Nyrstar Hobart Triennial Public Environment Report 2019 – 2021

VERSION 2: SUBMITTED 13 MAY 2022

TABLE OF CONTENTS

1. GENERAL MANAGER'S LETTER OF INTRODUCTION

It is my pleasure to present Nyrstar Hobart's Triennial Public Environmental Report. The contents of this report represent the environmental performance and work conducted at the site during the reporting period.

This Triennial Public Environment Report is a summary of Nyrstar Hobart's environmental activities for the period 1 January 2019 to 31 December 2021. It compares environmental performance against commitments and regulatory obligations, and reports on monitoring progress particularly in the areas of air, water, land and noise in the local community.

Our aim is to minimise the environmental impact of both our production processes and our products and to conduct our operations in compliance with all relevant environmental regulatory instruments. The environmental challenges posed by the site are not insignificant. Smelting operations over the past 105 years have resulted in contamination of soil and groundwater, accumulated waste stockpiles, and ecosystem impacts on the Derwent estuary. However, Nyrstar Hobart acknowledges and accepts these challenges and has made significant and increasingly rapid progress in addressing these issues.

The implementation of the Nyrstar Hobart (NH) Groundwater Management Strategy and Stormwater Management Strategy continued to be a primary focus for the site throughout the reporting period. In March 2020, NH completed the final phase of the site stormwater collection system. Infrastructure was installed to capture stormwater from the wharf apron and direct it to the site's stormwater system. The NH site is now a fully closed circuit stormwater system, with all stormwater captured on the site and directed to the on-site effluent treatment facility for treatment prior to discharge into the Derwent estuary. Construction of the tenth groundwater extraction system commenced in early 2020, with the installation of a 730 m pressure injected grout curtain, isolating the most contaminated area of the site from the Derwent estuary. Drilling of an upgradient horizontal drain and vertical collection sump to recover the groundwater captured by the grout curtain was completed in 2021.

Major planned shutdown activities were undertaken in 2020 and 2021 which involved significant maintenance and upgrades to plant and equipment. These maintenance activities have resulted in an improvement in the environmental performance of the plant, with a reduction in fugitive sulphur dioxide emissions, and a reduction in the risk of discharging effluent with a low pH into the Derwent estuary.

During the reporting period, we did breach the site's environmental permit on fifteen occasions. An additional five non-compliances with the permit conditions were identified during an audit, and the follow up site inspection conducted by EPA Tasmania. A number of actions to resolve the identified non-compliances have been completed, with some still in progress.

Overall, 2019 - 2021 has presented some environmental management challenges, particularly relating to increasing lead concentration in dust, and plant issues resulting in isolated incidents of elevated concentrations of metals in discharged effluent. However the triennial period has also seen a number of key objectives of site environmental management plans completed, particularly in improved management of groundwater, stormwater, and improved monitoring of emissions to air. We will continue to focus on the key areas of groundwater management, waste management and air emissions management in 2022-2024.

If you have any comments regarding this review, please contact our Environment Principal, Kylie Veale on (03) 6278 4604.

Britt Butler

GENERAL MANAGER

2. NYRSTAR OPERATIONS OVERVIEW

2.1 Corporate Overview

Nyrstar is a global multi-metals business with market leading positions in zinc and lead, and growing positions in other base and precious metals, such as indium, copper, gold and silver. Nyrstar has six smelters, one fumer and two mining operations located in Europe, the Americas and Australia and employ approximately 4,000 people.

In July 2019, Nyrstar's operational business became majority owned by Trafigura, one of the world's leading independent commodity trading companies.

2.1.1 Primary Products

Zinc

A global leader in zinc, Nyrstar is the world's second largest zinc smelting company based on production volumes. Nyrstar produces zinc in concentrate from its mining operations and a variety of refined market zinc products including special high grade zinc, zinc galvanising alloys, and zinc die-casting alloys as an outcome of its zinc smelting process. Zinc has diverse applications and uses, from construction and infrastructure, to transport, industrial machinery, communications, electronics and consumer products. This makes it an essential and highly sought-after resource.

Lead

Nyrstar has a market leading position in lead, producing a number of refined products for market. This includes lead concentrate and refined market lead (99.97% and 99.99%), as well as lead-antimony alloys, copperised-lead alloys, calcium lead alloys and calcium tin-lead alloys. Lead's primary usage is for the production of batteries. More than 80% of world production goes into the manufacture of lead acid batteries which continue to play an important part in the starter mechanism for automobiles. Lead is also used in a wide variety of products found in and around our homes including paint, ceramics, pipes and plumbing materials, solders, gasoline, batteries and cosmetics. Other end uses for lead include underwater cable sheathing, glassware, solder and roof sheeting.

Indium

Indium is a minor component in zinc sulphide ores. It is a rare, silver, metallic element. The production of indium at Nyrstar Auby's indium recovery plant is 100% carbon dioxide free. Global demand for indium has increased substantially in recent years. It is considered a technology-critical element. Indium is most notably used in the semiconductor industry, in low-melting-point metal alloys such as solders, in soft-metal high-vacuum seals, and in the production of transparent conductive coatings of indium tin oxide on glass, such as flat panel television and video displays

Copper

Nyrstar produces copper in concentrate and copper cathode. Copper is predominantly used in building construction. Other significant end-use markets include electrical and electronic products, transportation equipment, consumer products and industrial machinery and equipment.

Gold

Gold is produced in concentrate from our mining operations. Nyrstar also recovers gold in the lead refining process.

Silver

Silver is produced in concentrate from our mining operations. Nyrstar also recovers silver from the lead refining process as a silver doré and as a by-product from the zinc refining process into various leach products.

2.1.2 Nyrstar's Strategy

Nyrstar's management has a strategy aimed at positioning the business for a sustainable future as a leading metals processing business. Through its deep market insight and unique processing capabilities, Nyrstar aims to generate superior returns by extracting the maximum value inherent in the mineral resources and by-products it processes.

Accordingly, Nyrstar has developed a coordinated approach to redeveloping and operating its asset portfolio to optimise the concentrate feed into its smelters, maximise minor and precious metal extraction, and enhance the margins of its end-product mix.

To realise its strategy, management has determined the following strategic priorities

- Maintain Nyrstar's strong safety performance by improving visible safety leadership
- Optimise the zinc smelters to deliver their full potential, underpinned by operational stability
- Ramp up the Port Pirie Redevelopment to deliver the guided earnings uplift

2.2 Nyrstar Hobart Smelter

Nyrstar Hobart (NH) is a large scale zinc smelter located on the western bank of the Derwent estuary in Hobart, Tasmania (Figure 2.1). The Hobart site has operated for 105 years, celebrating its centenary in 2017. The site is one of the world's largest and most efficient zinc producers, with a production capacity of 280,000 tonnes of marketable metal. The facility uses the Roast, Leach, Electrowinning (RLE) process for zinc production and is closely integrated with the Nyrstar Port Pirie multi-metals smelter, which processes Hobart's paragoethite by-product as well as other leach by-products.

The Hobart smelter is focused on high value added products for export to growing markets in Asia. The site has been significantly upgraded and modernised over the last 40 years, with improvements such as:

- The modernisation of gas purification and acid plants in the roasting facility;
- The modernisation of the leaching and purification processes;
- The introduction of mechanised zinc stripping in electrolysis and;
- The automation of the casting plant.

These major capital works and operational improvements have increased the plant's annual operating capacity from approximately 170,000 tonnes of zinc in 1977 to approximately 280,000 tonnes today. Hobart's key products are special high grade zinc, die cast alloys (branded 'EZDA') and continuous galvanising grade alloys. The site also produces by-products of cadmium, copper sulphate, paragoethite, lead sulphate leach concentrate and sulphuric acid.

NH owns approximately 120 ha of land on the western shore and 100 ha on the eastern shore of the Derwent estuary, maintaining substantial buffer zones between the site and surrounding residential community.

The smelter is partially surrounded by a range of land uses, including General Residential, General Industrial, Utilities, Recreation, Open Space, Port and Marine, and Environmental Living. The NH operational site is shown in Figure 2.1, with the Planning Scheme information for NH and surrounding areas shown in Figure 2.2.

Figure 2-1 Nyrstar Hobart operational site location

Hobart city is built around the Derwent estuary on a coastal plain, with the majority of the population within a 10 km radius of the CBD. The climate is cool and temperate. The dominant wind direction is north-westerly, though airflows are strongly modified by the complex hill and mountain topography surrounding the city. The regional geology is dominated by Permian to Triassic sedimentary rock intruded by Jurassic dolerite. Hobart experiences variable rainfall over a large catchment, with the majority of potable water sourced from highland catchments that yield high quality water. NH operates within the management catchment of Glenorchy City Council.

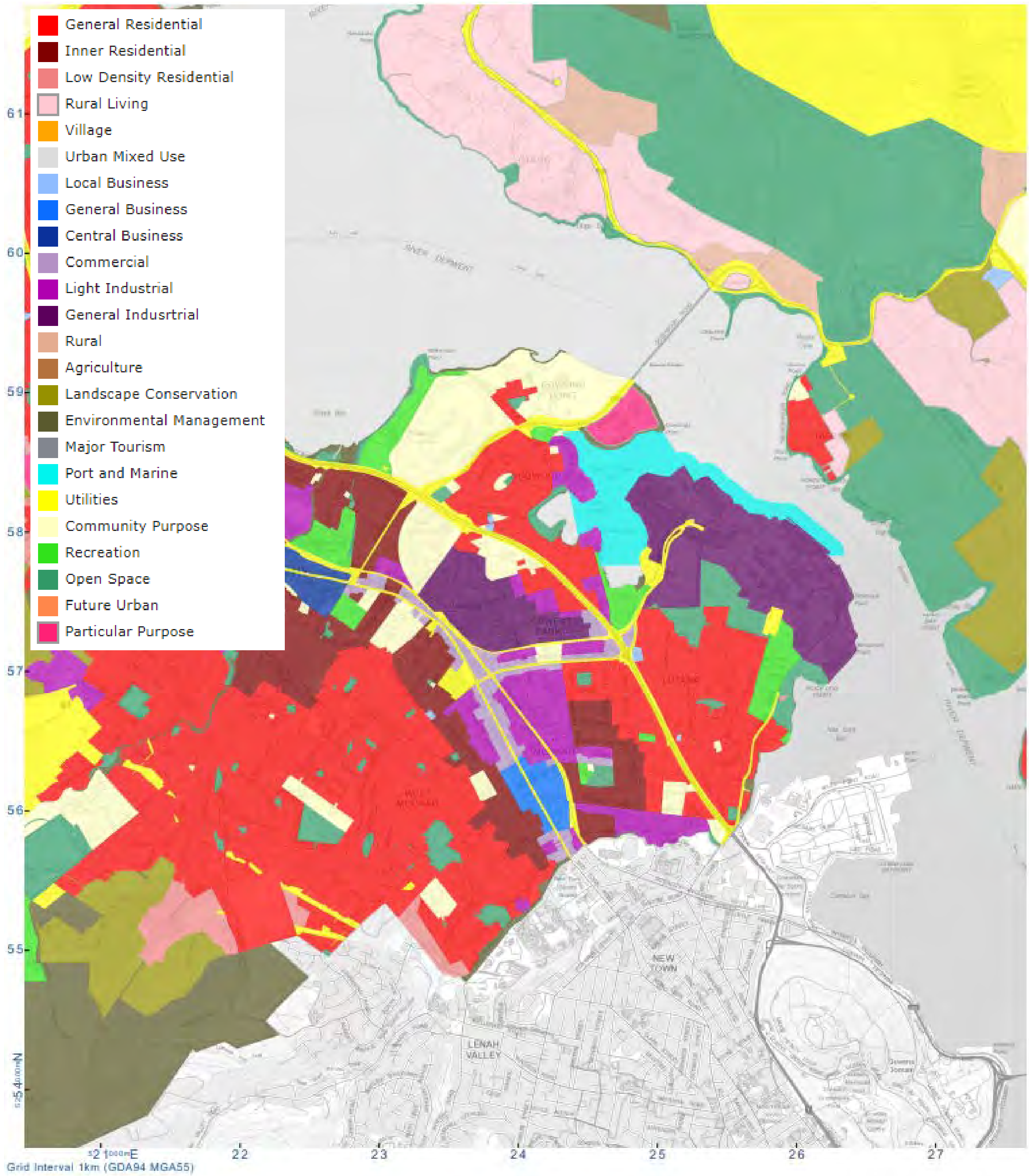
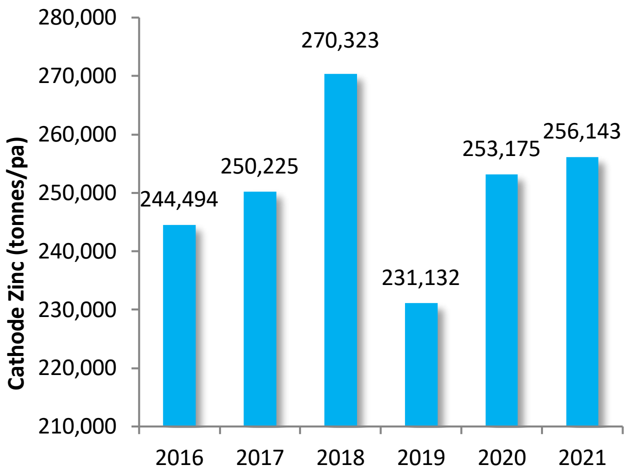


Figure 2-2 Land Use (as per the Tasmanian Planning Scheme) for NH and surrounding areas

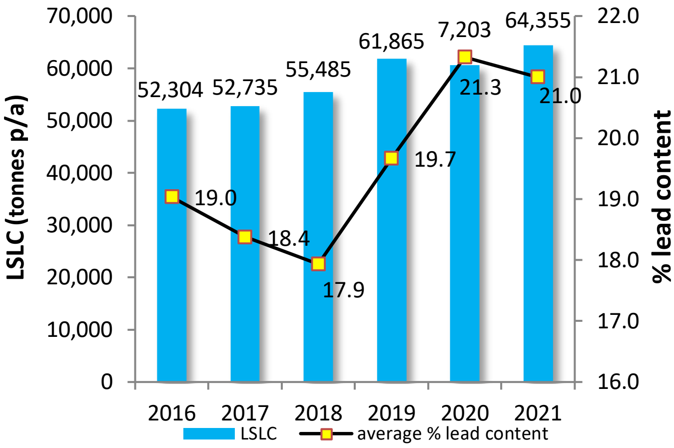
2.3 Production

Annual production rates for zinc and other major NH products for the period 1 January 2016 to 31 December 2021 are shown below.

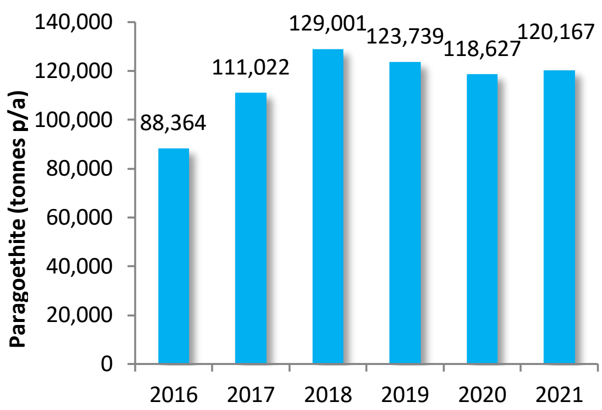
Cathode zinc production



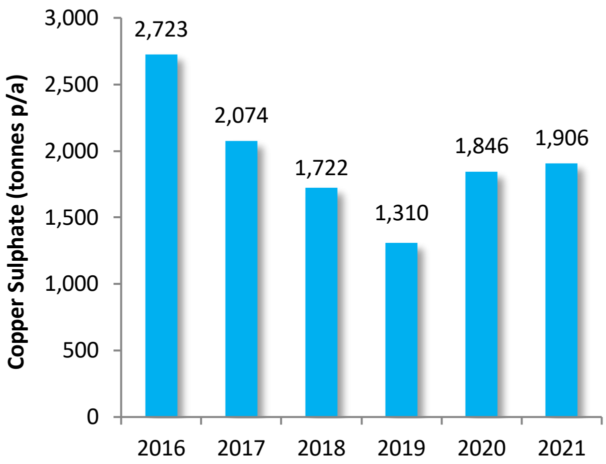
Lead sulphate leach concentrate



Paragoethite



Copper sulphate



Cadmium

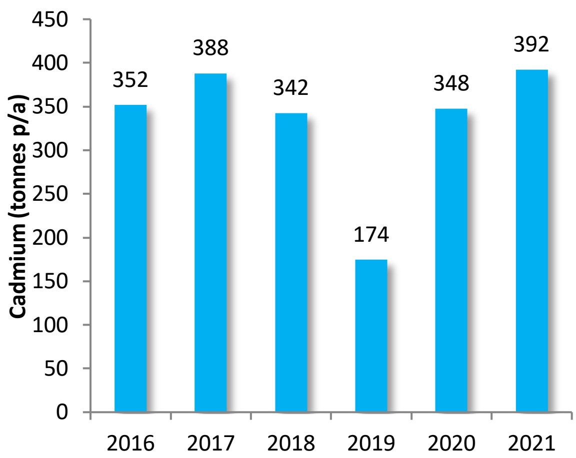


Figure 2-3 Product and by-product production 2016 –2021

2.4 Raw Materials

The major raw material used for site operations is zinc concentrate, made from the milling and beneficiation of mined zinc sulphide (sphalerite) ore. Concentrates arrive by ship and are unloaded at the NH wharf, on the eastern frontage of the smelter, then stockpiled in a closed concentrates shed prior to use. The concentrates shed is a purpose-built facility, constructed in 1997, to reduce dust emissions from stockpiling concentrates and other by-products.

NH experiences some variability in the yearly total of roasted zinc concentrates, with this variability primarily driven by plant maintenance requirements, and plant performance (Figure 2.4). During 2019 – 2021, the majority of concentrates were sourced from Min Metals Group (MMG) Rosebery mine in the west coast region of Tasmania, Glencore MIM (Mt Isa Mine) in northwest Queensland and Perilya Broken Hill mine. The Rosebery mine provided the largest volume of concentrates of any individual mine. The proportion of feed concentrates from each of the mines for the reporting period is shown in Figure 2.5.

Another significant source of feed material to the site is zinc oxide fume, a by-product of Nyrstar Port Pirie. This material is processed at NH on an ongoing basis with an average volume of 40,156 tonnes processed per annum over the reporting period.

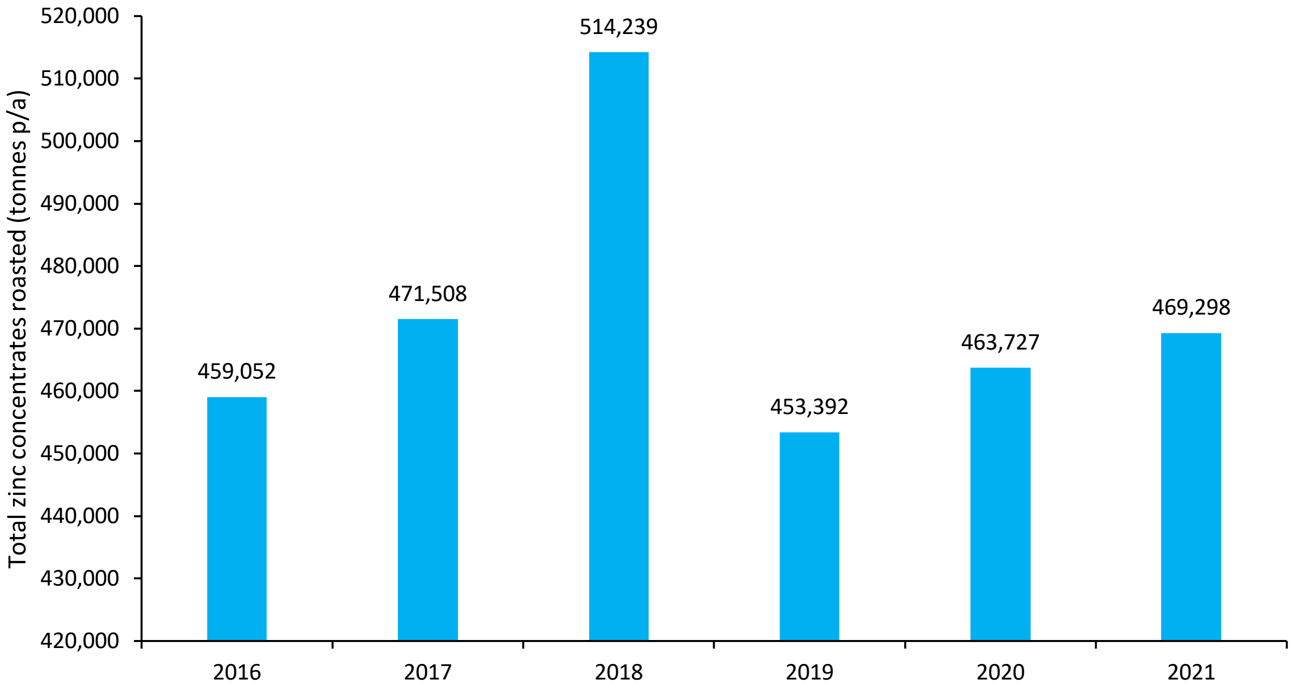


Figure 2-4 Total zinc concentrates roasted (tonnes p/a)

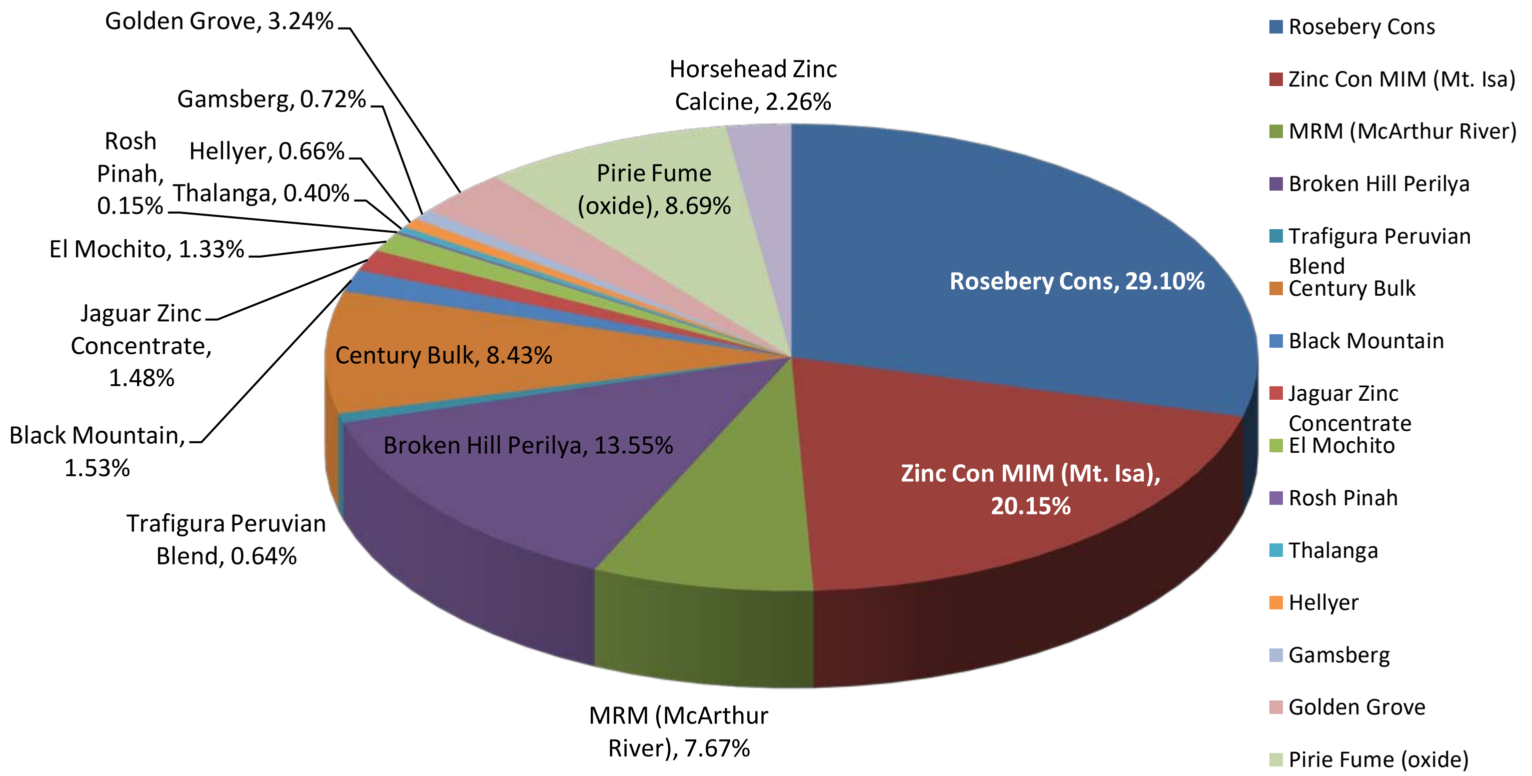


Figure 2-5 Proportion of feed materials by source 2019 – 2021

2.5 Site Products and their Uses

NH produces a range of premium products, including value-added alloys. Zinc is alloyed with other metals such as aluminium and manganese to produce targeted products.

