

New Zealand Aluminium Smelters Limited

Annual Environmental Monitoring Report 2016

Report to Environment Southland on consent monitoring and environmental effects of the Tiwai Aluminium Smelter for the year ending 31 December 2016

Table of Contents

SUMMARY	4
PART A - ENVIRONMENTAL MANAGEMENT	6
INTRODUCTION Environmental Incidents Reports to Environment Southland Two incident reports were issued to Environment Southland in 2016	6 6 6 6
PART B - DISCHARGES INTO AIR	7
INTRODUCTION	7
Main Stack Discharges Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons Potline Roof Louvre Discharges Fluoride Discharges Dust Collector Discharges Dust Collector Date Main Stack Smoke Discharges Sulphur Content of Raw Materials and Fuels	13 14 20 22 22 22 23 24
PART C - DISPERSION CONDITIONS	25
INTRODUCTION METEOROLOGICAL CONDITIONS COMMENTS	25 25 26
PART D - AMBIENT AIR	27
INTRODUCTION PERMIT LIMITS SITE LOCATIONS AMBIENT AIR AT 1 KILOMETRE HUT AMBIENT AIR AT NO. 1 BORE ON TIWAI PENINSULA	27 27 27 27 28 30
PART E - ATMOSPHERIC DEPOSITION	31
INTRODUCTION PERMIT GUIDELINES SITE LOCATIONS ATMOSPHERIC DEPOSITION MONITORING RESULTS	31 31 31 31 32
PART F - FLUORIDE IN UNGRAZED GRASS	33
INTRODUCTION Permit Guidelines Site Locations Ungrazed Grass Monitoring Results	33 33 33 33 34
PART I - WATER TAKE	35
INTRODUCTION PERMIT CONDITIONS SITE LOCATIONS WATER TAKE FROM AQUIFER	35 35 35 35 36
PART J - LIQUID DISCHARGES AND THEIR EFFECTS	39
PERMIT LIMITS DISCHARGE MONITORING COASTAL WATER MONITORING Sewage Land Disposal Area Groundwater Monitoring North Drain Discharges South Drain Discharges West Drain Discharges Treated Sewage Discharges	39 40 40 41 41 42 42 44 46 48
TREATED EFFLUENT DISCHARGES	52
	30

	56
PROPOSED OPERATION FOR 2017	56
AMOUNT AND TYPE OF MATERIALS DEPOSITED	58
LANDFILL GROUNDWATER MONITORING	60
PART L - GROUNDWATER	77
SPENT CATHODE PAD LEACHATE	77
SPENT CELL LINING STORAGE SHED	77
PART M - GREENHOUSE GAS DISCHARGES	78
CALCULATED CARBON DIOXIDE AND PERFLUOROCARBON DISCHARGES	78

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 2016.

Main Stack

Main Stack discharges to air were within permit standards during 2016. No stack sample was available for December due to stack sampling carried out on 6/12/16 failed due to technical difficulties. Subsequent attempts to resample failed due to unavailability of safety personnel and adverse weather conditions. Data reported for December is taken from the previous 12 month average.

Potline Roof Louvres

Potline roof louvre discharges were within permit standards during 2016.

Dust Collector Discharges

Seven dust collectors were tested during 2016. All duct collectors sampled were within permit limits.

Dispersion

Wind speeds and direction were generally similar to previous years.

Monthly rainfall for 2016 was variable with the annual total of 978mm being below the 5 year running average of 1010mm. Rainfall data for the period of 17th to the 31st of May is inaccurate due to a faulty rain gauge that was replaced.

Ambient Air

Gaseous and particulate fluoride levels were similar to previous years.

Atmospheric Deposition

Fluoride levels at both sites were similar to previous years.

Vegetation

The fluoride concentrations of ungrazed grass sites during 2016 were similar to the concentrations measured in previous years.

Water Take

Water take from the aquifer was within permit standards for 2016.

Liquid Discharges

Discharges from the North, South, and West drains and of Treated Effluent and their effect on the environment were within permit standards during 2016.

All permit standards were met for Treated Sewage discharges during 2016.

Groundwater monitoring results from the sewage monitoring bores showed no significant changes of analytes during 2016.

Groundwater

Groundwater monitoring around the SCL storage shed and underneath the storage shed showed no significant changes of analytes during 2016. The cathode pad stockpile groundwater showed no significant changes of analytes during 2016.

Landfill

Monitoring of groundwater near the NZAS landfill showed no significant changes of analytes during 2016.

Greenhouse Gas Discharges

Hot metal produced increased by 5,340 tonnes in 2016 compared to 2015. Despite an increase in metal production there was a slight decrease in absolute carbon dioxide emissions during 2016. The emission rate in 2016 was 1.93 t CO_2 -e / per tonne of aluminium produced.

Part A - Environmental Management

Introduction

This report summarises NZAS' environmental performance during 2016 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 team provides much of the data within this report. An auditing programme conducted by Environment Southland verifies the validity of this data.

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 Incidents

Discharge in excess of consent

There was one minor violation of the consent in October 2016 of excess suspended solids discharged via the Cathode Effluent treatment facility. NZAS self-reported to Environment Southland with no further action required.

Two other incidents were also reported. See section 'Reports to Environment Southland' for details.

Reports to Environment Southland

Two incident reports were issued to Environment Southland in 2016.

Alumina spillage

On 3rd March 2016, whilst alumina was being discharged onto the wharf conveyor belt by the ship unloader, alumina spilled from the conveyor belt onto the wharf. The discharge happened at the point where the conveyor belt from the wharf transfers to the causeway conveyor belt and was attributed to an excess of alumina on the belt caused by a higher than routine discharge rate.

The spillage was removed by a mechanical sweeper.

Operators have been instructed to manually reduce the removal rates if the rate increases above the normal discharge rate.

No further action was required.

Excessive dust on NZAS wharf during Ship Unloading

On the 19th July 2016, Environment Southland informed NZAS Shipping Services Crew Leader about excessive dust coming from the ship berthed at Tiwai wharf.

The ship, MV Emma Bulker, had begun discharging pet coke at 1545hrs. The Ship Unloader Operator observed an increase in fugitive dust at around 1720hrs (cameras confirmed this time) and informed the Crew Leader at 1730hrs. A decision to close the forward hatch cover, which was completed by 1740hrs, visibly reduced the amount of fugitive dust coming from the ships' hold.

The Ship Unloader Operator followed correct procedure and initiated action to reduce the amount of fugitive coke dust. No further action was required.

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 and amended on 22nd December 2014.

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 2016.

Parameter		Running 12 month average		
	Units	Permit Limit	2016	
Gas flow rate	Sm ³ / min	-	59,800	
Total particulate	kg/min	1.70	0.36	
Gaseous fluoride	kg/min	0.50	0.19	
Particulate fluoride	kg/min	0.20	0.01	
Sulphur dioxide	kg/min	21.4	11.3	
Total condensable hydrocarbons	kg/min	-	0.05	
Polycyclic aromatic hydrocarbons	kg/min	-	0.042	

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.

