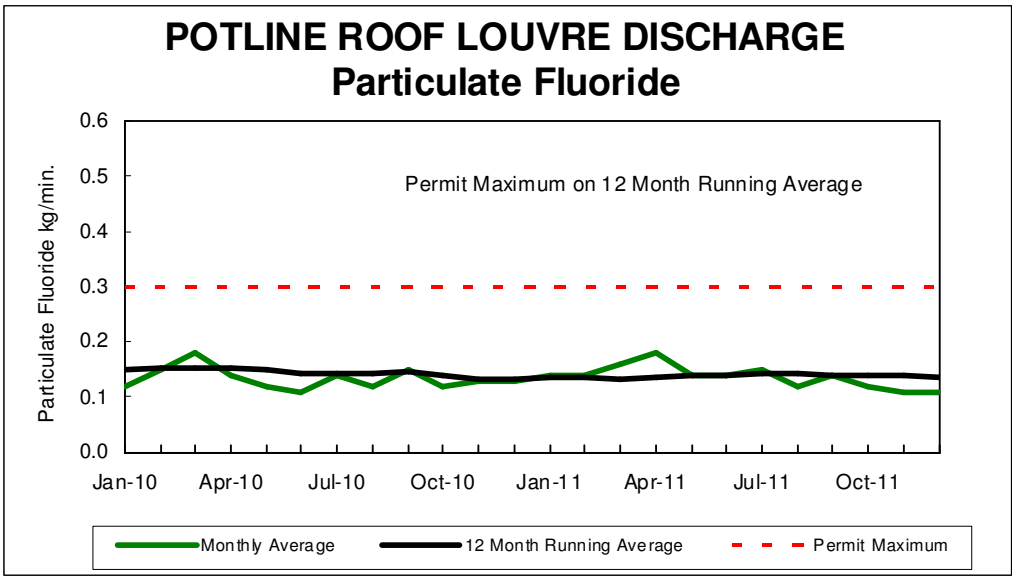


Potline Roof Louvre Discharges, continued

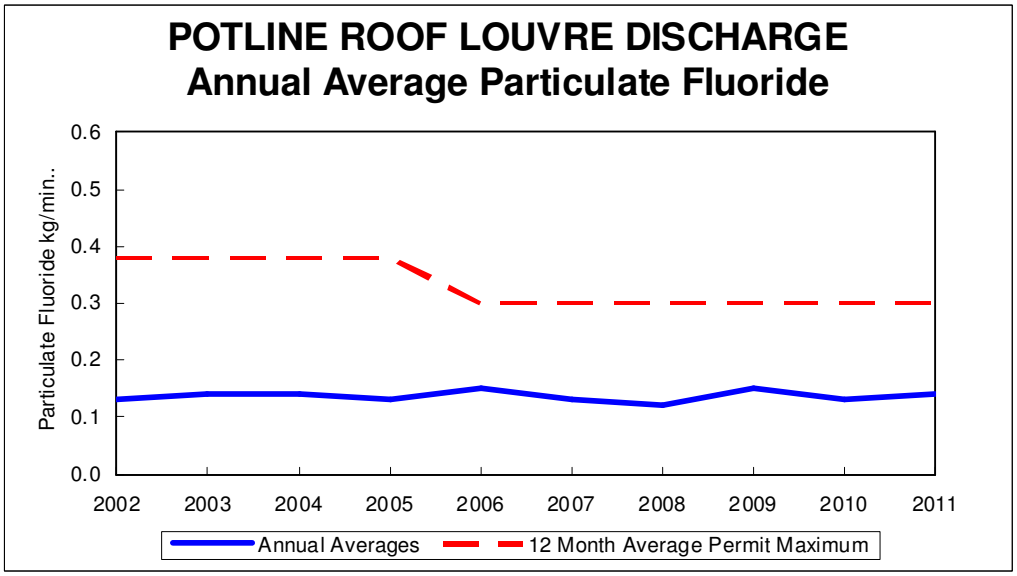
Particulate fluoride

Permit: 12 month running average not to exceed 0.30 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre particulate fluoride discharge during 2010 and 2011.



The following graph shows the annual average data for Potline roof louvre particulate fluoride discharge.

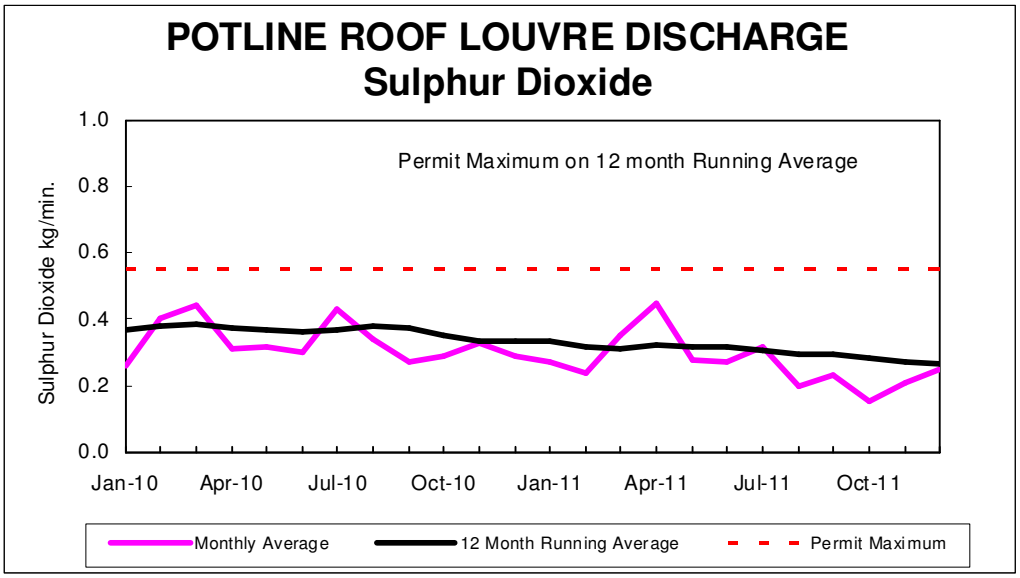


Potline Roof Louvre Discharges, continued

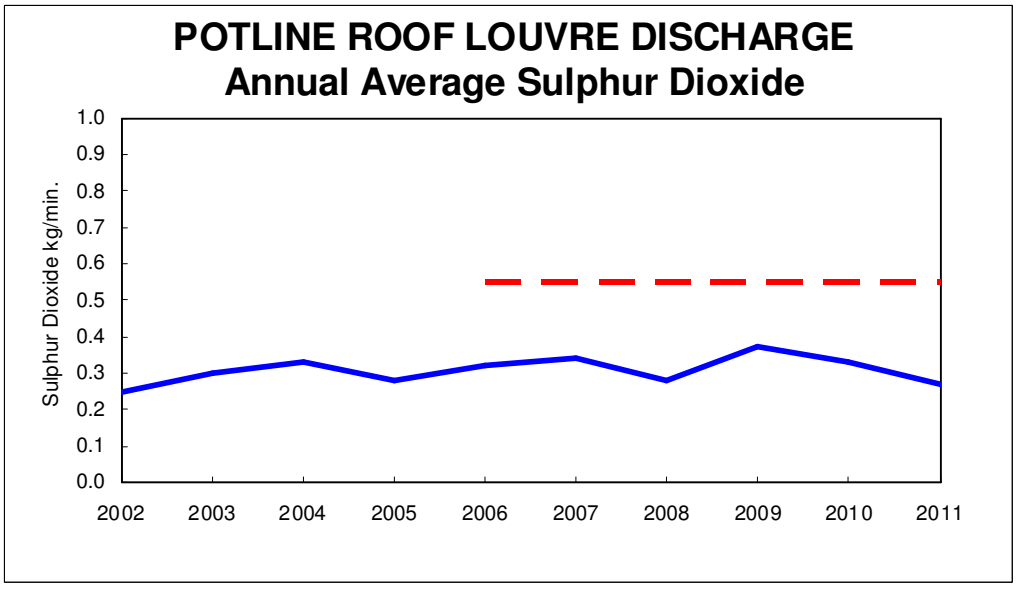
Sulphur dioxide

Permit: 12 month running average not to exceed 0.55 kg/min.

The following graph shows both the average monthly and 12 month running Potline roof louvre sulphur dioxide discharge during 2010 and 2011.



The following graph shows the annual average Potline roof louvre sulphur dioxide discharge.



Comments

The discharge of total particulate, sulphur dioxide, particulate fluoride and gaseous fluoride from the Potline roof louvres were within permit limits.

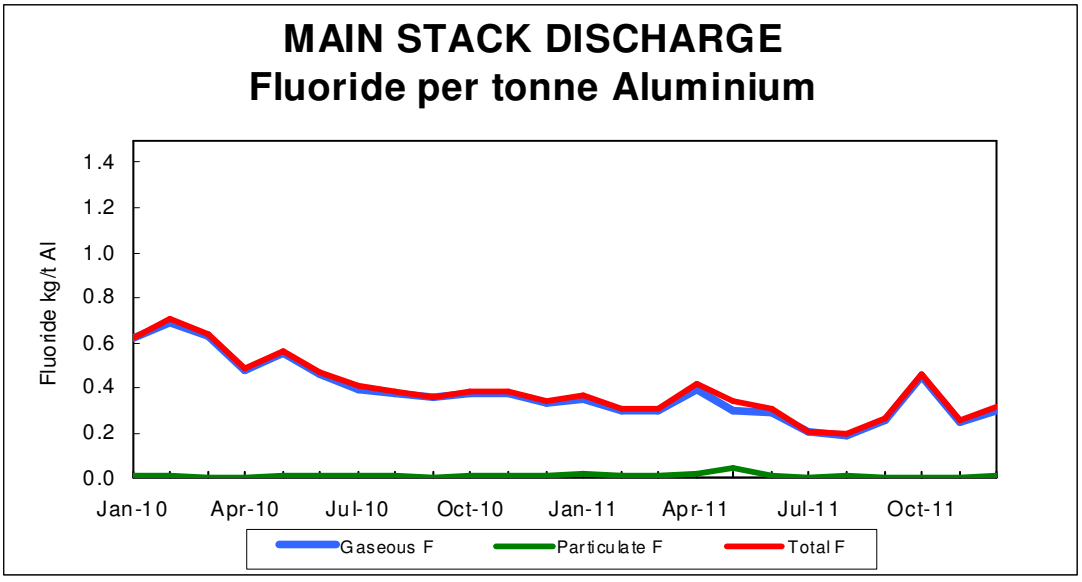
Fluoride Discharges

Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2011.

Parameter	Units	2011	Maximum for any month
Main Stack			
• Gaseous fluoride	kg/t Al	0.30	0.46
• Particulate fluoride	kg/t Al	0.01	0.04
• Total fluoride	kg/t Al	0.31	0.46
Reduction Line Roof Louvres			
• Gaseous fluoride	kg/t Al	0.14	0.22
• Particulate fluoride	kg/t Al	0.20	0.27
• Total fluoride	kg/t Al	0.34	0.49
Plant			
• Gaseous fluoride	kg/t Al	0.44	0.62
• Particulate fluoride	kg/t Al	0.21	0.29
• Total fluoride	kg/t Al	0.65	0.90

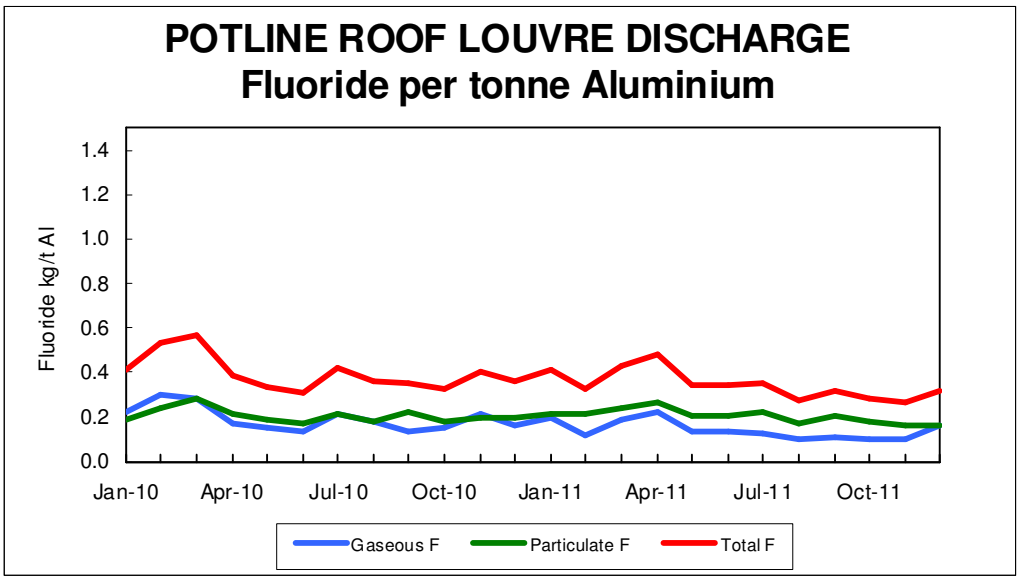
The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2010 and 2011.



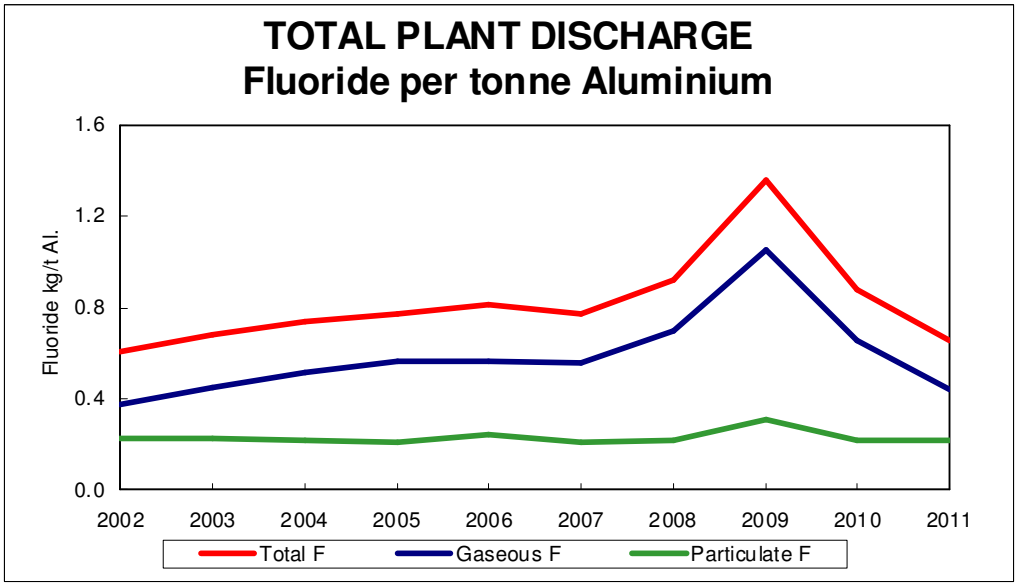
Fluoride Discharges, continued

Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2010 and 2011.



The following graph shows the average total plant fluoride per tonne aluminium for the last 10 years.



Comments

The annual total fluoride discharge rate from the plant has decreased during 2011.

Dust Collector Discharges

Permit Conditions:

Shall not exceed	250	mg/Sm^3
Action shall be taken if concentration exceeds	100	mg/Sm^3.

Monitoring results

The table below shows the Dust Collector monitoring results for 2011. The table reflects the new Air Discharge Permit standards, which came into effect in June 2006. The Permit requires that all dust collectors be tested once every two years.

Dust Collector	Test Date	Total particulate discharge mg/Sm^3
Daybin 3	17/1/11	2
Daybin 3	18/1/11	6
Sicon 3	17/1/11	1
Sicon 2	24/1/11	3
Sicon 2	25/1/11	10
Daybin 2	22/3/11	0
Daybin 2	23/3/11	1
Daybin 1	24/3/11	6
Daybin 1	25/3/11	1
Sicon 1	28/3/11	1
Sicon 1	29/3/11	1
Coke Store	31/3/11	1
Coke Store	2/4/11	0
Coarse cleaner	19/5/11	72
Coarse cleaner	19/5/11	74
Anode reamer	9/8/11	1
Anode reamer	10/8/11	1
103	21/9/11	168
103	31/10/11	3
Flakt	21/9/11	27
Flakt	21/9/11	20
Induction furnace	5/10/11	6
Induction furnace	7/10/11	11
C.R Butt fines	16/11/11	192
C.R.Butt fines	16/11/11	62
C.R Butt fines	25/11/11	1
C.R.Butt fines	25/11/11	1
Spray station	18/11/11	22
Spray station	18/11/11	15
Grizzly	9/12/11	4
West Reclaim	15/12/11	1

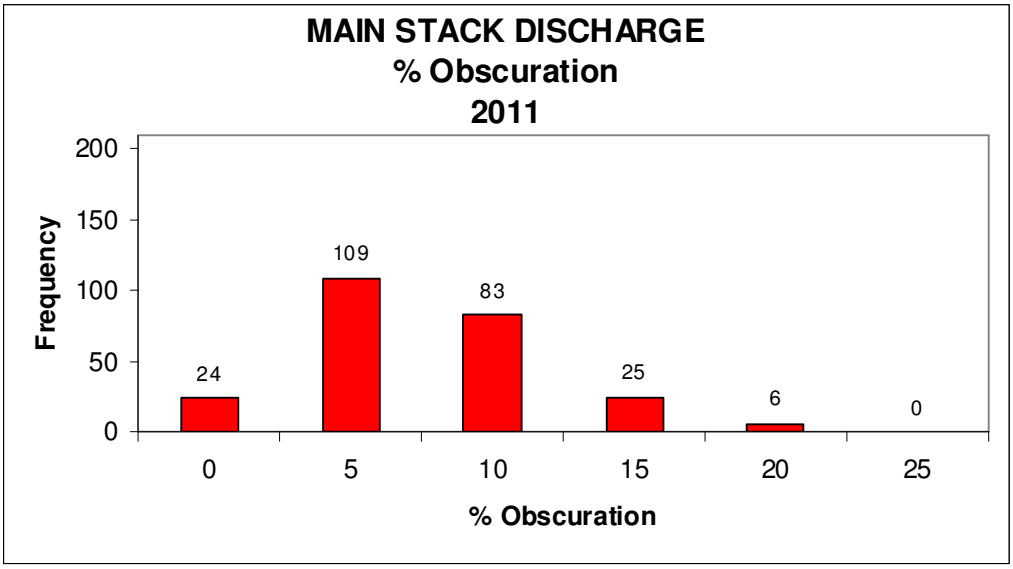
Comments

All dust collectors tested were within the consent limit during 2011. Two dust collectors exceeded the consent action level of 100 mg/Sm^3 with the C.R.Butt fines back to normal operational levels within a few days, however, there was a delay with the 103 (Carbon

Rodding Crushers & Stub Cleaners) due to delays in sourcing replacement filter bags and weather.

Main Stack Smoke Discharges

Main Stack smoke discharges were determined by visual observations using the standard Ringleman chart. The following graph summarises the observations recorded during 2011.



During 2011 there was a decrease in the frequency of observations in the 10 to 15% range and no observations greater than 20%.

Sulphur Content of Raw Materials and Fuels

The following table shows the maximum, minimum, and average sulphur content of raw materials and fuels delivered to the smelter during 2011.

Material	Units	Permit Maximum	2011 Annual Average	2011 Maximum	2011 Minimum
Petroleum Coke	%	4	2.78	3.06	2.39
Pitch	%	1	0.47	0.53	0.41
Heavy Fuel Oil	%	3.5	2.64	2.92	2.43

Comments

All shipments of raw materials and fuels during the 2011 met the permit standards for sulphur content.

During 2011 the average sulphur content of the Petroleum Coke decreased from 2.92 to 2.78%, while shipments of Heavy fuel oil have been increased slightly (0.13%) in sulphur content. Pitch also showed a slight increase (0.02%) in sulphur levels.

Part C - Dispersion Conditions

Introduction

This chapter covers the monitoring of meteorological conditions at the Tiwai Point meteorological station. These conditions effect the dispersion of discharges into air from the smelter. The data includes:

- the distribution of wind strength,
- the distribution of wind direction, and
- rainfall.

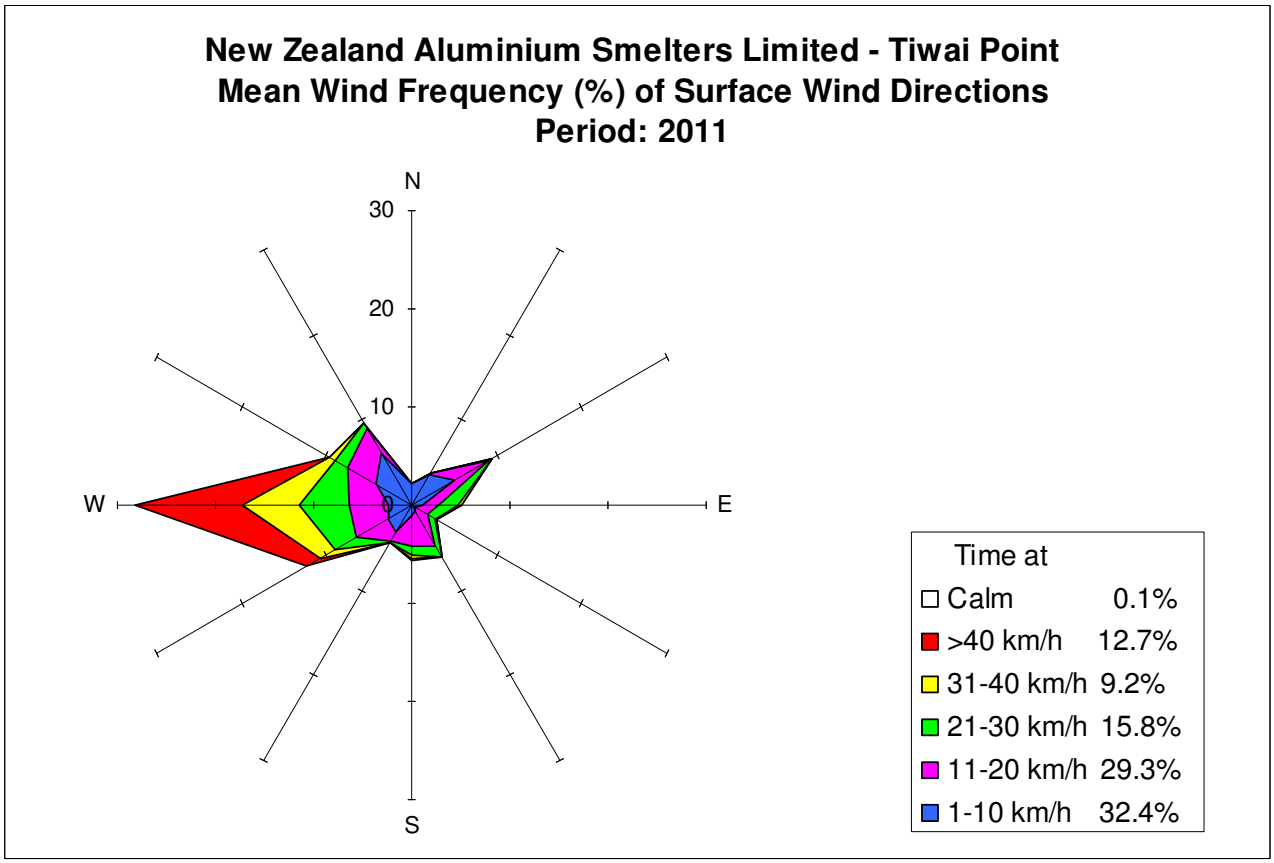
Meteorological Conditions

The mean wind frequency diagram on the following page shows that the 2011 wind pattern was dominated by westerly, north-westerly and north-easterly winds. Dispersion conditions are similar to previous years.