Zinc provides excellent corrosion resistance to iron and steel. It is also a relatively hard metal with a low melting point, making it suitable for die casting, but still soft enough to be formed, rolled, or extruded.

Zinc is found in materials in construction and infrastructure, transport and industrial machinery, and communications and electronics, to consumer products and human health applications.

The major uses for NH's zinc products are as follows:

- **Galvanising** – zinc's most important use is in protecting steel from corrosion. A thin layer of zinc protects the underlying steel, extending the life of motor vehicles, bridges, fences, buildings and a wide range of other products for many years. Zinc is also used as sacrificial anodes attached to ships' hulls, pipelines and underwater structures to prevent corrosion.
- **Die Casting** – one of the fastest growing uses of zinc is for the production of die-casting alloy – the shortest distance between raw material and finished product. Because of the quality of these zinc alloys, complex precision parts are mass-produced for products as diverse as bathroom fittings, zippers, automobile parts, vacuum cleaners, refrigerators, carburettors, and scale model vehicles and other toys.
- **Brass and Bronze** – a wide variety of brasses and bronzes are produced, which include zinc as an essential alloying ingredient. Modern uses include high purity zinc alloys used to purify water by removing chlorine, hydrogen sulphide, iron and other metals.
- **Chemicals** – in the form of various chemicals, zinc is essential in the manufacture of plastics, ceramics, medicinal products, paints, motor oil additives, soldering fluxes and many other items. Zinc is also used in the manufacture of a number of chemicals, most frequently zinc oxide, zinc sulphate and zinc chloride. These products are used in fertiliser, pharmaceuticals, paper, rubber, rayon, wood and other industries that require high quality zinc.

NH's other products include:

- **Sulphuric Acid** – NH recover sulphur in our production processes to produce a significant quantity of high purity sulphuric acid. Sulphuric acid is a vital commodity in any modern economy. In fact it is so widely used that its consumption rate – like steel production or electricity power – is a good barometer of a nation's prosperity. It is used either directly or indirectly in almost every industry. It is an essential ingredient in the production of fertilisers, fibres, paint, rubber, plastics, steel, detergent and medicines, and can even be found, perhaps surprisingly, in many beers and soft drinks. One of its more specialised uses is in the production of high strength fibres for use in bulletproof vests and yacht sails.
- **Cadmium** is a soft, bluish-white, ductile metallic element that occurs in association with zinc ores. Its main use is in the production of nickel cadmium batteries.

2.6 The Production Process

The production process at NH is shown in Figure 2.6.

The sequences of steps in the zinc production at NH are as follows:

- **Roasting** of zinc concentrate to calcine to make it more readily soluble for further purification. A by-product of this step is sulphuric acid.
- **Leaching** of the calcine in a five stage counter-current process, using the spent electrolyte from the electrolysis step. This produces an impure zinc sulphate solution and leaves a lead-silver product. Iron is also removed as paragoethite, which is normally further treated at Nyrstar's lead smelter at Port Pirie, South Australia.
- **Purification** of the zinc sulphate solution, removing metallic impurities by their displacement through the addition of zinc dust. Copper is recovered as a copper sulphate by-product, and cadmium metal is also recovered for sale.
- **Electrolysis** of the purified solution, whereby it is depleted of a portion of its zinc and regenerates sulphuric acid. This produces cathode zinc and spent electrolyte, which is recycled to the leaching stage.
- **Casting** of cathode zinc into slabs and blocks, and the production of alloys.

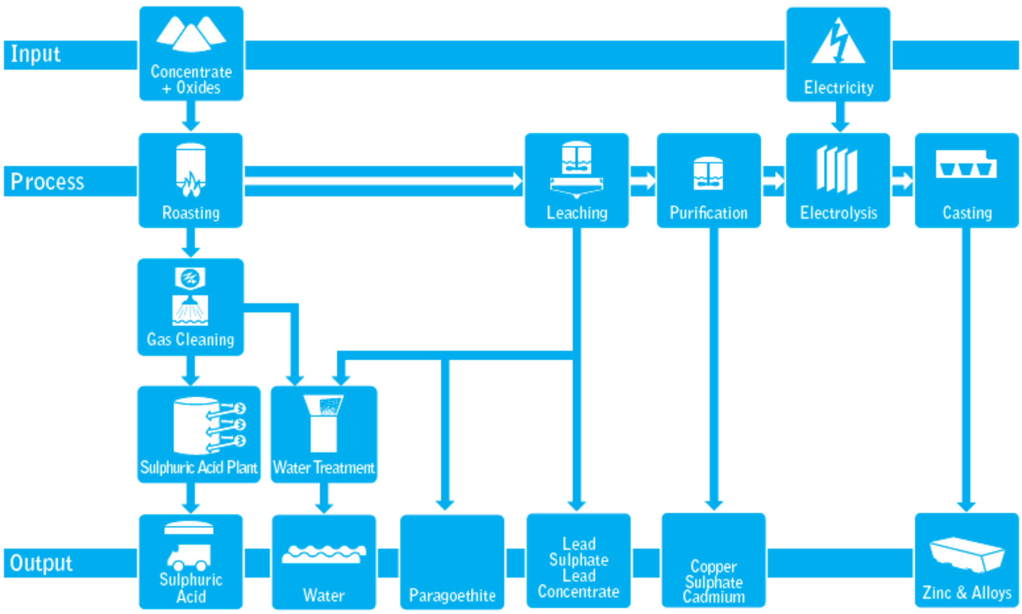


Figure 2-6 Production process

2.7 Environmental Procedural or Process Changes

NH implemented a number of process changes during the reporting period, including the completion of a major environmental project. These changes have been implemented, and managed in such a way that they have not resulted in a material difference to site emissions, nor is it considered that they have the potential to cause environmental harm.

2.7.1 Major Projects

Groundwater Management

NH has continued with the Groundwater Management Program throughout the reporting period. The most significant parcel of work for the period was the completion of the tenth groundwater extraction system at the site.

A 730 m long pressure-injected grout curtain was installed in early 2020 through the centre of the site. It was constructed via the drilling of primary, secondary and some tertiary bore holes, with the grout mix injected into the boreholes sealing the horizontal and vertical fractures through which groundwater travels. The curtain interrupts the groundwater pathways, enabling a higher volume of groundwater to be extracted and treated through the on-site effluent treatment plant.

Drilling of a 750 m long horizontal bore up gradient of the curtain commenced in November 2020 and was completed in May 2021. The horizontal bore collects the groundwater and drains it to a 600 mm vertical extraction well from where the groundwater will be pumped to the contaminated water ponds, for treatment through the effluent treatment plant. The layout of the grout curtain and the horizontal bore is shown in the drawing included as Attachment 1. An existing horizontal bore will collect groundwater from the northern 150 m section of the curtain, and recover it via an existing vertical extraction system.

Drilling of the vertical extraction well was completed in May 2021, with the installation of the pumping infrastructure completed in July 2021.

Figure 2.7 below shows the groundwater path (red lines) being interrupted by the grout curtain (brown line) and subsequently removed by the groundwater extractions systems (green lines). Note that the green lines radiating out towards the large building are existing horizontal groundwater collection drains, whilst the green line that runs adjacent to the brown line is the horizontal bore that was underway at the end of the reporting period.

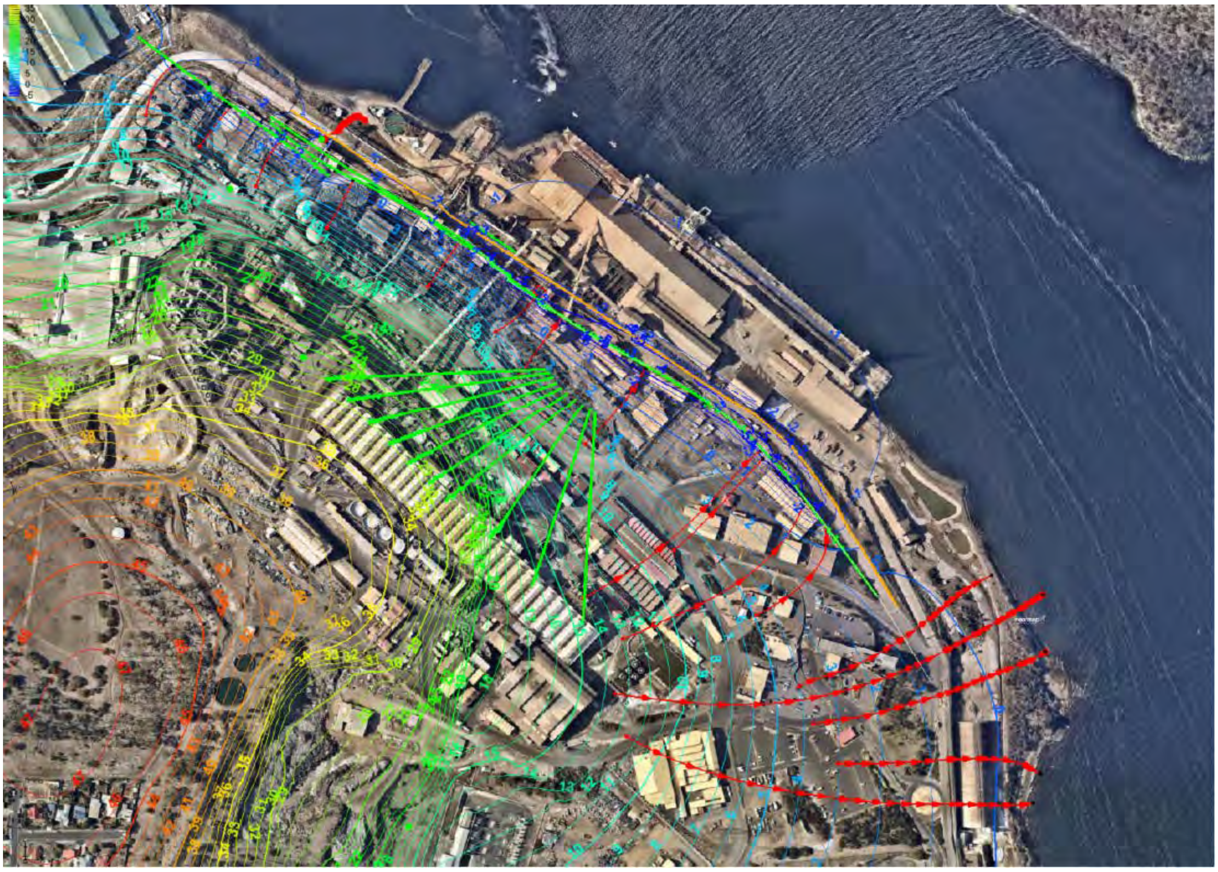


Figure 2-7 Modelled groundwater flow for the main operational area of the site with the new grout curtain and horizontal drain in place

Stormwater Management

In March 2020, NH completed the final phase of the site stormwater collection system. Drains, pipes and pumps were installed in and around the wharf apron to capture stormwater from this section of the site. The NH site is now a fully closed circuit stormwater system, with all stormwater being captured on the site and directed to the on-site effluent treatment facility for treatment prior to discharge into the Derwent estuary.

Figure 2-8 Image of one of the stormwater pits, and drains installed at the Wharf

Major Shutdowns

Major planned shutdowns of the #5 and #6 fluid bed roasters and acid plants took place during the reporting period, with extensive maintenance and upgrades completed. The works have improved the environmental performance of the plant, with a reduction in fugitive sulphur dioxide emissions, and a reduction in the risk of discharging effluent with a low pH into the Derwent estuary. In 2020, the site recorded two notifiable non-compliance associated with the discharge of effluent with a low pH. These incidents were in part a result of emergency shutdowns of the #6 acid plant. The major maintenance works have reduced the likelihood of future emergency shutdown situations.

New Cellhouse Environment Impact Assessment

NH is proposing the replacement of its existing electrowinning ‘Cellhouse’, parts of which have been in operation for over 100 years, with a contemporary Cellhouse considered global best practice. In 2021, an Environmental Impact Assessment (EIA) for the project was submitted to the regulating authorities, with assessment of the project continuing into 2022. The EIA included assessment and modelling of aspects such as air emissions and noise emissions from the proposed cellhouse, and a comparison of the environmental aspects of the proposed cellhouse as compared to the existing facility. Some of the most significant environmental benefits of the proposed Cellhouse include:

- The impermeable basement of the proposed Cellhouse will result in removal of a source of pollution from the existing Cellhouse once fully operational.
- Noise will be reduced by installation of equipment running at lower noise levels.
- New cooling towers and acid mist management system will capture fugitive emission, and have a higher efficiency rate for contaminant removal.
- Reduction in the volume of contaminated non-process waste generated from the ongoing maintenance of the existing Cellhouse.

2.7.2 Minor Projects

- Recommissioning of the Basic Zinc Sulphate Plant occurred in 2019 to remove magnesium from the zinc circuit, improving the site's recovery of zinc. The project has an environmental component with the additional production of chemical gypsum, a by-product that is used within the cement industry.

- Waste Management – with the new C Cell landfill facility providing an avenue for disposal of a number of NH waste streams, NH focused on moving significant stockpiles of waste to landfill, where it can be managed. During the reporting period, over 2,270 t of hazardous waste was moved from the site to landfill.
- Three community noise monitors were replaced in 2019. The previous monitors were over 20 years old, and were becoming less reliable. The new noise monitors have additional capability, including the ability to record noise. This can assist with investigations of elevated noise, or if concerns regarding noise is raised by community members.
- Installation of four on-line total suspended particulate matter (PM10) monitors to better track and understand potential sources of dust across the site.
- Feed Book characteristics changed with the introduction of a 5% blend of high mercury containing concentrates. This process was implemented following a trial which included additional monitoring of the foreshore stack emissions, the foreshore outfall discharge, and the ambient dust levels. Monitoring indicated that the concentrates could be processed on the site, with no degradation to environmental, or human health.
- Installation of two new 15 Mw watertube package boilers and ancillary equipment. The existing package boilers, regulated via EPN 7043/5 reached the end of their effective operating life, and required replacement. The project included the installation of new stacks, which will meet, or improve emission performance of the current facility. The system was commissioned in the second quarter of 2021.
- Spent Acid Plant Catalyst has long been a problematic waste product for NH, with the material being stored in bulka bags, and stockpiled on site for over 2 decades. The catalyst is an essential material in the process of sulphuric acid production, however once depleted, becomes a contaminated waste to be managed. In 2021, the site commenced transport of the material to the Nyrstar Port Pirie site, where it is treated through their plant.
- Construction and commissioning of a new zinc oxide unloading facility. The facility enables zinc oxide to be received at the site in 20 foot shipping containers, rather than single use bulka bags. The new containers are shipped from Port Pirie, then they're trucked from the wharf to the new unloading facility. The containers are backed in, connected to the unloader then lifted and tilted before being conveyed into the storage silo – all dust free. The storage silo allows for direct, automated and continuous feed of zinc oxide fume into Leach; improving zinc recovery. The reduction in waste to landfill is a significant environmental benefit from this project. A purpose built baghouse has been installed with a continuous emission monitor for assessment of particulates in the emission stream.

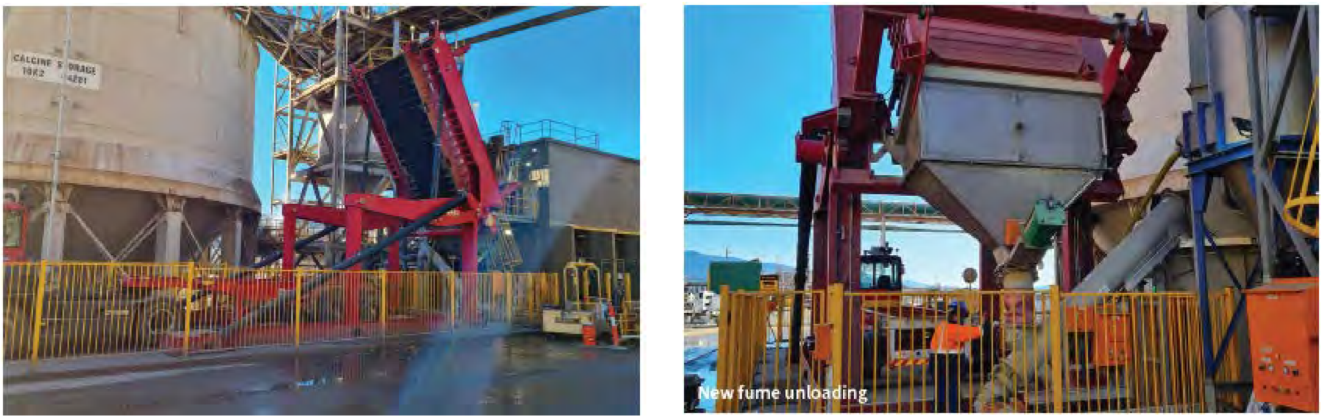


Figure 2-9 Images of the new zinc oxide unloading facility

3. ENVIRONMENTAL MANAGEMENT SYSTEM

3.1 Introduction and Overview

NH has integrated management of multiple systems into a one-business system covering the areas of Safety, Health, Environment and Quality (SHEQ). Specifically the SHEQ Management System has been developed to encompass:

- Strategic planning;
- Asset management;
- Environmental management;
- Occupational health and safety;
- Human resource management; and
- Quality management.

The objective of the management system is to share the responsibility for management of SHEQ at all levels in the organisation and to ensure that every individual is aware of and accountable for safety, health, environment and quality management issues in their area of influence.

NH has maintained accreditation for the international standards ISO 14001:2015 – Environmental Management Systems, ISO 9001:2015 – Quality Management System and has achieved accreditation again ISO 45001:2018 – Occupational Health and Safety Management System.

The site's Integrated Management System is internally evaluated against the above standards by applying specific audits and checklists, which are scheduled on a rotational basis. An external certified auditing body conducts annual external surveillance and triennial recertification audits.

The site has a specific Environmental Management System (EMS) that forms part of the Integrated Management System. The EMS is a step-by-step approach to environmental management that ensures environmental aspects are not overlooked, tasks are completed and checked, provision is made for changes, and response procedures are established for emergencies. An EMS also provides a process that is applicable across the different levels of the organisation to develop objectives and targets and review progress against those targets.

The NH EMS is applicable to all areas of the organisation's processes.

3.2 Environment Policy

The Nyrstar Environment Policy, as shown in Figure 3.1, is specifically designed to represent all Nyrstar operations. This policy was originally developed in Hobart with representatives from all Nyrstar sites, including regional and corporate offices. The policy was written collaboratively and consultatively with the aim of ensuring it reflected Nyrstar's values and received Board approval.

The Policy comprises three sections; 1 'Overview' which provides the business context, 2 'Intent' which outlines what Nyrstar hopes to achieve with respect to the Policy, and 3 'Action Plan' or 'Bullet Point Actions' to outline how Nyrstar plans to fulfil the commitments made in the policy. This policy is the cornerstone of our EMS. It drives the goals, objectives and strategies we use to achieve targets against which we measure our performance.