Monthly Limit applies 11 d				ly Results 1 out of 12 Months		
Parameter	Units	Permit Limit	Maximum	Number of times > Limit		
Total particulate	kg/min	3.00	0.63	0		
Gaseous fluoride	kg/min	0.65	0.23	0		
Sulphur dioxide	kg/min	23.0	13.3	0		

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 2015 and 2016.



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



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 2015 and 2016.



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



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 2015 and 2016.



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



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 2015 and 2016.



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



Total Condensable Hydrocarbons and Polycyclic Aromatic Hydrocarbons

The annual analysis for total condensable hydrocarbons (TCH) and 16 USEPA priority PAH's was carried out in April 2016. The following graphs shows the annual TCH discharges and the 16 USEPA priority PAH's.

Note: A dispensation was granted by Environment Southland for NZAS not to carry out this monitoring in 2012.





Comments

The discharge of total particulate, sulphur dioxide, particulate fluoride and gaseous fluoride from the Stack were within permit limits for 2016.

In December two Main Stack tests early in the month (6th/7th Dec. and 14th Dec) were aborted due to technical difficulties. Further attempts to gain access were prevented due to inclement weather conditions and a lack of available trained safety/rescue staff. Data reported for December is a calculated average of the previous 12 months data.

The level of total condensable hydrocarbons (TCH) is slightly lower than last year. The levels of the 16 USEPA priority PAH's is the same as for 2015.

Potline Roof Louvre Discharges

Monitoring results

The table below shows the Potline roof louvre monitoring results for 2016. The permit limits are for 12 month running averages. There is no permit limit on maximum emissions in any given month.

		Running 12 month average			
Parameter	Units	Permit Limit	2016	Maximum for any month	
Total particulate	kg/min	1.50	0.76	0.89	
Gaseous fluoride	kg/min	0.21	0.11	0.13	
Particulate fluoride	kg/min	0.30	0.12	0.14	
Sulphur dioxide	kg/min	0.55	0.17	0.22	

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 2015 and 2016.



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 2015 and 2016.



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.



Note:

The Boreal instruments used for continuous monitoring of HF in Potlines were removed for repair and servicing. One instrument was out of service between February and August and the other between September and November. The fault was identical in both instruments.

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 2015 and 2016.



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 2015 and 2016.



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 for 2016.

Line 4 remained closed for 2016 with the Gas Flow Rate for Roof Louvre emissions remaining at 720,800 Sm^3 /min.

Fluoride Discharges

Performance data

The table below shows the fluoride discharges expressed as a ratio of hot aluminium metal production during 2016.

Parameter	Units	2016	Maximum for any month
Main Stack			
• Gaseous fluoride	kg/t Al	0.29	0.36
Particulate fluoride	kg/t Al	0.02	0.08
Total fluoride	kg/t Al	0.31	0.39
Reduction Line Roof Louvres			
• Gaseous fluoride	kg/t Al	0.16	0.20
Particulate fluoride	kg/t Al	0.18	0.22
Total fluoride	kg/t Al	0.34	0.42
Plant			
• Gaseous fluoride	kg/t Al	0.45	0.55
Particulate fluoride	kg/t Al	0.20	0.28
Total fluoride	kg/t Al	0.65	0.80

The following graph shows the monthly main stack fluoride per tonne aluminium discharge during 2015 and 2016.



Performance data, Continued

The following graph shows the average monthly Potline roof louvre fluoride per tonne aluminium discharge during 2015 and 2016.



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 for 2016 remains similar to previous years.

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 2016. The table reflects the 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	Date	Total Particulate discharge (mg/Sm ³⁾	Flow Rate (Sm ³ /min)
T1 Tower	13/1/16	14	190
T1A Tower	21/1/16	1	148
West Reclaim	May/June 16	1	146
Green Carbon Ball Mill	28/7/16	1	146
Green Carbon Nuisance	30/6/16	11	427
Lab Bath Crusher	10/6/16	44	16
Bath Mill East	18/11/16	4	132

Comments

All dust collectors tested during 2016, were found to be within the consent level of 250 mg/Sm 3 .

Main Stack Smoke Discharges

Main Stack smoke discharges were determined by visual observations using the standard Ringlemann chart. The following graph summarises the observations recorded during 2016.



During 2016 there was an increase in the frequency of observations in the 1 to 5% range, a decrease in the 10% range and no observations greater than 10%. The majority of the observations were 0%.

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 2016.

		Pormit	2016	2016	2016
Material	Units	Maximum	Annual Average	Maximum	Minimum
Petroleum Coke	%	4	2.57	2.67	2.44
Pitch	%	1	0.50	0.65	0.28
Heavy Fuel Oil	%	3.5	2.72	2.92	2.49

Comments

All shipments of raw materials and fuels during 2016 met the permit standards for sulphur content.

During 2016 the average sulphur content of the Petroleum Coke decreased from 2.73% in 2015 to 2.57% in 2016. The average sulphur content of the Heavy fuel oil has increased from 2.44% in 2015 to 2.72% in 2016. Sulphur content of Pitch has decreased slightly.

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 2016 wind pattern was dominated by westerly winds. Dispersion conditions are similar to previous years.

The following table shows the predominant winds and total rainfall recorded for each month during 2016.

Month	Predominant Wind Direction	Rainfall (mm)
January	West & South	111
February	West	129
March	West	62
April	West & North	96
May	North & West	56*
June	West & North	66
July	North & West	111
August	North & West	35
September	West, East & North	47
October	West & North	112
November	West	89
December	West	64

Total rainfall for the year is 978mm. The five year running average is 1010mm. The long term average is 1102mm of rainfall.

*May – Faulty rain gauge



Comments

The total rainfall recorded in May was 56mm. This is not a true representation as the rain gauge was out of service from the 17th to the 31st of May.

Part D - Ambient Air

Introduction

This chapter covers the monitoring for gaseous and particulate fluorides in ambient air at two monitoring sites. The No 1 Bore site is monitored twice a year with a one month sampling period. The 1km Hut site is located on Rio Tinto freehold land and is sampled on a weekly basis.

Permit Limits

No limits apply to the 1Km Hut site for particulate and gaseous fluoride. A gaseous fluoride limit applies to the No. 1 Bore Hut site.

The sampling and analysis method used is referenced to AS 3580.1991 and has a detection limit of 0.1 μ g/m³.

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 2015 and 2016. The sampling frequency for ambient air fluoride at this site is seven days.