The following table shows the predominant winds and total rainfall recorded for each month during 2011.

Month	Predominant Wind Direction	Rainfall (mm)
January	West and northeast	110
February	West ,northwest and northeast	94
March	West and northwest	125
April	West and southwest	40
May	West ,northwest and northeast	109
June	West ,northwest and northeast	55
July	West and northwest	243
August	Southwest and west	70
September	West and southwest	75
October	West and northeast	65
November	West and southwest	122
December	Southeast	13

Total rainfall for the year is 1122 mm. The five year average is 1029mm. The long term average is 1107mm of rainfall.


New Zealand Aluminium Smelters Limited - Tiwai Point
Mean Wind Frequency (%) of Surface Wind Directions
Period: 2011
N
30
20
10
W
E
S
Time at
Calm 0.1%
>40 km/h 12.7%
31-40 km/h 9.2%
21-30 km/h 15.8%
11-20 km/h 29.3%
1-10 km/h 32.4%

Part D - Ambient Air

Introduction

This chapter covers the monitoring for gaseous and particulate fluorides in ambient air at five monitoring sites. At all sites, except the 1km Hut site, sampling is by a method based on a sampling period of up to one-month. The 1km Hut site is located on Rio Tinto Alcan freehold land and is sampled on a weekly basis.

Permit Limits

The limits for ambient air gaseous fluoride covered by the air discharge permit are:

- 24 hour average 2.0 µg/m^3
- 7 day average 1.0 µ g/m^3
- One month average 0.5 µ g/m^3

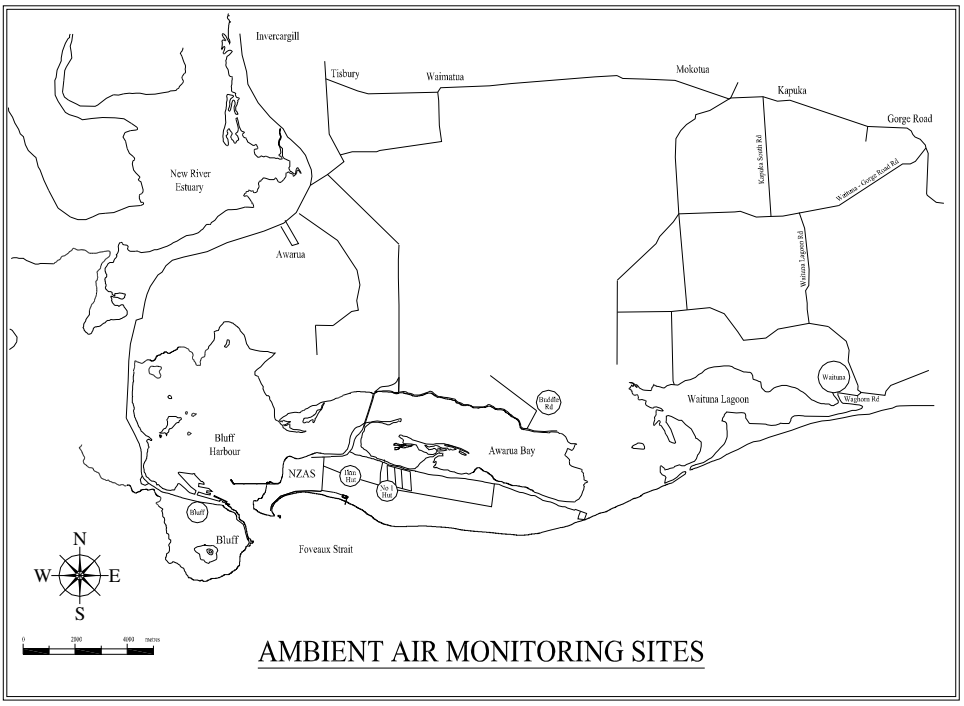
The limits apply to measurements on land other than Tiwai Peninsula and on Tiwai Peninsula east of Rio Tinto Alcan freehold land.

At sites other than the 1km Hut, if two consecutive monthly results exceed 0.3 micrograms per cubic metre gaseous fluoride, then the monitoring shall revert to a seven-day sampling period. Sampling on a longer time basis may be resumed when two consecutive seven-day results are each less than 0.3 micrograms per cubic metre.

The sampling and analysis method used is referenced to AS 3580.1991 and has a detection limit of 0.1 µg/m^3.

Site Locations

The locations of the monitoring sites are shown in following map.



Ambient Air at 1 Kilometre Hut

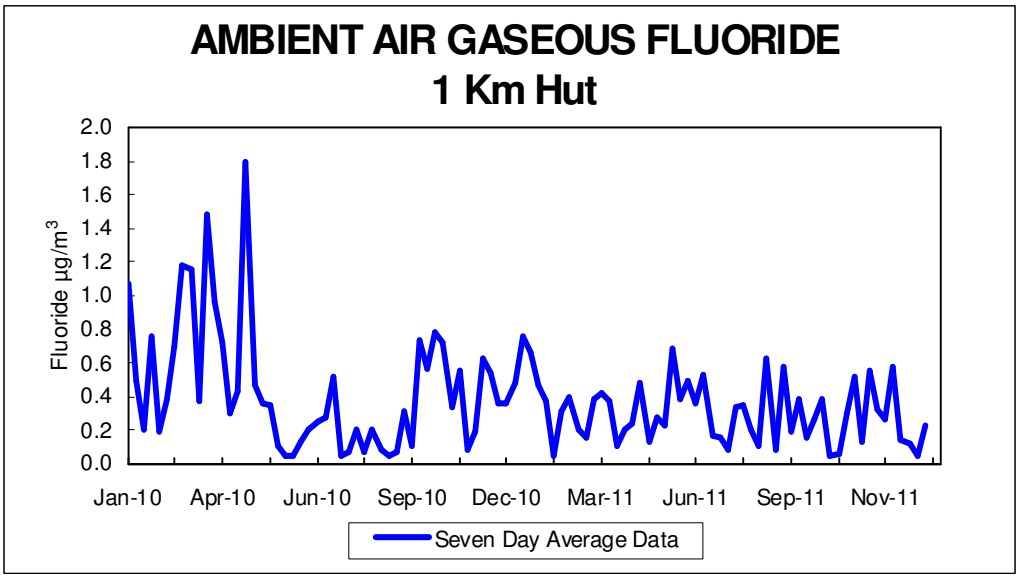
Monitoring results

The following table summarises the monitoring results during 2010 and 2011. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	2010	2011
Gaseous Fluoride Concentration			
• Max 7 day average	µg/m^3	1.80	0.70
• Max monthly average	µg/m^3	1.00	0.40
• Annual average	µg/m^3	0.46	0.31
Particulate fluoride concentration			
• Max 7 day average	µg/m^3	0.70	0.50
• Max monthly average	µg/m^3	0.30	0.20
• Annual average	µg/m^3	0.12	0.10

Gaseous fluoride

The following graph shows the seven-day average gaseous fluoride results for this site.

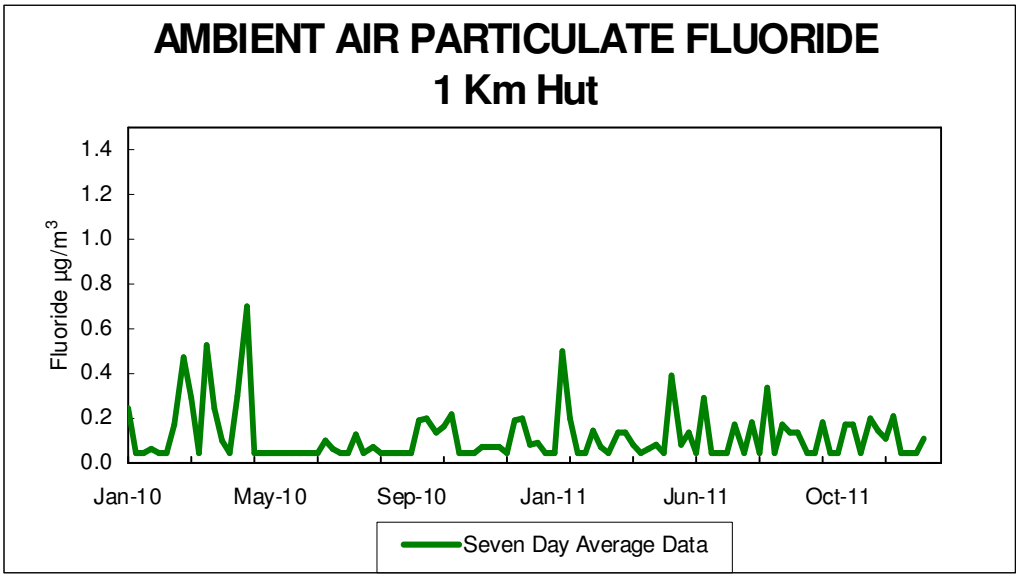


Note: Concentrations less than 0.1 µg/m^3 are plotted as 0.05 µg/m^3

Ambient Air at 1 Kilometre Hut, continued

Particulate Fluoride

The following graph shows the seven-day average particulate fluoride results for this site.



Note: Concentrations less than 0.1 µg/m^3 are plotted as 0.05 µg/m^3

Comments

The gaseous and particulate fluoride levels have decreased from those reported in 2010.

Ambient Air at No. 1 Bore on Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2010 and 2011 for the No. 1 Bore site located on Tiwai Peninsula.

Site	Parameter	Units	Limit	2010	2011
No. 1 Bore	Gaseous Fluoride				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	0.20	0.20
	• Annual average	$\mu g/m^3$		0.10	< 0.1
	Particulate Fluoride				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1

N.D: Not Determined.

Comments

Gaseous and particulate fluoride concentrations were within the permit standards throughout 2011.

Ambient Air at Sites off Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2010 and 2011 for the three ambient air-monitoring sites located off Tiwai Peninsula.

Site	Parameter	Units	Limit	2010	2011
Buddle Road	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1
Waituna	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	• Annual averge	$\mu g/m^3$		< 0.1	< 0.1
	Particulate Fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1
Bluff	Gaseous Fluoride Concentration				
	• Max 7 day average	$\mu g/m^3$	1.0	N.D.	N.D.
	• Max monthly average	$\mu g/m^3$	0.5	< 0.1	< 0.1
	• Annual averge	$\mu g/m^3$		< 0.1	< 0.1
	Particulate fluoride concentration				
	• Max 7 day average	$\mu g/m^3$		N.D.	N.D.
	• Max monthly average	$\mu g/m^3$		< 0.1	< 0.1
	• Annual average	$\mu g/m^3$		< 0.1	< 0.1

N.D: Not Determined.

Comments

Gaseous and particulate fluoride concentrations were below the detection limit of the Australian Standard (AS 3580.1991) method at these sites and thus within the permit standards throughout 2011.

Part E - Atmospheric Deposition

Introduction

This chapter covers the monitoring of atmospheric deposition at seven monitoring sites.

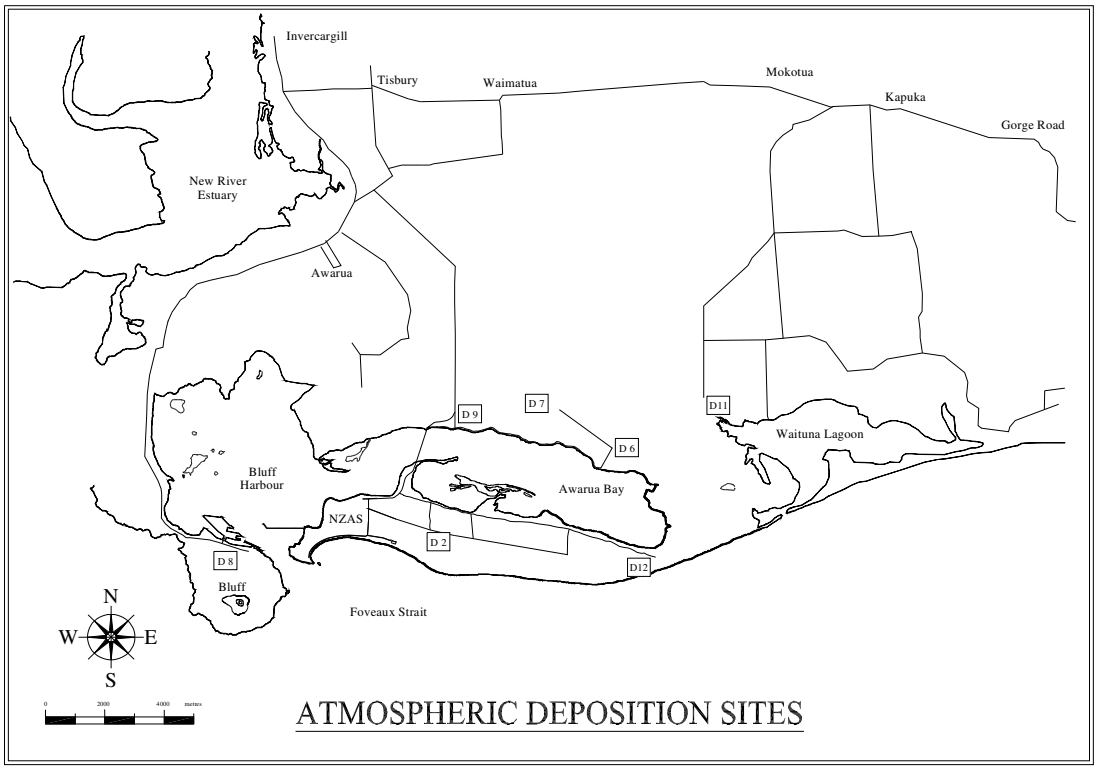
Permit Guidelines

The guidelines for atmospheric deposition apply to sites off Tiwai Peninsula and are shown in the table below.

Parameter	Unit	Guideline
Fluoride:	$g.m^{-3}$	0.9

Site Locations

The locations of the monitoring sites are shown in the following map.



Atmospheric Deposition Monitoring Results

Fluoride Deposition

The fluoride atmospheric deposition during 2011 is summarised in the following table.

Site	Units	2011 Average	Maximum for any month	Minimum for any month
D2. No.1 Bore[1]	$g.m^{-3}$	0.36	1.10	0.15
D12 TEF2[1]	$g.m^{-3}$	0.08	0.19	<0.05
D6 Buddle Road	$g.m^{-3}$	0.08	0.19	<0.05
D7 Gibson's Farm	$g.m^{-3}$	0.08	0.26	<0.05
D8 Bluff	$g.m^{-3}$	<0.05	0.09	<0.05
D9 Awarua Bay Road	$g.m^{-3}$	0.05	0.10	<0.05
D11 Marshall Road	$g.m^{-3}$	<0.05	0.17	<0.05

[1] Site located on Tiwai Peninsula and excluded from permit guideline.

Comments

All permit guidelines were met during 2011. Fluoride deposition during 2011 was within the normal range of results since the commissioning of the main stack dry scrubbing system in 1996.

Note 1: Sites D2 (No 1 Bore) and D12 (TEF2) which are not covered by the permit guidelines also were both within the limits for fluoride.

Part F - Fluoride in Ungrazed Grass

Introduction

This chapter covers the monitoring of fluoride in ungrazed grasses at 24 monitoring sites located at Bluff, Green Hills, Awarua Plains, Waituna Wetlands and Tiwai Peninsula.

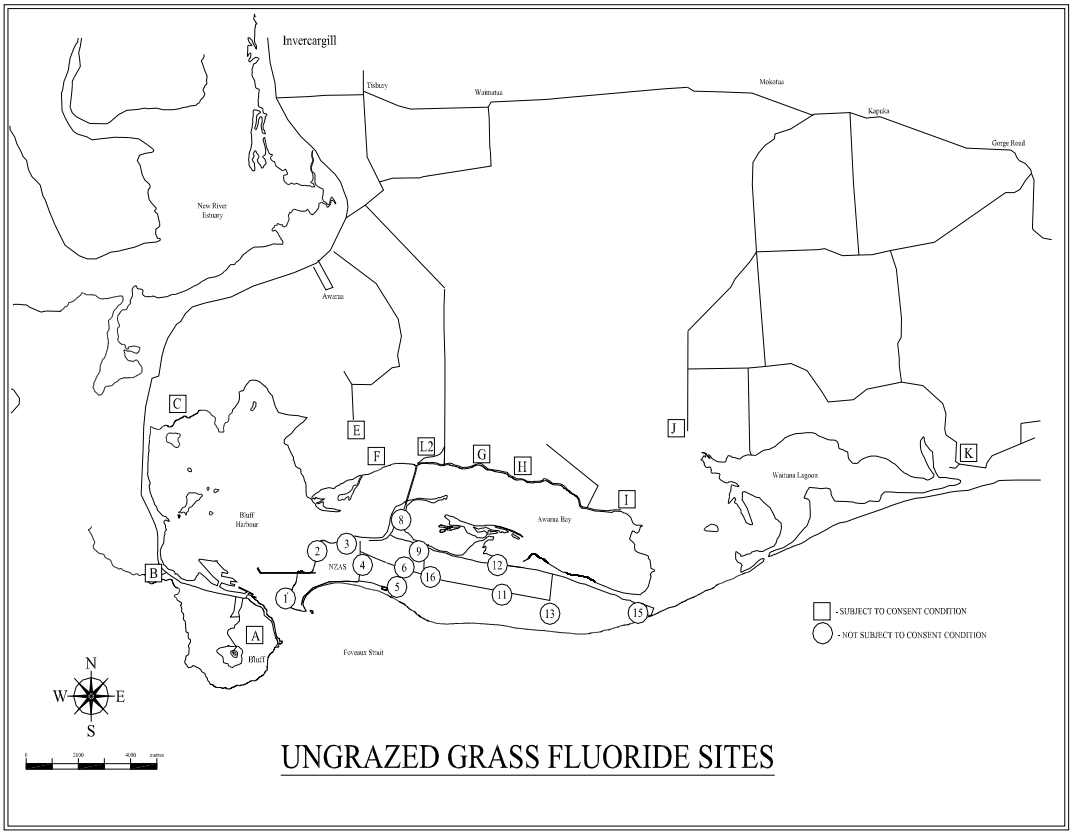
Permit Guidelines

The guidelines for fluoride in ungrazed grasses (on an unwashed, dry weight basis) on land off Tiwai Peninsula are detailed below. These guidelines came into effect in April 1994.

- Monthly sample shall not exceed 80 mg/kg more than once in any 12 consecutive months.
- Running average of any two consecutive months shall not exceed 60 mg/kg.
- Running average of any 12 consecutive months shall not exceed 40 mg/kg.

Site Locations

The ungrazed grass monitoring sites are shown on the following map.



Ungrazed Grass Monitoring Results

Annual average fluoride concentrations

The following table summarises monitoring results of ungrazed vegetation sites for 2010 and 2011. The permit guideline only applies to land other than Tiwai Peninsular (sites A to L2).

Site	Permit Guideline mg/kg	2010 Average mg/kg	2011 Average mg/kg
1	NA	10	5
2	NA	77	63
3	NA	123	123
4	NA	618	597
5	NA	23	19
6	NA	86	93
8	NA	11	10
9	NA	28	24
11	NA	8	8
12	NA	10	5
13	NA	6	7
15	NA	5	6
16	NA	27	26
A	40	4	5
B	40	3	4
C	40	10	10
E	40	3	4
F	40	6	5
G	40	7	5
H	40	6	8
I	40	5	5
J	40	3	5
K	40	2	3
L2	40	8	5

NA – Guideline not applicable.

Ungrazed Grass Monitoring Results, continued

Monthly maximum concentration

The following table shows the maximum monthly fluoride concentrations for sites off Tiwai Peninsula during 2011.

Sites off Tiwai Penninsula	Permit Guideline not to be exceeded more than once in any 12 month consecutive months. mgF/kg	Maximum Monthly Result During 2011 mgF/kg
Ungrazed Grass Site A	80	8
Ungrazed Grass Site B	80	7
Ungrazed Grass Site C	80	28
Ungrazed Grass Site E	80	11
Ungrazed Grass Site F	80	14
Ungrazed Grass Site G	80	7
Ungrazed Grass Site H	80	15
Ungrazed Grass Site I	80	8
Ungrazed Grass Site J	80	19
Ungrazed Grass Site K	80	7
Ungrazed Grass Site L2	80	9

The monthly fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2011. Site C continues to show elevated concentrations from time to time. This issue has been discussed with Environment Southland on previous occasions and is attributed to non NZAS activities around that location.