Nyrstar Environment Policy Statement

We are a global leader in mining, metals processing and recycling with operations across multiple cultures and continents. Our metal products meet society's needs worldwide and are inherently recyclable. We are located within communities who have expectations of us, which we must meet.

We operate our business in an environmentally responsible way. Our aim is to prevent harm to the environment and the community. We will build trust with our key stakeholders by meeting our commitments and maintaining open and honest communications.

To achieve this, we will:

- Minimise the environmental impact of our operations by applying leading practice, innovation and sound science
- Continually improve our performance through the identification and management of environmental risks and establishment of measurable objectives and targets
- Comply with legal obligations as a minimum and meet the requirements of our voluntary agreements
- Provide material stewardship through efficient and responsible use of resources, minimizing waste and expanding recycling options
- Recognize the environmental impact from past operations and address legacy issues
- Develop a culture of environmental ownership through integration of business goals and by increased awareness, skills and competency of our people
- Engage with our stakeholders, understand and respond to their expectations and effectively communicate our environmental performance

We believe that these commitments provide the foundation for a sustainable business.

nyrstar

Daniel Vanin - Chief Executive Officer
November 2019

Figure 3-1 Nyrstar Environment Policy Statement

3.3 Leadership

The NH senior management team demonstrates leadership and commitment with respect to the EMS through a number of channels. These include but are not limited to:

- The development of an Environmental Policy (Figure 3.1).
- Establishing environmental objectives and tracking of those objectives through internal NH reporting, and reporting to the Nyrstar Corporate group.
- Establishment of a specialist environment team, whose responsibility includes the continual improvement of the environmental management system.
- Ensuring the integration of the environmental management system requirements into the business process through the implementation of tools, systems, equipment, training etc. Examples include; risk assessment tools, emergency management tools, environmental incident and hazard reporting tools, and a document management system.
- Assigning the responsibility and authority for the EMS to the SHEQ Manager and the Environment Principal through specific position descriptions.

3.4 Planning

3.4.1 Environmental Aspects & Impacts

NH holds a register of environmental aspects and impacts for all issues related to current and historical activities. The register fulfils requirements for identification of aspects and impacts as well as risk, and has been verified through external audit as part of ISO14001:2015 certification. This register is reviewed on a continual basis as identified risk profiles change and when new risks are identified. The risk register is held in the site's Risk Information Management System (RIMS) database, which is routinely reviewed to ensure the currency of information.

3.4.2 Environmental Objectives and Targets

Nyrstar's key environmental objective is to 'operate our business in an environmentally responsible way by preventing harm to the environment and the community'.

NH environmental objectives, targets and programs are determined through the following means:

- NH significant environmental aspects;
- Nyrstar Corporate Environmental Policy;
- The Environment Protection Notice issued by EPA Tasmania; and

The environmental objectives and targets are developed each year as part of the strategic planning process. NH reviews the site's environmental performance, including progress against the environmental objectives and targets on an ongoing basis and reports this information to the Tasmanian EPA on an annual basis via an Annual Environment Review (AER).

Objectives as defined through the aforementioned documents are assigned at the commencement of the NH financial year to relevant personnel. Actions associated with achieving environmental objectives may also be assigned to personnel as an action in the RIMS database.

Table 3-1 outlines the environmental strategic direction for NH. In 2021 objectives were set that would see NH work towards this strategy, with these included in Table 3-2. A summary of progress against those objectives is included in Table 3-6.

Progress against these objectives will be reported in each AER, and in the 2023-2025 Public Environment Report.

Table 3-1 Environmental strategic objectives

Area	Objective
Waste and By-products	Produce resources not wastes. Decontaminate and divert non-process wastes to beneficial reuse where possible. If storage is required, manage appropriately to prevent environmental harm.
Noise	Manage noise sources to reduce ambient noise levels and prevent nuisance to the community.
Land Use and Aesthetics	Minimise the process footprint and improve the visual impact of the smelter site. Progressively rehabilitate land to an agreed end-use.
Hazardous Chemicals	Actively maintain our risk management system and implement mitigation strategies to reduce risks from hazardous chemicals and prevent harm.
Energy Use & Greenhouse	Make energy and raw materials efficiency a part of the way we do business.
Soil and Groundwater	Manage emissions to soil and groundwater to prevent further pollution to on site soil and groundwater and prevent off site harm. Systematically rehabilitate the site to an agreed standard.
Water	Manage stormwater and effluent to prevent impacts upon the receiving environment. Maximise water use efficiency and reuse.
Air Emissions	Manage emissions to air to prevent environmental harm or nuisance.
Stakeholder Engagement	Establish ourselves as a valued Tasmanian business who leads by example.

Table 3-2 Environmental objectives 2021–23

Waste and By-products

- Reduce existing stockpiles of process and non-process wastes by seeking out new and innovative recycling and stabilisation technologies.
- Develop outlets for future waste products to prevent stockpiling.

Noise

- Develop and implement an action plan for reducing nuisance noise sources.

Land Use and Aesthetics

- Continue to implement the site wide weed management plan to prioritise weed removal effort.

Energy Use and Greenhouse

- Continue to identify and pursue energy efficiency and greenhouse gas reduction opportunities through co-ordinated multi-disciplinary stakeholder session.

Soil and Groundwater

- Continued implementation of the site's Groundwater Management Strategy, including:
    - » Commissioning of the groundwater extraction system, completed in 2021.
    - » Completion of the design for the next groundwater management projects.
    - » Support for repairs to bunds that present a high risk to the environment due to disrepair, including inspections and advice on priorities for repair.
- Continue to review groundwater data as it's collected to assess trends in metal concentrations.
- Undertake an annual review of the groundwater monitoring program to ensure it continues to provide the necessary data to inform decisions.

Water

- Increase site use of the recycled water produced through the site's Reverse Osmosis plant to further reduce potable water use.

Air Emissions

- Develop an improved lead in air monitoring and reporting program, and work with departments to reduce dust emissions in general, thus reducing lead in air concentrations.
- Installation of continuous emission monitors on the paragoethite stack and the anode casting fume scrubber stack.

Stakeholder Engagement

- Meet all self-imposed obligations for community engagement, including community meetings and community newsletters.
- Increase visibility of NH environmental management in the surrounding community through promoting school visits.

Environmental Risk

- Continue to review and update the site's Risk Register by department.
- Develop management plan / controls for critical environmental risks based on the environmental risk review.

3.4.3 Legal Requirements

The NH Environmental Management System (EMS), certified to ISO 14001:2015, defines the process for managing the site's compliance program. Key components of the management system that assist in the maintaining our strong compliance record are:

- A procedure outlining the identification and management of site-specific legal and other environmental obligations.
- A consents register detailing all of the environmental permits and other consents with environmental requirements, that have been specifically issued to the site.
- The principal environmental obligation for NH operations is the *Environmental Management and Pollution and Control Act 1994* (EMPCA). Tasmania enacts the requirements under EMPCA through a suite of legislation which forms the framework for Tasmania's resource management and planning systems, comprising the following:
  - » *Land Use Planning and Approvals Act 1993;*
  - » *Resource Planning and Development Commission Act 1997;*
  - » *Resource Management and Planning Appeal Tribunal Act 1993;*
  - » *State Policies and Projects Act 1993;*
  - » *Environmental Management and Pollution Control Act 1994;*
  - » *Historic Cultural Heritage Act 1995;* and
  - » *Major Infrastructure Development Approvals Act 1999.*

3.4.3.1 Environment Protection Notice

NH operates under Environment Protection Notice (EPN) 7043/5 (Appendix 3 – Environment Protection Notice 7043/5) issued in April 2019 by the Environment Protection Authority (EPA) Tasmania under the EMPCA.

3.4.3.2 Proceedings and Infringements

NH did not incur any of the following during the reporting period 01/01/19 to 31/12/21:

- Proceedings (prosecutions) issued under Tasmanian or Commonwealth environmental legislation, or the environmental provisions of other legislation; or
- Enforcement action taken under any other Tasmanian or Commonwealth environmental legislation, the environmental provisions of other legislation, or the environmental provision of council by-laws; or
- Infringement notices issued under the EMPCA.

3.4.3.3 Other Regulatory Instruments Relevant to Operations[†]

- Tasmanian policies under the *State Policies and Projects Act 1993*;
- Tasmanian Coastal Policy 1996;
- State Policy on Water Quality Management 1997;
- Environmental Management and Pollution Control Regulations;
- *Australian Energy Efficiency Opportunities Act, 2006*;
- *Australian National Greenhouse & Energy Reporting System Act 2007 (NGERS)*;
- *Clean Energy Legislation (Carbon Tax Repeal) Act 2014* (superseding the *Clean Energy Act 2011*);
- *Environment Protection and Biodiversity Conservation Act 1999*;
- *Hazardous Waste (Regulation of Exports and Imports) Act 1989*;
- National Environment Protection Measures (NEPMs) are automatically adopted as State Policies under

section 12A of the State Policies and Projects Act 1993 and are administered by the Environment Protection Authority. Relevant NEPMs to the operation include:

- » National Environment Protection (Air Toxics) Measure 2004;
- » National Environment Protection (Ambient Air Quality) Measure 1998;
- » National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013;
- » National Environment Protection (Diesel Vehicle Emissions) Measure 2001;
- » National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998;
- » National Environment Protection (National Pollutant Inventory) Measure 1998; and
- » National Environment Protection (Used Packaging Materials) Measure 2011.

† This list represents a sample of key regulatory mechanisms relevant to operations at NH, however is not exhaustive.

3.4.3.4 Voluntary Agreements and Other Requirements

- Australian Industrial Chemicals Introduction Scheme (AICIS);
- International Zinc Association (IZA) Sustainability Charter;
- International Lead Association 'Lead Action 21' Charter.

3.5 Implementation and Operation

3.5.1 Environmental Training

Competence, training and awareness are critical to the continued implementation of the EMS as the framework for continual improvement. While accepting that the highest responsibility for the EMS lies with the Environment Department, NH uses a number of tools to provide basic understanding to the broader workforce and key users. The following tools and forums are used to propagate awareness of environmental issues at NH and the EMS and its requirements, particularly with respect to legal obligations:

- Site Induction – covers the general hazards associated with the plant, site policies, systems of work and other requirements. Environmentally it clarifies responsibilities with respect to environmental incident reporting, materials movement authority, hazardous chemicals, waste management, spill response and general care for the environment.
- Departmental Inductions – personnel working in operating departments must also undertake a specific departmental induction, which provides more detailed information about hazards in that respective area of the plant, and also informs personnel of specific environmental aspects and impacts associated with that section of the process. A competency test is also conducted as part of these inductions.
- Contractor Site Work Conditions – contractors who work on site must comply with documented standard site work conditions known as SC1. A section of these conditions deal with contractor's obligations in regard to site environmental requirements such as the Environmental Policy, EMS, waste management, materials movement, emissions and incident reporting.
- Emergency Response Officers (EROs) – undergo a specific environmental training program to enable them to appropriately respond to incidents that may have an environmental impact. ERO's are also specifically trained to conduct environmental inspections for material leaving site under the Materials Movement Authorisation Procedure, and in the use of the gaseous sulphur dioxide (SO2) modelling tool to assist them in responding in the event of an SO2 or SO3 release.
- Training and Assessment Guides – a process by which employees / contractors are deemed competent in all aspects of the required duty of work through a combination of on-the-job training, verification of learning outcomes, completion of an assessment and demonstration of a sound understanding of operating procedures, that apply to their tasks.

- Standard Operating Procedures – of most critical importance for current environmental performance is the inclusion of environmental aspects into Standard Operating Procedures (SOP) where impacts on the environment could result. This ensures that operators are aware of the critical operating parameters for the plant they are operating and the impact of operating outside of those parameters. This is most critical for Roast operations where loss of plant stability could result in SO2 emissions, and at the Effluent Treatment Plant where failure to follow SOPs could result in discharge of contaminated effluent to the Derwent estuary.
- Job Safety and Environment Analysis – is used to identify the jobs steps, associated safety and environment hazards and mitigating controls for work where a SOP has not been developed and the task risk rating is greater than low or involves Defined Hazardous Work (DHW).

3.5.2 Communications

NH has implemented a number of internal environmental communication processes for the site.

Internal communications are carried out through the following means:

- Daily Reporting – a RIMS report is circulated site wide to all NH email recipients, which covers the site's safety and environmental performance for the last 24 hours.
- Weekly Reporting – management team review of significant environmental incidents through the weekly site report.
- 'The Feedbook' – a monthly newsletter which communicates general information relating to site activities. Environmental information and initiatives are communicated as needed.
- Monthly reporting to the Management Team via the Monthly Performance Review meeting held by that group.
- Small group Environment Tours are held throughout the year. These tours are led by a member of the Environment Department, and involve a 60 minute tour of the site, with discussion on major environmental projects, viewing significant environmental management infrastructure, and a general increase in employee awareness of environmental management at the site.

NH has implemented processes for external communication to key stakeholders including neighbours, community groups, regulatory agencies, and customers. These processes include:

- Community Consultation Meetings – held twice per year (pre-COVID) and provide an opportunity for feedback and discussion of issues relating to the smelter's operations.
- Community notices for specific issues – where a specific environmental issue warrants community notification NH produce and distribute this material as required.
- Annual Environmental Review (AER) – NH produces an AER on an annual basis, and a Public Environment Report (PER) on a triennial basis. The AER and PER are submitted to the Tasmanian EPA and includes details of NH environmental objectives and targets and the site's progress towards meeting objectives and targets and annual environmental performance.
- Trafigura Sustainability Report – reports on annual sustainability performance for the Trafigura group of companies, which includes the Nyrstar mine and smelter sites.

In addition, NH uses electronic media to communicate with the local community, adopting such tools as:

- The NH website for general information including environmental reports and information relating to the site's Major Hazard Facility status.
- Social media, primarily in the form of a Nyrstar Hobart Facebook page.

A register of all community complaints received by the facility, along with follow-up investigations and actions, is maintained. Complaints received over the reporting period are summarised in Section 6.1, Appendix 1 – Community Complaints 2019 – 2021.

NH also engages in proactive community involvement activities such as Clean-up Australia Day, hosting a stall at the Moonah Taste of the World Festival (pre-COVID) and a community grants program that distributes grants of up to $3,000 to not for profit community groups.

In 2020 Nyrstar partnered with Big hART and North West Support Services to develop the Acoustic Life of Zinc. Big hART is Australia's leading arts and social change organisation. Founded in North West Tasmania 28 years ago, Big hART has worked in over 50 communities across Australia, winning over 45 awards. The Acoustic Life of Zinc captured the hidden world and social value of the Nyrstar Zinc Works resulting in an installation of sound and image. The Acoustic Life of Zinc featured during MONA FOMA, with NH welcoming members of the public to the Zinc Works site to experience the installation.

In 2021, Nyrstar was involved in two main local events, the Beaker Street Festival and Mind Games for Mental Health. The Beaker Street Festival ran in National Science Week where the audience got an insider's look into what happens at Nyrstar. The event was hosted at NH and was positively received by the community, with tickets selling out, and every ticket holder in attendance. Similarly, NH was a sponsor for the Mind Games which was a fun, action-packed event to raise money for mental health research. The event involved running one of eleven challenges that the teams from local companies competed in. NH was proud to educate the other participants on how zinc is made at the smelter in a fun and engaging manner. The event raised over $80,000 for The Menzies Institute for mental health research.

3.6 Checking

3.6.1 Monitoring and Measurement

NH conducts extensive environmental monitoring and measurement to:

- Ensure that smelting activities do not unduly impact upon the receiving environment and surrounding community.
- Assess compliance against the site's Environment Protection Notice (EPN).
- Track performance against the site's objectives and targets.
- Monitor the effectiveness of control and remedial actions taken.
- Fulfil other legal requirements such as National Pollutant Inventory and Derwent Estuary Program partnership.

Environmental monitoring programs are currently in place for groundwater, stormwater, effluent discharge (both to the Derwent estuary and trade waste), receiving waters and sediments, stacks, ambient air quality, noise, process and non-process waste, and biota.

All monitoring and measurement is undertaken in accordance with the site's Standard Operating Procedures, designed to comply with Australian Standards.

Critical and non-critical monitoring equipment is calibrated and serviced in accordance with the manufacturers' recommendations and relevant Australian Standards. The SAP electronic business system is used to manage the ongoing preventative and special maintenance requirements of critical environmental monitoring equipment. Recurring service requests are generated by this system to notify relevant personnel of calibration testing requirements. Specific controls are also invoked for items listed on the critical equipment / instrumentation register to ensure completion of calibration and maintenance.

3.6.2 ISO 14001 Certification

NH is audited triennially for recertification against ISO 14001:2015, ISO 9001:2015 and ISO 45001:2018. The last recertification audit was held in 2019, during the reporting period. In addition, two surveillance audits were conducted during the reporting period. All three audits were conducted by JAS/ANZ accredited auditing bodies to monitor and maintain the site's Integrated Management System (IMS), incorporating the Environmental Management System (EMS), and its certification.

NH uses the outcomes for these reviews to operate within the broad intent of the standard and management systems in general – that is, to strive for continuous improvement.

All 'areas of concern' raised during audits are formally tracked in the RIMS system through the year to ensure that the any system deficiencies are rectified and opportunities for improvement are acted upon. Non-conformances with the standard or significant areas of concern are the subject of investigations to ensure that not only are deficiencies rectified, but the root cause of failure is understood and addressed.

Table 3-3 Key findings of ISO 14001 2019 IMS Re-certification Audit

Strengths

- Top management support for the continued improvement to processes was noted, and this was demonstrated by the significant improvement projects noted since the previous assessment. These projects included the planned work with the installation of an underground curtain to further reduce the impact of groundwater on the river.

Areas of Concern - Corrective Action Required	**Comments/Actions on Area of Concern**
At the Wharf the following matter remains open from the previous assessment - some of the wharf conveyor belt dust shielding has broken off and not been replaced posing increased fugitive dust potential. There has been some attention given to this issue including approved expenditure requests which has been assessed as sufficient action to avoid escalation to major non-conformance.	Repairs to the dust shielding was completed in August 2019.
Nyrstar has calculated an Effluent Treatment outfall pH value that is unlikely to harm the waterways and breach the EPA requirements, however there is no calculated value for the potential impact to the receiving waterways. These circumstances of potential impact to the waterways could be regarded as an incident. pH records for outfall indicate that there is a number of instances where the KPI for pH has not been met.	Management of outfall pH in line with the KPI has been reviewed. The intent of the KPI is to establish a leading indicator that triggers discussion and proactive management of the outfall inputs (i.e. SO_2 load). An exceedance of the KPI does not represent an event (incident) nor does it indicate that there has been a material impact to the pH of the mixing zone or harm to the receiving environment. Current outfall pH management: • Outfall pH is monitored continuously by both the Roast Department and Environment team • Environment team maintain a monitoring dashboard that records outfall pH both instantaneously and at a 24hr average, with multi-state alarms to indicate when outfall pH is "satisfactory" (green) "of concern" (orange) and "potential to impact" (red). • Environment team liaises directly with the Roast Department when pH value are deemed to require attention. • Instances where active sampling of the waterway indicates a decline in pH at the mixing zone are recorded as "near misses" and "incidents" in the RIMS systems, depending on the nature of the pH result.

Table 3-4 Key findings of ISO 14001 2020 IMS Surveillance Audit

Strengths	
• There has been significant capital improvement that has been directed towards improving production, improving safety and environmental outcomes.	
Areas of Concern - Corrective Action Required	**Comments/Actions on Area of Concern**
The following matter remains open from the previous assessment. Nyrstar has calculated an Effluent Treatment outfall pH value that is unlikely to harm the waterways and breach the EPA requirements, however there is no calculated value for the potential impact to the receiving waterways. These circumstances of potential impact to the waterways could be regarded as an incident. pH records for outfall indicate that there is a number of instances where the KPI for pH has not been met.	Discussion regarding the KPI was had again with the auditors and agreement reached that if the KPI of a daily median of less than pH 2.4 was not met, this would be logged in RIMS as an incident and investigated. An automatic alert has been set up, so that in the event that this occurs, a text message is sent to members of the environment team.

Table 3-5 Key findings of ISO 14001 2021 IMS Surveillance Audit

Strengths	
• EMS roadmap is a good standard • A number of improvement projects have been implemented or are underway to further improve visibility of data through more real time measurement and reporting of key process parameters, their tracking within set standards or limits, to ensure better/more timely and accurate decision making • HSE incident reporting & investigation and weekly RIMS status reporting to Extended Leadership Team	
Areas of Concern - Corrective Action Required	**Comments/Actions on Area of Concern**
The system has failed to ensure that documented information of the results of management review is retained i.e. to show conclusions on continuing suitability, adequacy and effectiveness of MS, decisions on continual improvements, need for any changes, actions when objectives are not achieved, OFIs to improve integration with business processes, etc.;	Management review of information pertaining to the environmental management system is undertaken, however minutes are not taken of the meeting. Minutes will be collected, and thus provide evidence of compliance with the standard.
The system failed to ensure that the MS internal audit program is sufficiently defined and planned i.e. the audit program does not define the full audit cycle to ensure full coverage of MS requirements	NH to run internal auditor training, commencing in 2022. An appropriate internal audit schedule, to meet the requirements of the standard will be put in place.
The system has failed to ensure that documented information is kept up to date	The relevant document for 14001:2015 is the Environment Management System Roadmap is to be updated by the end of March 2022.

3.7 Environmental Compliance

The prevention of environmental incidents is promoted as an integral part of everyone's work responsibility. When incidents occur there is a procedure to investigate and implement corrective actions to reduce the risk of that particular incident occurring again.

The site uses a database referred to as 'RIMS' to track all environmental incidents impacting both on and off site, as well as near misses and community complaints, which ultimately provides data on areas where the operation can make environmental improvements. A daily incident report is generated from RIMS for all site personnel, which shows the details of reported incidents.

Incident investigations are completed for all environmental incidents with a consequence rating greater than 1 and for all 'off-site impact' incidents. Incident risk ratings are used to determine the level of investigation required. All incidents require the basic 'root cause' to be identified, but for more significant incidents a full investigation using the Incident Cause Analysis Methodology (ICAM) is required.