Parameter	Units	2015	2016
Gaseous Fluoride Concentration			
• Max 7 day average	µg/m³	1.10	0.80
 Max monthly average 	µg/m³	0.60	0.40
Annual average	µg/m³	0.28	0.28
Particulate fluoride concentration			
• Max 7 day average	µg/m³	1.10	0.60
 Max monthly average 	µg/m³	0.60	0.30
 Annual average 	µg/m³	0.15	0.16

Gaseous fluoride

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



Note: Concentrations < 0.1 μ g/m³ are plotted as 0.05 μ g/m³

Particulate Fluoride



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

Note: Concentrations < 0.1 μ g/m³ are plotted as 0.05 μ g/m³

Comments

Concentrations of gaseous & particulate fluoride were within the normal range for the 1km hut site throughout 2016.

Ambient Air at No. 1 Bore on Tiwai Peninsula

Monitoring results

The following table summarises the monitoring results during 2015 and 2016 for the No. 1 Bore site located on Tiwai Peninsula.

Site	Parameter	Units	Limit	2015	2016
No. 1 Bore	Gaseous Fluoride				
	• Max 7 day average	µg/m³	1.0	N.D.	N.D.
	 Max monthly average 	µg/m³	0.5	0.10	0.10
	 Annual average 	µg/m³		< 0.1	< 0.1
	Particulate Fluoride				
	• Max 7 day average	µg/m³		N.D.	N.D.
	 Max monthly average 	µg/m³		0.10	< 0.1
	 Annual average 	µg/m³		< 0.1	< 0.1

N.D: Not Determined.

Comments

Gaseous and particulate fluoride concentrations are similar to those previously reported.

Part E - Atmospheric Deposition

Introduction

This chapter covers the monitoring of atmospheric deposition at two monitoring sites. Monitoring was carried out monthly until the end of 2014. During the subsequent years monitoring has been biannually and is usually done for the months of March & October.

Permit Guidelines

No guidelines are applicable to the two monitoring sites that are located on Tiwai land

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 2016 is summarised in the following table.

Site	Units	Mar-16	Oct-16
D2. (No1 Bore)	g/m ³	0.23	0.16
D12. (TEF2)	g/m ³	< 0.05	< 0.05



Comments

Fluoride levels at both sites are similar to previous years

Part F - Fluoride in Ungrazed Grass

Introduction

This chapter covers the monitoring of fluoride in ungrazed grasses at 13 monitoring sites located on Tiwai Peninsula. This monitoring is carried out biannually, usually, in March & October.

Permit Guidelines

There are no guidelines since changes were made to the Discharge to Air Consent in December 2014.

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 the monitoring results of ungrazed vegetation sites for 2015 and 2016.

	Permit	2015	2016
Site	Guideline	Av Fluoride	Av Fluoride
	mg/kg	mg/kg	mg/kg
1	NA	8	13
2	NA	42	85
3	NA	43	93
4	NA	650	306
5	NA	17	12
6	NA	56	31
8	NA	7	8
9	NA	13	11
11	NA	9	4
12	NA	11	8
13	NA	5	4
15	NA	5	4
16	NA	17	18

NA – Guideline not applicable.

Comments

The average fluoride levels for each site are similar to concentration levels measured in previous years.

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 m³/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.



Monitoring Results

The total volume of water taken from the aquifer was recorded daily until early December 2012. Due to organisational restructuring the readings are no longer done in the weekends or public holidays. The practice now is to take the reading on the first available day and record the average. The data 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-16	2263	2475		
Feb-16	2134	2687		
Mar-16	1587	1928		
Apr-16	1574	1953		
May-16	1542	2160		
Jun-16	1635	2234		
Jul-16	1642	1968		
Aug-16	1617	2199		
Sep-16	1605	1928		
Oct-16	1734	2190		
Nov-16	1626	2092		
Dec-16	1562	1842		
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) <i>Total well depth in Italics</i>									
		So	uth		Boro 1	North			
Date	D	С	В	Α	DOIG	Α	В	С	D
	5.64	5.50	5.50	4.62	16.4	5.32	5.30	5.55	5.27
Jan-16	2.73	2.23	3.84	2.40	1.87	3.05	3.17	4.08	5.00
Feb-16	2.63	2.13	3.65	1.70	1.70	2.90	2.95	3.65	4.70
Mar-16	2.80	2.25	3.75	2.40	1.90	3.15	3.40	4.20	4.80
Apr-16	2.70	2.20	3.65	2.40	1.80	3.00	3.10	4.00	4.85
May-16	2.40	1.80	3.10	1.90	1.30	2.60	2.70	3.60	4.80
Jun-16	2.40	1.85	3.30	2.00	1.40	2.60	2.80	3.90	4.90
Jul-16	2.30	1.70	3.30	1.90	1.30	2.50	2.65	3.60	4.80
Aug-16	2.40	1.80	3.50	2.20	1.40	1.70	2.90	4.00	4.90
Sep-16	2.60	2.00	3.60	2.20	1.65	2.90	3.20	4.20	5.00
Oct-16	2.50	2.00	3.50	2.20	1.80	2.80	3.00	4.00	5.00
Nov-16	2.70	2.10	3.70	2.50	1.70	3.00	3.20	4.00	4.70
Dec-16	2.90	2.40	3.90	2.60	2.00	3.30	3.50	4.30	4.90



East Monitoring Bore Water Levels (from Mean High Sea Level in metres)									
Total well depth in Italics									
		Soι	ıth				Nor	th	
Date	D	С	В	Α	Bore 6	Α	В	С	D
	4.32	5.35	5.79	3.82	8.6	5.46	5.4	5.45	5.5
Jan-16	3.74	4.08	3.84	dry	2.83	5.38	3.93	3.73	4.00
Feb-16	3.55	3.90	3.65	dry	3.02	5.38	3.73	3.50	3.80
Mar-16	3.70	4.00	3.75	dry	2.75	5.40	3.85	3.70	4.00
Apr-16	3.60	3.90	3.65	dry	3.30	5.40	3.70	3.50	3.85
May-16	3.10	3.50	3.10	3.50	2.20	4.90	3.20	3.10	3.50
Jun-16	3.20	3.50	3.30	3.70	2.30	5.10	3.40	3.30	3.65
Jul-16	3.10	3.40	3.30	3.60	2.40	5.00	3.30	3.10	3.50
Aug-16	3.30	3.80	3.50	dry	2.30	5.10	3.50	3.30	3.70
Sep-16	3.60	3.90	3.60	dry	2.50	5.30	3.70	3.50	3.90
Oct-16	3.40	3.80	3.50	dry	2.50	5.30	3.60	3.50	3.80
Nov-16	3.60	4.00	3.70	dry	2.60	5.40	3.70	3.60	3.90
Dec-16	3.80	4.10	3.90	dry	3.60	5.40	4.00	3.80	4.90



Comments

Water levels in the monitoring bores have not changed significantly during 2016. Bore South A was dry for 9 of the 12 months as reflected in the graph above compared to 8 of the 12 months in 2015.