Ungrazed Grass Monitoring Results, continued

Two month average concentration

The following table shows the maximum two-month running average fluoride concentrations for sites off Tiwai Peninsula during 2011.

Sites off Tiwai Penninsula	Permit Guideline mgF/kg	Maximum Two Month Running Average During 2011 mgF/kg
Ungrazed Grass Site A	60	8
Ungrazed Grass Site B	60	6
Ungrazed Grass Site C	60	22
Ungrazed Grass Site E	60	7
Ungrazed Grass Site F	60	11
Ungrazed Grass Site G	60	6
Ungrazed Grass Site H	60	13
Ungrazed Grass Site I	60	8
Ungrazed Grass Site J	60	11
Ungrazed Grass Site K	60	5
Ungrazed Grass Site L2	60	8

The two month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2011. Site C continues to show elevated concentrations from time to time. This issue has been discussed with Environment Southland on previous occasions and is attributed to non NZAS activities around that location.

Ungrazed Grass Monitoring Results, continued

Running 12 month average concentration

The following table shows the maximum 12 month running average fluoride concentrations for sites off Tiwai Peninsula during 2011.

Sites off Tiwai Penninsula	Permit Guideline mgF/kg	Maximum Twelve Month Running Average During 2011 mgF/kg
Ungrazed Grass Site A	40	5
Ungrazed Grass Site B	40	4
Ungrazed Grass Site C	40	11
Ungrazed Grass Site E	40	4
Ungrazed Grass Site F	40	6
Ungrazed Grass Site G	40	7
Ungrazed Grass Site H	40	9
Ungrazed Grass Site I	40	5
Ungrazed Grass Site J	40	6
Ungrazed Grass Site K	40	3
Ungrazed Grass Site L2	40	8

The 12 month running average fluoride concentration in ungrazed grass was within the permit guideline for all sites during 2011.

Comments

The 2011 annual average fluoride concentrations in all ungrazed grass sites off Tiwai Peninsula were less than or similar to the annual average fluoride concentration levels in 2010.

Sites on Tiwai Peninsula and close to the smelter are similar to concentration levels measured in previous years.

Part G - Fluoride in Pinus radiata

Introduction

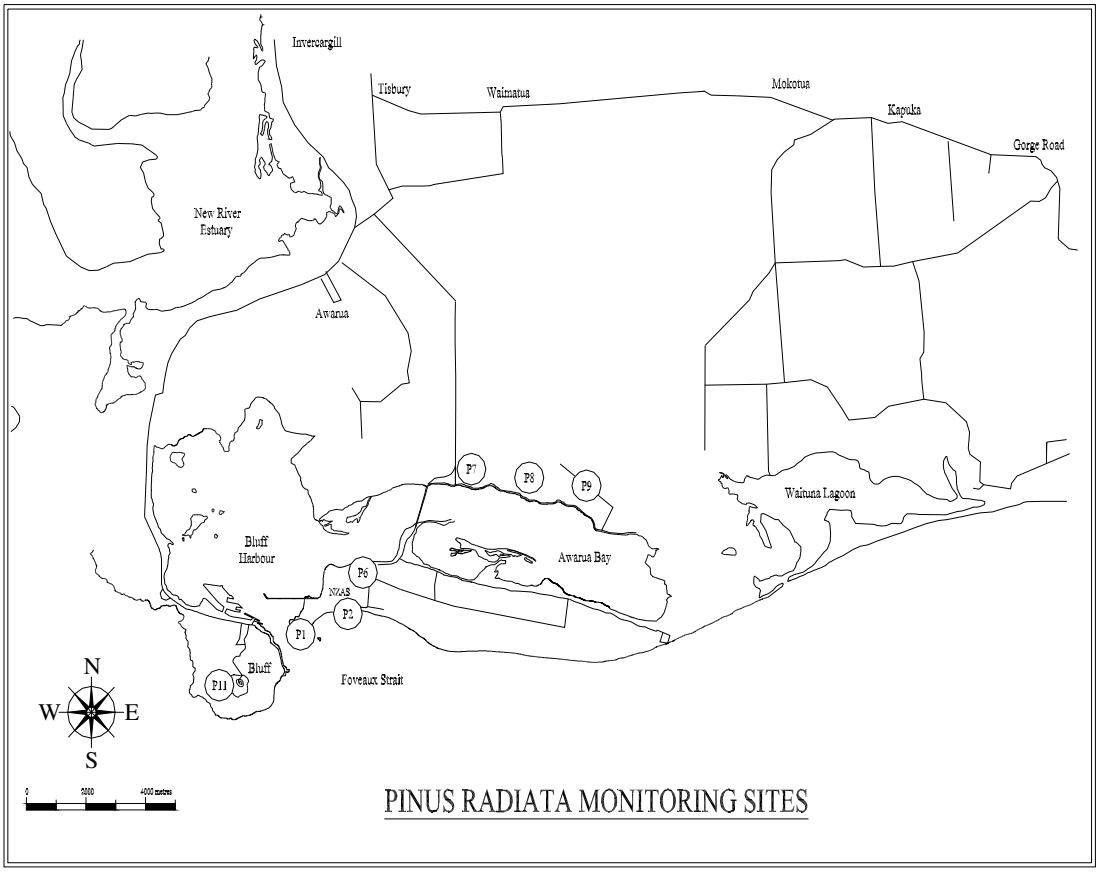
This chapter covers the monitoring of fluoride in *Pinus radiata* at seven monitoring sites located at Bluff, Awarua Plains, Waituna and Tiwai Peninsula.

Permit Guidelines

Pine needles between one and two years old are sampled quarterly. The guideline for fluoride in washed *Pinus radiata* needles on land off Tiwai Peninsula is 75 mg/kg.

Site Locations

The locations of the monitoring sites are shown in the following map.



Pinus radiata Monitoring Results

The following tables summarise the monitoring results for 2010 and 2011 for the sites on and off Tiwai Peninsular. Guidelines apply only to land other than Tiwai Peninsular.

Sites on Tiwai Peninsular	Units	Guideline	2010 Average	2011 Average
P1	mg/kg	NA	14	17
P2B	mg/kg	NA	91	76
P6	mg/kg	NA	169	155

NA – Guideline not applicable.

Sites off Tiwai Peninsular	Units	Guideline	2011 Average	2012 Average
P7	mg/kg	75	7	7
P8	mg/kg	75	3	5
P9	mg/kg	75	8	10
P11	mg/kg	75	4	3

Comments

Fluoride concentrations in *Pinus radiata* needles sites off Tiwai Peninsula were within the permit guideline during 2011. The permit guideline only applies to sites off Tiwai Peninsula.

Fluoride concentrations of pine needles at all sites off Tiwai Peninsula and close to the smelter were similar to previously recorded average levels with fluctuations within normal limits.

Part H - Grazing Monitor Farms

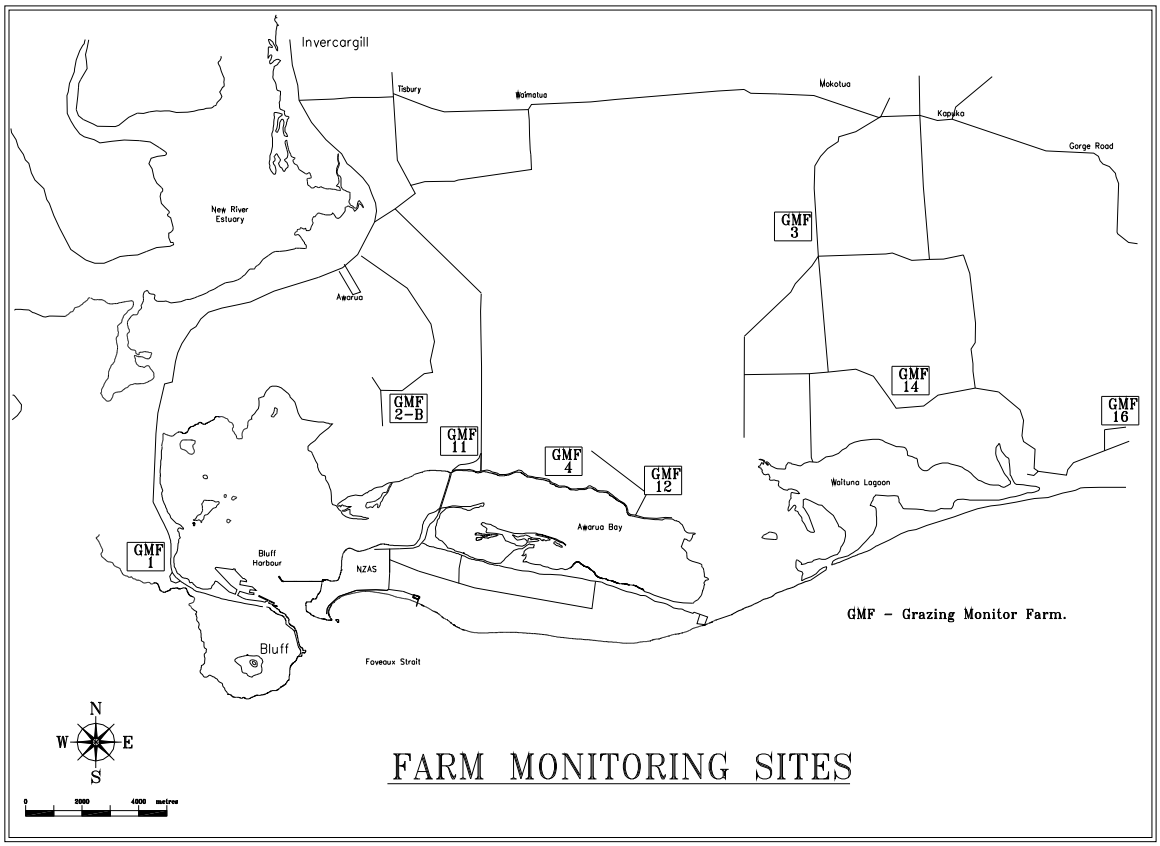
Introduction

Air Discharge Permit Number 203378 requires NZAS to report on the effects of discharges to atmosphere on farm livestock annually.

The Grazing Monitor Project was established in 1969 prior to the smelter being commissioned. The project has continued since then with modifications as part of NZAS' Environmental Monitoring Program.

Site Locations

The following map shows the location of the farms included in the Grazing Monitor Project.



Monitoring the Health of Farm Livestock

The health of farm livestock is monitored by measuring the fluoride concentration of cattle urine.

Urinary fluoride
The urinary fluoride concentrations are corrected to a specific gravity of 1.030.

Permit Standards

The Air Discharge Permit contains a number of standards. A standard is defined in the permit as a limit which is not to be breached.

The standards for fluoride in grazed pasture (on an unwashed, dry weight basis) on land off Tiwai Peninsula are:

- monthly sample shall not exceed 80 mg/kg more than once in any 12 consecutive months,
- the average of any two consecutive months samples shall not exceed 60 mg/kg,
- running averages of monthly samples for a period of twelve months shall not exceed 40 mg/kg.

Permit Guidelines

The Air Discharge and Coastal Permit also contain a number of guidelines. A guideline is defined in the permit as a level which is set on best current knowledge, the exceeding of which requires further investigation or other action.

The guidelines for animal health monitoring are urinary fluoride in beef cattle should not exceed 10 mg/L corrected to S.G. 1.030.

Grazing Monitor Farm No.1

Introduction

The following information is contained in this section:

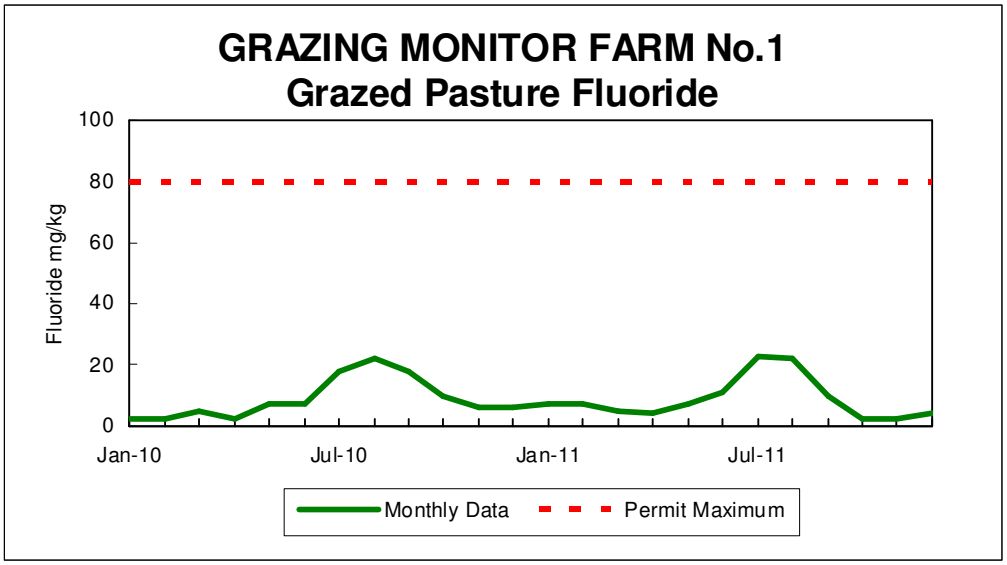
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

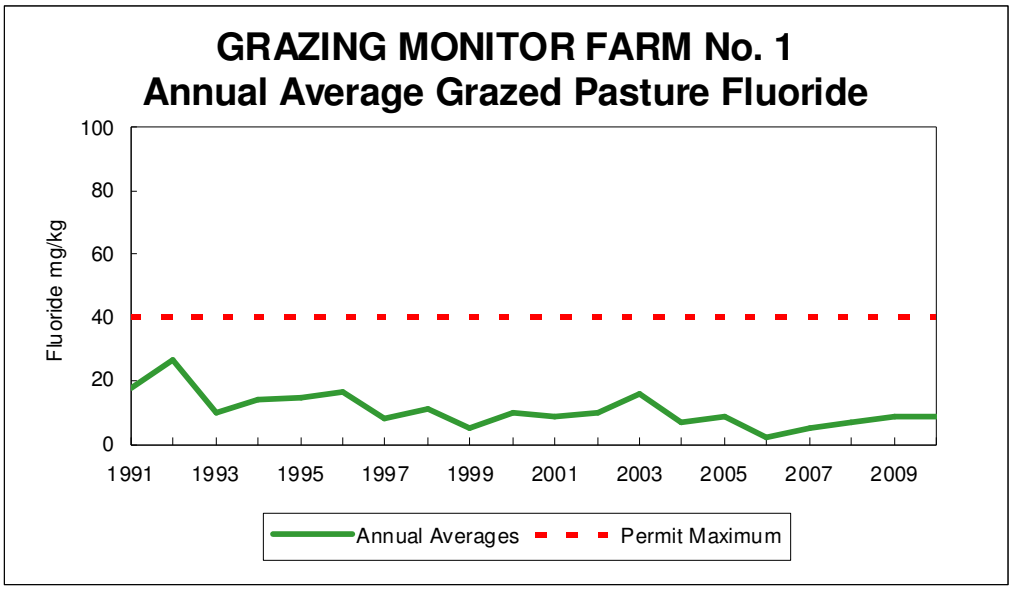
	Units	Standard	2011
Monthly sample maximum	mg/kg	80	23
Two monthly average maximum	mg/kg	60	23
Twelve monthly running average maximum	mg/kg	40	11
Annual average	mg/kg		9

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



Grazing Monitor Farm No.1, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride in grazed pasture was within the permit standards. The 2011 average grazed pasture fluoride concentration of 9 mg/kg was the same as the 2010 average.

Grazing Monitor Farm No. 2

Introduction

The following information is contained in this section:

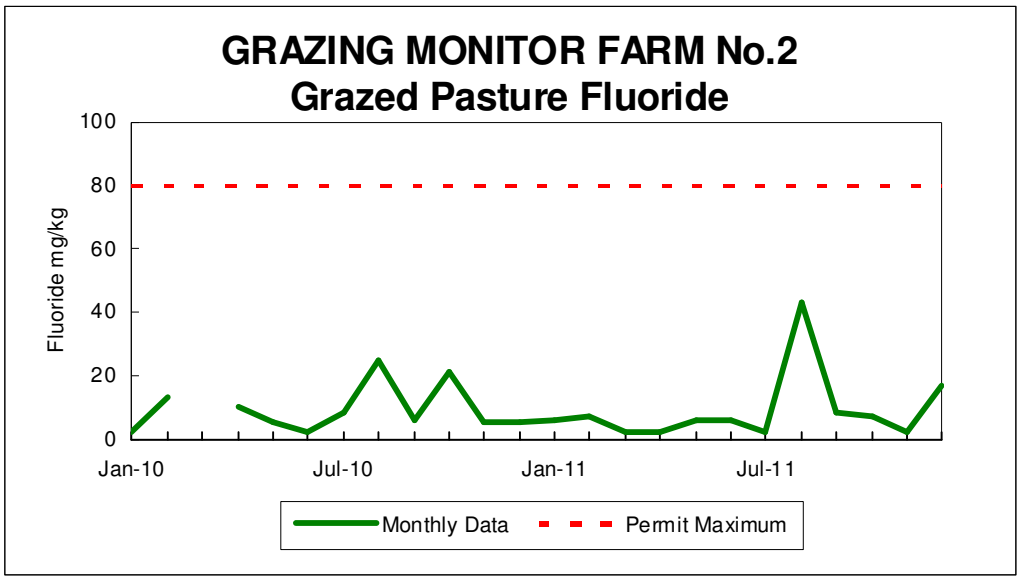
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

	Units	Standard	2011
Monthly sample maximum	mg/kg	80	43
Two monthly average maximum	mg/kg	60	26
Twelve monthly running average maximum	mg/kg	40	10
Annual average	mg/kg		9

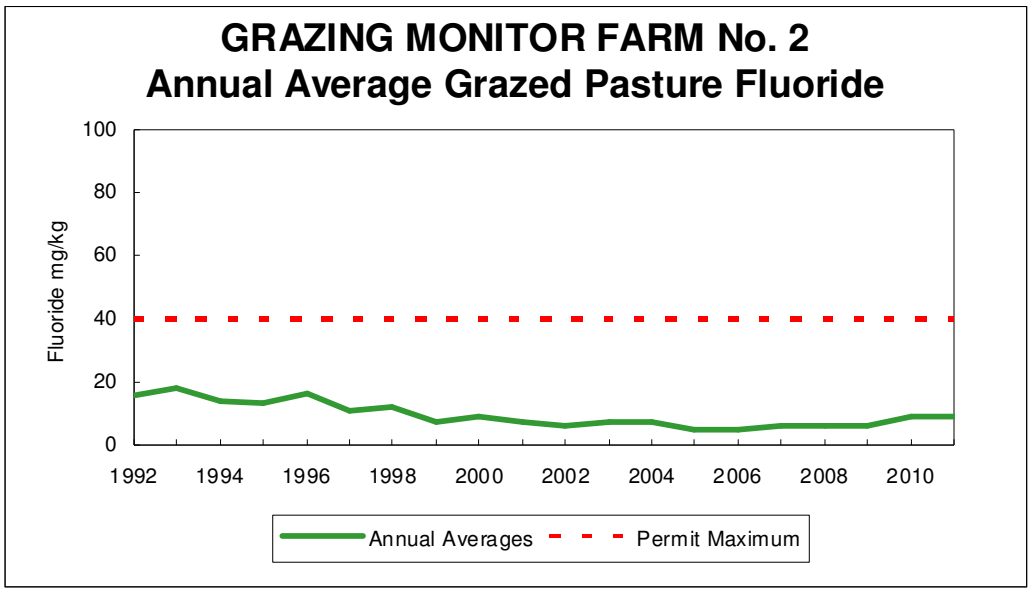
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



No data for March 2010 as fertilizer had been applied within 28 days of sampling.

Grazing Monitor Farm No. 2, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride in grazed pasture was within the permit standards. The 2011 average grazed pasture fluoride concentration of 9 mg/kg was the same as the average fluoride concentration measured during 2010.

Grazing Monitor Farm No. 3

Introduction

The following information is contained in this section:

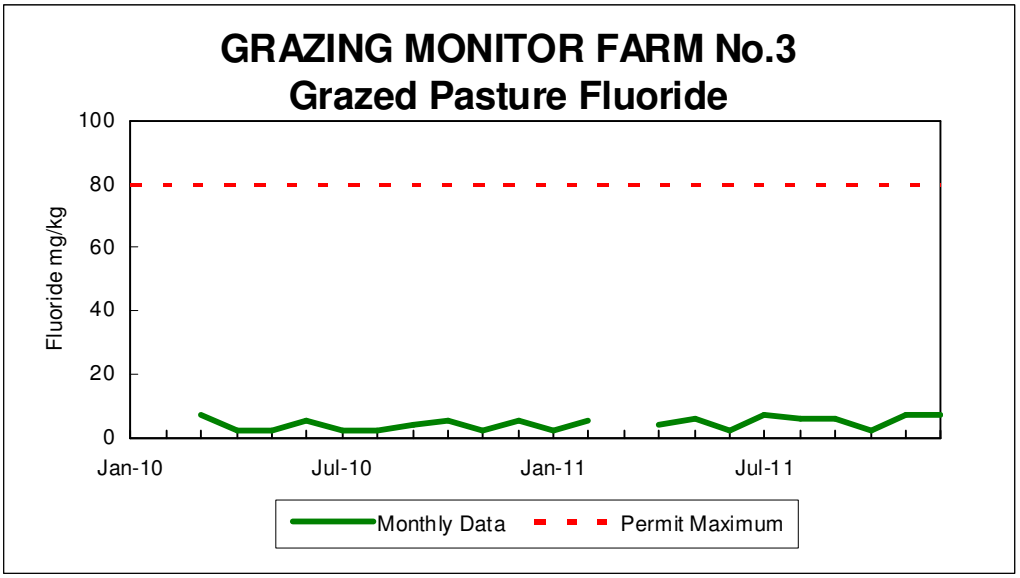
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

	Units	Standard	2011
Monthly sample maximum	mg/kg	80	7
Two monthly average maximum	mg/kg	60	7
Twelve monthly running average maximum	mg/kg	40	5
Annual average	mg/kg		5

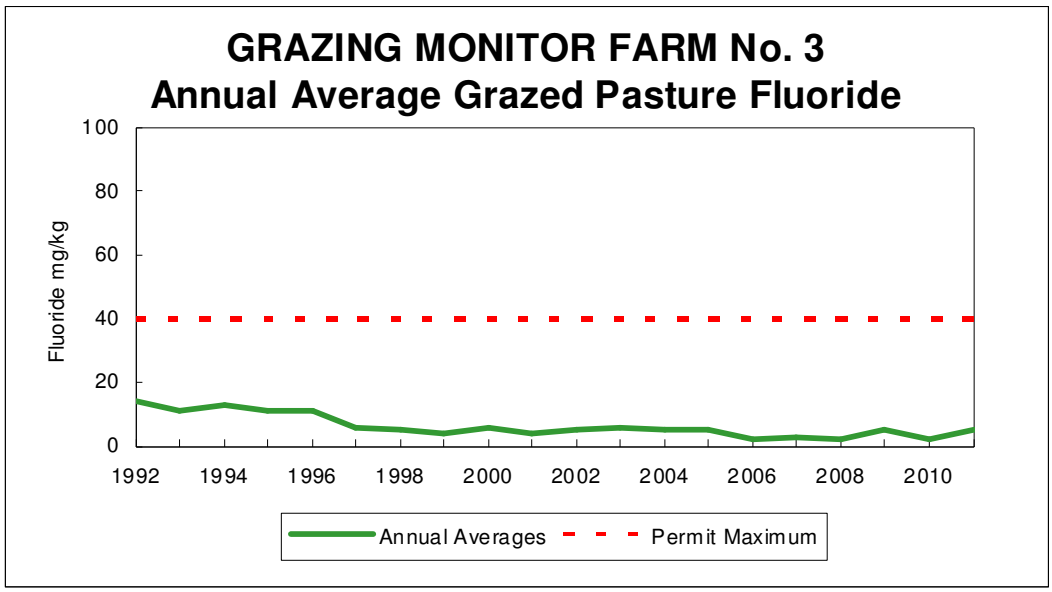
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



No data for February 2010 and 2011 as fertilizer had been applied within 28 days of sampling.