While we ultimately aim to be 100% compliant, NH recorded 15 environmental incidents that resulted in a regulatory non-compliance during the 2019–2021 period; two in 2019, nine in 2020 and four in 2021. In addition, an audit conducted in 2019 by the EPA of EPN 7043/5 found NH to be non-compliant with four conditions of the site's environmental permit. During a site inspection conducted by the EPA in 2021 to assess close out of the 2019 audit actions, NH was found to be non-compliant with one further permit condition.

Details of these incidents and audit findings, including corrective actions, are presented in Section 6.2, Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021.

No incident that constituted material environmental harm as defined by the *Environmental Management & Pollution Control Act 1994* occurred during the reporting period.

3.8 Summary of Fulfilment of 2019–21 Environmental Objectives

NH had a number of environmental objectives for the 2019–21 period. An update against each objective is provided in Table 3-6.

Table 3-6 Progress against 2019–21 environmental objectives

Waste and By-products	
2019–2021 Objectives	**2019-2021 Progress**
Reduce existing stockpiles of process and non-process wastes by seeking out new and innovative recycling and stabilisation technologies.	NH continues to pursue recycling options for all of their waste streams. In early 2020, NH trialled the recycling of mercury filter cake, sending 25 t of the product to Melbourne. In late 2020, stabilisation trials for the material were conducted, with a view to making the product suitable for landfill disposal. A stockpile of waste grease was sent to Victoria in 2019 where it was incinerated for energy recovery. Spent Acid Plant Catalyst has long been a problematic waste product for NH, with the material being stored in bulka bags, and stockpiled on site for over 2 decades. In 2021, the site commenced transport of the material to the Nyrstar Port Pirie site, where it is treated through their plant.
Develop outlets for future waste products to prevent stockpiling.	A Level 3 landfill facility opened in 2018, which has allowed NH to dispose of some contaminated materials that had been historically stockpiled, and has also enabled the site to cease stockpiling certain waste streams.
Noise	
2019–2021 Objectives	**2019-2021 Progress**
Develop and implement an action plan for reducing nuisance noise sources.	The top three nuisance noise sources from the site were identified in a site wide noise survey completed in 2017. One of the nuisance noise sources identified was the reversing beepers on forklifts. NH signed a new contract for the supply of fork trucks in 2020, with the requirement for white noise beepers added to the contract requirements. The noise from white noise beepers have been shown to travel far less than the traditional style reversing beepers. The first of the new fork trucks are expected to arrive on site in late 2022.
Investigate options to upgrade the community noise monitors in order to be able to better understand the source of community noise issues when they arise.	The site upgraded the three community noise monitors in early 2020. The new monitors include additional features, including ongoing recording of noises, improving the ability to investigate specific noise concerns from the community.

Land Use and Aesthetics	
2019–2021 Objectives	**2019-2021 Progress**
Continue to implement the site wide weed management plan to prioritise weed removal effort.	NH completed weed reduction activities in 2019 and 2020 focussing on weeds in the re-vegetated section of the site, and on a gorse infestation on which removal efforts commenced in 2016. Last minute issues with sourcing an appropriate weed management contractor stymied the attempts to continue the work in 2021. NH intend to resolve these issues by up-skilling NH staff to enable weed management to be completed in-house.
Monitor ongoing foreshore erosion issue and develop protection projects as required.	NH inspects the foreshore on a regular basis to assess impact of erosion from river traffic. No remedial works were required during the reporting period.
Ensure all the existing re-vegetated zones are sustained through development and implementation of a maintenance plan.	Maintenance of the re-vegetated zones takes place each year and includes repair and replacement of irrigation components and replanting where required. Two new areas on the site were re-vegetated in 2020, and one large area in 2021. All three areas are on the foreshore, improving the visual amenity of the site from the river. The new areas are inspected on a regular basis, and the plants are flourishing.

Energy Use and Greenhouse	
2019–2021 Objectives	**2019-2021 Progress**
Continue to identify and pursue energy efficiency opportunities.	NH launched the #GreenZone project on the site. #GreenZone is a program driven by Nyrstar's parent company, Trafigura. The purpose of #GreenZone is to promote a 5% reduction in greenhouse gas emissions by implementing simple changes on the site. NH have promoted #GreenZone through educate campaigns and site discussions. 

Soil and Groundwater	
2019–2021 Objectives	**2019-2021 Progress**
Continued implementation of the site's Groundwater Management Strategy, including: • Completion of the detailed design of the next groundwater extraction system • Commencement of the construction of the groundwater extraction system • Support upgrades to the sites effluent treatment facility - required to manage the additional load to be produced from the future groundwater extraction systems Support for repairs to the Secondary Purification bund – a current source of cadmium contamination.	Work was completed on the detailed design of the next major extraction system in 2019 and was submitted to the EPA for approval in late 2019. Construction of the system commenced in January 2020 with the installation of a 730 m long pressure injected grout curtain. COVID-19 delayed the drilling of the upgradient 750 m long horizontal drain and vertical collection sump, with these works only commencing in Q4 of 2020. The drilling works were completed in 2021. Upgrades to the effluent treatment facility are not currently considered to be required. Temporary repairs on the Secondary Purification bund were completed in early 2020, and have held up. Further work to the bund is scheduled to take place in 2023-2026, with the schedule driven by the refurbishment of the tanks within the bund. The temporary repairs have resulted in a decrease to the cadmium concentration in the groundwater in the area.
Continue to review groundwater data as it is collected to ascertain any upward trends in metal concentrations.	This work is completed on an ongoing basis. Groundwater sampling is conducted every 6 months with the data reviewed upon receipt.
Undertake a review of bunds and sumps in the Leach plant and develop a prioritised plan for repair.	A review of the bunds and sumps across the whole site was completed in 2018 and again in 2020. A prioritised list for repair has been developed, with commitments made to the regulator to undertake repairs in 2021 to those bunds that carry a high risk of potential harm to the environment.
Ensure the Electrolysis Cell House basement sealing is maintained.	The cell house basement sealing project was completed in 2018 with funds assigned each year to undertake maintenance. Ongoing pier refurbishment works in the basement has required sections of the original basement sealing to be cut away. These sections are primarily repaired using asphalt.
Investigate feasibility of a site wide drain / sump inspection campaign and develop a prioritised improvement program.	No work was completed on this in 2019-2021.
Undertake an annual review of the groundwater monitoring program to ensure it continues to provide the necessary data to inform decisions.	This review is undertaken following the assessment of data collected from the end of year groundwater monitoring program.

Water	
2019–2021 Objectives	**2019-2021 Progress**
Investigate the feasibility of diverting NH car park catchment out of the main site stormwater system.	The efficacy of the aged bio retention systems existing in the car park was studied, and the metal load removal capacity was assessed. The assessment found that whilst the system removed an average of 47% of the metal load from the car park stormwater runoff, metal concentrations still exceeded the limits set out in the EPN. The car park stormwater will continue to be sent to the on-site effluent treatment plant for treatment prior to discharge.
Increase site use of the recycled water produced through the site's Reverse Osmosis plant to further reduce potable water use.	There was a decline in recycled water produced through the RO plant in 2019 and 2020. This was partially due to upgrades to the filtration system being put in place, which had the plant off-line for over a month in 2019. In 2020 and 2021, issues with the quality of the feed to the plant also resulted in over a month of downtime.
Complete the design and construction of new stormwater capture infrastructure across the wharf under the Wharf Structural Recovery Project.	The project was completed in Q1 of 2020. All stormwater from the wharf apron area is now captured and directed to the effluent treatment plant for treatment, prior to discharge into the Derwent estuary via the permitted outfall discharge pipe. With the incorporation of the wharf apron into the stormwater network, the entirety of the NH operational site is now a closed stormwater system. All stormwater generated within the operational footprint is captured and treated prior to discharge into the estuary.
Obtain further understanding of the interaction of the site's effluent stream with the Derwent estuary.	A complete literature review was conducted, collating all available reports on the implementation of the mixing zone. It is intended that this information may form the basis of future works.

Air Emissions	
2019–2021 Objectives	**2019-2021 Progress**
Identify stacks at risk of causing a breach of the environmental permit and implement remedial actions to improve performance.	Upgrades to the Anode Casting Stack were completed in early 2020. A section of duct was replaced, a variable speed drive was installed on the drafting fan, a particulate analyser was installed and the furnace control system was upgraded to incorporate additional operational safety measures. NH completed the construction of a new zinc oxide fume unloading facility which has replaced the current fume de-bagging facility. The new facility includes a new baghouse, stack, and an online continuous dust monitor. The emissions from the stack were tested in October 2021 to assess metal concentrations. All results were within the required limits. The new stack will be incorporated into the site's existing stack

	emission testing program, with monitoring conducted by a specialised contracting company every 6 months.
Redesign the MZR processing facility to allow dross to be air cooled within the casting building, prior to being discharged to a storage bin for transport to the Concentrate shed. New design should focus on eliminating dust emissions to atmosphere as a result of the interim method of dross dust handling.	Design options were assessed in 2019 for cooling MZR fines prior to transport whilst reducing the explosion risk. A final design was selected in 2020. Construction commenced in 2021 and is to be completed in early 2022. Temporary measures have been put in place to reduce dust emissions in the interim, until the permanent solution is in place.
Develop plan to better control dust emissions that result from the handling and storage of raw materials and by-products	The performance of the site's material storages came under review in late 2019. The storage facilities were found to be in need of attention and were identified as a contributing factor to site dust levels. A lead in air action group was established and a remedial plan was subsequently developed. Actions that were completed in 2020 included repairs to the roof and walls of the concentrate and residue shed, mobilisation of a new street sweeper to improve road conditions, and the provision of tarpaulins and other covers for temporary stockpiles. Lead in air continued to be a challenge for NH throughout 2021. The site implemented improved reporting of the data collected utilising new software, and works commenced on implementing a sprinkler system along Risdon Road North. Rapid close doors on the Concentrate and Residue Shed were installed, to help minimise loss of dust through the doorways. The reduction of fugitive dust emissions, and lead in air will continue to be a strong focus for the site throughout the upcoming reporting period.
Stakeholder Engagement	
2019–2021 Objectives	**2019-2021 Progress**
Meet all self-imposed obligations for community engagement, including community meetings and community newsletters.	NH continues to maintain its community communication strategy. During the reporting period two community consultation meetings were held per year, and an updated leaflet regarding potential soil contamination in the surrounding communities was distributed.
Increase visibility of NH environmental management in the surrounding community through promoting school visits, and involvement with community groups such as the Hobart City Council Bush Care program and Conservation Volunteers.	NH achieves this through participation in community events such as Business Clean Up Australia Day, and through partnership with the Derwent Estuary Program. NH hosted many school visits throughout the reporting period – many of which were interested in environmental management at the site. A member of the environment team presents to these groups. COVID-19 did prevent such visits during 2020-2021, however NH are hopeful that these visits will resume when appropriate.

Environmental Risk	
2019–2021 Objectives	**2019-2021 Progress**
Continue to review and update the site's Risk Register by department.	A bund condition assessment and associated risk register was undertaken in 2018, and reviewed in 2020 to inform future years capital planning. This information was also used to inform the risk of groundwater contamination on the site 'Baseline' risk register.
Develop management plan/controls for critical environmental risks based on the environmental risk review.	No work was completed on this during the reporting period.
Undertake departmental environmental audits.	A triennial re-certification audit for the site's ISO14001:2105 accreditation was completed. This included review of EMS in key operating departments.

Environmental Management	
2019–2021 Objectives	**2019-2021 Progress**
Develop and implement an ongoing environmental education program. This program may include aspects such as site-wide competitions, development of educational posters, recognition and reward for environmental awareness and improvement to the environmental induction for new-starters.	New starters at the site are taken on a site tour by a member of the environmental department to discuss environmental issues and projects. The purpose of this tour is to raise awareness, and to provide information to personnel on the main environment risks associated with the work they do, and how they can be minimised.
Review/develop mechanism for systemised approach to SHE considerations in early capital project development.	A formal process still has not been successfully implemented. The Environment team review the list of capital projects at the commencement of the year to assess the potential for the projects to require environmental input.

4. MONITORING PROGRAMS

4.1 Atmospheric Emissions

The handling, storage and processing of materials at NH has the potential to adversely impact air quality both on and off site. Many process inputs, intermediate streams and residues comprise fine particulate materials that contain compounds of metals such as zinc, lead, cadmium, mercury, arsenic and antimony. Handling and smelting processes used at NH may release airborne particles and gases that contain these contaminants. These releases can be categorised into point source and diffuse source emissions. NH operates and maintains a range of systems to mitigate emissions to air such as gas scrubbing equipment, baghouses and dust minimisation controls.

4.1.1 Point Source Stack Emissions

4.1.1.1 Point Source Stack Emissions Background

Point source emissions originate from stacks, which are used to provide an outlet for air streams involved in the industrial process. Stacks, like chimneys, rely on atmospheric dispersion to reduce contaminant concentration to a low level that does not adversely affect human or environmental health. Where there is potential for an untreated emission to cause environmental harm due to insufficient dispersion, NH uses additional safeguards in the form of gas-cleaning technologies that clean the stream prior to its release. Technologies used at NH to treat air or gas streams from process and hygiene ventilation systems include wet scrubbers, baghouses, chemical absorption towers, and electrostatic precipitators.

Over the reporting period, NH stacks that rely on these gas cleaning processes to achieve sufficient exit air quality have been monitored according to requirements defined in EPN 7043/5. Over the reporting period, some changes have been made to the operating plant and the associated stacks in operation.

- Two new package boilers, each with an associated stack were installed to replace the two old boilers in the Roast Department and,
- A zinc oxide fume unloader was installed with an associated baghouse and stack.

Each of these have been monitored according to the same requirements outlined in EPN 7043/5. Therefore, the list of monitored stacks include:

- Anode Casting Plant Exhaust Stack
- Cadmium Smelter Plant Scrubber Stack
- Copper Sulphate Crystalliser Plant Vent Stack
- Foreshore (Tail Gas Scrubber) Stack
- ^Package Boiler 1 Stack
- ^Package Boiler 2 Stack
- Paragoethite (PG) Dryer Baghouse Stack
- Roaster Baghouse Stack
- Start-up Scrubber Stack
- V1 Furnace Baghouse Stack
- V2 Furnace Baghouse Stack
- Zinc Dust Plant 1 (ZP1) Baghouse Stack
- Zinc Dust Plant 3 (ZP3) Baghouse Stack
- *MZR baghouse and
- *Zinc Oxide Fume Unloader

The locations of these monitored stacks relative to site are shown in Figure 4.1

*These stacks were installed after the EPN 7043/5 was issued and are not listed as nominated exhaust stacks however are monitored to the same requirements.

^ These stacks relate to the two new boilers.

Figure 4-1 Locations of monitored exhaust points

4.1.1.2 Point Source Stack Emissions Monitoring Program Details

EPN 7043/5 details monitoring and compliance requirements for stacks. These requirements are summarised below in Table 4-1. Except for continuous monitors and stacks used only during maintenance conditions, all tests are required to be undertaken during normal plant operating conditions.

Table 4-1 Point source emissions monitoring, limits and reporting requirements.

Emission point / monitoring location	Test frequency	Test parameter	Emission limits
Foreshore (Tail Gas Scrubber) Stack	Continuous Six monthly	SO_2 SO_3 NO_x Particulates	7.2 g/m^3 (2,520 ppm) 100 mg/m^3 2 g/m^3 100 mg/m^3
Start Up Scrubber Stack	If online >3/12 months and at least three yearly	SO_2 Particulates Metals * Cd Hg	7.2 g/m^3 100 mg/m^3 5 mg/m^3 1 mg/m^3 1 mg/m^3
Package Boilers 1 & 2 Stacks	If online >3/12 months and at least three yearly	SO_2 NO_x Particulates	7.2 g/m^3 2 g/m^3 100 mg/m^3
Anode Casting Plant Exhaust Stack	Six monthly	Particulates Metals * Cd Hg	100 mg/m^3 5 mg/m^3 1 mg/m^3 1 mg/m^3
Cadmium Smelter Plant Scrubber Stack			
Copper Sulphate Crystalliser Plant Vent Stack			
Paragoethite Dryer Baghouse Stack			
Roaster Baghouse Stack			
V1 Furnace Stack			
V2 Furnace Stack			
Zinc Dust Plant 1 Baghouse Stack			
Zinc Dust Plant 3 Baghouse Stack			

*The metals parameter is the sum total of Pb, As, Sb, Cd and Hg.

4.1.1.3 Point Source Stack Emissions Results & Discussions

Discrete Emission Monitoring

The results of each annual program of testing between 2019 to 2021 are shown in Table 4-2. For comparison purposes, the results from the preceding three years have also been included.

Stack monitoring at NH is conducted independently by Ektimo. All results from Ektimo in this report are NATA accredited.

The 2021 stack monitoring reports, as produced by the stack monitoring consultants are included as Appendix 4 – 2021 Stack Emission Reports.

Table 4-2 Stack emission results – contaminant concentrations 2016 – 2021

Stack name	Test date	Particulates (mg/m^3)	SO_2 (mg/m^3)	SO_3 (mg/m^3)	NO_x (mg/m^3)	Cd (mg/m^3)	Hg (mg/m3)	Metals (mg/m3)
EPN limit		100	7,200	100	2,000	1	1	5
Foreshore (Tail Gas Scrubber) Stack	11/04/2016	3.36	*	0.28	12.9	0.0112	<0.001	0.03162
	29/09/2016	2.05	*	0.40	7.5	0.0078	0.00019	0.02099
	05/04/2017	<2	*	0.12	8.3	0.0013	<0.001	0.05407
	19/10/2017	5.5	*	0.20	9	0.0019	0.00022	0.03437
	15/05/2018	<1	*	0.18	10	0.0111	0.0004	0.05510
	11/10/2018	<1	*	3.45	13	0.0031	<0.0001	0.01345
	16/05/2019	1.75	*	0.13	32.5	0.0007	<0.0005	0.03344
	18/11/2019	<2	*	1.56	68.5	0.0039	0.0007	0.05813
	24/05/2020	1.15	*	0.21	55.5	0.0026	0.0009	0.04128
	10/12/2020	<1	*	7.15	31.5	0.00115	0.00092	0.0306
	22/04/2021	1.2	*	0.33	56.5	0.0039	0.00106	0.08421
	17/10/2021	1.75	*	0.12	50	0.00205	0.00045	0.03800
Paragoethite Dryer Baghouse	05/04/2016	5.7	<3	-	27.9	0.0039	0.002	1.6210
	06/10/2016	8.0	-	-	51	0.0067	0.0066	0.1834
	04/04/2017	<2	39	-	49	0.0017	0.00037	0.1712
	16/10/2107	3.3	-	-	42	0.0011	<0.005	0.1541
	16/05/2018	2.4	<5	-	41	0.019	0.0015	0.4495
	09/10/2018	9.7	-	-	42	0.0028	<0.0003	0.3261
	17/05/2019	17	<5	-	50	0.0081	<0.0009	1.873
	08/10/2019	37	-	-	55	0.0065	<0.0004	1.0699
	25/04/2020	55	<5	-	63	0.056	<0.001	6.719
	10/12/2020	69	-	-	60	0.028	0.0021	5.3501
	23/04/2021	16	-	-	52	0.0096	<0.002	0.9036
	12/10/2021	6.9	-	-	50	0.0033	<0.001	0.0723
Cadmium Smelter Plant Scrubber	07/04/2016	<1.8	<3	-	<4.1	0.0202	<0.001	0.0603
	27/09/2016	<3	-	-	<3	0.0077	<0.003	0.0330
	06/04/2017	<2	<6	-	<4	0.026	<0.0002	0.0532
	18/10/2017	<2	-	-	<3	0.18	0.0018	0.2238
	14/05/2018	<2	5.4	-	<3	0.03	<0.0004	0.0954
	10/10/2018	<2	-	-	<3	0.0062	<0.0002	0.0704
	20/05/2019	<3	<5	-	<3	0.0093	<0.0008	0.1071
	19/11/2019	<2	-	-	<3	0.013	0.00033	0.0583
	23/04/2020	<2	<5	-	4.7	0.093	<0.001	0.424
	09/12/2020	1.7	-	-	<4	0.0036	<0.0005	0.0261

	21/04/2021	<2	-	-	<3	0.0093	<0.0007	0.209
	12/10/2021	<2	-	-	<3	0.0036	<0.0005	0.0461
Copper Sulphate Crystalliser Plant Vent Stack	08/04/2016	2.5	<3	-	<4.1	0.1160	0.008	0.2570
	28/09/2016	<3	-	-	<3	0.0500	0.032	0.1100
	03/04/2017	6.2	<6	-	<3	0.12	0.0073	0.0373
	16/10/2107	<3	-	-	<3	0.0018	0.017	0.062
	14/05/2018	<2	<5	-	<3	0.025	0.019	0.128
	01/11/2018	<3	-	-	<3	0.013	0.0018	0.0408
	24/06/2019	<2	<5	-	<3	0.033	<0.0006	0.0826
	17/11/2019	3.7	-	-	<3	0.015	0.0007	0.0577
	22/04/2020	<3	<5	-	<3	0.032	0.047	0.112
	18/12/2020	<3	-	-	<4	0.028	<0.0007	0.0877
	26/04/2021	<3	-	-	<3	0.027	0.015	0.151
	13/10/2021	4.8	-	-	<3	0.031	0.014	0.1755
Casting Furnace Baghouse V1	04/04/2016	2	<3	-	<4.1	0.0059	<0.001	0.0360
	26/09/2016	<2	-	-	<3	<0.0007	<0.0003	0.0141
	03/04/2017	<2	<6	-	<4	0.0009	<0.0002	0.0172
	16/10/2017	<2	-	-	<3	0.0006	0.00081	0.01241
	08/05/2018	<2	<5	-	<3	0.0008	<0.0003	0.0139
	09/10/2018	<3	-	-	<3	<0.0007	<0.0003	0.0182
	13/05/2019	<3	<5	-	<3	0.001	<0.0005	0.0405
	04/11/2019	3.3	-	-	<4	<0.0004	<0.0004	0.0133
	21/04/2020	<3	<5	-	<3	0.00067	<0.0006	0.0403
	08/12/2020	<2	-	-	<4	<0.0008	<0.0006	0.0203
	19/04/2021	3.4	-	-	<3	0.0022	<0.0008	0.07
	14/10/2021	>2	-	-	<3	0.004	<0.0006	0.0526
Casting Furnace Baghouse V2	04/04/2016	2.8	16	-	<4.1	0.0046	<0.001	0.0299
	26/09/2016	<3	-	-	<3	<0.0008	<0.0003	0.0169
	03/04/2017	<2	<6	-	<4	0.0006	<0.0002	0.0117
	16/10/2017	<2	-	-	<3	0.0007	0.00086	0.2156
	08/05/2018	4.7	<5	-	<3	0.0005	<0.0003	0.0198
	09/10/2018	3	-	-	3.6	<0.0004	<0.0002	0.0186
	13/05/2019	<3	<5	-	<3	0.0015	<0.0005	0.047
	04/11/2019	<2	-	-	<4	<0.0009	<0.0004	0.0223
	21/04/2020	<2	8.3	-	<3	<0.0008	<0.0005	0.0263
	08/12/2020	<2	-	-	5.6	0.0008	<0.0008	0.0236
	19/04/2021	<2	-	-	<3	0.0016	<0.0009	0.0595
	14/10/2021	<2	-	-	<3	0.0022	<0.0005	0.0297