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 	m³/day	140
 Total suspended solids 	g/m ³	100
Free cyanide	g/m ³	20
Treated sewage		
Maximum daily flow	m³/day	295
 Biochemical oxygen demand 	kg/day	18
 Total suspended solids 	kg/day	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°C and the natural temperature of the water shall not exceed 25°C;
- 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 of 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 20%;
- 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 2g/m³ 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 5g/m³.

Site Locations



The locations of liquid discharges and their 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 from the cathode pad treatment facility is sampled once per batch of treated effluent. However, due to a batch of effluent that was over the suspended solid consent limit being discharged in November a pre sample is now taken to check for suspended solids only, prior to the actual sample being taken.

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. The coastal water monitoring sites are chosen to monitor the effects of discharges on coastal waters. The 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 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 Average
Total Suspended solids	g/m ³		12.3	13.1
 Maximum Quarterly Average 	g/m³	30	15.1	15.1
 No. of Times Quarterly Average >30 g/m³ 		0	0	0
рН			7.6	7.6
Fluoride	g/m ³		5.3	6.3
Conductivity	µS/cm		43220	41434

Coastal water monitoring results

The following table summarises the North Drain weekly coastal water monitoring results during 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 Average
Fluoride	g/m ³		1.3	1.3
Maximum Quarterly Average	g/m³	2	1.3	1.3
 No. of Times Quarterly Average >2.0 g/m³ 		0	0	0
 Maximum Individual Sample 	g/m³	5	2.2	1.7
• No of Times Individual Sample > 5.0 g/m ³			0	0
рН			8.1	8.1
Conductivity	µS/cm		51366	51038
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 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Result	2016 Result
Fluoride	g/m ³		1.3	1.3
Maximum Quarterly Average	g/m³		1.3	1.3
• No. of Times Quarterly Average >2.0 g/m ³			0	0
Maximum Individual Sample	g/m³		1.8	1.4
• No of Times Individual Sample > 5.0 g/m ³			0	0
рН			8.1	8.1
Conductivity	µS/cm		51460	50948
Visible Oil - No. of times Observed			0	0

Annual Monitoring results

The following table summarises the North Drain annual coastal water monitoring results during 2016 and shows a comparison with 2015 results.

Site	Parameter	Units	Limit	2015	2016
Discharge	Temperature	°C		16.2	13.2
Seawater	Temperature	°C	<25	16.3	13.2
	Dissolved oxygen	mg/L	>= 5	8.1	9.9
	Dissolved Oxygen Saturation	%	>80	88.3	92.7
Control	Temperature	°C	<25	15.9	13.1
	Dissolved oxygen	mg/L	>= 5	8.2	9.7
	Dissolved Oxygen Saturation	%	>80	85.1	94.5
	Change to temperature	°C	3	0.4	0.1

Comments

Discharges from the North Drain were within permit limits during 2016.

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 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 Average
Total Suspended solids	g/m ³		2.5	2.9
Maximum Quarterly Average	g/m³	30	4.2	5.2
 No. of Times Quarterly Average >30 g/m³ 		0	0	0
рН			6.6	6.6
Fluoride	g/m ³		5.0	5.2
Conductivity	µS/cm		434	409

Coastal water monitoring results

The following table summarises the South Drain weekly coastal water monitoring results during 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 Average
Fluoride			1.3	1.3
Maximum Quarterly Average	g/m ³	2	1.4	1.3
 No. of Times Quarterly Average >2.0 g/m³ 	g/m³	0	0	0
 Maximum Individual Sample 		5	1.5	1.7
• No of Times Individual Sample > 5.0 g/m ³	g/m ³		0	0
рН			8.1	8.1
Conductivity			50183	50133
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 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Result	2016 Result
Fluoride	g/m ³		1.3	1.3
Maximum Quarterly Average	g/m³		1.3	1.3
 No. of Times Quarterly Average >2.0 g/m³ 			0	0
Maximum Individual Sample	g/m³		1.6	1.6
• No of Times Individual Sample > 5.0 g/m ³			0	0
рН			8.1	8.1
Conductivity	µS/cm		50466	50648
Visible Oil - No. of times Observed			0	0

Annual monitoring results

The following table summarises the South Drain annual water monitoring results during 2016 and shows a comparison with 2015 results.

Site	Parameter	Units	Limit	2015	2016
Discharge	Temperature	°C		16.7	14.9
Seawater	Temperature	°C	<25	13.9	12.4
	Dissolved oxygen	mg/L	>= 5	10.3	9.8
	Dissolved Oxygen Saturation	%	>80	100	94.4
Control	Temperature	°C	<25	14.3	12.9
	Dissolved oxygen	mg/L	>= 5	10.4	9.3
	Dissolved Oxygen Saturation	%	>80	101	87.8
	Change to temperature	°C	3	0.4	0.5

Comments

Discharges from the South Drain were within permit limits during 2016.

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.

Discharge monitoring results

The following table summarises the West Drain discharge monitoring results during 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 Average
Total Suspended solids	g/m ³		9.8	9.8
Maximum Quarterly Average	g/m³	30	14.6	11.8
 No. of Times Quarterly Average >30 g/m³ 		0	0	0
рН			7.4	7.4
Fluoride	g/m ³		2.1	2.2
Conductivity	µS/cm		11820	11202

Coastal water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Average	2016 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/m³ 	g/m³	0	0	0
Maximum Individual Sample		5	1.4	1.5
• No of Times Individual Sample > 5.0 g/m^3	g/m ³		0	0
рН			8.1	8.1
Conductivity			51390	51046
Visible Oil - No. of times Observed			0	0

Control Site water monitoring results

The following table summarises the West Drain weekly coastal water monitoring results during 2016 and shows a comparison with 2015 results.

Parameter	Units	Limit	2015 Result	2016 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	1.5
• No of Times Individual Sample > 5.0 g/m ³			0	0
рН			8.1	8.1
Conductivity	µS/cm		50466	50648
Visible Oil - No. of times Observed			4	0

Annual water monitoring results

The following table summarises the West Drain annual water monitoring results during 2016 and shows a comparison with 2015 results.

Site	Parameter	Units	Limit	2015	2016
Discharge	Temperature	°C		14.6	14.5
Seawater	Temperature	°C	<25	14.4	13.5
	Dissolved oxygen	mg/L	>= 5	9.9	9.9
	Dissolved Oxygen Saturation	%	>80	97.1	96.3
Control	Temperature	°C	<25	14.6	13.6
	Dissolved oxygen	mg/L	>= 5	9.9	9.9
	Dissolved Oxygen Saturation	%	>80	97	97.7
	Change to temperature	°C	3	0.2	0.1

Comments

Discharges from the West Drain were all within permit limits during 2016.