Grazing Monitor Farm No. 3, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride in grazed pasture was within the permit standards. The 2011 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to the average fluoride concentration measured during 2010.

Grazing Monitor Farm No. 4

Introduction

The following information is contained in this section:

- fluoride in grazed pasture,
- cattle urinary fluoride, and
- comments on the monitoring.

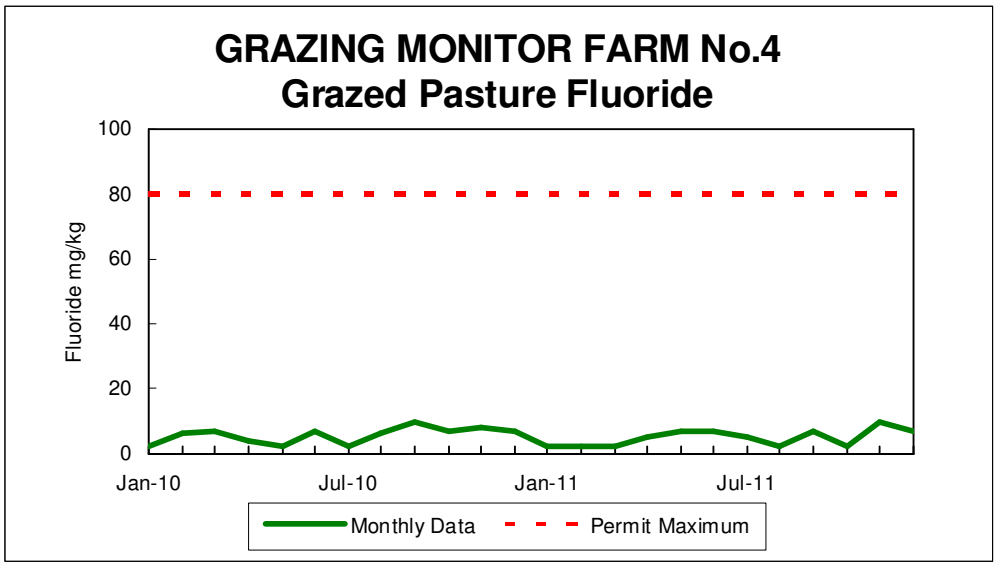
This farm was sold in late 2006 and the new owner has changed the farming practice for this farm. This farm is in the process of being converted from a sheep and cattle farm to dairy.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

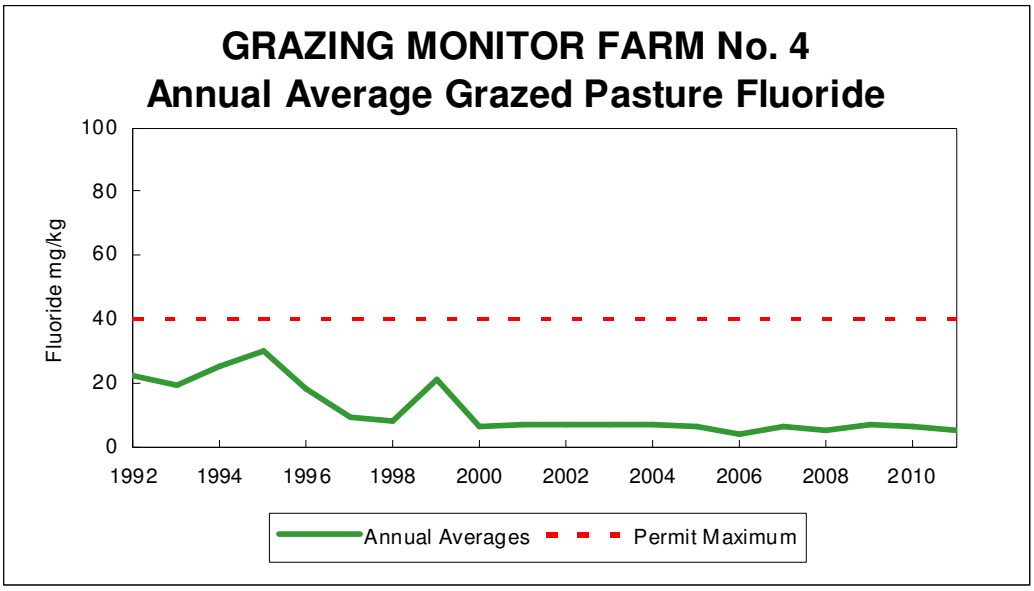
	Units	Standard	2011
Monthly sample maximum	mg/kg	80	10
Two monthly average maximum	mg/kg	60	9
Twelve monthly running average maximum	mg/kg	40	6
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



Grazing Monitor Farm No. 4, continued

The following graph shows the annual average fluoride concentration in grazed pasture.

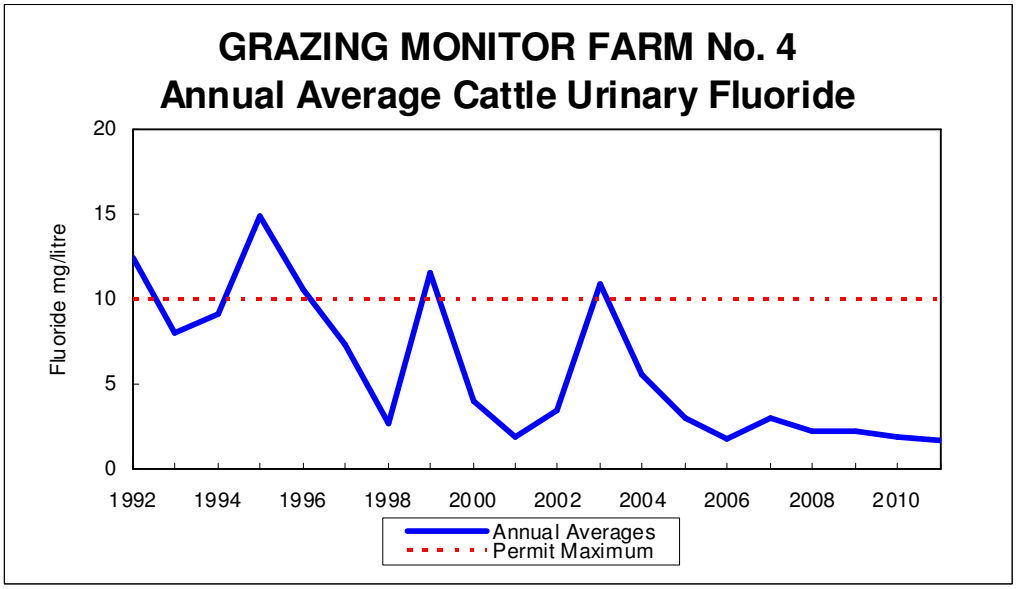


Cattle urinary fluoride

The following table summarises the results of cattle urinary fluoride monitoring during 2011.

	Units	Guideline	2011
Average fluoride concentration	mg/L	-	2
Maximum fluoride concentration	mg/L	10	2
Minimum fluoride concentration	mg/L	-	1
No. of samples	mg/L	-	6

The following graph shows the annual average fluoride concentration in cattle urine.



Grazing Monitor Farm No. 4, continued

Comments

The fluoride concentrations of cattle urine and grazed pasture on GMF4 were within the permit guidelines during 2011.

The 2011 annual average grazed pasture fluoride concentration of 5 mg/kg was similar to that determined during 2010.

The annual average urinary fluoride concentration measured during 2011 was 2 mg/L the same as the average measured during 2010. It should be noted that this farm is now a dairy farm and not all the stock remains on the farm over the winter.

Grazing Monitor Farm No. 11

Introduction

The following information is contained in this section:

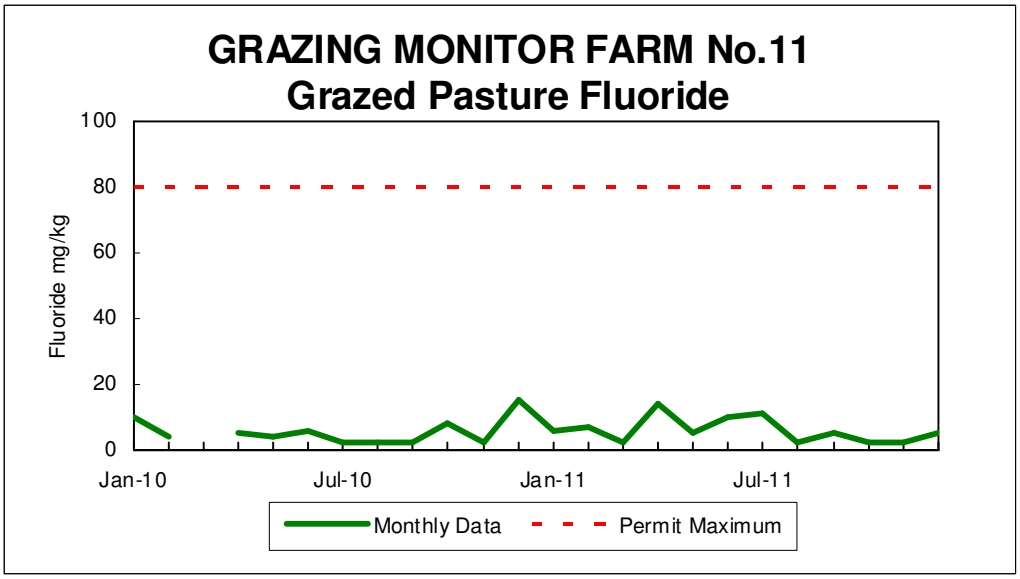
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

	Units	Standard	2011
Monthly sample maximum	mg/kg	80	14
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		6

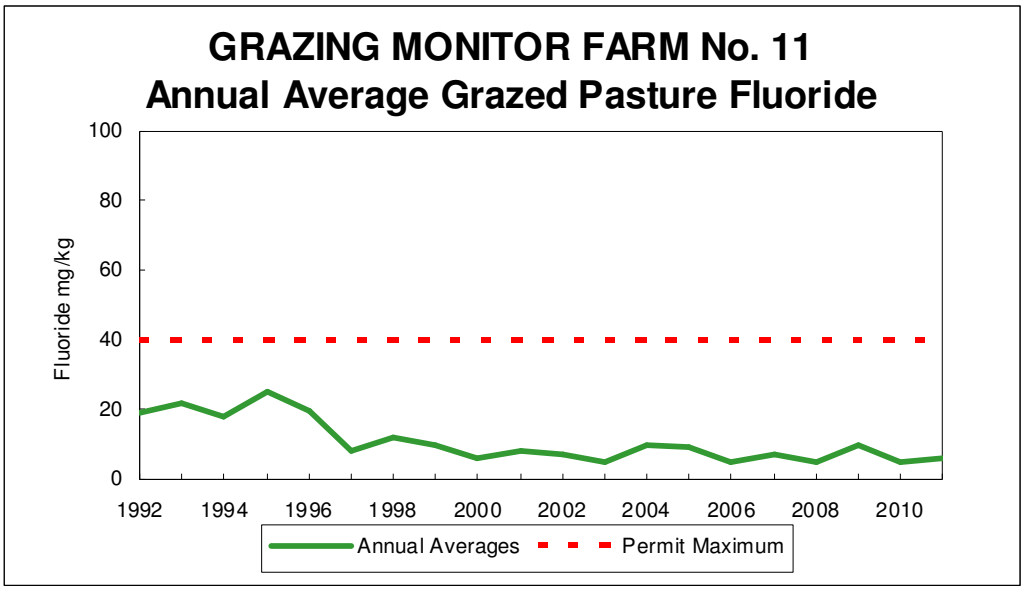
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



No data for March 2010 as fertilizer had been applied within 28 days of sampling.

Grazing Monitor Farm No. 11, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride in grazed pasture was within the permit standards. The 2011 average grazed pasture fluoride concentration of 6 mg/kg is a similar to the fluoride concentration measured during 2010.

Grazing Monitor Farm No. 12

Introduction

The following information is contained in this section:

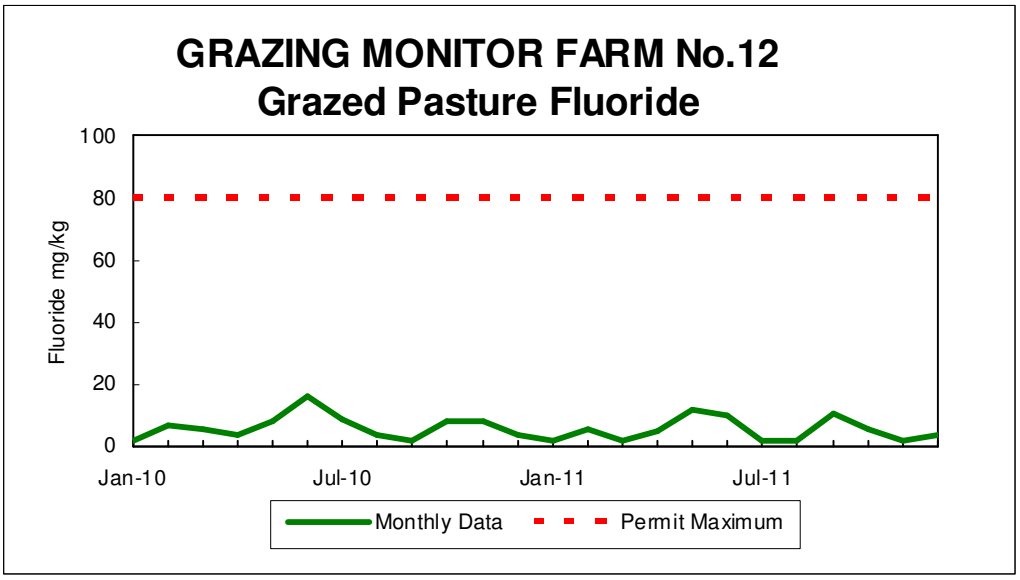
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the maximum grazed pasture monitoring results for 2011.

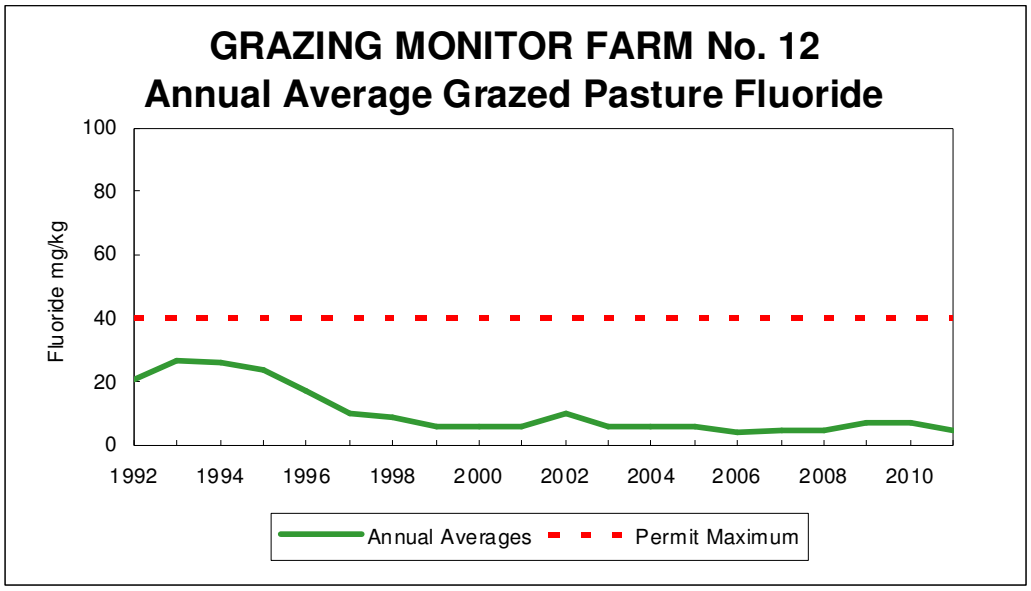
	Units	Standard	2011
Monthly sample maximum	mg/kg	80	12
Two monthly average maximum	mg/kg	60	11
Twelve monthly running average maximum	mg/kg	40	7
Annual average	mg/kg		5

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



Grazing Monitor Farm No. 12, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride in grazed pasture was within the permit standards. The 2011 annual average grazed pasture fluoride concentration of 5 mg/kg is similar to the average concentration measured in 2010.

Grazing Monitor Farm No. 14

Introduction

The following information is contained in this section:

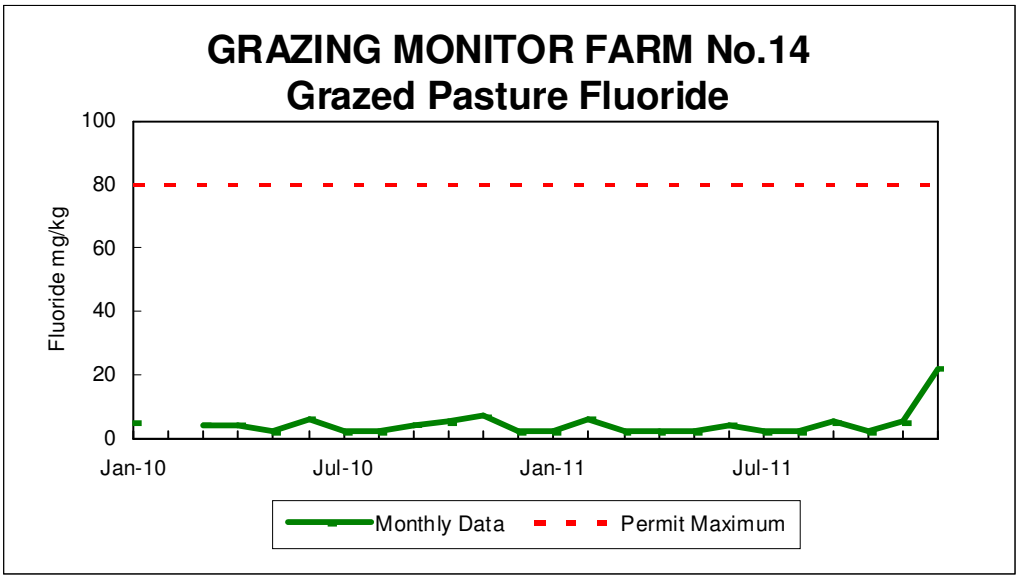
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

	Units	Standard	2011
Monthly sample maximum	mg/kg	80	22
Two monthly average maximum	mg/kg	60	14
Twelve monthly running average maximum	mg/kg	40	5
Annual average	mg/kg		5

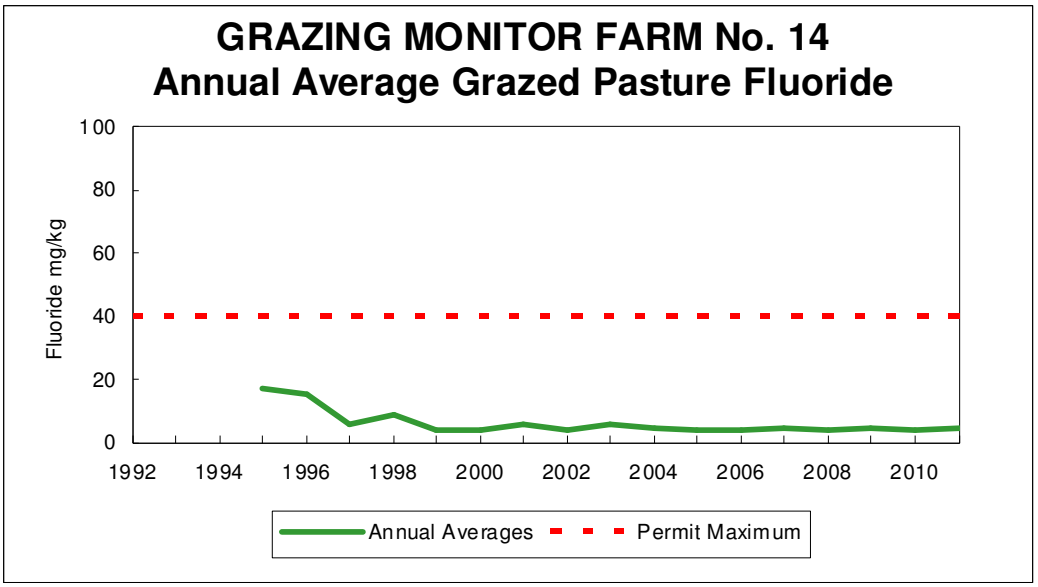
The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



No data for February 2010 as fertilizer had been applied within 28 days of sampling.