Roaster Baghouse	06/04/2016	<2.5	690	1.5	<4.1	0.0019	0.0059	0.0646
	28/09/2016	3.9	2,400	-	<3	0.0290	0.0013	0.2613
	05/04/2017	130	9.7	0.025	<4	0.31	0.00074	4.57014
	18/10/2017	7.3	2,900	-	<3	0.031	0.00056	0.51286
	09/05/2018	56	82	0.1	<3	0.31	0.0035	3.0445
	11/10/2018	65	-	-	<3	0.12	0.0032	1.5582
	15/05/2019	<3	830	0.4	<3	0.0073	<0.0008	0.3094
	18/11/2019	9	<5	-	<3	0.021	<0.0005	0.4259
	25/04/2020	<3	2.5	0.15	<3	0.0082	0.18	0.3572
	08/12/2020	2.7	-	-	<4	0.028	0.0014	0.531
	20/04/2021	50	1,900	1.1	3.4	0.18	0.012	2.524
	16/10/2021	37	-	-	5.3	0.026	0.018	0.4544
Anode Casting Plant Exhaust Stack	05/04/2016	50.6	<3	-	<4.1	0.0009	<0.001	39.4119
	26/06/2016	-	-	-	-	0.0013	0.00064	0.4289
	27/09/2016	3.7	-	-	<3	0.0008	0.0013	0.1901
	04/04/2017	<3	<6	-	<4	0.001	0.00099	0.66099
	18/10/2017	<2	-	-	<3	0.0061	<0.0004	0.1135
	16/05/2018	22	<5	-	<3	0.016	0.0009	0.5176
	10/10/2018	4.8	-	-	<3	<0.0004	<0.0002	0.0836
	14/05/2019	14	<5	-	<3	0.0083	<0.0009	0.2422
	09/10/2019	2.8	-	-	<4	<0.0004	<0.0002	0.1666
	23/04/2020	12	<5	-	<3	0.005	0.0013	0.4043
	09/12/2020	<3	-	-	<4	0.001	0.00093	0.1809
	21/04/2021	4.7	-	-	<3	0.009	0.0012	0.2002
	15/10/2021	120	-	-	<3	0.016	0.0011	1.8271
Zinc dust plant baghouse 1	07/04/2016	1.9	<3	-	<4.1	0.0008	<0.0012	0.0549
	26/09/2016	<2	-	-	<3	<0.0007	<0.0003	0.0138
	10/04/2017	<2	<6	-	<4	0.012	<0.0003	0.0473
	18/10/2017	2.7	-	-	<3	0.001	0.00045	0.06445
	09/05/2018	2.8	<5	-	<3	0.016	<0.0003	0.4703
	09/10/2018	24	-	-	<3	<0.0006	0.00036	0.162
	15/05/2019	4.3	<5	-	<3	0.0012	<0.0005	0.0697
	19/11/2019	5.5	-	-	<3	0.0037	0.00075	0.1005
	22/04/2020	32	<5	-	<3	0.018	0.0026	0.4406
	09/12/2020	<3	-	-	<4	0.0011	<0.0009	0.038
	27/04/2021	<2	-	-	<3	0.013	<0.0007	0.0727
	15/10/2021	4.4	-	-	<3	0.019	<0.0008	0.1708
	06/04/2016	3.0	<3	-	<4.1	0.0056	<0.0015	0.1993

Zinc dust plant baghouse 3	26/09/2016	2.1	-	-	<3	<0.0006	<0.0002	0.0278
	07/04/2017	<2	<6	-	<4	0.0011	<0.0003	0.0204
	17/10/2017	8.2	-	-	<3	0.013	0.00023	0.05823
	10/05/2018	3.9	<5	-	<3	0.0037	<0.0002	0.1727
	09/10/2018	<2	-	-	<3	<0.0005	<0.0002	0.0247
	14/05/2019	3.1	10	-	<3	0.0047	<0.0007	0.1844
	17/11/2019	6.5	-	-	<3	0.0056	<0.0007	0.0833
	21/04/2020	24	8.3	-	<3	<0.001	<0.0006	0.0833
	09/12/2020	8.5	-	-	<4	0.00059	<0.0007	0.1033
	21/04/2021	4.7	-	-	<3	0.081	0.0019	1.1069
	16/10/2021	26	-	-	<3	0.0015	<0.001	0.1815
Historic Package Boiler 1 Stack (Pre 2020)	12/05/2016	<0.76	<2.85	-	74.65	0.0015	0.0008	0.0338
	05/06/2019	<2	<4	-	130	0.017	<0.0005	0.0765
Historic Package Boiler 2 Stack (Pre 2020)	12/05/2016	0.86	<2.85	-	126.64	0.0013	<0.0009	0.0280
	05/06/2019	<1	<4	-	130	0.023	<0.0003	0.0883
Package Boiler 1 Stack (Post 2020)	13/10/2021	<2	<5	-	130	-	-	-
Package Boiler 2 Stack (Post 2020)	13/10/2021	<2	<5	-	140	-	-	-
Start-up Scrubber Stack	12/05/2016	2.03	<2.85	-	<4.06	0.007	0.0014	0.0999
	06/11/2019	18	13	-	12	0.032	<0.0005	0.1367
Metaullics Zinkoff Recovery (MZR) exhaust system	12/04/2016	4.2	<3	-	<4.1	0.0136	<0.001	0.0634
	27/09/2016	2.0	-	-	<3	<0.0009	<0.0002	0.0471
	10/04/2017	<2.0	<6	-	<4	0.0095	0.00035	0.03885
	17/10/2017	<3.0	-	-	<3	0.0012	0.00029	0.02029
	10/05/2018	6.8	<5	-	<3	0.0025	<0.0004	0.1319
	10/10/2018	<3	-	-	4.2	<0.0007	<0.0003	0.032
	14/05/2019	2.5	14	-	4.8	<0.0008	<0.0004	0.0272
	17/11/2019	<2	-	-	<3	0.0045	<0.0005	0.037
	23/04/2020	<3	<5	-	5.9	0.002	<0.0008	0.0308
	08/12/2020	<2	-	-	<4	<0.0008	<0.0006	0.0214
	20/04/2021	<2	-	-	4.7	0.0015	0.0011	0.0376
	16/10/2021	<2	-	-	<3	0.0075	0.0082	0.1247
Zinc Oxide Fume Unloader	14/10/2021	<8	-	-	<3	0.0075	0.0082	0.1247

"Green Text"	Indicates a compliant result for specified parameter under EPN 7043/5
"Red Text"	Indicates a non-compliant result for specified parameter under EPN 7043/5
"Shaded cell"	Indicates results for parameters not specified for testing under EPN 7043/5

* SO_2 emissions are covered in foreshore stack – continuous emission monitoring

Continuous Emission Monitoring Results

15 minute average data for SO_2 emissions from the foreshore (tail gas scrubbing) stack over the current reporting period and the preceding three years is shown in Figure 4.2. Long-term performance statistics for 2016 – 2021 are shown below in Table 4-3. Spikes in SO_2 concentration are the result of plant upsets. Processing rates are controlled to ensure the EPN conditions for the foreshore stack SO_2 emissions are met. The EPN limit is based on a Continuous (air) Emission Monitoring device and the limit for SO_2 is not considered breached unless the limit is exceeded continuously for greater than 15 minutes. At no point during the reporting period did the site breach this condition.

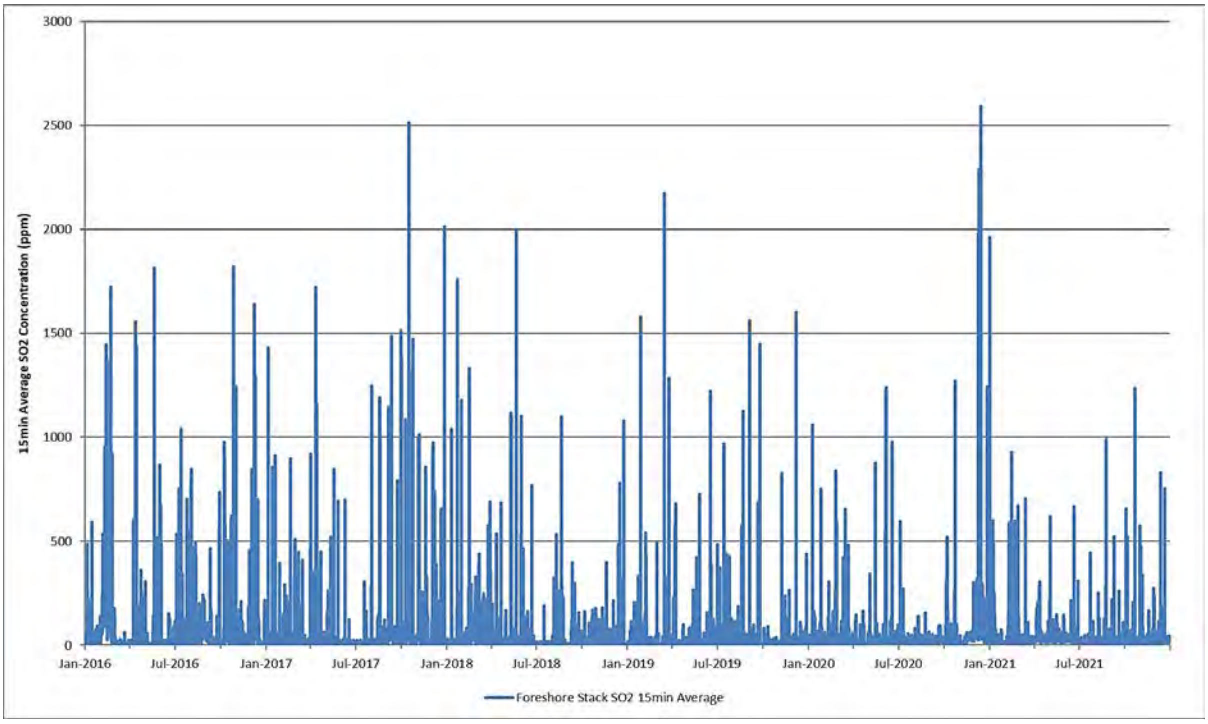


Figure 4-2 Foreshore stack SO_2 continuous emission monitor readings 2016 – 2021 reporting period

Table 4-3 Foreshore stack emissions – long-term performance 2016 – 2021

Continuous Emission Analysis	Year					
	2016	2017	2018	2019	2020	2021
Yearly average SO_2 15min (ppm)	60	40	27	19	27	24
50% of results were below	10	10	9	8	15	13
90% of results were below	164	90	67	29	50	47
99% of results were below	527	461	201	181	239	135

Emission Monitoring Discussion

Three non-compliant incidents were recorded for emissions to atmosphere during the reporting period. During the biannual Stack Testing, on 25/04/2020 the combined metals emission from the Paragoethite dryer baghouse (PGDB) was measured at 6.8 mg/m^3, exceeding the limit as stipulated by EPN 7043/5 of 5 mg/m^3 for the combined specific metal load of antimony, arsenic, cadmium, lead and mercury. The stack testing report was received from Ektimo on 17/06/2020 and upon receipt, a formal investigation commenced. The primary cause was due to four damaged bags that were identified within the PGDB unit 2 on 13/05/2020. The damaged bags reduced the capacity of the baghouse collection system to effectively capture metalliferous particulate emissions. A review of the inspection and maintenance plan for the PGDB and associated ductwork was undertaken as well as removal of residue material from the baghouse inlet/outlet ductwork. Due to travel restrictions imposed by COVID-19, stack testing consultants were refused entry into Tasmania until the next biannual stack testing was completed in December 2020. The stack emissions from the PGDB were re-tested by Ektimo on 10/12/2020, with results received on 03/02/2021. A combined metals emissions result of 5.4 mg/m^3 was recorded, which again exceeded the permit limit of 5 mg/m^3. The investigation that followed determined the contributing causes to be failure of baghouse filtration where some integrity issues of the bags and bag housing were identified as well as increased metalliferous load on the baghouse.

On 15/10/2021 during biannual Stack Testing, the concentration of total particulate matter at the Anode Casting stack was measured at 120 mg/m^3, exceeding the limit of 100 mg/m^3 as stipulated by EPN 7043/5. The data from the stack testing indicated most elements were elevated compared to the last two testing rounds. Metals including zinc, lead and copper had increased by a factor of approximately 10 – 20 mg/m^3. Most noticeably, manganese was elevated by a factor of 170. The elevated manganese concentration supports an operator's statement suggesting a higher proportion of unscrubbed anodes (i.e. anodes unsuitable for automatic cleaning in the scrubber) were charged (i.e. added) to the furnace at the time of testing, and indicates that the melting of the unscrubbed anodes was potentially the cause of the elevated particulate matter. Further testing and plant trials will be undertaken in early 2022.

The start-up scrubber and package boiler stacks must be tested every three years and fell due within the reporting period. Results from these stacks were consistent with previous years and showed low emissions compared to applicable limits.

The graphical (Figure 4.2) and tabulated (Table 4-3) trends show that the reporting year has seen average, 90th percentile and 99th percentile SO_2 emissions from the tail gas scrubbing (foreshore) stack predominantly decreasing in comparison to the figures recorded in 2016 with the exception of 2020 where a slight increase has been noted. It is considered that this increase is primarily due to the operational issues within the acid plant, that occurred throughout 2020, at times resulting in emergency shutdowns which do cause excess SO_2 to be diverted to the foreshore stack.

4.1.2 Ambient Sulphur Dioxide

4.1.2.1 Ambient Sulphur Dioxide Background

The foreshore (tail gas scrubbing) stack is the major source of SO_2 emitted from NH. In this stack, SO_2 concentrations are monitored continuously in order to manage the production process such that environmental impacts are minimised (see Table 4-3). To verify that these controls are effective in the receiving environment, additional SO_2 monitors are installed around the plant and in the community. These provide feedback to the plant for monitoring compliance with ground level concentration (GLC) regulations.

Emissions during normal operations are well within accepted guideline and regulatory values, but abnormal or emergency conditions have greater potential for releases of SO_2 gas to impact the community. Damage to or deterioration of infrastructure can also result in diffuse emissions that can increase GLCs.

NH operational emergency response protocols are well-established and any abnormal gas releases are detected and acted upon quickly. GLCs are displayed on process control screens at the Roast and Effluent Treatment control rooms. Trigger values are set for five minute and one hour average data to alert relevant personnel to elevated GLCs so that appropriate controls can be initiated. Operational responses include progressively reducing plant output or, if emissions cannot be controlled, isolating and shutting down the Roasting and Acid plants.

4.1.2.2 Ambient Sulphur Dioxide Monitoring Program Details

EPN 7043/5 Condition A2 reflects the National Environment Protection (Ambient Air Quality) Measure 1998 and mandates monitoring requirements for the assessment of ambient SO_2. Reportable limits are presented in Table 4-4 below.

Table 4-4 EPN specified limits for SO_2

Emission point / monitoring location	Test frequency	Test parameter	Emission limits
Ambient air	Continuous	GLC SO_2	24 hour average: 0.20ppm
			1 day average: 0.080ppm

Continuous SO_2 monitoring of ambient air occurs at three locations as shown in Figure 4.3. These locations were selected as points most likely to represent areas impacted by plant SO_2 releases.

- Technopark, Dowsing's Point, Goodwood;
- Tennis Court, Risdon Road, Lutana; and
- NH buffer zone, near Birch Road, Lutana.

Ambient SO_2 concentrations are monitored using Teledyne API 100E and Thermo Fisher 43i analysers, certified to be compliant with recognised international standards for performance. SO_2 is measured continuously and five minute average concentration results are sent via telemetry to NH databases.

Figure 4-3 Community SO_2 monitor locations

4.1.2.3 Ambient Sulphur Dioxide Results & Discussions

There were no exceedances of one hour and 24 hour rolling average limits across the reporting period. Annual results from 2016 – 2021 are displayed for each of the three monitoring sites in Figure 4.4, Figure 4.5 and Figure 4.6. The graphs represent rolling 1 and 24 hour averages as measured every five minutes from 2016 – 2021. The figures below show that GLC SO_2 concentrations remained within regulatory limits for all monitors over the reporting period.