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 2015 and 2016. The permit limit for daily flow is $295m^3/day$.



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 (CBOD₅) discharge from the sewage treatment plant during 2015 and 2016. The permit limit for CBOD₅ 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 in the discharge from the sewage treatment plant during 2015 and 2016. 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 40.

Boromotor	Unito	2015	2016	Previous Range
Farameter	Units	Average	Average	(post commission)
North Bore (Upstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2
Total phosphorus	g/m ³	0.33	0.35	0.046 - 0.68
Total ammoniacal-N	g/m ³	<0.01	0.01	< 0.01 - 0.03
Nitrate-N	g/m ³	<0.01	0.01	< 0.01 - 0.058
Total Nitrogen	g/m ³	0.10	0.19	0.02 - 0.4
рН		7.9	7.9	7.4 - 8.1
Conductivity	µS/cm	363	356	305 - 399
Chlorinated Aliphatic HC	g/m ³	B.L	ND	B.L.
South Bore (Downstream)				
Faecal coliforms	MPN/100 ml	Absent	Absent	< 2 - 65
Total phosphorus	g/m ³	0.024	0.18	< 0.01 - 0.14
Total ammoniacal-N	g/m ³	<0.01	<0.01	< 0.01 - 0.02
Nitrate-N	g/m ³	0.22	0.23	< 0.01 - 0.54
Total Nitrogen	g/m ³	0.44	0.75	0.05 - 0.78
рН		7.6	7.7	6.8 - 7.9
Conductivity	µS/cm	440	444	227 - 503
Chlorinated Aliphatic HC	g/m ³	B.L	ND	B.L.

Chlorinated Aliphatic Hydrocarbons only determined biennially.

ND - not done

BL - below detection limit

Comments

The discharges of treated sewage onto land during 2016 were similar to previously seen. The downstream South Bore has shown an increase in phosphorus and total nitrogen compared to levels in 2015, but are still within previously seen levels.

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 2016 and shows a comparison with the 2015 results.

Parameter	Units	Limits	2015 Result	2016 Result
Maximum daily discharge	m ³ /day	140	80	80
Suspended Solids Maximum Concentration			38	120
Average Concentration	g/m ³	100	5.0	17.7
No.> 100 g/m ³		0	0	1
Free Cyanide				
Maximum Concentration	g/m ³	20	4.3	6.8
Average Concentration	_		1.9	1.5
No.> 20 g/m ³		0	0	0

The following graph shows the free cyanide concentration of treated effluent discharged during 2016



Discharge monitoring results, continued

The following graph shows the total suspended solids concentration of treated effluent discharged during 2016.



Discharge rate

The following table shows the average, maximum and minimum discharge rates for the discharge of treated effluent to Foveaux Strait during 2014, 2015 and 2016.

There were 34 discharges throughout 2016 with a total volume of 2720m³ discharged.

Deremeter	Unito	2013	2014	2015
Farameter	Units	Result	Result	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

Comments

On 26th Oct 80m³ of cathode effluent (one batch) that was over the permit limit for suspended solids was discharged. Environment Southland where informed and no further action was required. On the basis of this discharge NZAS now collects a pre discharge sample for checking of suspended solid concentration prior to discharge of effluent.

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	2015	2016
Coastal	Fluoride	g.m ⁻³		1.3	1.2
	Total Cyanide	g.m ⁻³		<0.008	<0.01
	Conductivity	µS/cm		50668	52500
	рН			8.1	8.1
	Dissolved Oxygen	mg/L	>=5	11.8	9.5
	% Saturation	%	>80	104.0	98.3
	Temperature	°C	<25	8.9	15.6
Control	Fluoride	g.m ⁻³		1.3	1.2
	Total Cyanide	g.m ⁻³		<0.008	<0.01
	Conductivity	µS/cm		50360	52500
	рН			8.1	8.1
	Dissolved Oxygen	mg/L	>=5	11.7	9.4
	% Saturation	%	>80	106.0	98.7
	Temperature	°C	<25	9.1	16.0
	Change to Temperature	°C	3	0.2	0.4

Condition of the Cathode Discharge Structure

The Cathode Outfall Discharge Structure including the diffuser was inspected on 14th March. Overall the structure was found to be in good condition in an upright position on the seafloor as intended with parts having between 65-75% of their life remaining until replacement will be needed. Growth on the structure was found to be similar to other years. The structure was scraped clean making sure to leave any small snails in place. The snails seem to stop the sea tulips attaching themselves to the structure. All discharge tubes were cleaned of growth and blockages removed.



Out fall structure before cleaning

Main diffuser pipe after cleaning

Comments

The annual coastal water monitoring parameters were all within permit limits for 2016.

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.

The general operation of the on-site landfill is outlined in the NZAS Landfill Management Plan. Additional details on the proposed operations during 2017 are included in the following sections:

- proposed operation at the landfill for 2017,
- comments on operations for 2016,
- amount and type of materials deposited, and
- 2016 groundwater monitoring results.

Proposed Operation For 2017

The operation of the General waste, Clean fill and MMMF areas will continue with no major changes proposed for 2017. Those areas have capacity for many years of future landfilling and do not require any structural changes within the next 12 months.



Carbon Waste

The current carbon waste tipping area was opened in 2002 and it is anticipated that this area will be at full capacity within the next 12 - 18 months. The NZAS consent allows for a new tipping area to be opened in the future at the NZAS landfill. Investigations into possible new tipping areas are continuing. TAHA defaulted in 2016 so the possibility of backfilling the MRP area as the dross is mined out may no longer be a viable option.

Comments on operations for 2016

General Waste

The general waste tip had the gravel wall extended on the western side to shelter from the westerly winds. The face was worked from the west to the east along the access road. The long term intentions are to increase the height of the area rather than enlarge the foot print. The general waste area was progressively capped with pea gravel as per the Landfill Management Plan.

Man Made Mineral Fibre Area

The pit that was dug south of the old pit in 2015 is still in use and will provide enough capacity for another 1-2 years with the current rate of waste produced.

Metal Reclamation Plant Stockpile

Dross was not mined from the old MRP area during 2016. TAHA placed dross that was hard to process back onto the pile during the year. On 1 August 2016 TAHA was placed into receivership and stopped processing dross. Dross is currently containerised for further processing when new contractor is established on site in late 2017.

Carbon Dust Tipping Area

Further drain pipes were added to the carbon pile to prevent pooling of rain water in the area.

Timber Stockpile

In November 2016 the waste wood pile was chipped by external contractor to reduce the volume. Staff and contractors were allowed to remove waste wood from site for firewood.



General waste area with wood pile chipped

Introduction

As per NZAS' consent conditions for landfill operations, a report detailing waste sent to landfill is required to be submitted every second year. The last full report was for the calendar year 2015.