Grazing Monitor Farm No. 14, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride concentration in grazed pasture was within the permit standards during 2011. The 2011annual average grazed pasture fluoride concentration of 5mg/kg was similar to the average concentration measured during 2010.

Grazing Monitor Farm No. 16

Introduction

The following information is contained in this section:

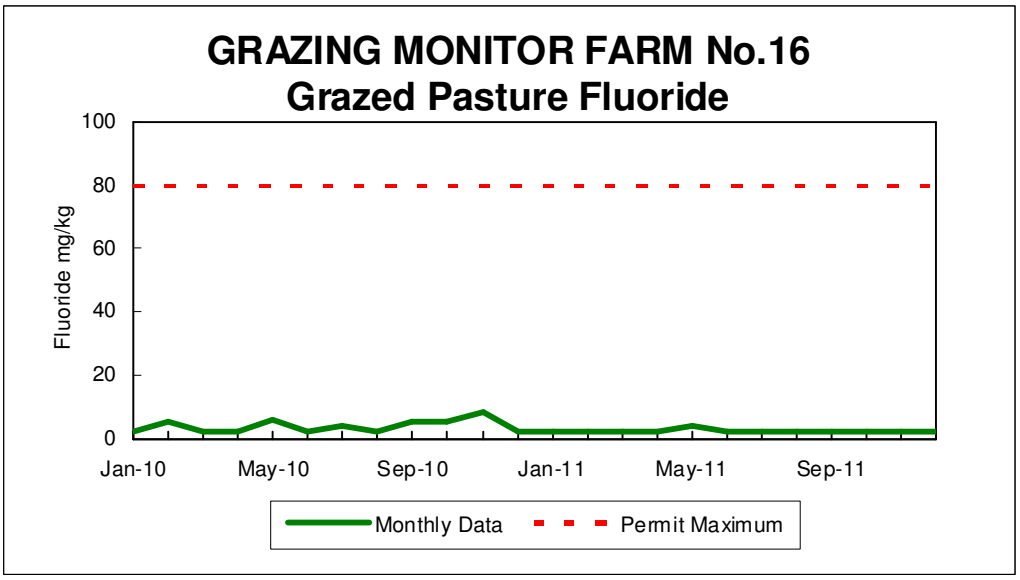
- fluoride in grazed pasture, and
- comments on the monitoring.

Fluoride in grazed pasture

The following table shows the grazed pasture monitoring results for 2011.

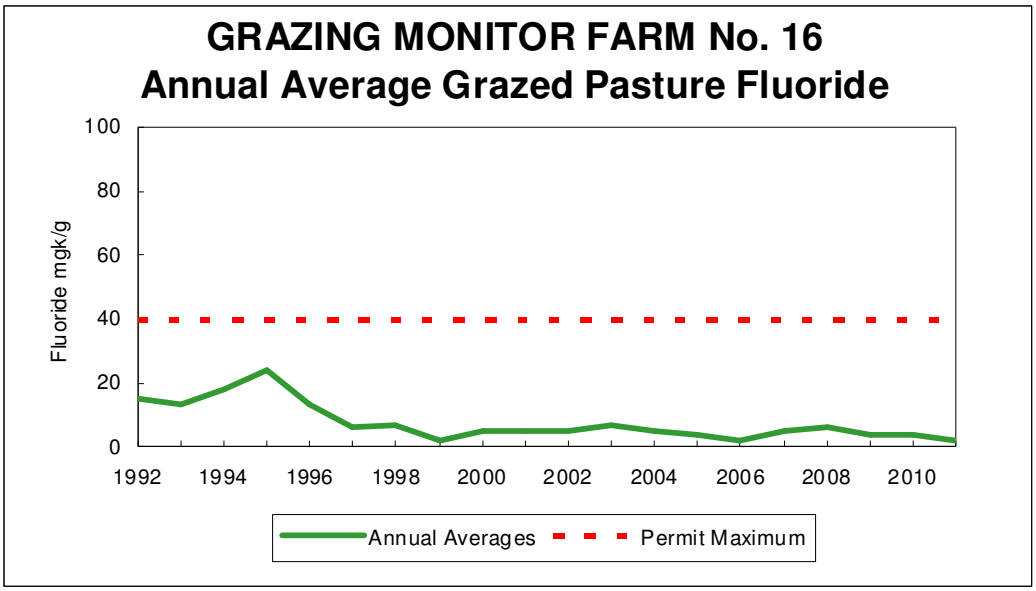
	Units	Standard	2011
Monthly sample maximum	mg/kg	80	4
Two monthly average maximum	mg/kg	60	3
Twelve monthly running average maximum	mg/kg	40	4
Annual average	mg/kg		< 4

The following graph shows the results of monthly fluoride monitoring of grazed pasture during 2010 and 2011.



Grazing Monitor Farm No. 16, continued

The following graph shows the annual average fluoride concentration in grazed pasture.



Comments

The fluoride concentrations in grazed pasture were within the permit standards during 2011. The 2011 annual average grazed pasture fluoride concentration of <4 mg/kg was similar to the concentration measured in 2010.

Part I - Water Take

Introduction

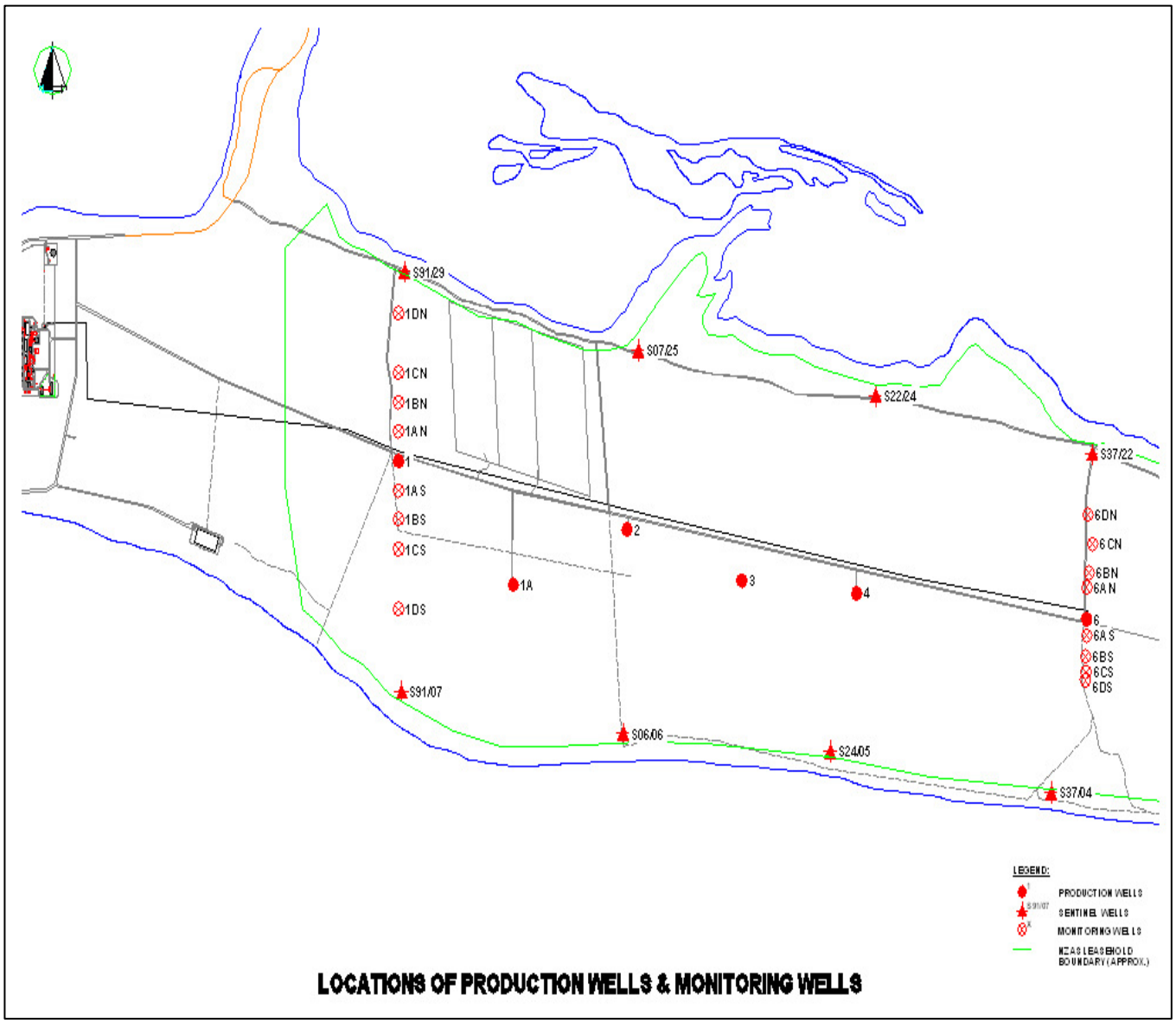
Water Take from the aquifer on Tiwai Peninsula is covered by Consent Number 202958 issued by Southland Regional Council on the 12th September 2005.

Permit Conditions

Total abstraction rate not to exceed 4,564 m^3/day.
Results of monitoring to be reported to the Council by the 31st March each year.

Site Locations

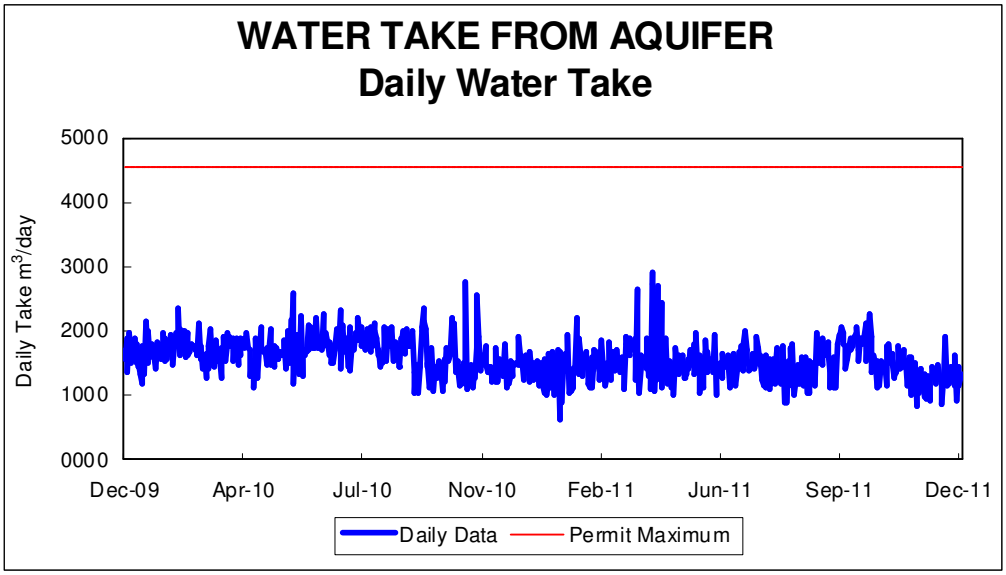
The locations of the Production and Monitoring Water Wells are shown in the following map.



Water Take from Aquifer

Monitoring Results

The total volume of water taken from the aquifer is recorded daily and is displayed in the graph below.



The table below summarises the daily data on a monthly basis.

Daily Water Take		
Date	Average m^3/day	Maximum m^3/day
Jan-11	1365	2214
Feb-11	1469	1896
Mar-11	1585	2640
Apr-11	1604	2906
May-11	1479	1965
Jun-11	1489	1990
Jul-11	1431	1904
Aug-11	1390	1972
Sep-11	1677	2071
Oct-11	1648	2263
Nov-11	1356	1756
Dec-11	1273	1919

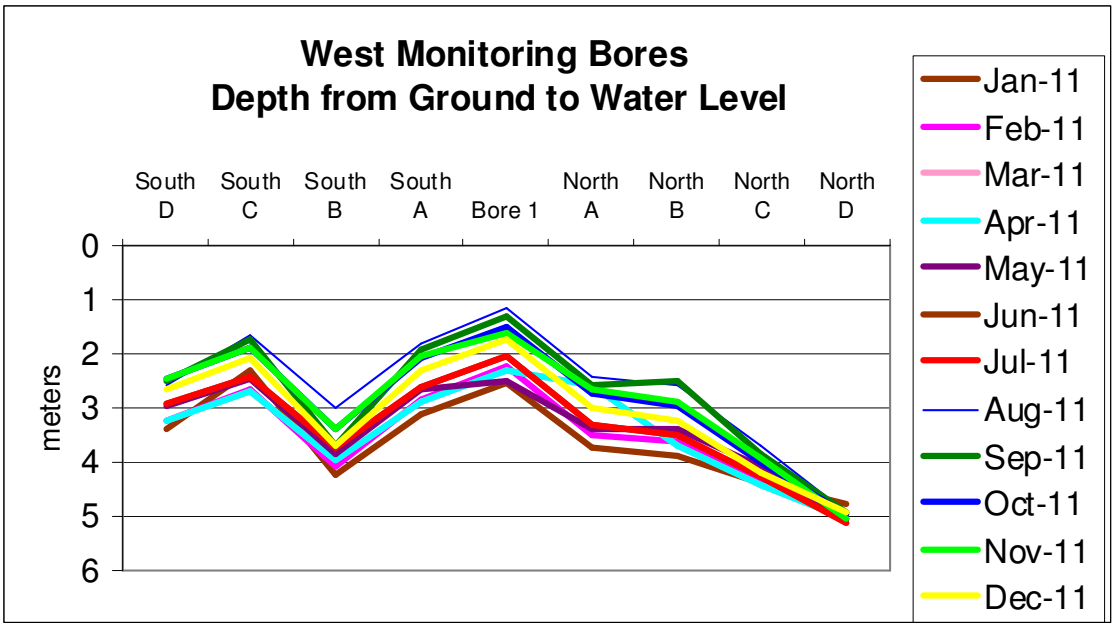
From the 21st of November 2011 the daily water take was under recorded due to an obstruction in a bypass valve. The valve was fixed on the 10th of January and the correct daily water take recorded. During this time it is estimated that the recorded figure was low by approximately 280m3/day. This estimate was based on historical data and weekly boreline meter readings. It is believed that the water take was well within the consent limit of 4546 m^3/day.

Water Take from Aquifer, continued

The following tables and graphs show the water level for each monitoring bore around production bores 1 and 6, measured while pumping from the production bores.

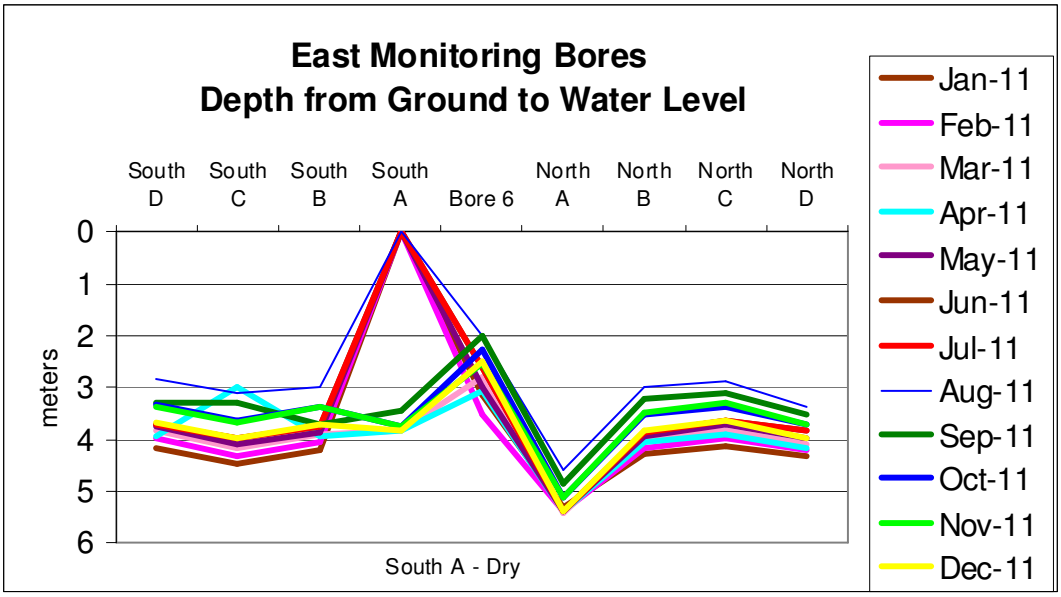
West Monitoring Bore Water Levels
(from Mean High Sea Level in metres)
Total well depth in Italics

Date	South				Bore 1	North			
	D	C	B	A		A	B	C	D
	5.64	*5.50*	*5.50*	*4.62*	*16.4*	*5.32*	*5.30*	*5.55*	*5.27*
Jan-11	3.38	2.28	4.21	3.12	2.54	3.73	3.88	4.38	4.78
Feb-11	3.20	2.66	4.05	2.82	2.22	3.49	3.62	4.30	4.90
Mar-11	3.02	2.52	3.90	2.72	2.22	3.30	3.45	4.20	4.95
Apr-11	3.22	2.67	3.95	2.86	2.30	2.55	3.70	4.42	5.04
May-11	2.94	2.46	3.85	2.66	2.50	3.38	3.38	4.08	5.02
Jun-11	2.93	2.39	3.73	2.61	2.01	3.28	3.48	4.26	5.12
Jul-11	2.93	2.39	3.73	2.61	2.01	3.28	3.48	4.26	5.12
Aug-11	2.58	1.64	2.98	1.78	1.16	2.41	2.56	3.67	4.93
Sep-11	2.49	1.71	3.70	1.90	1.30	2.57	2.47	3.85	4.92
Oct-11	2.43	1.86	3.37	2.05	1.49	2.72	2.95	4.00	4.95
Nov-11	2.44	1.86	3.38	2.01	1.60	2.66	2.86	3.90	5.01
Dec-11	2.64	2.07	3.69	2.29	1.71	2.98	3.23	4.18	4.93



Water Take from Aquifer, continued

East Monitoring Bore Water Levels (from Mean High Sea Level in metres) *Total well depth in Italics*									
	South					North			
Date	**D**	**C**	**B**	**A**	**Bore 6**	**A**	**B**	**C**	**D**
	4.32	*5.35*	*5.79*	*3.82*	*8.6*	*5.46*	*5.4*	*5.45*	*5.5*
Jan-11	4.16	4.48	4.21	DRY	3.13	5.31	4.28	4.11	4.32
Feb-11	3.98	4.30	4.05	dry	3.51	5.37	4.15	3.96	4.20
Mar-11	3.82	4.15	3.90	3.80	2.80	5.40	3.95	3.80	4.08
Apr-11	3.95	2.98	3.95	3.80	3.05	5.36	4.04	3.88	4.17
May-11	3.76	4.08	3.85	dry	2.97	5.38	3.92	3.72	3.98
Jun-11	3.71	3.99	3.73	DRY	2.60	5.36	3.86	3.64	3.81
Jul-11	3.71	3.99	3.73	DRY	2.60	5.36	3.86	3.64	3.81
Aug-11	2.82	3.09	2.98	DRY	2.01	4.57	2.98	2.88	3.36
Sep-11	3.30	3.30	3.70	3.45	2.00	4.83	3.21	3.10	3.50
Oct-11	3.33	3.64	3.37	3.75	2.27	5.12	3.50	3.37	3.72
Nov-11	3.36	3.68	3.38	3.73	2.53	5.12	3.49	3.30	3.69
Dec-11	3.67	3.98	3.69	3.81	2.50	5.37	3.80	3.64	3.97



Comments

Water levels in the monitoring bores have not changed significantly during 2011. Bore South A was dry for 6 of the 12 months as reflected in the graph above.

Part J - Liquid Discharges and Their Effects

Introduction

Liquid discharges from the smelter are covered by Discharge Permits issued by the Southland Regional Council. These permits commenced in June 2006.

This chapter gives details of the monitoring results for each permit.

Permit Limits

The following table shows the permit limits applying to the discharges to water and onto land.