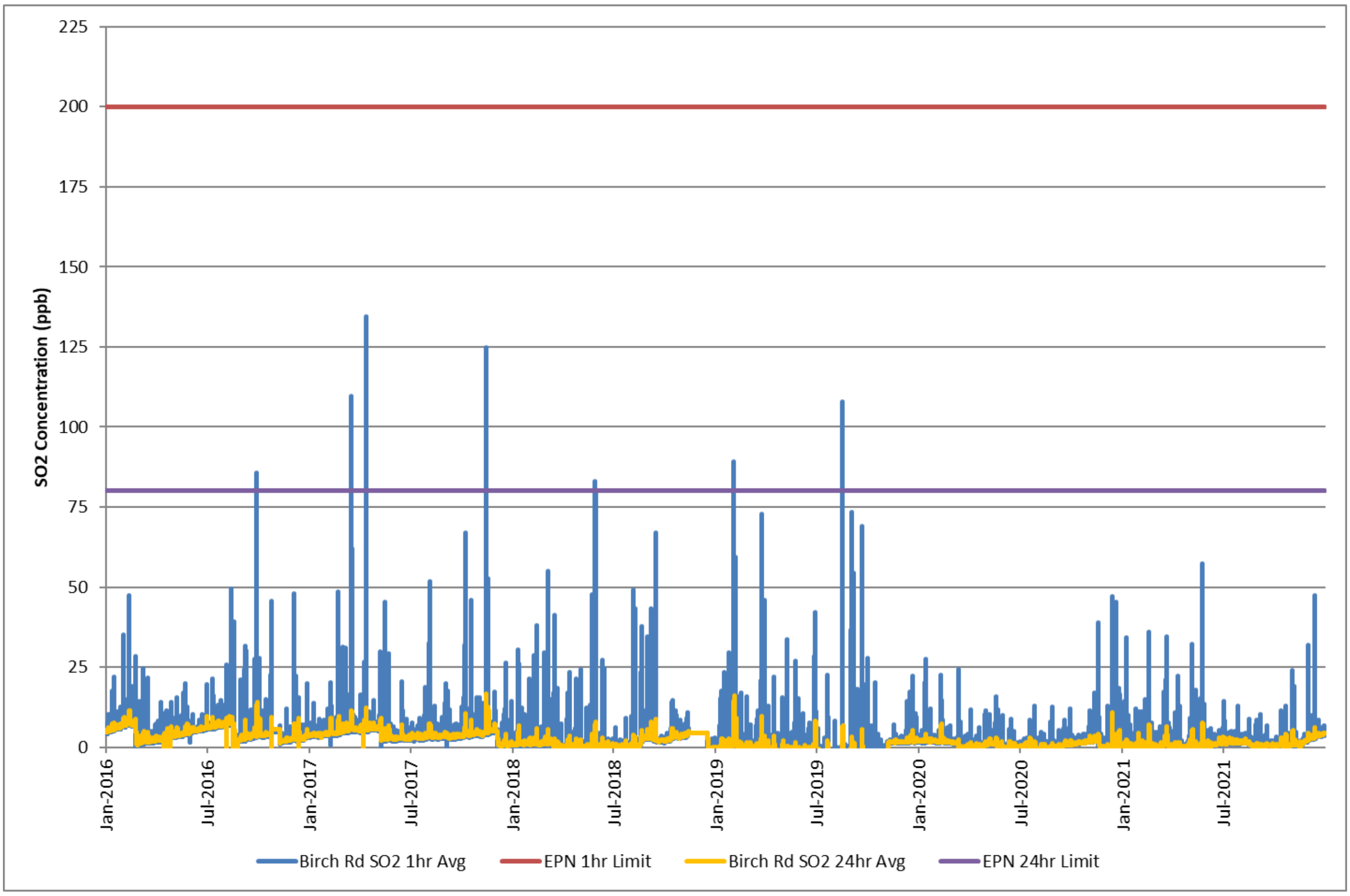


Figure 4-4 Birch Road GLC SO_2 (1 hour and 24 hour averages) 2016-2021

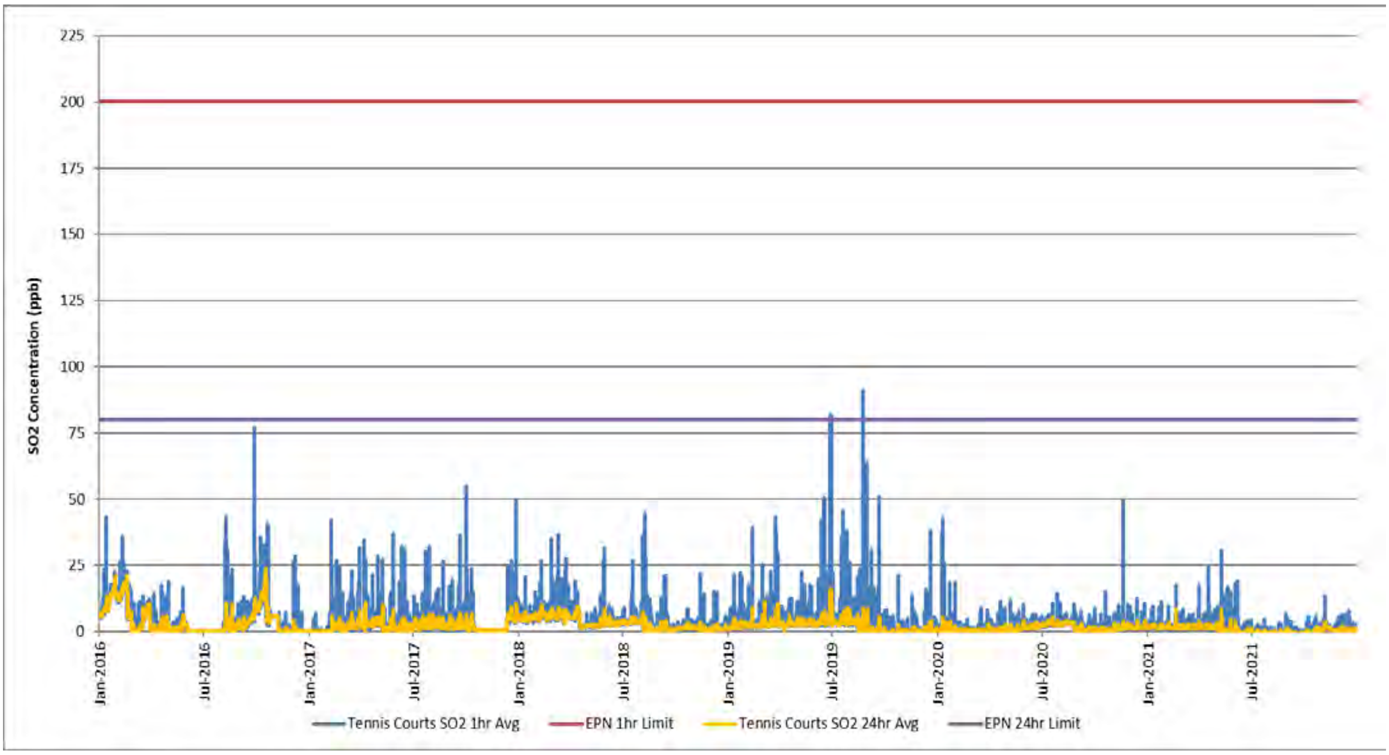


Figure 4-5 Tennis Courts GLC SO_2 (1 hour and 24 hour averages) 2016-2021

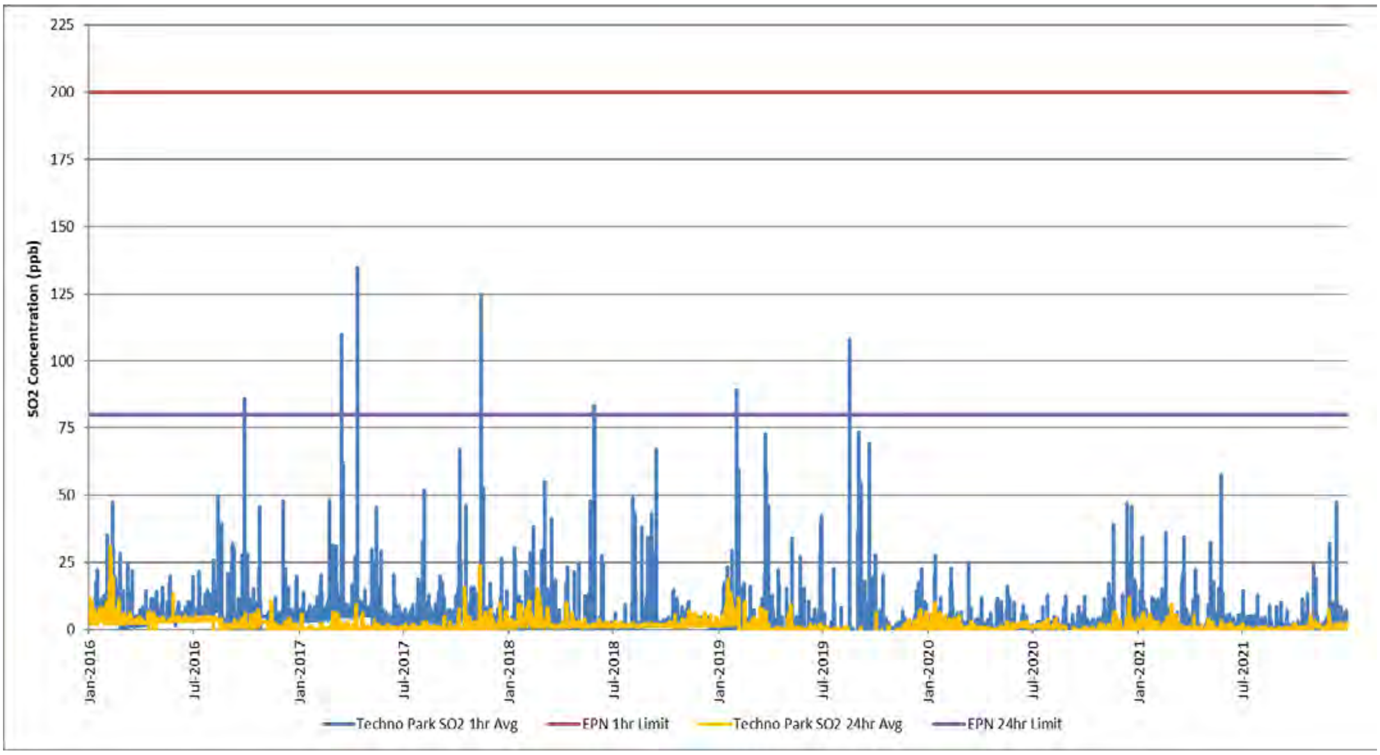


Figure 4-6 Techno Park GLC SO_2 (1 hour and 24 hour averages) 2016-2021

4.1.3 Ambient Particulate Matter

4.1.3.1 Ambient Particulate Matter Background

Dust generation has the potential to have adverse effects when the material released is high in heavy metals and / or very high in general concentration. Process streams, residual materials, contaminated open areas and vehicle movements can all contribute to dust emissions, particularly in dry and windy conditions.

Dust emissions at NH generally impact the local plant area but may contribute to dust in the broader atmosphere. Ambient particulate matter in air and its composition is measured at several monitoring sites around NH and the surrounding community to gauge the smelter's impact on air quality and to guide ongoing improvement strategies. This monitoring is achieved using high volume air sampling (HVAS) units to capture total suspended particulate matter (TSPM) samples.

NH employs a range of operational and engineering controls in order to prevent dust emissions, including but not limited to; undercover storage, gas-cleaning technologies such as baghouses and scrubbers, sweeper and water trucks to clean and wet roadways and revegetation strategies.

4.1.3.2 Ambient Particulate Matter Monitoring Program Details

EPN 7043/5 Conditions A2 and A8 reflects the National Environment Protection (Ambient Air Quality) Measure (NEPM) guidelines for monitoring ambient particulate matter. Accordingly, TSPM levels are measured at three regulated locations around the NH site (Figure 4.7). Reportable limits are presented in Table 4-5.

Table 4-5 Air quality EPN permit limits

Emission point / monitoring location	**Test frequency**	**Test parameter**	**Emission limits**
Ambient air at three representative sites	Every six days for a continuous 24 hour period	Lead	0.0015 mg/m^3 90 day rolling average

TSPM results are not regulated per EPN requirements, but are shown in this section in comparison to the NSW EPA guideline of 90 µg/m^3 for annual mean TSPM.

High volume sampling of ambient air for compliance reporting purposes occurs at three locations as shown in Figure 4.7. These community monitoring locations are:

- Risdon Road North, NH northern exit, Lutana;
- Tennis Courts, Risdon Road, Lutana; and
- NH buffer zone, near Birch Road, Lutana.

The sampling units collect 24 hour composite samples, operating continuously for a 24 hour period on a six day cycle. The units draw a large volume of air, approximately 70 m^3/hr, using a vacuum pump, with airborne dust collected on a glass fibre filter paper. Filter papers are analysed for total particulate load and metals including lead, zinc, cadmium, iron and manganese. Average concentrations of dust and metals in air are calculated according to Australian Standard specifications using the HVAS operating hours, flow rate and particulate mass to give a result in micrograms per cubic metre (µg/m^3).

Figure 4-7 Location of high volume TSPM sampling equipment

4.1.3.3 Ambient Particulate Matter Results & Discussions

Total suspended particulate matter (TSPM) results show that the mean concentration was below the NSW EPA guideline for TSPM for the reporting period across the monitoring sites (Figure 4.8). The Risdon Road North (RRN) monitoring site receives the highest dust load of the three compliance sites which is noticeably illustrated in Figure 4.9. When comparing the current reporting period to the past sampling period, the TSPM concentration varies slightly from year to year with no clear trend.

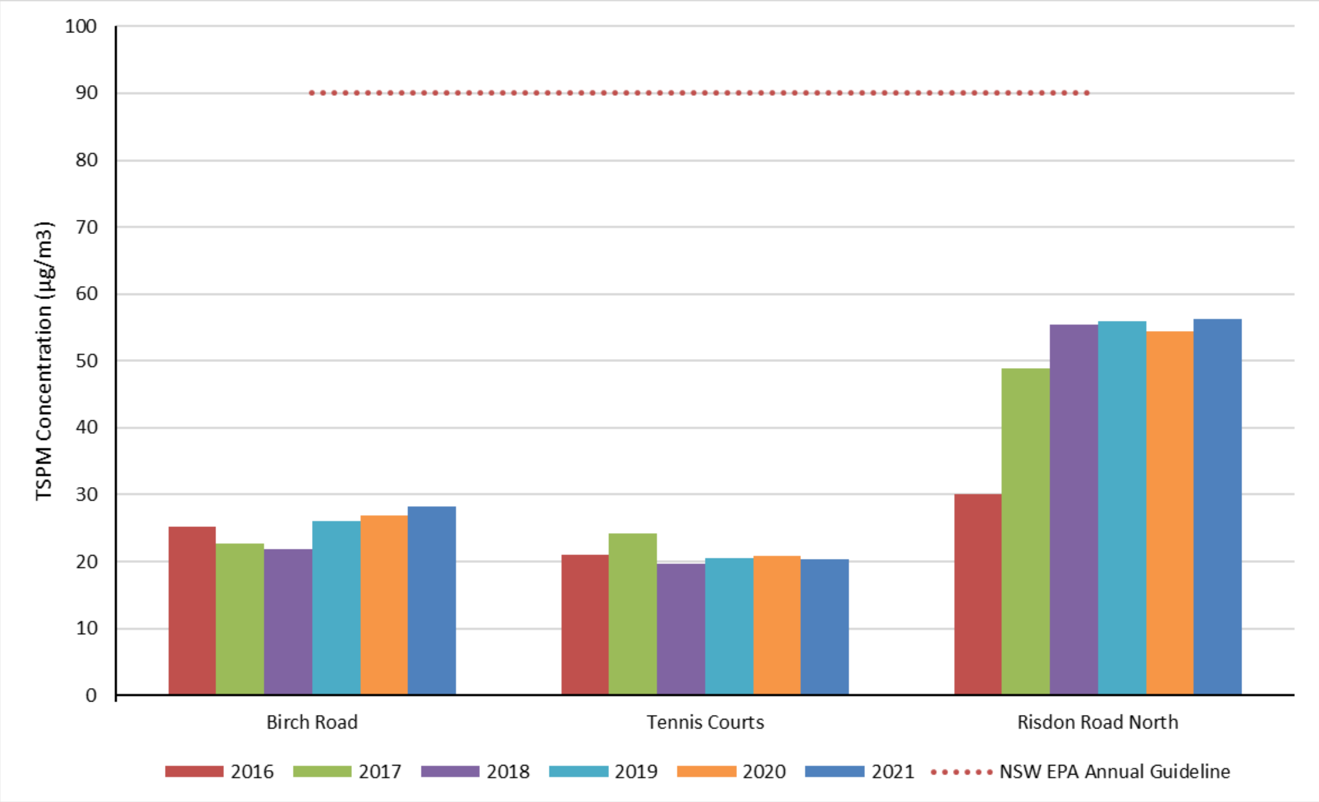


Figure 4-8 Annual mean TSPM Concentrations across three monitoring sites compared to NSW EPA Annual Guideline for 2016 – 2021.

The 90 day rolling average for total suspended particulate matter of lead (TSPM-Pb) is the primary performance indicator for process dust emissions. The TSPM-Pb 90 day rolling average for the three sites between 2016 – 2021 are shown in Figure 4.9. The lead in TSPM results at Birch Road and the Tennis Courts were consistently well below the limit prescribed by EPN 7043/5. These findings are consistent with the previous 2016-2018 sampling period during which no non-compliances were recorded. The TSPM-Pb results at these two sites have typically shown a general downward trend in summer peak values since monitoring commenced in 2007.

Between 2019 – 2021, NH recorded two incidents where the TSPM-Pb concentration at Risdon Road North (RRN) breached the EPN 90 day average limit. During a three week period in late January 2019, the 90 day average TSPM-Pb concentration reached 1.6 µg/m^3. This was unfortunately not noted at the time. During this time period, the site suffered from a cyber-attack, and the entire business system was shut down. As such, access to the monitoring data was not available for a period of approximately 3 months. The data was reviewed once it became available, however it also was not noted at the time that one sample from February has been included by the Laboratory software within January. Due to the February sample recording a low lead result, when included erroneously within the 90 day rolling average calculation, the result was lower than it should otherwise have been. On recognising the error, the EPA were notified of the non-compliance.

From late December 2019 to April 2020 there was a significant incident that resulted in elevated TSPM-Pb concentrations ranging from 1.5 µg/m^3 to 2.1 µg/m^3 at the RRN site. A detailed explanation of the incident has been reported in Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021. Possible causes were linked to increased lead content of raw material during 2019-2020, ambient weather conditions and storage and handling practices. It should also be noted that due to the location of the sampling site, it is unlikely that this exceedance of the EPN has caused material environmental harm or nuisance to NH's surrounding community or environs.

Within the RRN TSPM-Pb results, seasonal trends are evident, with dust generally lower during the winter months. Again, this is consistent with the data recorded during the 2016-2018 sampling period.

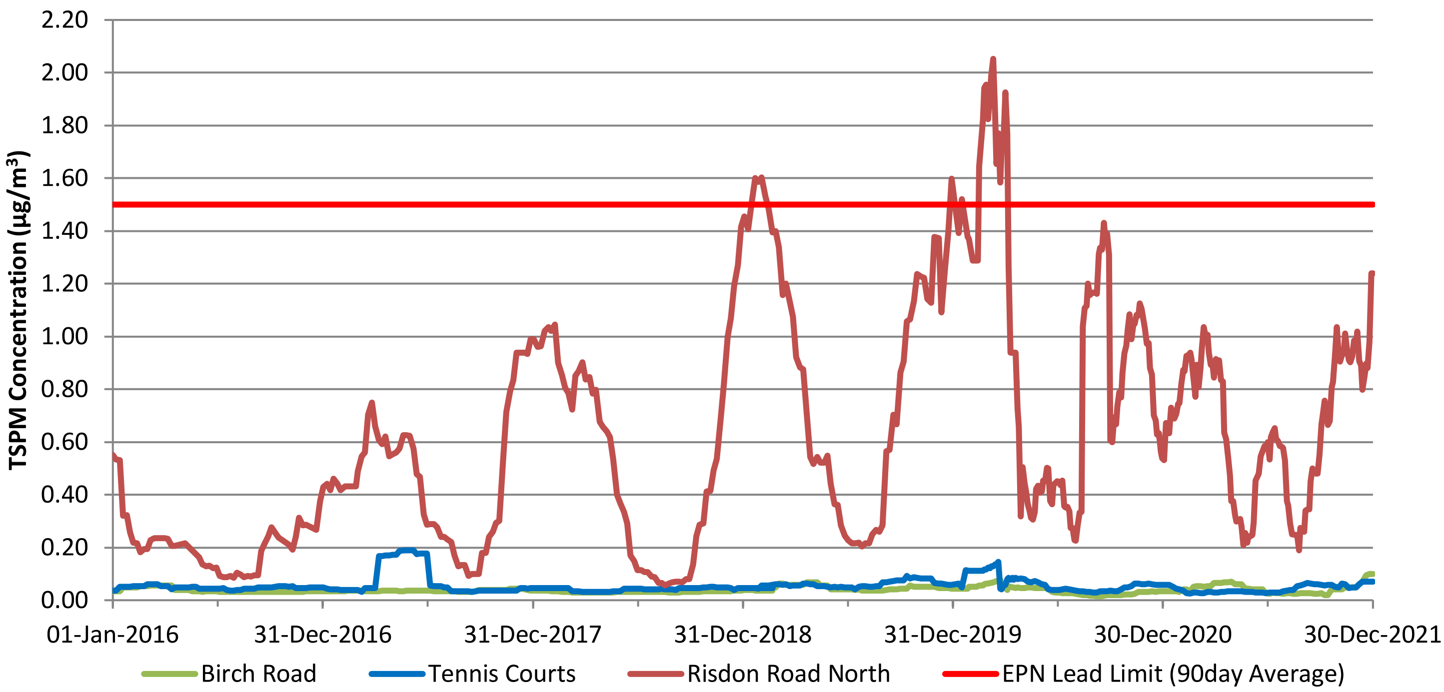


Figure 4-9 90-day rolling average for TSPM-Pb across three monitoring sites compared to EPN lead Limit 2016 – 2021.

The increased lead in air recorded at the site in the past 3 years has prompted improvements in the assessment of the data. Four continuous PM10 monitors were installed at the site in 2020 to enable more frequent assessment of ambient dust levels. In 2021, the site adopted the use of OpenAir, an R package primarily developed for the analysis of air pollution measurement data. The new software and improved the understanding of dust conditions under certain wind conditions, and enables much improved interrogation of data, and use of the data in decision making. An example of one of the data display functions of OpenAir is shown as Figure 4.10.

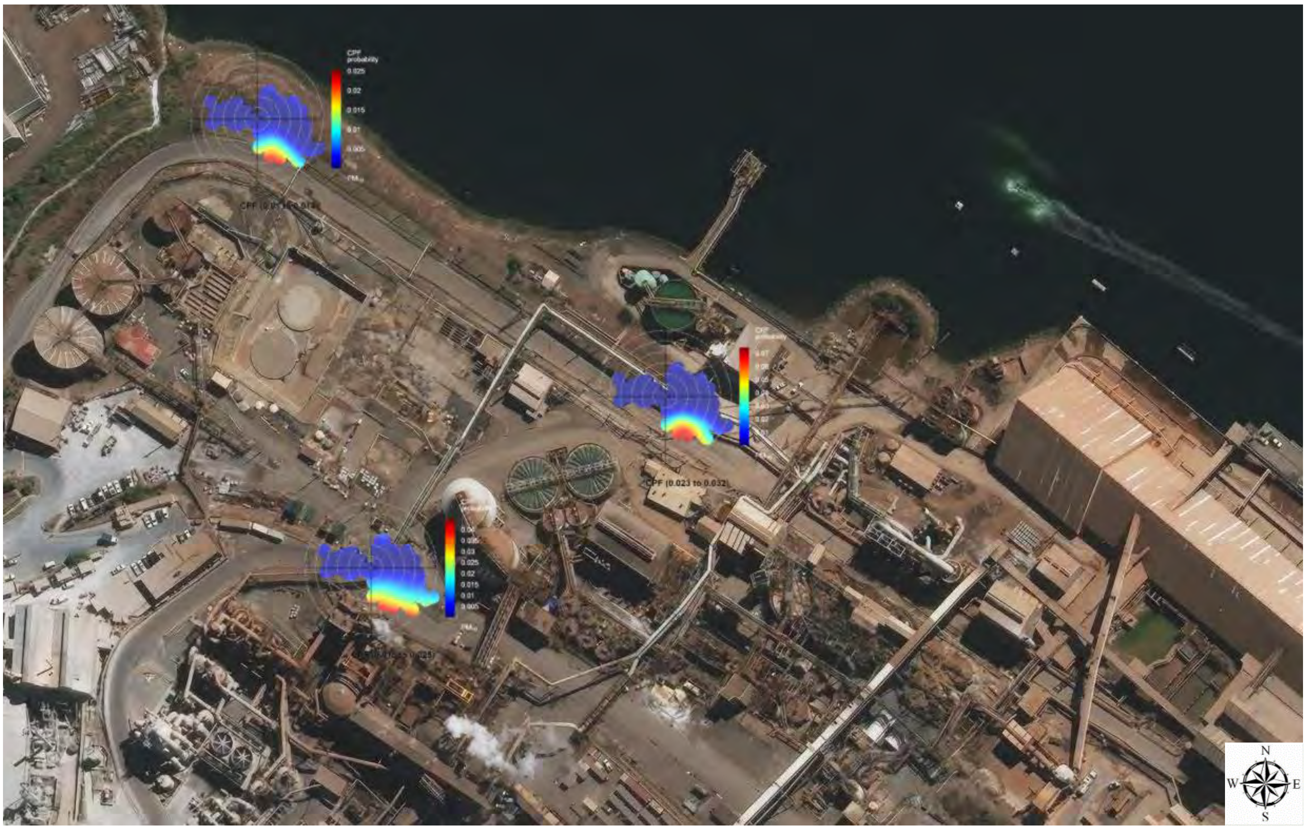


Figure 4-10 *Polar Plot produced with R software to show dust load under certain wind speed, and wind direction conditions. This plot shows the highest dust load (coloured red) is occurring during a SSE wind. The concentric circles display wind speed.*

4.2 Site Water Management

Site water management forms a critical element of emissions mitigation and minimisation at NH. This is reflected in the site's EPN conditions that require all contaminated and potentially contaminated wastewater that is not recycled or reused in the plant be treated in the Effluent Treatment Plant (ETP). NH also maintains a high-level strategy aimed at improving all aspects of water management at the site.