In December 2013 TrueSouth Surveyors performed the first aerial drone survey of the NZAS landfill using UAV and photogrammetry. This was to create a baseline for the future method to produce highly detailed orthometric photos as well as contour plans and calculate the volumes of the various stockpiles. This method has been used for estimates of waste from 2014 onwards. The following areas are surveyed at least annually:

- general waste,
- clean fill,
- carbon,
- MRP dross, and
- Haysom's dross



The December 2016 survey provided the following estimates for volumes of material deposited during 2016:

Waste deposited at NZAS Landfill in 2016				
Waste Material	Increase (m3)	Comments		
General pile	1231	Slight increase on 2015 volume. Likely to be due to more gravel mixed in to cover waste to ensure is it not blown away		
Clean pile	941	100% increase on 2015 volume mainly due to extra concerete and floor bricks		
Carbon pile	3007	Similar to last year		
MRP dross	818	Material TAHA rejected for processing went back onto the MRP pile. New arisings are containerised for future processing		

To ensure that the photogrammetry method is reliable the Haysom's dross pile was measured as a control site. This pile had no material added or removed between 2013 and 2016. The following results were obtained:

Control Sites					
Waste Material Increase (m3) Comments					
2003 Haysoms dross	441	Equates to a height increase of 15mm which is likely to be natural increase in the vegetation on the pile.			

The table above shows that the aerial survey method is highly accurate if no vegetation is present. There is no vegetation on the current general, clean, carbon or MRP piles.

Comments on Carbon Pile

The individual waste streams deposited in the carbon area is weighed and summarized in table below. The increase is mainly due to less carbon waste recycled back into the process so more high purity metal can be produced. This trend may continue as NZAS is continuously striving to optimise the production of pure aluminium.

Measured Process Waste to the NZAS Carbon Pile By Material 2013 - 2016						
Material Weighed	2013	2014	2015	2016		
Alumina	12	53	30	24		
Carbon	2320	2562	2744	2772		
Furnace Slag (mainly carbon)	283	333	386	411		
Reject Bath	120	14	59	9		
Resistor Coke (mainly carbon)*	528	606	648	303		
Miscellaneous (Mixture)	325	30	54	148		
Total Process (tonnes)	3588	3598	3921	3667		

*A change from carbon to graphite on start-up of cells resulted in a reduction in quantity of solid material removed from the cell when it is operating.

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.



Bore A20 monitoring results

The table below shows a summary of results from samples collected from bore A20 during 2015 and 2016. Bore A20 is located north of the landfill (upstream).

Analyte	Units	2015 Average	2016 Average	Range (since Commissioning)
Temperature	⁰ C	12.3	N.D.	7.5 - 13.4
рН		5.9	6.2	5.1 - 7.2
Conductivity	µS/cm	856	601	635 - 1063
Alkalinity	g/m ³	31	55	8 - 240
Carbonaceous BOD5	g/m ³	<2	<2	<1 - 6
Total Nitrogen	g/m ³	1.30	2.60	0.1 - 2.1
Total Ammoniacal Nitrogen	g/m ³	0.21	0.35	0.02 - 0.34
Fluoride	g/m ³	2.00	8.10	0.03 - 11
Sulphate	g/m ³	34	19	21 - 55
Total Iron	g/m ³	7.05	8.15	0.46 - 26
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 11.6
Total Kjeldahl Nitrogen	g/m ³	1.24	2.50	0.2 - 2
Nitrate Nitrogen	g/m ³	<0.2	N.D.	<0.002 - 14
Nitrite Nitrogen	g/m ³	<0.2	N.D.	<0.002 - 0.014
Weak Acid Dissociable Cyanide	g/m ³	<0.001	N.D.	<0.001 - 0.1
Boron	g/m ³	0.066	N.D.	0.032 - 0.067
Manganese	g/m ³	0.153	N.D.	0.111 - 0.394
Nickel	g/m ³	0.0042	N.D.	0.0018 - 0.01
Potassium	g/m ³	4	N.D.	2.9 - 4.1
Vanadium	g/m ³	0.0073	N.D.	<0.001 - 0.0079





Bore A21 monitoring results

The table below shows a summary of results from samples collected from bore A21 during 2015 and 2016. Bore A21 is located north of the landfill (upstream).

Analyte	Units	2015	2016	Range (since
		Average	Average	Commissioning)
Temperature	0 ⁰	11.7	N.D.	6.5 - 13.7
рН		5.8	6.1	5.1 - 6.9
Conductivity	µS/cm	766	591	502 - 1723
Alkalinity	g/m ³	32	82	1 - 160
Carbonaceous BOD5	g/m ³	<2	<2	<0.1 - 16
Total Nitrogen	g/m ³	3.7	4.3	0.7 - 8
Total Ammoniacal Nitrogen	g/m ³	0.6	0.6	0.1 - 4.6
Fluoride	g/m ³	2.9	4.0	0.2 - 3.8
Sulphate	g/m ³	37	15	8 - 114
Total Iron	g/m ³	10.1	18.5	0.66 - 94.6
Naphthalene	mg/m ³	<0.001	<0.001	<0.1 - 1
Anthracene	mg/m ³	<0.00002	<0.00002	<0.02 - 0.2
Phenanthrene	mg/m ³	<0.00002	<0.00002	<0.005 - 0.2
Fluoranthene	mg/m ³	<0.00002	<0.00002	<0.02 - 0.2
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 7.3
Total Kjeldahl Nitrogen	g/m ³	3.65	4.5	0.8 - 6.5
Nitrate Nitrogen	g/m ³	0.06	N.D.	0 - 29
Nitrite Nitrogen	g/m ³	<0.02	N.D.	<0.002 - 0.028
Weak Acid Dissociable Cyanide	g/m ³	0.0012	N.D.	<0.001 - 0.1
Boron	g/m ³	0.103	N.D.	0.07 - 0.154
Manganese	g/m ³	0.091	N.D.	0.064 - 0.473
Nickel	g/m ³	0.0039	N.D.	<0.0005 - 0.007
Potassium	g/m ³	6.6	N.D.	5 - 11
Vanadium	g/m ³	0.0102	N.D.	0.001 - 0.043







Bore A41 monitoring results

The table below shows a summary of results from samples collected from bore A41 during 2015 and 2016. Bore A41 is located north of the Haysoms' area (upstream).