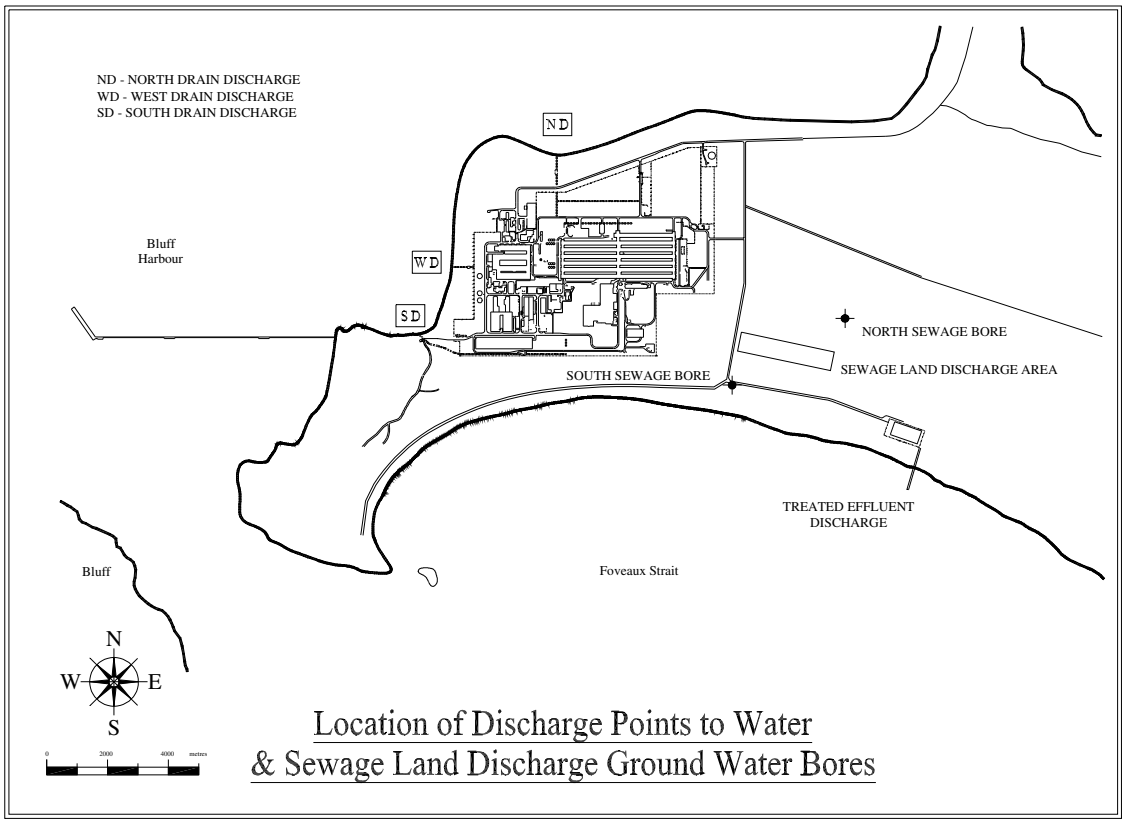
	Units	Limit
North, South, and West Drain		
• Quarterly average total suspended solids	g/m^3	30
Treated effluent		
• Maximum daily discharge	m^3/day	140
• Total suspended solids	g/m^3	100
• Free cyanide	g/m^3	20
Treated sewage		
• Maximum daily flow	m^3/day	295
• Biochemical oxygen demand	g/m^3	18
• Total suspended solids	g/m^3	8

The following permit limits apply to coastal water monitoring sites:

- The natural temperature of the water shall not be changed by more than 3° Celsius and the natural temperature of the water shall not exceed 25° Celsius;
- Any pH change and/or any discharge of a contaminant into the water or water into water or onto the seabed shall not result in a loss of biological diversity or a change in community composition;
- The concentration of dissolved oxygen shall exceed 80% of saturation concentration;
- Fish or other aquatic organisms shall not be rendered unsuitable for human consumption by the presence of contaminants;
- There shall be no undesirable biological growths as a result of any discharge if a contaminant into the water;
- Aquatic life is not adversely affected by the taking of any physical, chemical or biological constituent from the water;
- Visual clarity shall not be diminished by more than twenty percent;
- The water shall not be rendered unsuitable for bathing by the presence of contaminants;
- The water shall not be altered in those characteristics which have a direct bearing upon cultural or spiritual values;
- The quarterly average fluoride concentration at drain coastal water monitoring sites shall not exceed 2 g/m^3 based on the results of representative samples collected each week; and
- The fluoride concentration in any representative drain coastal water monitoring sample collected weekly shall not exceed 5 g/m^3.

Site Locations

The locations of the liquid discharge and their effects monitoring sites are shown in the following map.



Discharge Monitoring

The discharges from the North, South and West Drains are sampled once each week. The temperature of each discharge is measured once each year as part of the annual seawater quality monitoring survey.

The discharge of treated sewage is sampled over a 24 hour period once each month.

The discharge of treated effluent is sampled once per batch of treated effluent.

Coastal Water Monitoring

Coastal water quality is determined by comparing the results of monitoring at coastal water monitoring sites with the results at control sites where coastal water monitoring sites are chosen to monitor the effects of discharges on coastal waters, and control sites are chosen to best represent the background coastal water quality.

Some coastal water monitoring is undertaken each time a drain discharge is sampled.

Additional coastal water monitoring for drain discharges is undertaken annually.

Annual coastal water monitoring is undertaken for the discharge of treated effluent.

Sewage Land Disposal Area Groundwater Monitoring

Groundwater near the sewage land disposal area is monitored by sampling from one upstream bore north of the disposal area, and one downstream bore south of the disposal area.
Monitoring is carried out at about six monthly intervals.

North Drain Discharges

Introduction

Discharges from the North Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the North Drain discharge monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Total Suspended solids	g/m^3		6.7	9.3
• Maximum Quarterly Average	g/m^3	30	7.2	11.5
• No. of Times Quarterly Average >30 g/m^3		0	0	0
pH			7.8	7.8
Fluoride	g/m^3		3.0	3.3
Conductivity	µS/cm		47270	45785

Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Fluoride	g/m^3		1.4	1.4
• Maximum Quarterly Average	g/m^3	2	1.4	1.5
• No. of Times Quarterly Average >2.0 g/m^3		0	0	0
• Maximum Individual Sample	g/m^3	5	3.3	3.5
• No of Times Individual Sample > 5.0 g/m3			0	0
pH			8.1	8.1
Conductivity	µS/cm		51025	50937
Visible Oil - No. of times Observed			0	0

North Drain Discharges continued.

Control Site water monitoring results

The following table summarises the North Drain weekly control site water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Result	2011 Result
Fluoride	g/m^3		1.3	1.4
• Maximum Quarterly Average	g/m^3		1.3	1.4
• No. of Times Quarterly Average >2.0 g/m^3			0	0
• Maximum Individual Sample	g/m^3		1.5	5.6
• No of Times Individual Sample > 5.0 g/m3			0	1
pH			8.1	8.1
Conductivity	µS/cm		51358	51033
Visible Oil - No. of times Observed			0	0

Annual Monitoring results

The following table summarises the North Drain annual coastal water monitoring results during 2011 and shows a comparison with 2010 results.

Site	Parameter	Units	Limit	2010	2011
Discharge	Temperature	°C		15.7	24.1
Seawater	Temperature	°C	<25	15.6	24.1
	Dissolved oxygen	mg/L	>=5	9.7	8.1
	Dissolved Oxygen Saturation	%	>80	97	115.8
Control	Temperature	°C	<25	15.6	20.3
	Dissolved oxygen	mg/L	>=5	9.6	8.3
	Dissolved Oxygen Saturation	%	>80	96	116.5
	Change to temperature	°C	3	0	3.8

Comments

Discharges from the North Drain were within permit limits during 2011 on all but one occasion.

As reported on 13th July to Environment Southland, during routine sampling of the North Drain on the 8th July during heavy rain and strong on-shore winds, the fluoride concentration in the seawater control site (100m upstream) of the exit of the Drain was determined to be 5.6 g F/m^3. NZAS interprets this result as a breach of Consent 203373 Section 4(b) in that a seawater sample collected exceeded a concentration of 5.0 g F/m^3. This is because differentiation between the control and the seawater site (50m downstream of the drain exit) was difficult due to rough sea conditions. The Consent does not specify limits on analytes at the seawater control site. The above table reflects the results of samples as taken on the day. No adverse impacts were observed on the seawater environment.

South Drain Discharges

Introduction

Discharges from the South Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the South Drain discharge monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Total Suspended solids	g/m^3		3.3	2.9
• Maximum Quarterly Average	g/m^3	30	4.4	3.4
• No. of Times Quarterly Average >30 g/m^3		0	0	0
pH			6.8	6.9
Fluoride	g/m^3		5.4	4.5
Conductivity	µS/cm		353	372

Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m^3	2	1.3	1.4
• No. of Times Quarterly Average >2.0 g/m^3	g/m^3	0	0	0
• Maximum Individual Sample		5	1.6	1.6
• No of Times Individual Sample > 5.0 g/m3	g/m^3		0	0
pH			8.1	8.1
Conductivity			50393	49665
Visible Oil - No. of times Observed			0	0

South Drain Discharges, continued

Control Site water monitoring results

The following table summarises the South Drain weekly control site water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Result	2011 Result
Fluoride	g/m^3		1.3	1.3
• Maximum Quarterly Average	g/m^3		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m^3			0	0
• Maximum Individual Sample	g/m^3		1.4	1.4
• No of Times Individual Sample > 5.0 g/m3			0	0
pH			8.1	8.1
Conductivity	µS/cm		51133	50363
Visible Oil - No. of times Observed			0	0

Annual monitoring results

The following table summarises the South Drain annual water monitoring results during 2011 and shows a comparison with 2010 results. This monitoring was actually carried out in January 2012 as the drain was dry during the scheduled monitoring period.

Site	Parameter	Units	Limit	2010	2011
Discharge	Temperature	°C		15.8	13.9
Seawater	Temperature	°C	<25	15	13.9
	Dissolved oxygen	mg/L	>= 5	11.3	7.7
	Dissolved Oxygen Saturation	%	>80	111	95.1
Control	Temperature	°C	<25	15.3	14.1
	Dissolved oxygen	mg/L	>= 5	10.6	7.6
	Dissolved Oxygen Saturation	%	>80	105	94.1
	Change to temperature	°C	3	0	0.2

Comments

Discharges from the South Drain were within permit limits during 2011.

The monthly rainfall in December was 13mm which contributed to no flow exiting this drain during the scheduled monitoring period. The annual survey was completed in January 2012 once flow was re-established in the drain.

West Drain Discharges

Introduction

Discharges from the West Drain are covered by Discharge Permit & Coastal Permit Consent No. 203373 which commenced on 6 June 2006.

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Discharge monitoring results

The following table summarises the West Drain discharge monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Total Suspended solids	g/m^3		8.2	9.7
• Maximum Quarterly Average	g/m^3	30	11.5	11.8
• No. of Times Quarterly Average >30 g/m^3		0	0	0
pH			7.5	7.6
Fluoride	g/m^3		1.5	1.4
Conductivity	µS/cm		15711	16418

Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Average	2011 Average
Fluoride			1.3	1.3
• Maximum Quarterly Average	g/m^3	2	1.3	1.3
• No. of Times Quarterly Average >2.0 g/m^3	g/m^3	0	0	0
• Maximum Individual Sample		5	1.4	1.4
• No of Times Individual Sample > 5.0 g/m3	g/m^3		0	0
pH			8.1	8.1
Conductivity			51288	51025
Visible Oil - No. of times Observed			0	0

West Drain Discharges, continued

Control Site water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2011 and shows a comparison with 2010 results.

Parameter	Units	Limit	2010 Result	2011 Result
Fluoride	g/m^3		1.3	1.3
• Maximum Quarterly Average	g/m^3		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m^3			0	0
• Maximum Individual Sample	g/m^3		1.5	1.4
• No of Times Individual Sample > 5.0 g/m3			0	0
pH			8.1	8.1
Conductivity	µS/cm		51133	50363
Visible Oil - No. of times Observed			0	0

Annual water monitoring results

The following table summarises the West Drain annual water monitoring results during 2011 and shows a comparison with 2010 results.

Site	Parameter	Units	Limit	2010	2011
Discharge	Temperature	°C		15.4	26
Seawater	Temperature	°C	<25	15.2	21.1
	Dissolved oxygen	mg/L	>= 5	9.3	8.4
	Dissolved Oxygen Saturation	%	>80	93	116.7
Control	Temperature	°C	<25	15.1	20.4
	Dissolved oxygen	mg/L	>= 5	9.19	8.5
	Dissolved Oxygen Saturation	%	>80	92	117.7
	Change to temperature	°C	3	0	0.7

Comments

Discharges from the West Drain were all within permit limits during 2011.

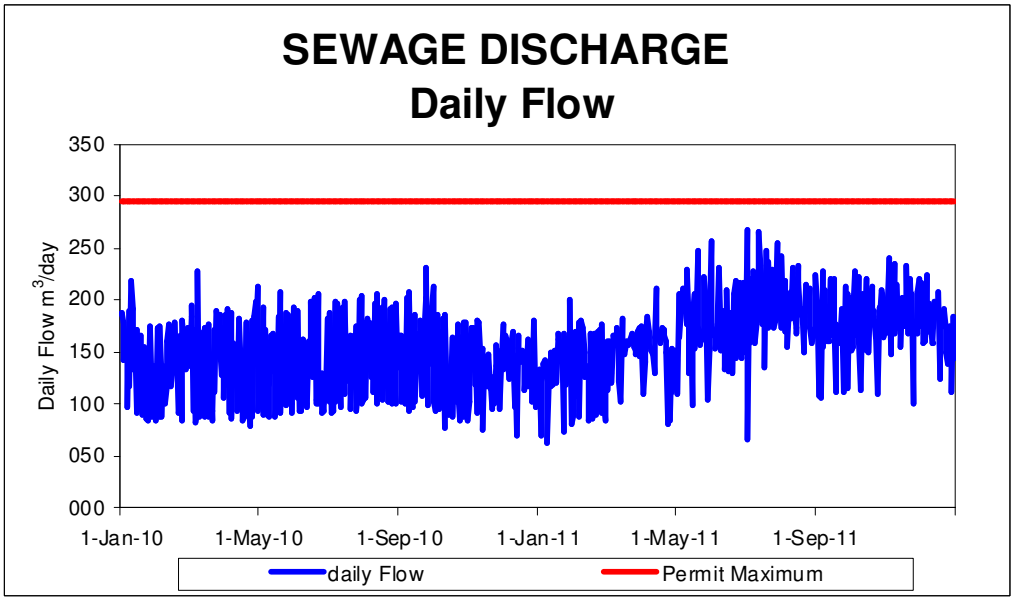
Treated Sewage Discharges

Introduction

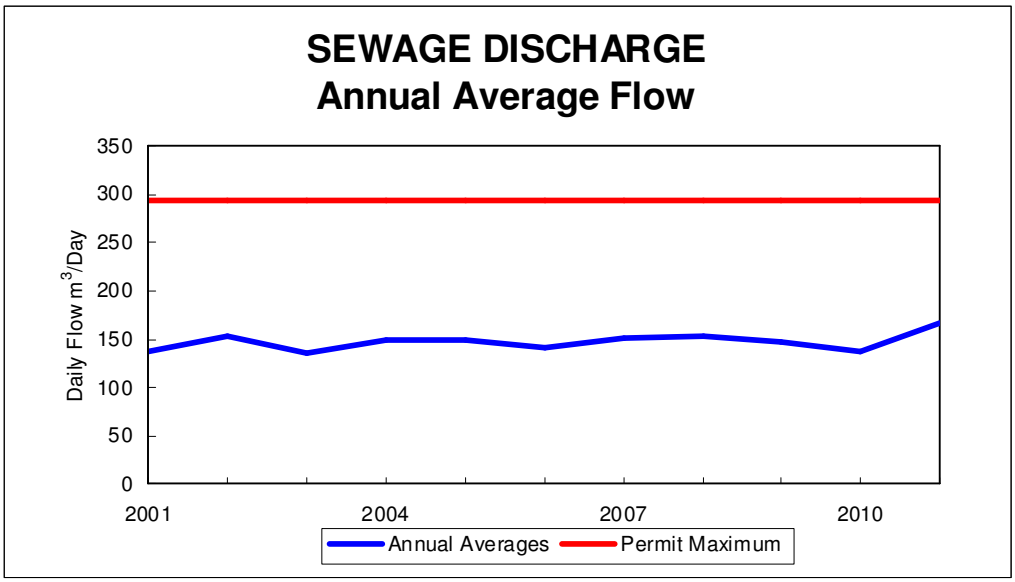
Discharges of treated sewage onto land are covered by Discharge Permit Number 203376, which was granted on 6 June 2006.

Discharge monitoring results

The following graph shows the daily sewage discharge flow during 2010 and 2011. The permit limit for daily flow is 295 m^3/day.

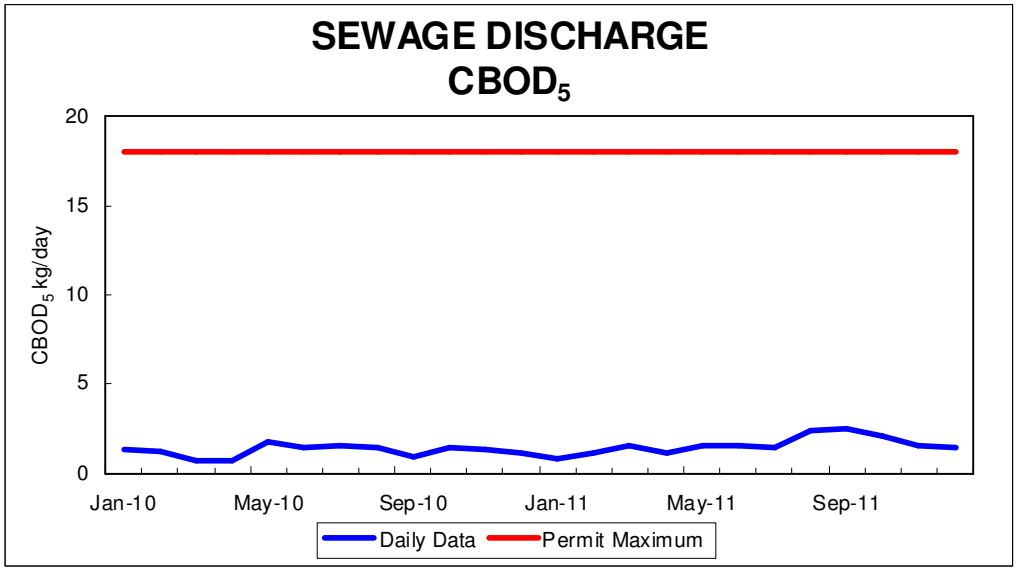


The following graph shows the annual average daily sewage discharge flow into the sewage treatment facility.

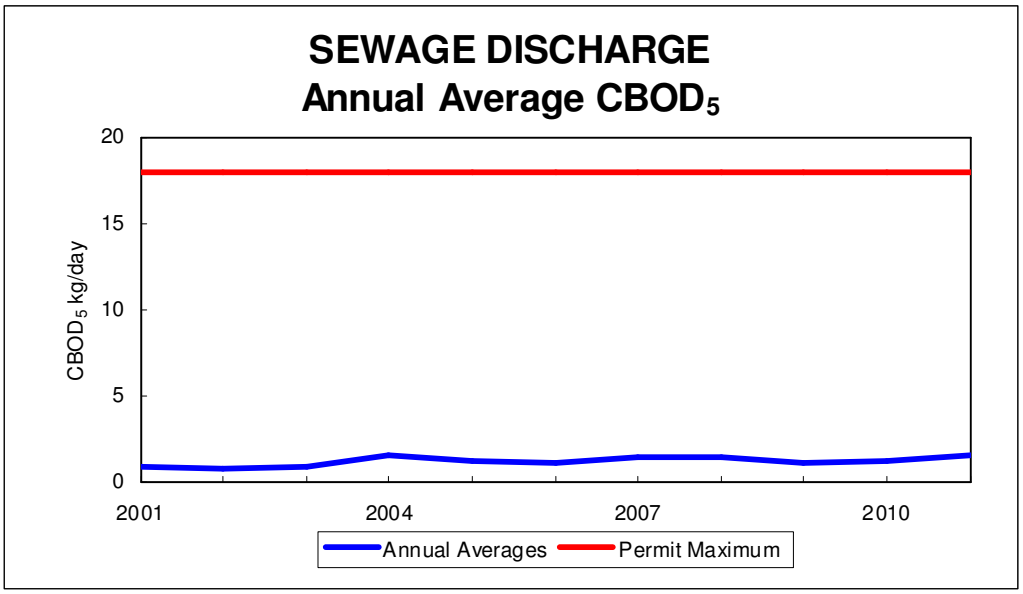


Treated Sewage Discharges, continued

The following graph shows the monthly carbonaceous biochemical oxygen demand ($CBOD_5$) discharge from the sewage treatment plant during 2010 and 2011. The permit limit for $CBOD_5$ is 18kg/day.

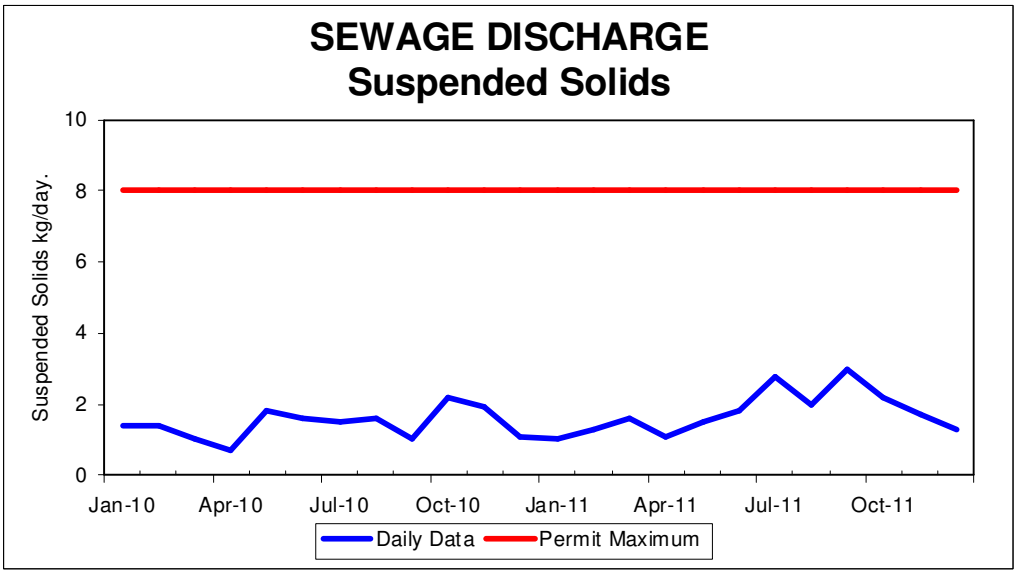


The following graph shows the annual average $CBOD_5$ discharge from the sewage treatment plant.