Contained site stormwater and extracted groundwater is treated through the ETP to remove metals and solids before being discharged through the permitted discharge point. NH operates a closed drainage system to direct all flows to the contaminated water ponds (CWP).

4.2.1 Process Water

4.2.1.1 Process Water Background

Process waters are defined here as those that result from various production processes such as cooling or scrubbing waters, filtrate from the processing of some solids, plant wash-waters and mercury removal filtrate (MRF). Process waters are collected by site drains and directed to either the CWP, the detention basins, or directly to the ETP. The ETP removes metals through lime neutralisation and flocculation to settle solids before discharging effluent to the Derwent estuary via the foreshore scrubber outfall (FSO). Solids removed from the CWP and ETP process are returned either to the leaching department or sent to Nyrstar's Port Pirie Smelter for metal recovery. Monitoring key site drains helps identify contamination into the ETP and this information is used to ensure unnecessary inputs at the source are minimised.

The ETP was commissioned in 1992 and has a design capacity of 2,500 ML per annum (dependent on influent composition).

Prior to discharge through the permitted outfall, flows from the ETP are combined with tail gas scrubber discharge (refer Figure 4.11).

Potable water usage is a critical element of site water management, as much of this water combines with process waters and requires treatment through the ETP. Monitoring, operational and strategic actions to reduce potable water consumption are important in minimising unnecessary additions to the process circuit. This links with Nyrstar's Environment Policy wherein we aim to minimise the use of natural resources, such as the energy and lime required to treat our effluent.

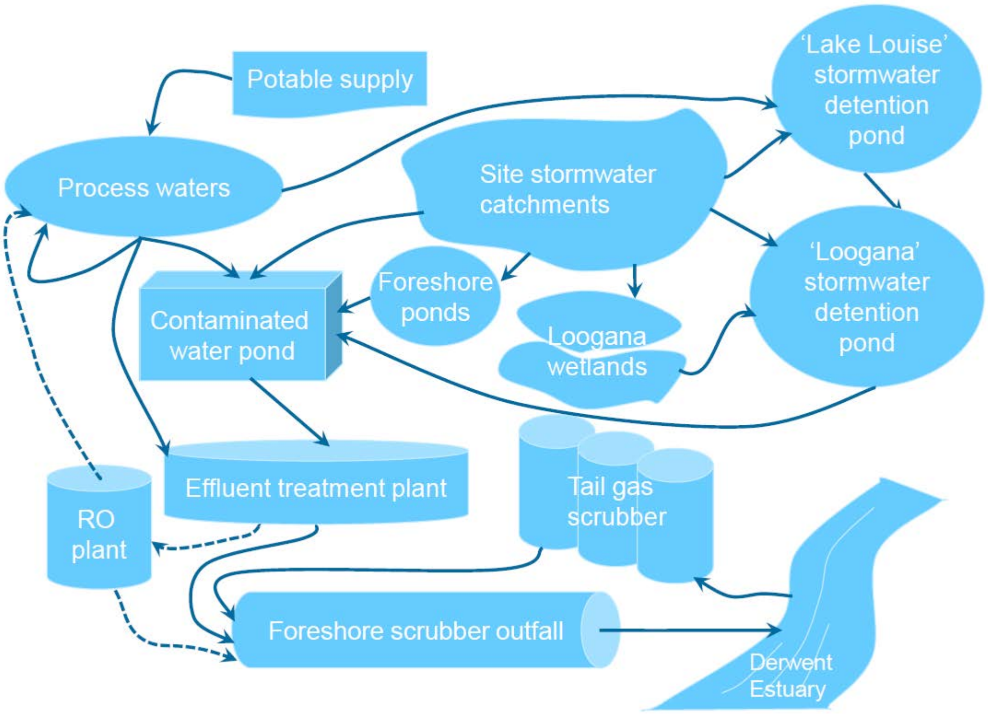


Figure 4-11 Process and stormwater system. Recycled water flows that came online in 2016 shown with a dotted line

4.2.1.2 Process Water Monitoring Program Details

Two daily 24 hour composite samples are taken from the FSO using programmed water auto-samplers. The samplers draw approximately 30 mL of water into a sample bottle at approximately 15 minute intervals from the discharging stream. The samplers are listed on the site's Critical Instrumentation Register and receive three monthly programmed maintenance checks as well as priority repair status if any failures occur. The daily composite samples are analysed for pH, iron, sulphate, copper, cadmium, mercury, lead and zinc.

An average of the two composite samples is taken and used for reporting purposes. The flow rate is measured in the two major contributors to the FSO (estuarine-sourced scrubbing water and effluent from the ETP), the sum of which gives a total discharge.

If the composite sample is above EPN limits this constitutes a regulatory non-compliance and is immediately reported to the EPA.

In addition to the daily sampling schedule, further analysis is conducted six monthly in accordance with the EPN, and for National Pollutant Inventory (NPI) reporting purposes. Each year a minimum of two of the 24 hour composite samples are analysed for the extended suite of analyses given in Table 4-6 to ensure that these substances do not exceed the EPN emission limits. The suite is further extended to include beryllium, cobalt and nickel for annual NPI reporting.

Table 4-6 Foreshore outfall monitoring and reporting requirements and permit limits

Monitoring / sampling frequency	Monitoring parameter	Regulatory limit (mg/L)
Daily 24 hour composite	Discharge (L/h)	-
	Zinc	5.00
	Cadmium	0.03
	Lead	0.20
	Mercury	0.01
Six monthly	Arsenic	0.25
	Copper	1.00
	Iron	5.00
	Total suspended solids	60.00
	N (as ammonia)	1.50
	Fluoride	10.00
	Manganese	5.00

Figure 4.12 shows the annual flow discharged from the FSO for both the current reporting period, and the previous triennial reporting period. The total flow is split in to the two streams – the estuarine water used to scrub residual SO_2 from the gas stream through the tail gas scrubbers, and the effluent that is treated, and discharged from the ETP. The total volume of water discharged to the Derwent estuary (three saltwater intake lines and ETP effluent) during the reporting period was 97 GL. This is an increase on the previous sampling period 2016 – 2018 where 94 GL was discharged.

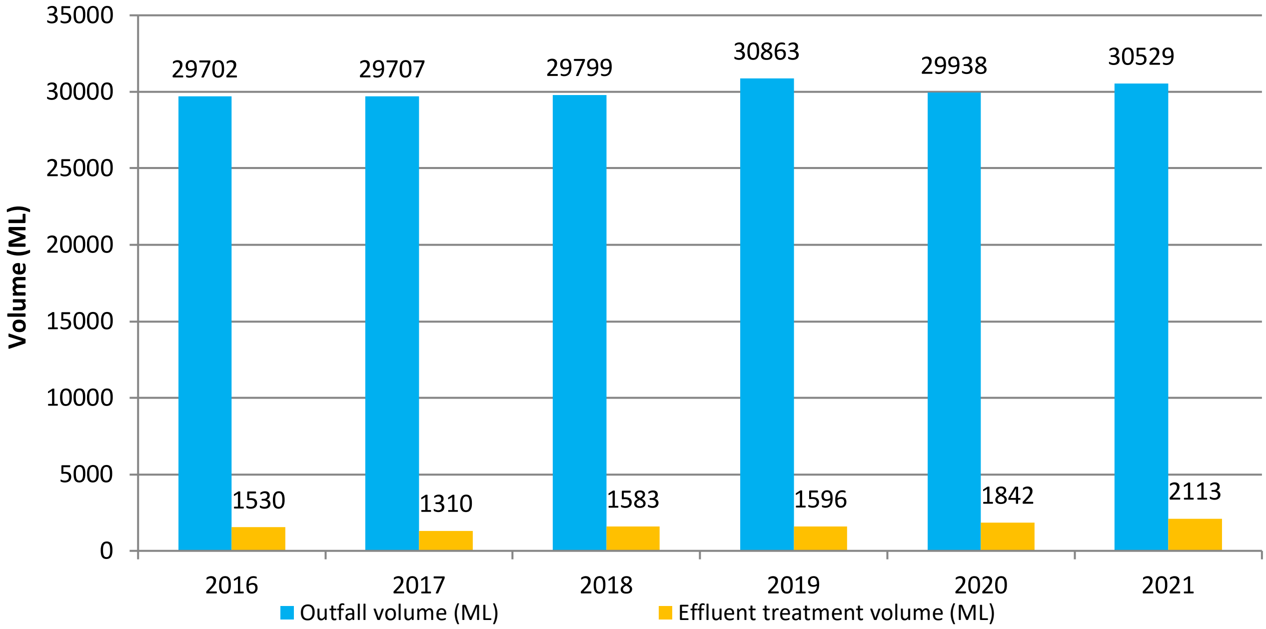


Figure 4-12 Discharge from the foreshore outfall

Composite Sampling Results

Minimum, maximum and mean results of the daily and monthly analyses are presented below in Table 4-7, together with the regulatory limits for each analyte. Note that where the result was recorded at below the laboratory limit of reporting, the limit of reporting value was used.

Table 4-7 Summary of outfall analytical results; January 2019 to December 2021.

Monitoring / sampling frequency	Monitoring parameter	Limit of reporting (mg/L)	Minimum concentration (mg/L)	Mean concentration (mg/L)	Maximum concentration (mg/L)	Regulatory limit (mg/L)
Daily 24 hour composite	Zinc	0.030	0.030	0.090	11.20	5.00
	Cadmium	0.005	0.005	0.005	0.120	0.03
	Lead	0.030	0.030	0.031	0.43	0.20
	Mercury	0.00005	0.0001	0.0010	0.0108	0.0100
Six monthly	Arsenic	0.001	0.001	0.005	0.075	0.25
	Copper	0.0001	0.0001	0.0015	0.0055	1.00
	Iron	0.015	0.010	0.092	0.220	5.00
	Total suspended solids	2.000	2.000	3.431	10.700	60.00
	N (as ammonia)	0.005	0.033	0.057	0.110	1.50
	Fluoride	0.1	1.400	1.789	2.200	10.00
	Manganese	0.005	0.005	0.016	0.480	5.00

Of the daily metals analysed on a 24 hour basis, only zinc and mercury are typically present at concentrations above the laboratory limit of reporting. A comparison of the average annual concentration of these metals for the reporting period, and for the previous sampling period are displayed in Figure 4.13 below. Trends are displayed as both the mean and median in an effort to identify longer term trends, less susceptible to short term spikes which may influence the annual mean concentration.

It can be seen in Figure 4.13, that the average zinc in outfall increased significantly during 2016, which was primarily a result of an incident that resulted in a breach of the discharge limit. The median concentration of zinc in outfall has remained relatively constant over the past six years with a slightly increasing trend in 2021.

An increase in mercury concentration within outfall between 2019 and 2021 is apparent within Figure 4.13, with the median and mean concentrations increasing. The site metallurgical team have identified the problem to be the hot gas precipitators (HGPs) and the electromagnetic precipitator (EMP) used to strip charged particulates from the gas train originating from the Roasters. The decrease in efficiency of the HGPs and EMP has led to an increase in metalliferous carry over into the acid plant and subsequently the mercury removal filtrate which reports to the ETP prior to discharge into the estuary. These problems became most significant between July and August 2020, as can be seen within Figure 4.14. A reduction in mercury concentrations was achieved with extensive repairs to the internals of HGPs, and ongoing cleaning of the EMP.

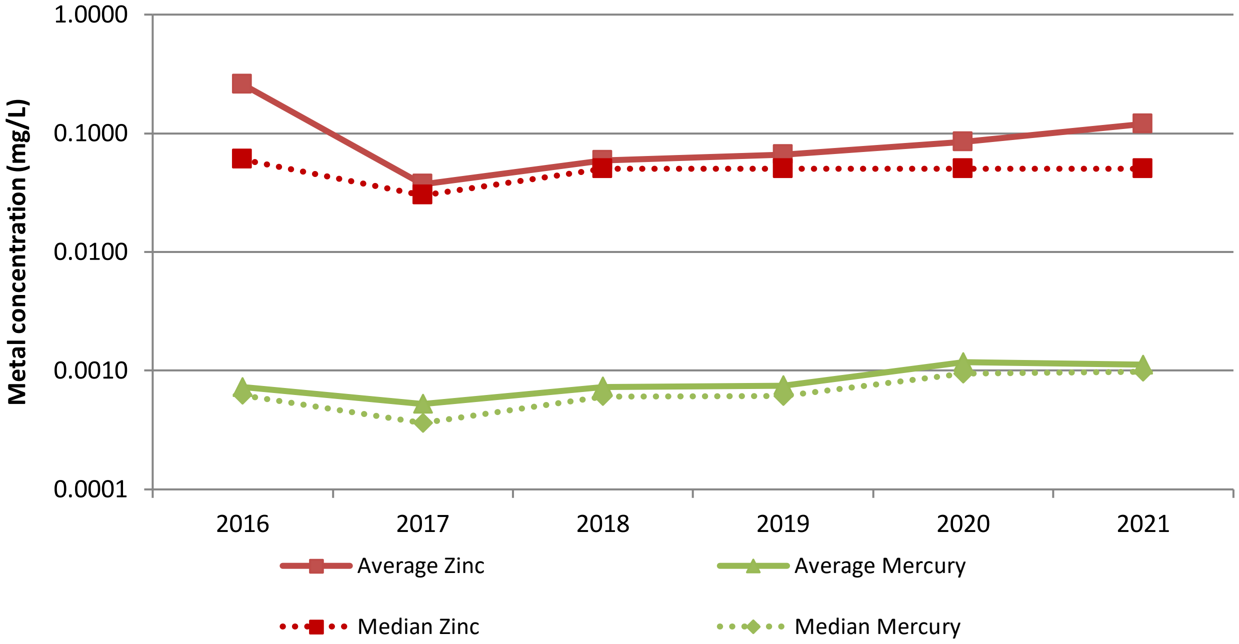


Figure 4-13 Average annual zinc and mercury concentration in outfall

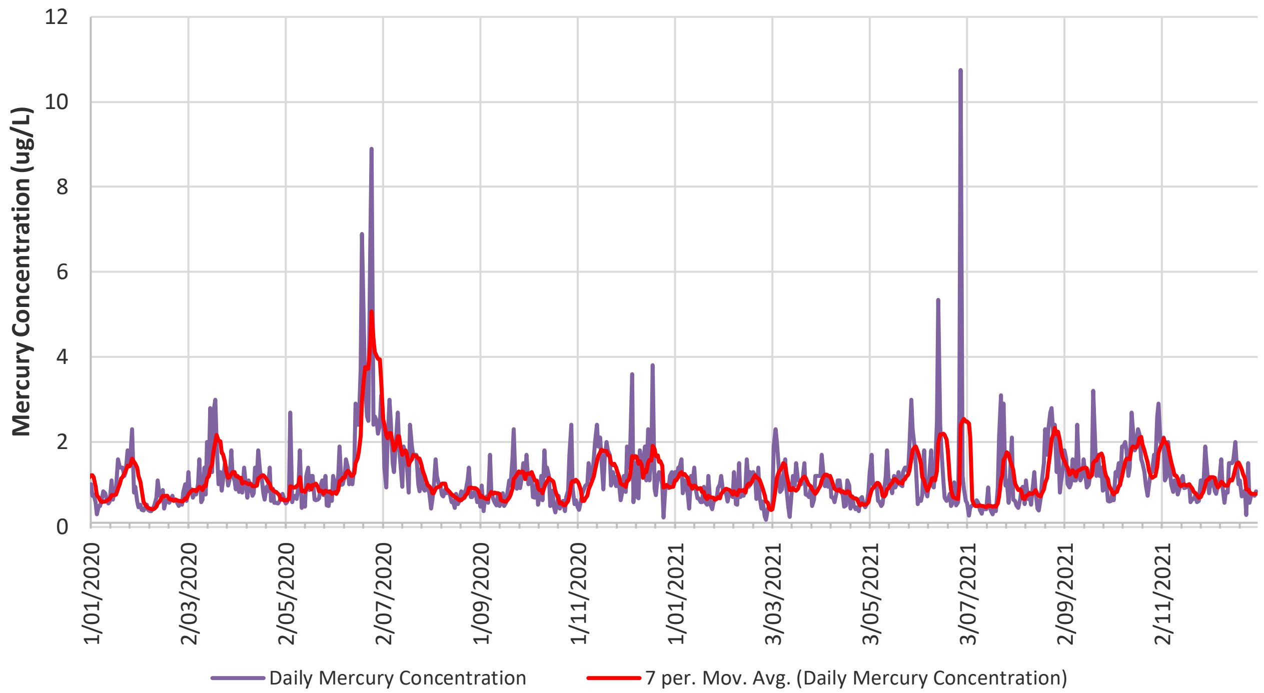


Figure 4-14 Daily mercury concentration in outfall 2020 – 2021

Environmental Protection Notice Discharge Limit Exceedance

The concentration of outfall exceeded the maximum discharge limits three times during the reporting period.

A blockage occurred on 20/05/2020 between two reactors in Neutral Leach department resulting in process solution overflowing into the bund. Overflows from the bund were diverted to the Loogana dam which was receiving water from the Contaminated Water Ponds (CWP) before being treated in the ETP. Solids were being imported from the CWP and human error in the pumping rate resulted in thickener overflows reporting directly to the Derwent estuary via the TGS. This ultimately resulted in elevated zinc and cadmium concentrations in the outfall as shown in Table 4-8. The details of the incident are included within Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021.

On 28/06/2021, NH became aware that the outfall liquor released into the Derwent estuary on 27/06/2021 exceeded the discharge limits for cadmium. Due to the delay in resolving the problem, outfall liquor released on 28/06/2021 also exceeded discharge limits for cadmium, zinc and lead as shown in Table 4-8. After investigation it was found the incident was caused by a failed valve that was responsible for isolating metal laden slurry from exiting NH's effluent management system. The composite sample collected during 29/06/2021 identified that outfall liquor had returned to permitted concentrations as a result of the corrective actions taken.

On 03/09/2021, NH became aware that the outfall liquor released into the Derwent estuary on 02/09/2021 exceeded the discharge limits of cadmium (Table 4-8). This incident was likely caused by Effluent Treatment (ET) Thickener bed material entering plant overflow due to high wind and residue build up within the overflow lauder. This resulted in the elevated outfall subsequently being released into the estuary. The details of the incident are included within Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021.

Due to the limited duration of outfall liquor that was above the discharge limits and the minor exceedances relative to the discharge limits, it is reasonable to suggest that these incidents did not result in material environmental harm or nuisance to NH's surrounding environment or community.

Table 4-8 Composite TGS Outfall Discharge Results during exceedance events

Incident Date	Cadmium (Cd)		Zinc (Zn)		Lead (Pb)	
	Result (mg/L)	Regulatory EPN limit (mg/L)	Result (mg/L)	Regulatory EPN limit (mg/L)	Result (mg/L)	Regulatory EPN limit (mg/L)
20/05/2020	0.048	0.03	6.26	5.00	/	0.2
27/06/2021	0.040	0.03	/	5.00	/	0.2
28/06/2021	0.120		11.2		0.43	
02/09/2021	0.042	0.03	/	5.00	/	0.2

4.2.2 Potable, Reused and Recycled Water Consumption

Monitoring operational and strategic actions to reduce potable water consumption are important in meeting sustainability objectives in accordance with Nyrstar's Environment Policy. Figure 4.15 shows the site's potable water consumption over the current, and previous triennial reporting period, and the volume of reused/recycled water utilised on site.

The recycled water is generated through two different sources:

- Wastewater collected in the CWP and reused in the plant.
- The on-site RO plant through which water is recycled and used in the plant.

During the previous sampling period, stormwater was harvested from the Glenorchy City Council Recycled Stormwater Program, which commenced in September 2013. In 2018, this source of recycled water for Nyrstar was concluded as it became economically unfeasible to continue to purchase water through the scheme. This change can be seen in Figure 4.15 below, as a significant reduction in recycled water usage. Over the past two years the RO plant filtration system has fouled twice due to hydrocarbons entering the system. This caused the plant to be offline for 4 months during 2019 and 2020 and as a result was not in operation for the majority of 2021.

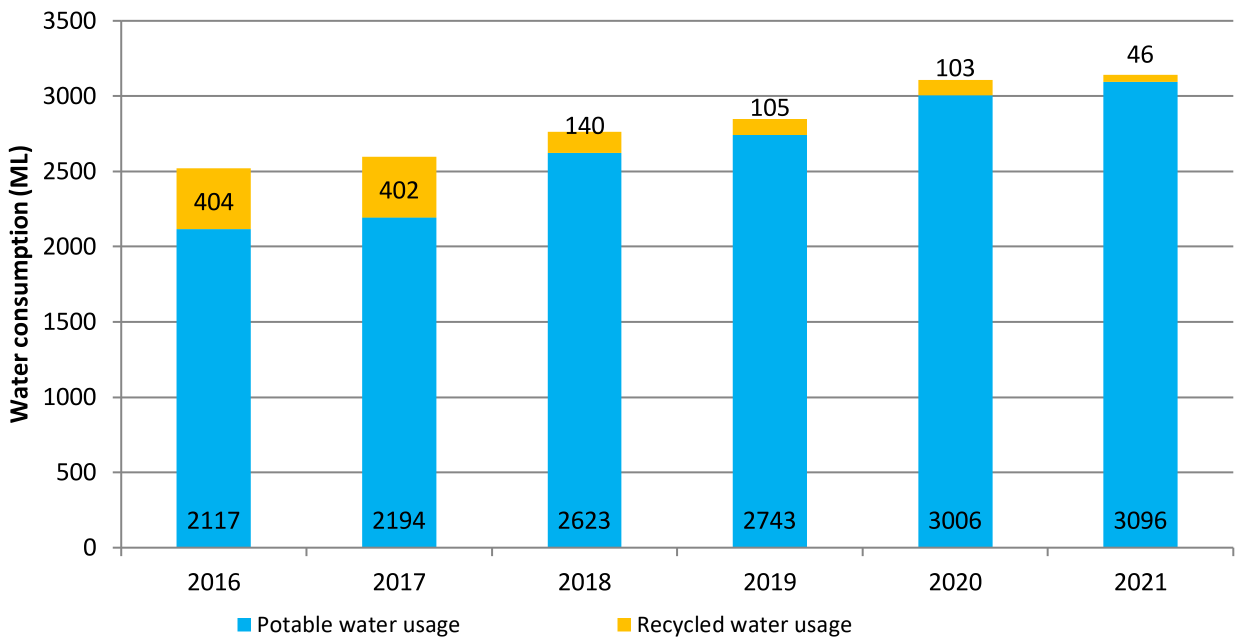


Figure 4-15 Water consumption (potable and recycled) 2016 – 2021

4.2.3 Stormwater

4.2.3.1 Stormwater Background

Due to contamination of surfaces, stormwater flow from the site has the potential to exceed prescribed limits for discharges to surface waters. The State Policy on Water Quality Management 1997 requires that diffuse sources of pollution be controlled in order to meet declared water quality objectives for the receiving waters. These requirements are reflected in EPN 7043/5 Condition SW1 which requires all stormwater to be contained on site and treated through the Effluent Treatment Plant (ETP) prior to discharge from the monitored outfall point (refer Table 4-9).