Analyte	Units	2015 Average	2016 Average	Range (since Commissioning)
рН	-	6.7	5.8	5.8 - 7.9
Alkalinity	g/m ³	46	9	8.6 - 170
Temperature	⁰ C	11.7	N.D.	5.8 - 7.9
Conductivity	µS/cm	465	413	282 - 984
Carbonaceous BOD ₅	g/m ³	<2	<2	0.5 - 1
Fluoride	g/m ³	1.2	1.3	0.25 - 5
Sulphate	g/m ³	22	25	19.2 - 47
Total Iron	g/m ³	0.10	0.11	0.04 - 0.63
Boron	g/m ³	0.06	N.D.	0.04 - 4.1
Manganese	g/m ³	<0.01	N.D.	<0.01 - 0.023
Potassium	g/m ³	0.97	N.D.	0.27 - 4.8
Vanadium	g/m ³	0.97	N.D.	<0.002 - 0.011
Nickel	g/m ³	0.0007	N.D.	0.0005 - 0.004
Ammoniacal-Nitrogen	g/m ³	<0.01	<0.01	0.005 - 0.16
Total Nitrogen	g/m ³	0.68	0.63	0.39 - 26
Total Kjeldahl Nitrogen	g/m ³	0.45	0.53	0.28 - 3.1
Nitrate Nitrogen	g/m ³	0.22	N.D.	0.22 - 23
Nitrite Nitrogen	g/m ³	<0.02	N.D.	<0.002 - 0.2
Total Petroleum Hydrocarbons	g/m ³	<1.5	N.D.	<1
Weak Acid Dissociable Cyanide	g/m ³	0	N.D.	0.0005 - 0.0035

Bore A22 monitoring results

The table below shows the averages of results from samples collected from bore A22 during 2015 and 2016. Bore A22 is located west of the landfill.

Analyte	Units	2015 Average	2016 Average	Range (since Commissioning)
Temperature	⁰ C	11.1	N.D.	8.6 - 12.1
рН		4.9	5.1	4.2 - 7.3
Conductivity	µS/cm	601	595	354 - 1204
Alkalinity	g/m ³	10	19	1 - 294
Carbonaceous BOD5	g/m ³	6	5.0	<1 - 15
Total Nitrogen	g/m ³	8.7	8.2	0.42 - 8.7
Total Ammoniacal Nitrogen	g/m ³	2.40	2.35	0.01 - 2.4
Fluoride	g/m ³	3.2	3.3	0.03 - 4
Sulphate	g/m ³	3	5	0 - 165
Total Iron	g/m ³	1.83	4.40	0.59 - 4.5
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 4.5
Total Kjeldahl Nitrogen	g/m ³	8.7	8.1	0.9 - 8.7
Nitrate Nitrogen	g/m ³	0.1	N.D.	<0.02 - 0.2
Nitrite Nitrogen	g/m ³	0.1	N.D.	<0.002 - 0.13
Weak Acid Dissociable Cyanide	g/m ³	0.003	N.D.	<0.001 - 0.1
Boron	g/m ³	0.055	N.D.	0.006 - 0.071
Manganese	g/m ³	0.0175	N.D.	0.0049 - 0.394
Nickel	g/m ³	0.0031	N.D.	0.0007 - 0.01
Potassium	g/m ³	5.1	N.D.	1.65 - 5.3
Vanadium	g/m ³	0.0049	N.D.	0.002 - 0.022







Bore A23 monitoring results

The table below shows a summary of results from samples collected from bore A23 during 2015 and 2016. Bore A23 is located west of the landfill.

Analyte	Units	2015	2016	Range (since
		Average	Average	Commissioning)
Temperature	⁰ C	11.3	N.D.	9 - 12.5
рН		6.0	5.9	5.4 - 6.4
Conductivity	µS/cm	532	496	378 - 745
Alkalinity	g/m ³	30	31	31 - 60
Carbonaceous BOD5	g/m ³	1	<2	<1 - 5
Total Nitrogen	g/m ³	2.20	2	0.88 - 2.7
Total Ammoniacal Nitrogen	g/m ³	1.0	1	0.05 - 1.4
Fluoride	g/m ³	0.3	0.3	<0.1 - 0.36
Sulphate	g/m ³	1.25	0.7	0.25 - 30
Total Iron	g/m ³	5.3	4.4	2.6 - 13
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1 - 7.2
Total Kjeldahl Nitrogen	g/m ³	2.2	1.975	1.1 - 2.3
Nitrate Nitrogen	g/m ³	0.01	N.D.	<0.02 - 0.05
Nitrite Nitrogen	g/m ³	0.01	N.D.	<0.02 - 0.019
Weak Acid Dissociable Cyanide	g/m ³	<0.001	N.D.	<0.001 - 0.1
Boron	g/m ³	0.05	N.D.	0.04 - 0.05
Manganese	g/m ³	0.055	N.D.	0.05 - 0.12
Nickel	g/m ³	0.0032	N.D.	<0.0005 - 0.0016
Potassium	g/m ³	4	N.D.	4 - 5
Vanadium	g/m ³	0.0095	N.D.	0.013 - 0.021

Bore A24 monitoring results

The table below shows a summary of results from samples collected from bore A24 during 2015 and 2016. Bore A24 is located east of the landfill.

Analyte	Units	2015	2016	Range (since
		Average	Average	Commissioning)
Temperature	⁰ C	11.2	N.D.	9.4 - 12.8
рН		8.5	8.4	6.9 - 8.7
Conductivity	µS/cm	3465	3295	447 - 7290
Alkalinity	g/m ³	1235	1145	108 - 2600
Carbonaceous BOD5	g/m ³	27	23	2 - 120
Total Nitrogen	g/m ³	193	164	16.8 - 560
Total Ammoniacal Nitrogen	g/m ³	152	134	28.2 - 450
Fluoride	g/m ³	72	68	<0.1 - 120
Sulphate	g/m ³	79	101	0 - 312
Total Iron	g/m ³	26	23	8.2 - 60
Naphthalene	mg/m ³	0	0.29	0.06 - 510
Anthracene	mg/m ³	0.0010	0.00045	<0.3 - 1.2
Phenanthrene	mg/m ³	0.0039	0.0028	<0.3 - 4.9
Fluoranthene	mg/m ³	0.00105	0.00055	<0.3 - 1
Total Petroleum Hydrocarbons	g/m ³	2	N.D.	<1 - 18.6
Total Kjeldahl Nitrogen	g/m ³	192	163	63 - 560
Nitrate Nitrogen	g/m ³	1	N.D.	0.05 - 33
Nitrite Nitrogen	g/m ³	1	N.D.	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m ³	0.013	N.D.	<0.01 - 0.1
Boron	g/m ³	8.2	N.D.	4.1 - 17
Manganese	g/m ³	0.117	N.D.	0.084 - 0.22
Nickel	g/m ³	0.03	N.D.	0.004 - 0.05
Potassium	g/m ³	43	N.D.	11 - 79
Vanadium	g/m ³	0.93	N.D.	0.21 - 2.54









Bore A6 monitoring results

The table below shows a summary of results from samples collected from bore A6 during 2014 and 2015. Bore A6 is located south east of the landfill.