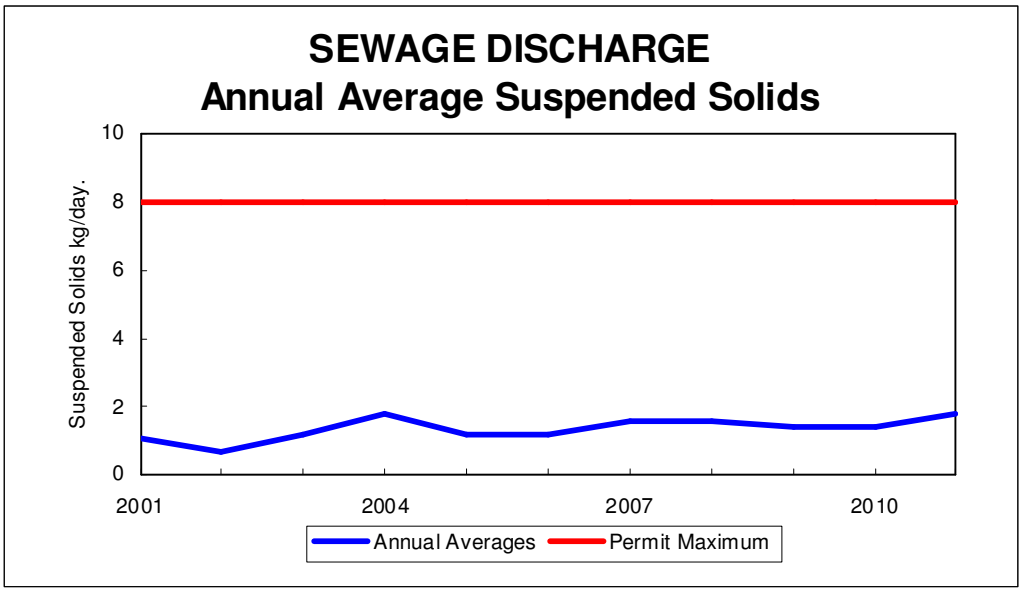


Treated Sewage Discharges, continued

The following graph shows the monthly suspended solids discharge from the sewage treatment plant during 2010 and 2011. The permit limit for suspended solids is 8 kg/day.



The following graph shows the annual average suspended solids discharge from the sewage treatment plant.



Treated Sewage Discharges, continued

Land disposal area groundwater monitoring results

The following table summarises the results of groundwater monitoring near to the area where sewage is discharged to land. The location of the bores is shown in the Site Locations map on page 68.

Parameter	Units	2010 Average	2011 Average	Previous Range (post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2
Total phosphorus	g/m^3	0.08	0.20	0.046 - 0.15
Total ammoniacal-N	g/m^3	0.01	0.01	< 0.01 - 0.03
Nitrate-N	g/m^3	0.006	0.006	< 0.01 - 0.058
Total Nitrogen	g/m^3	0.05	0.12	0.02 - 0.4
pH		7.6	7.7	7.4 - 8.1
Conductivity	µS/cm	338	341	305 - 362
Chlorinated Aliphatic HC	g/m^3	N.D.	B.L.	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2 - 65
Total phosphorus	g/m^3	0.0585	0.02	< 0.01 - 0.068
Total ammoniacal-N	g/m^3	<0.01	<0.01	< 0.01 - 0.02
Nitrate-N	g/m^3	0.270	0.260	< 0.01 - 0.54
Total Nitrogen	g/m^3	0.55	0.51	0.05 - 0.78
pH		7.4	7.8	6.9 - 7.9
Conductivity	µS/cm	437	430	227 - 503
Chlorinated Aliphatic HC	g/m^3	N.D.	B.L.	B.L.

HC = Hydrocarbons N.D. = Not determined.

B.L. = Below limit of detection for each of the 23 compounds determined.

Chlorinated Aliphatic Hydrocarbons only determined biennially.

Comments

The discharges of treated sewage onto land during 2011 were similar to previously seen except for phosphorous in the North Bore. The phosphorous concentration in the North Bore has shown a increase from an average of 0.07g/m^3 over the last 2 years to a single result of 0.34 g/m^3 in November The high phosphorous analysis was been queried and the result confirmed by Hill Laboratories who carried out the analysis but it appears to be a statistical outlier. If this result was removed from the data the average would be similar to 2010.

Treated Effluent Discharges

Introduction

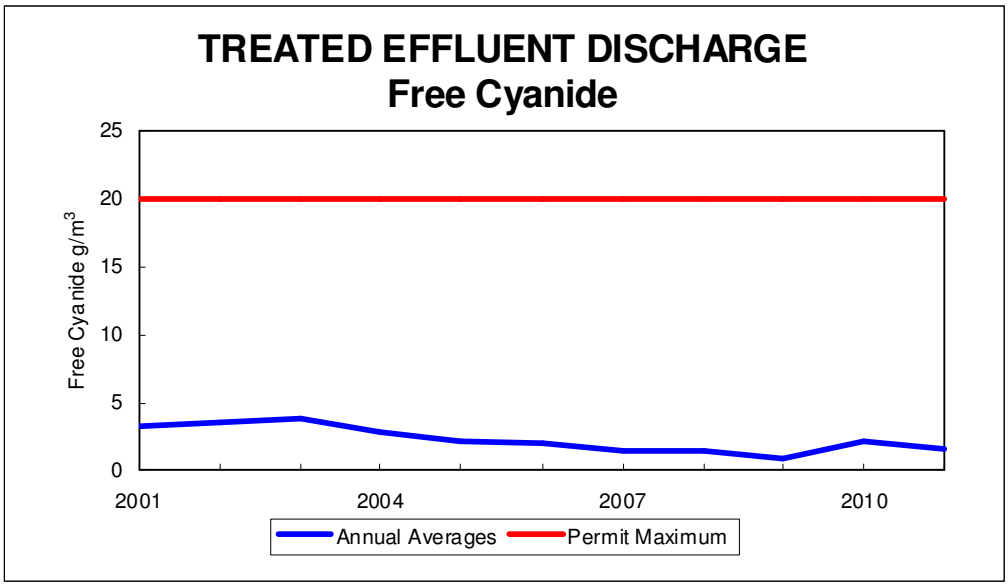
Discharges of treated effluent into Foveaux Strait are covered by Coastal Permit Number 203375 which commenced on 6 June 2006.

Discharge monitoring results

The following table summarises the results of treated effluent discharge monitoring during 2011 and shows a comparison with the 2010 results.

Parameter	Units	Limits	2010 Result	2011 Result
Maximum daily discharge	m^3/day	140	80	80
Suspended Solids				
Maximum Concentration			24	34
Average Concentration	g/m^3	100	5.3	8.1
No.> 100 g/m^3		0	0	0
Free Cyanide				
Maximum Concentration	g/m^3	20	8.9	4.1
Average Concentration			2.1	1.6
No.> 20 g/m^3		0	0	0

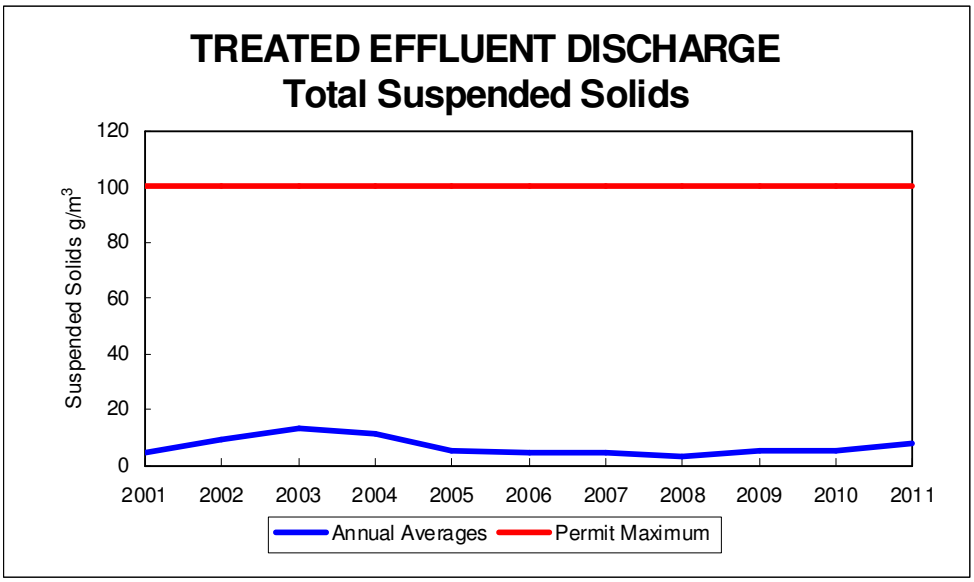
The following graph shows the annual average free cyanide concentration of treated effluent discharged.



Treated Effluent Discharges, continued

Discharge monitoring results, continued

The following graph shows the annual average total suspended solids concentration of treated effluent discharged.



Discharge rate

The following table shows the average, maximum and minimum discharge rates for the discharge of treated effluent to Foveaux Strait during 2009, 2010 and 2011. There were 37 discharges throughout 2011 with a total volume of 2910 m^3 discharged.

Parameter	Units	2009 Result	2010 Result	2011 Result
Average Discharge Rate	L/min	5	5	5
Maximum Discharge Rate	L/min	5	5	5
Minimum Discharge Rate	L/min	5	5	5

Treated Effluent Discharges, continued

Annual Coastal Water Monitoring Results

The following table summarises the annual coastal water monitoring for the discharge of treated effluent.

Site	Parameter	Units	Limit	2010	2011
Coastal	Fluoride	$g.m^{-3}$		1.5	1.3
	Total Cyanide	$g.m^{-3}$		<0.006	<0.006
	Conductivity	µS/cm		52900	52400
	pH			8.1	8.3
	Dissolved Oxygen	mg/L	>=5	8.0	7.76
	% Saturation	%	>80	101	94.5
	Temperature	°C	<25	15.5	14
Control	Fluoride	$g.m^{-3}$		1.6	1.3
	Total Cyanide	$g.m^{-3}$		<0.006	<0.006
	Conductivity	µS/cm		53000	52500
	pH			8.1	8.3
	Dissolved Oxygen	mg/L	>=5	8.0	7.74
	% Saturation	%	>80	101	94.7
	Temperature	°C	<25	15.6	14
	Change to Temperature	°C	3	0	0.1

Condition of the diffuser

The Cathode Outfall Discharge Structure including the diffuser was inspected on 9th December 2011. The structure on inspection was found to be in good condition upright on the seafloor as intended. Growth on the structure was found to be less than other years. It was noticed that Paddle Crabs were feeding on and around the structure which may contribute to the lesser amount of growth.

Comments

All discharges of treated effluent were within permit limits during 2011.

Part K - Landfill Operations

Introduction

Operation of the landfill on the smelter's Tiwai Point property is covered by Discharge Permit No. 202196 issued by the Southland Regional Council on 8 December 2004.

This report covers:

- proposed operation at the landfill for the next twelve months,
- comments on operations for 2011,
- the amount and type of materials deposited at the landfill, and
- groundwater monitoring.

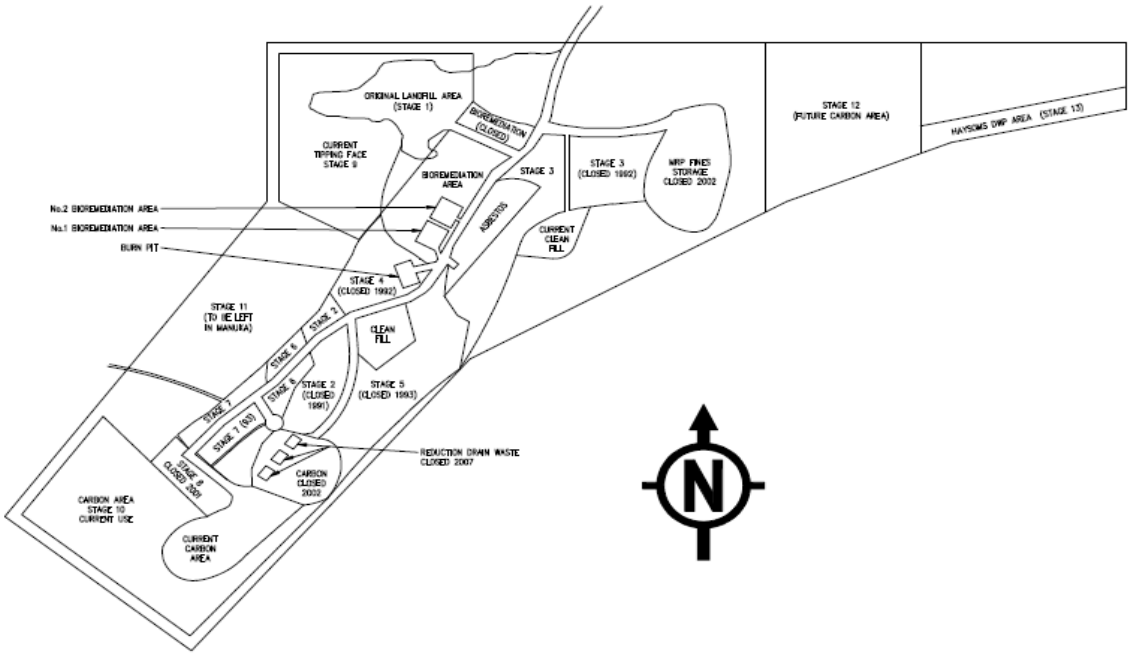
Proposed Operation For 2012

Introduction

The proposed operation of the landfill is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2012 are included in the following sections.

Landfill areas being developed or extended

The following map shows the current landfill disposal and storage areas.



The general waste tip face is heading in a Northerly direction, towards the general waste area access road. Once it reaches the access road the enclosed area will then be completely filled. During December drainage pipes were laid across the future landfill area to allow drainage to occur when this area has been filled. It is planned for the original landfill (Stage one) to be re-vegetated with Hebe's, flax's & tussocks this year.

Landfill areas being developed or extended, continued

The Stage ten carbon dust tipping area was opened in 2002 and will continue operation through 2012. The carbon is being layered at the South East end of the Carbon tipping area. It will be taken up to the same height as the Lined Carbon area. Once this area is completed the fill will head directly north to fill the rest of the available area. Investigations into possible alternative tipping areas are continuing including the possibility of backfilling the MRP area as the dross comes out.

The South drain will be excavated of all process waste material (alumina) during January and this material will be stockpiled beside the South drain to allow drainage to occur. When dry enough it will be relocated into one of the two outer settling ponds located at the landfill.

The large stockpile of timber at the landfill has been completely removed and was sent for offsite for recycling.

Comments on Operations for 2011

Asbestos Storage Area
In November a pallet of hardened refractory cement which potentially had asbestos in its composition was removed from the stores and placed into the asbestos storage area and covered.

Man Made Mineral Fibre Area
The existing man made mineral fibre bunker was completely filled during 2011 and a new storage area was created directly North of the previous bunker.

Metal Reclamation Plant Stockpile
The MRP area was opened in July 2011 and the pea gravel cover pulled back to expose the process material. Intermittent loads of MRP material have been trucked to the Taha plant for the aluminium to be extracted. This will continue through 2012 as it is required.

Carbon Dust Tipping Area
As noted above.

General Wasted Tipping Area
The powerlines and poles which prevented further access in an Easterly direction were completely removed as it was deemed that power to that area of the landfill was not required.

Amount and Type of Materials Deposited

Introduction

In 2011 the plant operated at full capacity with record metal production.

As per NZAS' consent conditions for landfill operations, results detailing wastes sent to landfill for the 2011 period is included below.

Survey Procedure for Non-Process Waste

The non-classifiable waste is not routinely weighed hence an annual survey is conducted to estimate the quantities deposited at the landfill. The latest survey was conducted from December 2011 to January 2012.

The latest survey was conducted over 33 working days following the procedure described below:

- Each truck load of waste was weighed before and after deposition at the landfill.
- The contents and source of each truckload was recorded.
- The amount of waste measured during the survey period was used to estimate the annual deposition.
- Annual estimates are corrected to account for any special events that are known to have occurred outside of the survey period.

Non-Process Waste Results

The following tables show the various types of waste observed in the NZAS landfill waste stream and their estimates for their annual generation rates over the past four survey periods.

Estimate of Non-Process Material to Landfill 2008-2011				
Material	**2008**	**2009**	**2010**	**2011**
Gravel and Sand	5	8	0	21
Bricks and Refractory	268	593	622	126
Non-classifiable waste	59	180	131	311
Plastic	84	95	27	71
Concrete	4	226	47	53
Timber	37	67	7	18
Paper & Cardboard	105	123	69	73
Dust collector bags	20	48	20[1]	20[2]
Furnace elements	2	0	0	0
Rubber	14	21	8	5
Metals	20	7	34	6
Textiles	16	49	20	49[3]
Asbestos	0	0.5	0	0
Total (tonnes)	**634**	**1417**	**985**	**753**

[1,4] No dust collector bags were deposited during the survey period, however a number of D/Cs were refurbished during 2010 and 2011. Estimates used

[3] MMF included

Amount and Type of Materials Deposited continued

The total quantity of non-process waste materials sent to landfill decreased from 2010 to 2011 by approximately 250 tonnes. However the apparent reduction might not be a true indication as most repair work producing waste bricks was carried out in spring before the 2011 landfill survey. Quantities of most non-process material streams were of similar values as estimated for 2010 but non-classifiable waste has doubled. There is no specific explanation for this increase. The value for non-classifiables has always been very variable from year to year.

Material such as plastic, paper and cardboard are still relative low. This indicates that the implemented recycling schemes around the plant are well embedded. Levels have reached a plateau as some recyclables are contaminated and can not be recycled.

Process Waste Results

Process waste was weighed during the entire year and is now accurately reported rather than an estimate based on survey results which was used previously.

Measured Process Waste to the NZAS Landfill By Material 2008 - 2011

Material	2008	2009	2010	2011
Alumina	37	22	87	45
Carbon	2359	2173	2310	2147
Furnace Slag	179	154	154	164
Reject Bath	67	40	102	123
Resistor Coke	96	635	191	245
Miscellaneous	77	58	39	153
Total Process	**2815**	**3082**	**2883**	**2877**

The total amount of process waste in 2011 was similar to 2010 and 2008.

Total Waste

Total Waste to the NZAS Landfill 2007 – 2011

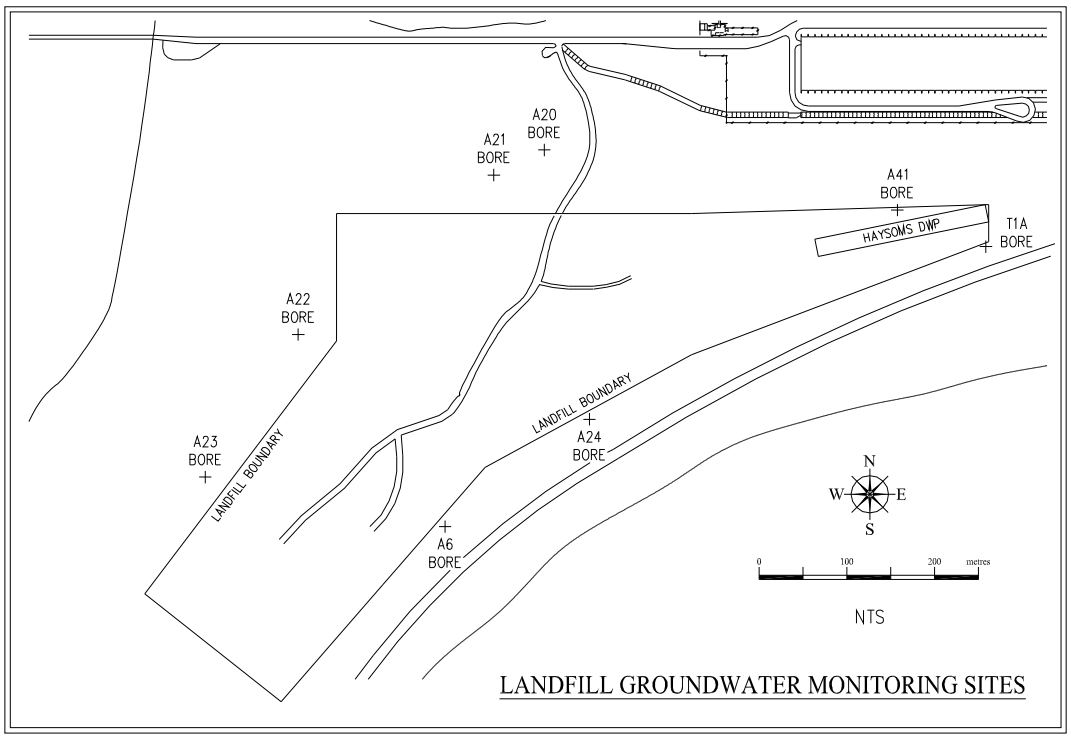
Material	2008	2009	2010	2011
Non-Process Waste	**634**	**1417**	**985**	**753**
Process Waste	**2815**	**3082**	**2883**	**2877**
Total Waste	**3449**	**4499**	**3868**	**3630**

The total amount of waste sent to landfill appears to be back to 2008 levels.

Landfill Groundwater Monitoring

Site locations

The locations of the groundwater monitoring bores are as shown in the following map. Three of the bores are north (upstream) of the landfill, and there are three bores south east and two bores west (downstream) of the landfill.