Analyte	Units	2015	2016	Range (since
		Average	Average	Commissioning)
Temperature	0 ⁰	11.2	N.D.	9.4 - 12.8
рН		8.5	8.4	6.9 - 8.7
Conductivity	µS/cm	3465	3295	447 - 7290
Alkalinity	g/m ³	1235	1145	108 - 2600
Carbonaceous BOD5	g/m ³	27	23	2 - 120
Total Nitrogen	g/m ³	193	164	16.8 - 560
Total Ammoniacal Nitrogen	g/m ³	152	134	28.2 - 450
Fluoride	g/m ³	72	68	<0.1 - 120
Sulphate	g/m ³	79	101	0 - 312
Total Iron	g/m ³	26	23	8.2 - 60
Naphthalene	mg/m ³	0	0.29	0.06 - 510
Anthracene	mg/m ³	0.0010	0.00045	<0.3 - 1.2
Phenanthrene	mg/m ³	0.0039	0.0028	<0.3 - 4.9
Fluoranthene	mg/m ³	0.00105	0.00055	<0.3 - 1
Total Petroleum Hydrocarbons	g/m ³	2	N.D.	<1 - 18.6
Total Kjeldahl Nitrogen	g/m ³	192	163	63 - 560
Nitrate Nitrogen	g/m ³	1	N.D.	0.05 - 33
Nitrite Nitrogen	g/m ³	1	N.D.	0.01 - 1.3
Weak Acid Dissociable Cyanide	g/m ³	0.013	N.D.	<0.01 - 0.1
Boron	g/m ³	8.2	N.D.	4.1 - 17
Manganese	g/m ³	0.117	N.D.	0.084 - 0.22
Nickel	g/m ³	0.03	N.D.	0.004 - 0.05
Potassium	g/m ³	43	N.D.	11 - 79
Vanadium	g/m ³	0.93	N.D.	0.21 - 2.54






Landfill Groundwater Monitoring, Continued

Bore T1A monitoring results

The table below shows a summary of results from samples collected from bore T1A in 2014 and 2015. Bore T1A is located east of the Haysoms DWP area.

Analyte	Units	2015 Average	2016 Average	Range (since
pН	-	7.3	7.4	6.8 - 9.6
Alkalinity	g/m ³	198	240	107 - 2110
Temperature	⁰ C	12.4	N.D.	10.6 - 13.7
Conductivity	µS/cm	1125	819	473 - 8930
Carbonaceous BOD ₅	g/m ³	<2	<2	<1 - 10
Fluoride	g/m ³	5	7	<0.1 - 210
Sulphate	g/m ³	39	21	17.4 - 338
Total Iron	g/m ³	0.06	<0.04	0.01 - 15.3
Boron	g/m ³	2.1	N.D.	0.05 - 12.6
Manganese	g/m ³	0.17	N.D.	0.0006 - 0.253
Potassium	g/m ³	25	N.D.	2.44 - 69.1
Vanadium	g/m ³	0.04	N.D.	<0.01 - 0.34
Nickel	g/m ³	<0.001	N.D.	<0.0005 - 0.044
Ammoniacal-Nitrogen	g/m ³	11	1.2	<0.01 - 580
Total Nitrogen	g/m ³	55	12	1.5 - 783
Total Kjeldahl Nitrogen	g/m ³	11	2	0.4 - 630
Nitrate Nitrogen	g/m ³	28	N.D.	1.25 - 229
Nitrite Nitrogen	g/m ³	<0.02	N.D.	0.003 - 20.8
Total Petroleum Hydrocarbons	g/m ³	0.4	N.D.	<1
Weak Acid Dissociable Cyanide	g/m ³	0.001	N.D.	<0.001 - 0.325

N.D: Not analysed – only required biennially.







Comments

The first survey for 2016 was carried out at the end of April and the second in November.

Two of the upstream bores (A20, A21) continue to show low, but increasing, levels of fluoride and total nitrogen and low levels of sulphate. The typical levels are fluoride 1-10gm³, total nitrogen 1-6gm³, sulphate 15-40gm³.

TPH and PAHS' are below the detection limit in Bore A21.

The upstream bore, A41, has analytes remaining at steady low levels.

The bores to the west of the landfill (A22 and A23) also show low levels of analytes with a slight increasing trend for total nitrogen in bore A22.

The bore to the east of the landfill (A24) shows a consistent level of between 60-120gm³ of fluoride, decreasing levels of total nitrogen over 10 years from 500gm³ to under 200gm³. The level of sulphate remains consistent. PAHs have been found at variable levels over the past 10 years but have now remained stable at the DL since 2014.

The bore to the south east of the landfill (A6) has showed an overall decrease in total nitrogen and sulphate. Fluoride has shown an increasing trend from 2007 to the end of 2015. During 2017 the level has decreased and levelled off. Cyanide levels remain low, TPH and PAH's are at the detection limit.

The bore located to the east of Haysom's DWP area (T1A) shows decreasing levels of analytes. No material has been added or removed from the Haysoms Dross fill since it was buried in 2003.

Part L - Groundwater

Spent Cathode Pad Leachate

Monitoring of the groundwater during 2016 showed similar levels to 2015.

Spent Cell Lining Storage Shed

Monitoring of the membranes under the Spent Cell Lining storage shed continued during 2016. The concentration of fluoride and cyanide in the liquid between the membranes has not changed significantly.

Monitoring of the groundwater around the shed showed 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 increased the metal production slightly in 2016 compared to 2015 by having more cells operating at any given time. This was achieved by faster turnaround time for rebuilding cells after failure. Line 4 has not been operating since 2011.

Carbon Dioxide - 2016

The total calculated carbon dioxide equivalent (CO₂-e) discharge from NZAS during the year ending 31 December 2016 was 651,840 tonnes. This was 2% less CO₂-e than last year and with metal production increased by 5,340 tonnes. The average emission rate in 2016 was 1.93 t CO₂-e / per tonne of aluminium produced, which is the best result in the last 5 years.



The total calculated CO_2 equivalents are emitted from carbon consumption (anodes), perfluorocarbons generation (PFCs) and fuel usage. The contribution from PFCs and fuels decreased on 2015 values due to a fuel efficiency project in the baking furnaces and better process stability in the Reduction Lines. The percentage distribution is displayed on the next page.



Anodes – 2016

82.8% 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).

Perfluorocarbons – 2016

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. Greater cell stability was observed in 2016 with fewer anode effects which led to a slightly improved performance of the total quantity of PFCs discharged. The percentage of PFC's emitted as CO_2 equivalent out of the total greenhouse gas emission is 1% lower compared to 2015. In previous years it has typically been around 10%.

Fuel – 2016

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 improved during 2016 by 8%. The overall greenhouse gas contribution from fuels is now under 8% which was last seen in 2008. It typically sits around 10%.

End of Report for 2016