Landfill Groundwater Monitoring, Continued

Bore A20 monitoring results

The table below shows a summary of results from samples collected from bore A20 during 2010 and 2011. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^{0}C	N.D.	8.7	7.5 - 13.4
pH		5.8	5.9	5.1 - 7.2
Conductivity	µS/cm	970	956	644 - 1063
Alkalinity	g/m^3	13	20	8 - 240
Carbonaceous BOD5	g/m^3	<1	<1	<1 - 6
Total Nitrogen	g/m^3	1.04	1.28	0.1 - 1.68
Total Ammoniacal Nitrogen	g/m^3	0.12	0.31	0.02 - 0.34
Fluoride	g/m^3	1.15	1.29	0.025 - 11
Sulphate	g/m^3	35	32	25 - 55
Total Iron	g/m^3	0.75	11.3	0.46 - 26
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1 - 11.6
Total Kjeldahl Nitrogen	g/m^3	0.97	1.27	0.2 - 1.67
Nitrate Nitrogen	g/m^3	N.D.	0.014	<0.002 - 14
Nitrite Nitrogen	g/m^3	N.D.	0.003	<0.002 - 0.014
Weak Acid Dissociable Cyanide	g/m^3	N.D.	<0.001	<0.001 - 0.1
Boron	g/m^3	N.D.	0.032	0.032 - 0.067
Manganese	g/m^3	N.D.	0.111	0.111 - 0.394
Nickel	g/m^3	N.D.	0.0018	0.0018 - 0.01
Potassium	g/m^3	N.D.	3.7	2.9 - 4.1
Vanadium	g/m^3	N.D.	0.003	<0.001 - 0.0079

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A21 monitoring results

The table below shows a summary of results from samples collected from bore A21 during 2010 and 2011. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^{0}C	N.D.	7.7	6.5 - 13.7
pH		6.1	6.1	5.1 - 6.9
Conductivity	µS/cm	943	896	502 - 1723
Alkalinity	g/m^3	37	36	9 - 160
Carbonaceous BOD5	g/m^3	<1	1.2	<1 - 16
Total Nitrogen	g/m^3	3.6	3.1	0.7 - 8
Total Ammoniacal Nitrogen	g/m^3	0.9	1.4	0.1 - 4.6
Fluoride	g/m^3	2.0	3.0	0.19 - 3.8
Sulphate	g/m^3	11	34	8 - 114
Total Iron	g/m^3	33.1	17.7	2.2 - 94.6
Naphthalene	mg/m^3	<1	<0.5	<0.1 - 1
Anthracene	mg/m^3	<0.4	<0.1	<0.02 - 0.2
Phenanthrene	mg/m^3	<0.4	<0.5	<0.005 - 0.2
Fluoranthene	mg/m^3	<0.4	<0.1	<0.02 - 0.2
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1 - 7.3
Total Kjeldahl Nitrogen	g/m^3	N.D.	3.1	0.8 - 6.5
Nitrate Nitrogen	g/m^3	N.D.	0.004	0.004 - 29
Nitrite Nitrogen	g/m^3	N.D.	0.007	<0.002 - 0.028
Weak Acid Dissociable Cyanide	g/m^3	N.D.	<0.001	<0.001 - 0.1
Boron	g/m^3	N.D.	0.08	0.07 - 0.154
Manganese	g/m^3	N.D.	0.088	0.064 - 0.473
Nickel	g/m^3	N.D.	0.0026	<0.0005 - 0.007
Potassium	g/m^3	N.D.	6	5 - 11
Vanadium	g/m^3	N.D.	0.02	0.001 - 0.043

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A41 monitoring results

The table below shows a summary of results from samples collected from bore A41 during 2010 and 2011. Bore A41 is located north of the Haysom's area (upstream).

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
pH	-	7	6.3	6.2 - 7.9
Alkalinity	g/m^3	54	24	11.9 - 170
Temperature	^0C	N.D.	11.2	6.2 - 7.9
Conductivity	µS/cm	457	526	282 - 984
Carbonaceous BOD_5	g/m^3	0.5	0.5	0.5 - 0.5
Fluoride	g/m^3	1.2	1.2	0.25 - 4.4
Sulphate	g/m^3	25	24	19.2 - 47
Total Iron	g/m^3	0.13	0.06	0.05 - 0.63
Boron	g/m^3	N.D.	0.044	0.04 - 4.1
Manganese	g/m^3	N.D.	<0.01	<0.01 - 0.023
Potassium	g/m^3	N.D.	1.09	0.27 - 4.8
Vanadium	g/m^3	N.D.	<0.002	<0.002 - 0.011
Nickel	g/m^3	N.D.	0.0005	0.0005 - 0.004
Ammoniacal-Nitrogen	g/m^3	0.005	0.03	0.005 - 0.16
Total Nitrogen	g/m^3	4	4	0.75 - 26
Total Kjeldahl Nitrogen	g/m^3	0.99	0.49	0.41 - 3.1
Nitrate Nitrogen	g/m^3	N.D.	0.34	0.269 - 23
Nitrite Nitrogen	g/m^3	N.D.	<0.002	<0.002 - 0.2
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1
Weak Acid Dissociable Cyanide	g/m^3	N.D.	0.0005	0.0005 - 0.0035

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A22 monitoring results

The table below shows the averages of results from samples collected from bore A22 during 2010 and 2011. Bore A22 is located west of the landfill.

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^{0}C	N.D.	9.4	8.6 - 12.1
pH		5.2	4.9	4.2 - 7.3
Conductivity	µS/cm	544	566	354 - 1204
Alkalinity	g/m^3	16	7	0.5 - 294
Carbonaceous BOD5	g/m^3	4	8	<1 - 15
Total Nitrogen	g/m^3	5.7	6.8	0.42 - 8.1
Total Ammoniacal Nitrogen	g/m^3	1.23	1.46	0.005 - 1.4
Fluoride	g/m^3	2.4	2.6	0.025 - 3.2
Sulphate	g/m^3	3	3	0.25 - 165
Total Iron	g/m^3	1.78	1.55	0.59 - 3.45
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1 - 3.45
Total Kjeldahl Nitrogen	g/m^3	5.6	6.7	0.9 - 8
Nitrate Nitrogen	g/m^3	N.D.	0.09	<0.02 - 0.2
Nitrite Nitrogen	g/m^3	N.D.	0.006	<0.002 - 0.13
Weak Acid Dissociable Cyanide	g/m^3	N.D.	<0.001	<0.001 - 0.1
Boron	g/m^3	N.D.	0.041	0.006 - 0.066
Manganese	g/m^3	N.D.	0.0156	0.0049 - 0.394
Nickel	g/m^3	N.D.	0.0023	0.0007 - 0.01
Potassium	g/m^3	N.D.	4.8	1.65 - 5.3
Vanadium	g/m^3	N.D.	0.005	0.002 - 0.022

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A23 monitoring results

The table below shows a summary of results from samples collected from bore A23 during 2010 and 2011. Bore A23 is located west of the landfill.

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^{0}C	N.D.	10.2	9 - 12.5
pH		5.8	5.75	5.4 - 6.4
Conductivity	µS/cm	482	489	378 - 745
Alkalinity	g/m^3	34	30	31 - 60
Carbonaceous BOD5	g/m^3	<1	1	<1 - 5
Total Nitrogen	g/m^3	1.94	1.85	0.88 - 2.7
Total Ammoniacal Nitrogen	g/m^3	1.0	0.9	0.05 - 1.4
Fluoride	g/m^3	0.1	<0.1	<0.1 - 0.36
Sulphate	g/m^3	2.5	2.5	0.25 - 30
Total Iron	g/m^3	5.2	4.8	2.6 - 13
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1 - 7.2
Total Kjeldahl Nitrogen	g/m^3	1.9	1.8	1.1 - 2.3
Nitrate Nitrogen	g/m^3	N.D.	<0.02	<0.02 - 0.05
Nitrite Nitrogen	g/m^3	N.D.	<0.02	<0.02 - 0.019
Weak Acid Dissociable Cyanide	g/m^3	N.D.	<0.001	<0.001 - 0.1
Boron	g/m^3	N.D.	0.05	0.04 - 0.05
Manganese	g/m^3	N.D.	0.05	0.05 - 0.12
Nickel	g/m^3	N.D.	0.0014	<0.0005 - 0.0016
Potassium	g/m^3	N.D.	4	4 - 5
Vanadium	g/m^3	N.D.	0.009	0.013 - 0.021

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A24 monitoring results

The table below shows a summary of results from samples collected from bore A24 during 2010 and 2011. Bore A24 is located south east of the landfill.

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^{0}C	N.D.	10	9.4 - 12.8
pH		8.6	8.5	6.9 - 8.7
Conductivity	µS/cm	5165	4595	447 - 7290
Alkalinity	g/m^3	1945	1703	414 - 2600
Carbonaceous BOD5	g/m^3	72	70	2 - 120
Total Nitrogen	g/m^3	343	285	16.8 - 560
Total Ammoniacal Nitrogen	g/m^3	240	233	28.2 - 450
Fluoride	g/m^3	93	91	<0.1 - 120
Sulphate	g/m^3	14	39	0 - 312
Total Iron	g/m^3	37	34	8.2 - 60
Naphthalene	mg/m^3	131	212	0.06 - 510
Anthracene	mg/m^3	<0.3	0.6	<0.3 - 1.2
Phenanthrene	mg/m^3	1	2.3	<0.3 - 4.9
Fluoranthene	mg/m^3	<0.3	0.675	<0.3 - 1
Total Petroleum Hydrocarbons	g/m^3	N.D.	2.2	<1 - 18.6
Total Kjeldahl Nitrogen	g/m^3	350	285	63 - 560
Nitrate Nitrogen	g/m^3	N.D.	0.42	0.05 - 33
Nitrite Nitrogen	g/m^3	N.D.	0.08	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m^3	N.D.	<0.01	<0.01 - 0.1
Boron	g/m^3	N.D.	12.6	4.1 - 17
Manganese	g/m^3	N.D.	0.136	0.11 - 0.22
Nickel	g/m^3	N.D.	0.03	0.004 - 0.05
Potassium	g/m^3	N.D.	56	11 - 79
Vanadium	g/m^3	N.D.	2	0.21 - 2.54

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore A6 monitoring results

The table below shows a summary of results from samples collected from bore A6 during 2010 and 2011. Bore A6 is located south east of the landfill.

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
Temperature	^0C	N.D.	11.5	10.3 - 13.5
pH		6.9	6.9	6.1 - 7.6
Conductivity	µS/cm	2845	2730	158 - 5689
Alkalinity	g/m^3	615	595	280 - 943
Carbonaceous BOD5	g/m^3	3	3	1 - 6
Total Nitrogen	g/m^3	24	23	9.7 - 47.4
Total Ammoniacal Nitrogen	g/m^3	15	14	0.15 - 34.7
Fluoride	g/m^3	47	50	2 - 104
Sulphate	g/m^3	720	690	480 - 2050
Total Iron	g/m^3	29	30	4.2 - 40
Naphthalene	mg/m^3	<2	<2	<0.1 - 1
Anthracene	mg/m^3	<0.4	<0.4	0.05 - 1.34
Phenanthrene	mg/m^3	<0.4	<0.4	<0.05 - 0.2
Fluoranthene	mg/m^3	<0.4	<0.4	<0.01 - 0.2
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1 - 9.2
Total Kjeldahl Nitrogen	g/m^3	24	23	14.2 - 48
Nitrate Nitrogen	g/m^3	N.D.	0.11	0.001 - 14
Nitrite Nitrogen	g/m^3	N.D.	0.04	0.004 - 0.218
Weak Acid Dissociable Cyanide	g/m^3	N.D.	0.0027	0.0018 - 0.1
Boron	g/m^3	N.D.	0.79	0.66 - 2.54
Manganese	g/m^3	N.D.	1.5	0.22 - 1.85
Nickel	g/m^3	N.D.	0.0056	0.005 - 0.022
Potassium	g/m^3	N.D.	14	14 - 37
Vanadium	g/m^3	N.D.	0.18	0.05 - 0.4

N.D: Not analysed – only required biennially.

Landfill Groundwater Monitoring, Continued

Bore T1A monitoring results

The table below shows a summary of results from samples collected from bore T1A in 2010 and 2011. Bore T1A is located south east of the Haysoms DWP area.

Analyte	Units	2010 Average	2011 Average	Range (since Commissioning)
pH	-	8.9	8.9	6.8 - 9.6
Alkalinity	g/m^3	900	535	108 - 2110
Temperature	^0C	N.D.	11.2	10.6 - 13.7
Conductivity	µS/cm	3665	2258	473 - 8930
Carbonaceous BOD_5	g/m^3	1	2	<1 - 10
Fluoride	g/m^3	85	84	<0.1 - 210
Sulphate	g/m^3	64	50	17.4 - 338
Total Iron	g/m^3	0.94	0.67	0.01 - 15.3
Boron	g/m^3	N.D.	3.9	0.05 - 12.6
Manganese	g/m^3	N.D.	0.06	0.0006 - 0.253
Potassium	g/m^3	N.D.	10	2.44 - 69.1
Vanadium	g/m^3	N.D.	0.11	<0.01 - 0.34
Nickel	g/m^3	N.D.	<0.01	<0.0005 - 0.044
Ammoniacal-Nitrogen	g/m^3	69	68	<0.01 - 580
Total Nitrogen	g/m^3	245	142	1.5 - 783
Total Kjeldahl Nitrogen	g/m^3	73	77	0.4 - 630
Nitrate Nitrogen	g/m^3	N.D.	28	1.25 - 229
Nitrite Nitrogen	g/m^3	N.D.	1.4	0.003 - 20.8
Total Petroleum Hydrocarbons	g/m^3	N.D.	<1	<1
Weak Acid Dissociable Cyanide	g/m^3	N.D.	0.01	<0.001 - 0.325

N.D: Not analysed – only required biennially.

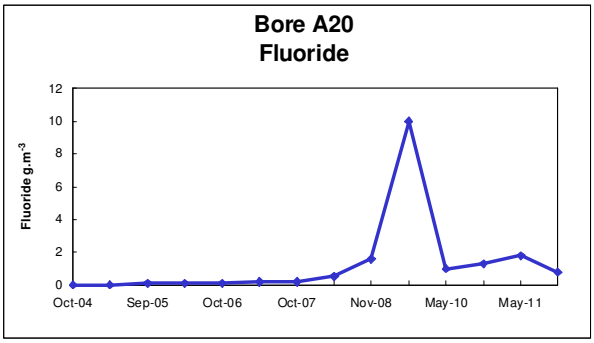
Comments

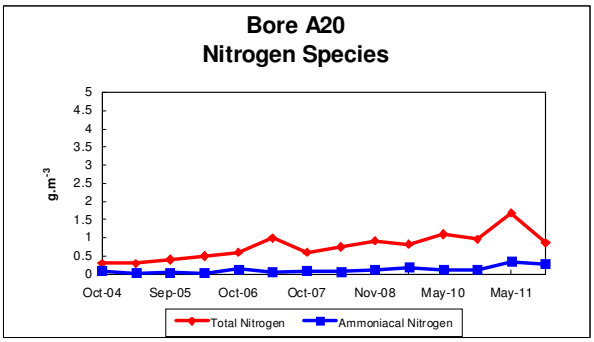
Most of the Landfill bores showed variations in analyte concentrations during the two surveys carried out in 2011. The 1st survey was carried out in May 2011 and the 2nd in November 2011.

Shown below are the bores, which showed significant changes or trends in analyte concentrations in 2010 but have stabilised in 2011.

Bore A20

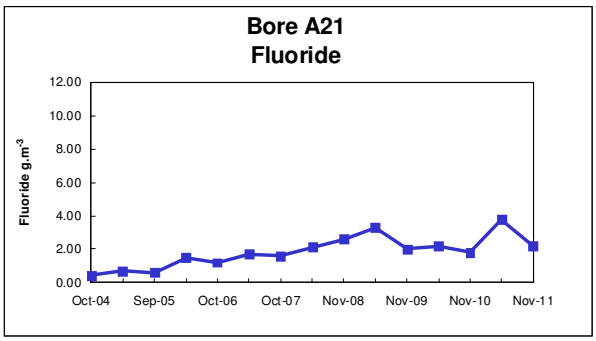
Fluoride, Ammoniacal nitrogen and total nitrogen have stabilised in upstream bore A20 during 2011.

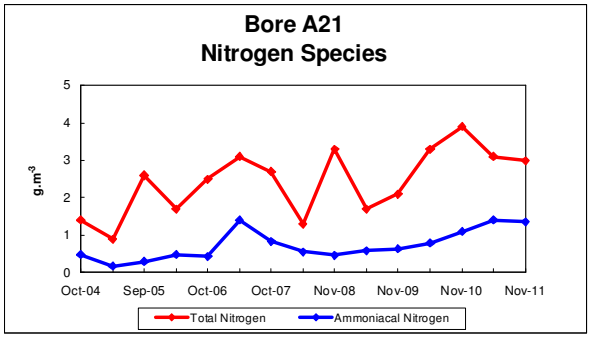




Bore A21

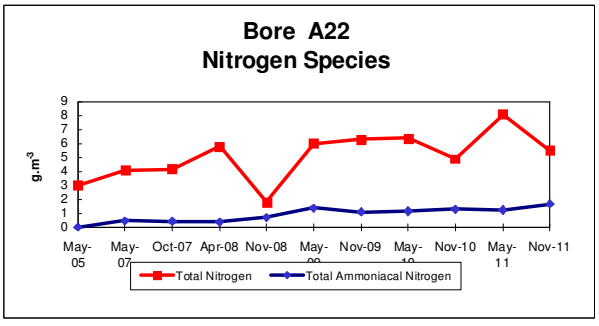
Fluoride and nitrogen species in Bore A21, north of the landfill has stabilised during 2011.





Bore A22

Downstream Bore A22, west of the landfill after a period of stable nitrogen species showed an increase in total nitrogen species in the first survey but returned to previously seen levels in the 2nd survey.



Part L - Groundwater

Spent Cathode Pad Leachate

Monitoring of the groundwater during 2011 showed a spike in some levels of contaminants in several of the shallow bores close to the pad. Increased monitoring is currently being undertaken and early indications show a drop again in concentrations to pre 2011 levels.

During 2011 the pipeline which takes treated effluent from sedimentation tanks to the undersea diffuser was pressure tested in the section from the tanks to the highest point prior to the beach. No leaks which would cause a pressure drop across this part of the underground pipeline were detected.

Spent Cell Lining Storage Shed

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2011. The concentration of fluoride and cyanide in the liquid between the membranes has not changed significantly.

Monitoring of the groundwater around the shed shows that the concentrations of cyanide and fluoride in the groundwater have not changed significantly.

Part M - Greenhouse Gas Discharges

Calculated Carbon Dioxide and Perfluorocarbon Discharges

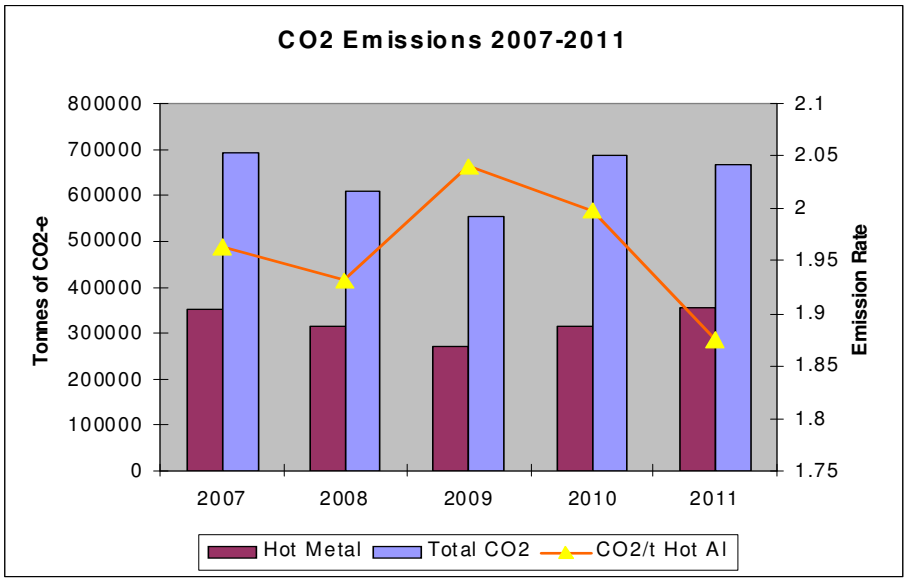
Introduction

Air discharge permit 203378 does not have a requirement to report calculated carbon dioxide and perfluorocarbon discharges from NZAS during each calendar year; however NZAS will continue to report this for general information purposes.

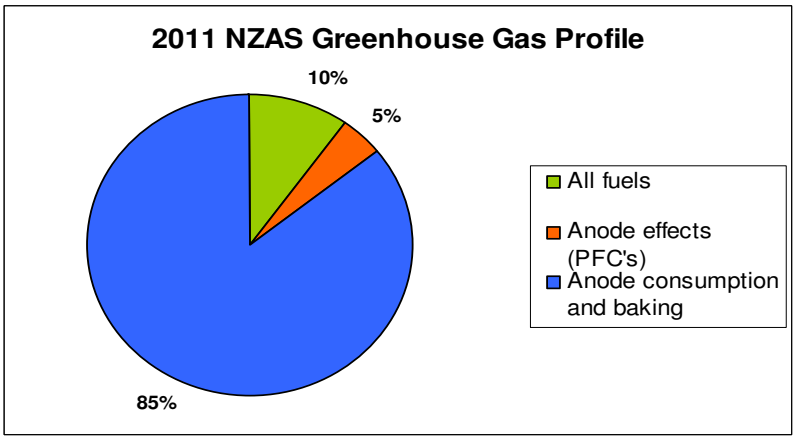
NZAS had a year with record metal production and lowest ever PFC emissions. Records were achieved due to stable operating conditions and continuous effort placed on energy efficiency and emission controls to reduce the impact on climate change and deliver improved business value.

Carbon Dioxide - 2011

The total calculated carbon dioxide equivalent (CO_2-e) discharge from NZAS during the year ending 31 December 2011 was 668,852 tonnes. 18,292 tonnes less CO_2-e than last year and with metal production increased by 12,813 tonnes. The emission rate in 2011 was 1.87 t CO_2-e / per tonne of aluminium produced. The lowest rate ever recorded in NZAS's history.



The total calculated CO_2 equivalents are emitted from carbon consumption (anodes), perfluorocarbons generation (PFCs) and fuel usage.



Greenhouse Gas Discharges, Continued

Anodes – 2011

85% of the total CO_2 emissions from the smelter are due to baking and consuming carbon anodes. Emission of greenhouse gases during the production of aluminium is unavoidable as the consumption of carbon anode blocks form part of the chemical process to produce aluminium. However emissions can be minimised by manufacturing high quality anodes and ensure that they are not burning when in contact with air in the cells (airburn). A very low rate of airburn was observed during 2011, which decreased the total calculated anode consumption relative to the metal production during 2011.

Perfluorocarbons – 2011

Perfluorocarbons (PFCs) contribute to climate change in the same way that CO_2 does. PFCs are gases emitted from the aluminium production process when conditions in the cells become unstable. The total calculated PFCs discharged from NZAS during 2011 decreased by 34% compared to 2010 after experiencing a relatively stable year. The percentage of PFC's emitted as CO_2 equivalent out of the total greenhouse gas emission was the best ever at 5%. In 2010 the PFC's contributed with 6% and in 2006 it was 12% of the total emissions.

Fuel - 2011

Heavy fuel oil is the main fuel used on site and is used for baking the carbon anodes and heating of some casting furnaces. Calculated CO_2 equivalents from fuels decreased slightly during 2011. The greenhouse gas contribution from fuels is stable at 10% of the total emissions.

End of Report for 2011