Key to this process is the site's closed drainage system that ensures flows within the process area report to the contaminated water pond (CWP) or to a detention basin. Flows exceeding the capacity of the ETP and interim storages must only be discharged from the nominated emission points as illustrated in Figure 4.16.

NH has developed and progressively implemented the Stormwater Management Strategy to ensure regulatory requirements are met and continuous improvement is achieved through best practice environmental management principles.

Table 4-9 Storm event monitoring parameters and reporting requirements

Monitoring and sampling frequency	Monitoring parameters	Regulatory limits*	Reporting
Grab sample, or composite if applicable, from each stormwater outfall or overflow.	Zinc Cadmium Copper Lead Total Suspended Solids (TSS) Total Petroleum Hydrocarbons (TPH)	5.00 mg/L 0.03 mg/L 1.00 mg/L 0.20 mg/L 60.0 mg/L Not listed	Within 1 month of the storm event and annually in the Annual Environment Review.

* These limits do not apply to stormwater discharged under a critical duration storm event as described in EPN 7043/5, provided the stormwater generated during such an event is managed in accordance with the requirements of EPN 7043/5.

4.2.3.2 Stormwater Monitoring Program Details

The present stormwater system has six emergency overflow points to the Derwent estuary as defined in Attachment 9 of EPN 7043/5. These are depicted within Figure 4.16 and listed below:

- New Town Bay outfall;
- Loogana overflow;
- C drain outfall;
- B drain outfall;
- #2 CWP outfall; and
- Wharf stormwater pond overflow.

High frequency storm events are contained within the site's stormwater infrastructure for treatment at the ETP. During larger storms, the most contaminated flows (based on catchment land use) are directed to the CWP as a priority.

The CWP has a total containment volume of approximately 7,000 m^3, of which the nominal operating volume is 1,000 m^3, leaving 6,000 m^3 available as surge volume for stormwater during rain events. Operational controls exist during storm events to preserve the capacity of the CWP which typically contains the sites most contaminated stormwater. This ensures that should an overflow occur, it will likely contain a lower concentration of contaminants. These controls are detailed in the Rain Event Strategy and include actions such as ceasing non-critical process tasks that generate wastewater and utilising the peripheral detention storages efficiently.

Should such an overflow occur, sampling is conducted from any point at which discharge of stormwater occurs and is analysed by the NH laboratories. Stormwater incidents are reported to the EPA in accordance with EPN requirements.

Figure 4-16 Surface water discharge monitoring locations – all points are emergency stormwater overflow points

4.2.3.3 Stormwater Results and Discussion

Nyrstar's regulatory obligations for stormwater monitoring relate to the identification of stormwater overflows which may have breached the provisions of the EPN 7043/5.

During the reporting period, one incident occurred where untreated stormwater was discharged to the Derwent estuary. Provision SW2 of the EPN identifies that NH may only discharge untreated stormwater during a critical duration storm event, with 0.2 annual exceedance probability (AEP).

During a 38 hour period between 21 and 23 June 2020, the NH site recorded 77.5 mm of rainfall. This storm event caused the discharge of untreated stormwater to the Derwent estuary. As part of the investigation, the intensity of the rainfall event was compared to Bureau of Meteorology intensity-frequency-duration (IFD) estimations. This comparison identified that the intensity of the rain event was above a 20% AEP and therefore did not constitute a breach of EPN 7043/5. Estimates were made by the investigation team which suggested that approximately 156 m^3 of untreated storm water overflowed from the Wharf Stormwater ponds to the Derwent. The overflow water was sampled, with the results included within the report provided to the EPA and provided in Table 4-10. This event is discussed in further in Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021.

Table 4-10 Overflow water quality and load results 2020

Event	Emission Point	Overflow Volume	Cadmium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)	TSS	TPH (µg/L)
June 2020	22/06/2020 Wharf Ponds Overflow	156m^3	0.8	1.3	7.3	61	306.7	<100

Note: where multiple overflow samples were collected over the course of an overflow event, the average concentration is provided in the table above.

4.2.4 Groundwater

4.2.4.1 Groundwater Background

Significant soil and groundwater contamination has occurred across the site as a result of 105 years of smelting operations. Sources have included; leakage of process solutions in operational areas, ground infiltration of contaminated surface water, infiltration through stockpiled feedstocks and residues and leaks from above and below ground storage tanks and pipes. The majority of these sources have been eliminated, with work continuing to address current, known, ongoing sources.

Groundwater is monitored for relative standing water level (RSWL)/ hydraulic head and water quality across the site at all active monitoring bores and nine individual groundwater extraction systems.

All references to RSWL/hydraulic head is in meters above Australian Height Datum (AHD).

4.2.4.2 Groundwater Monitoring Program Details

Groundwater monitoring requirements are stipulated within EPN 7043/5. This includes the frequency of monitoring and the data collection required (Section GW4) and the specific bores requiring monitoring (Attachment 5).

A minimum of six monthly measurements of standing water level (SWL)/ depth to water (DTW) must be taken at all bores nominated within the EPN. Operational bores are shown within Figure 4.17. SWL/DTW is measured from the top of the bore casing to the top of the bore water. To calculate the hydraulic head/relative standing water level, the DTW value is subtracted from the surveyed top of casing elevation.

Each of the EPN nominated bores must be sampled to assess groundwater quality once every two years.

In April 2016, the sample frequency for many onsite bores was increased to obtain higher resolution data from areas deemed to be high risk, to ensure that emerging issues were recognised as early as possible. The following method, put forward by GHD (2012) to determine individual bore sampling frequency using a risk based approach was adopted:

- All bores with decreasing or stable contaminant trends and with concentrations below 1000 x the ANZECC (2000) guidelines for 80% protection of marine ecosystems (for any contaminant) are to be monitored on a biennial basis.
- All bores with decreasing or stable contaminant trends but with concentrations higher than 1000 x the ANZECC (2000) guidelines for 80% protection of marine ecosystems (for any contaminant) are to be monitored on an annual basis.
- All bores with increasing contaminant trends and with concentrations below 1000 x the ANZECC (2000) guidelines for 80% protection of marine ecosystems (for any contaminant) are to be monitored on an annual basis.
- All bores with increasing contaminant trends but with concentrations above 1000 x the ANZECC (2000) guidelines for 80% protection of marine ecosystems (for any contaminant) are to be monitored on a biannual basis.
- In the event of a paucity of data from an individual bore, the geographic location of the bore was also taken into account and if the location was deemed to be high risk (e.g. within the main operational footprint of the plant), the bore was assigned a biannual sampling frequency. It is the intention that the program will be reviewed each year as new data is collected and assessed.

The risk based method of determining sampling frequency has resulted in the following sampling program:

- High risk bores: 21 bores sampled in June and December each year.
- Medium risk bores: 41 bores sampled in November each year.
- Low risk bores: 44 bores sampled in November every second year (2017, 2019 etc.).

Figure 4-17 Groundwater monitoring borehole locations

4.2.4.3 Groundwater Results & Discussion

Standing Water Levels (SWLs)

SWL must be measured at a minimum, six monthly in all wells. The captured data is used to assess changes in groundwater levels over time, which may indicate:

- Sources or sinks in the system that could require investigation;
- Changes in the hydrogeological model for the site; and
- The performance of groundwater harvesting systems in creating hydraulic drawdown towards extraction locations.
  - This information is validated with the measurement of groundwater flow from each extraction bore.

Rainfall typically influences the hydraulic head within the unconfined aquifer onsite via infiltration, leading to aquifer recharge. In some monitoring locations, the hydraulic head within the deeper, semi confined system is also influenced by seasonal rainfall indicating a leaky upper boundary.

The measured hydraulic head across the reporting period is presented within the following pages, utilising data obtained during the summer monitoring round.

2019 Quarter 4

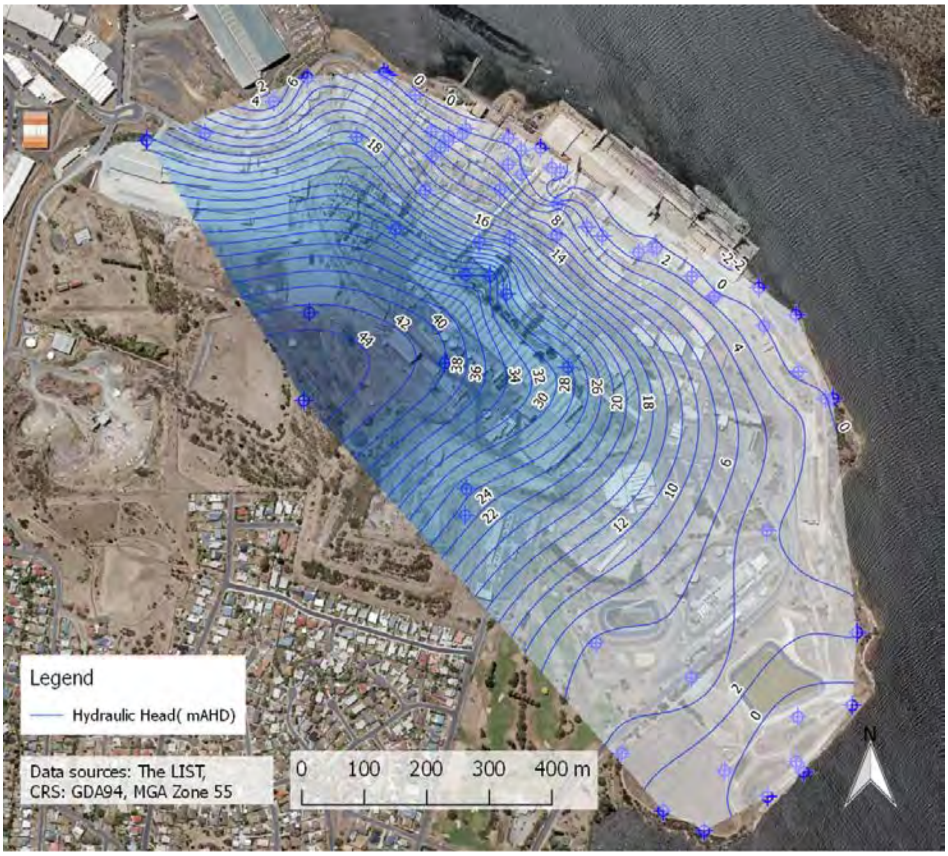


Figure 4-18 Hydraulic head within the shallow aquifer Q4 2019

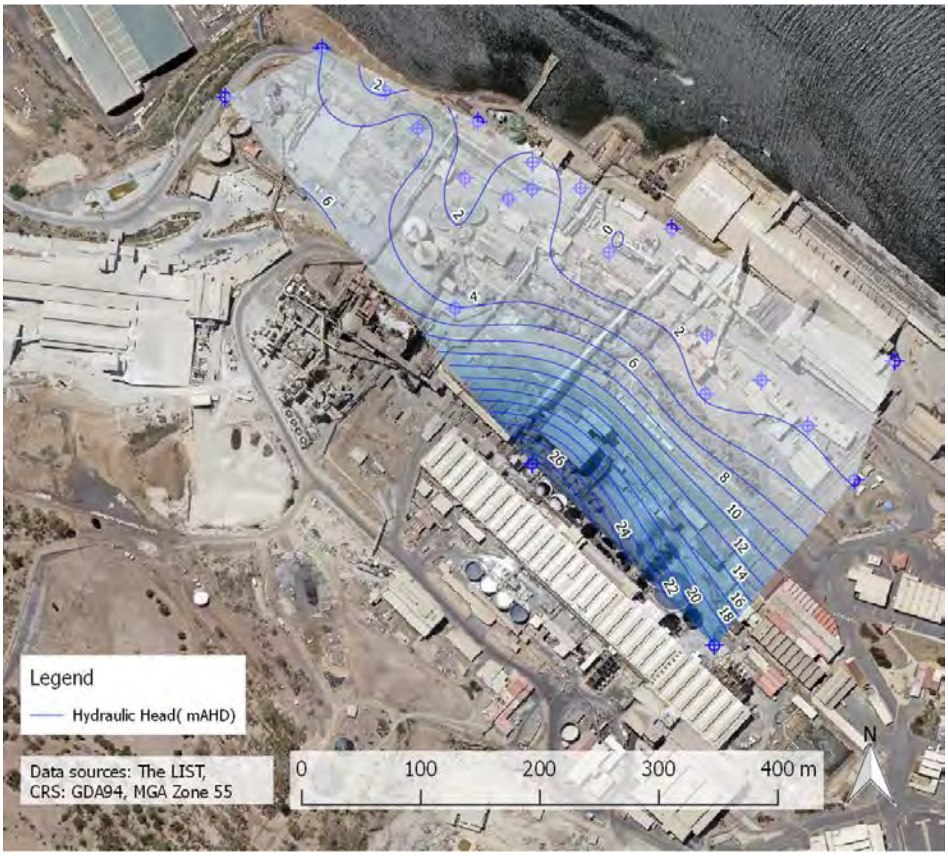


Figure 4-19 Hydraulic head within the deep aquifer Q4 2019

2020 Quarter 4

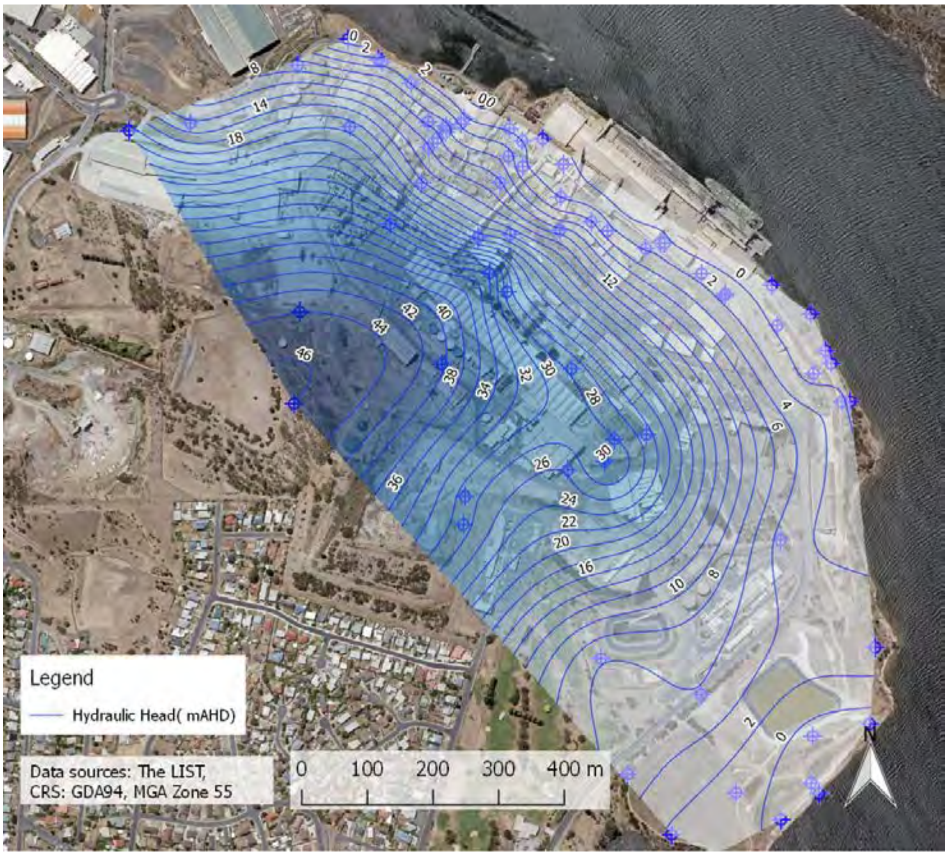


Figure 4-20 Hydraulic head within the shallow aquifer Q4 2020

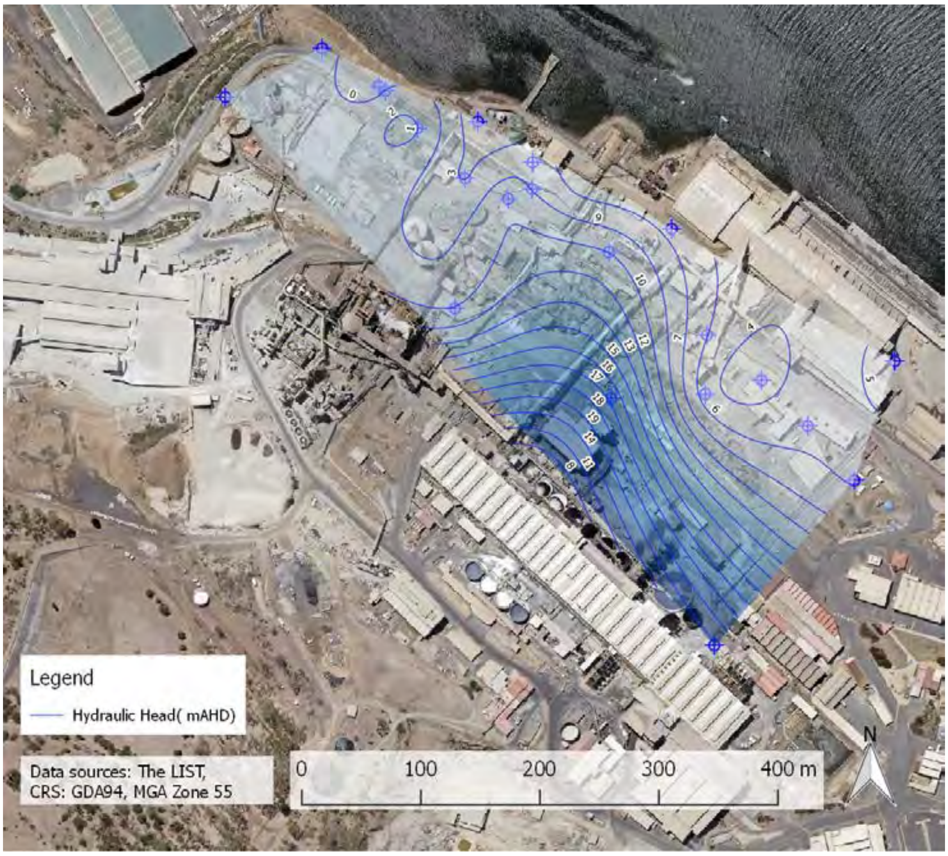


Figure 4-21 Hydraulic head within the deep aquifer Q4 2020

2021 Quarter 4

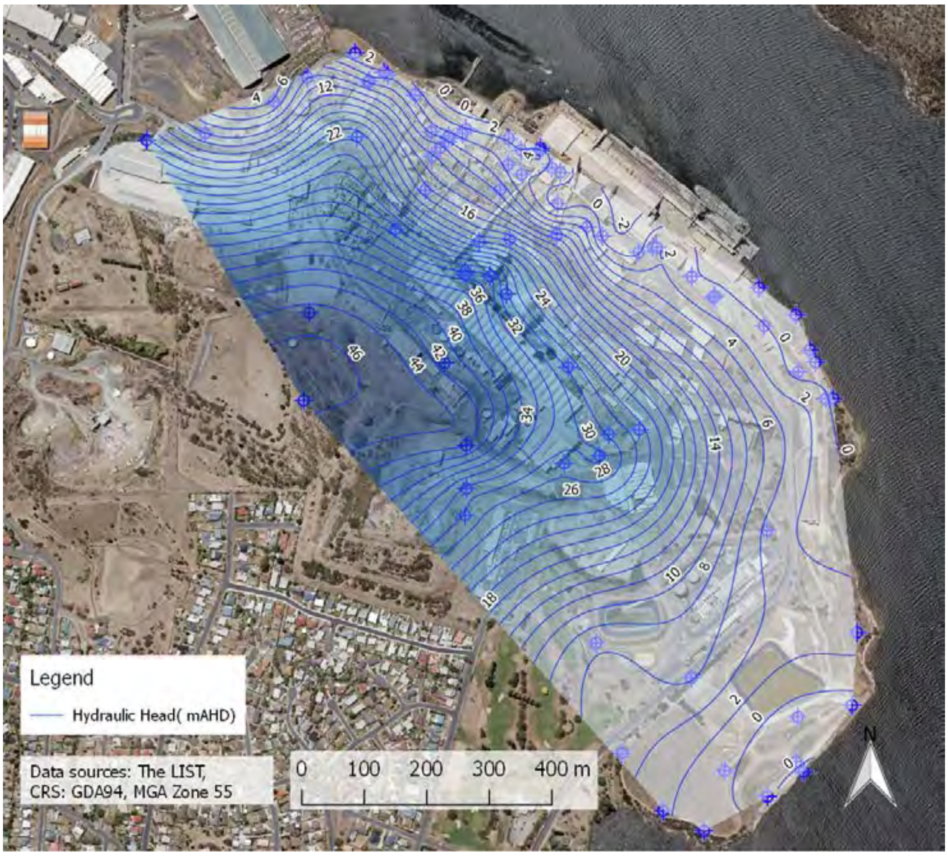


Figure 4-22 Hydraulic head within the Shallow Aquifer Q4 2021

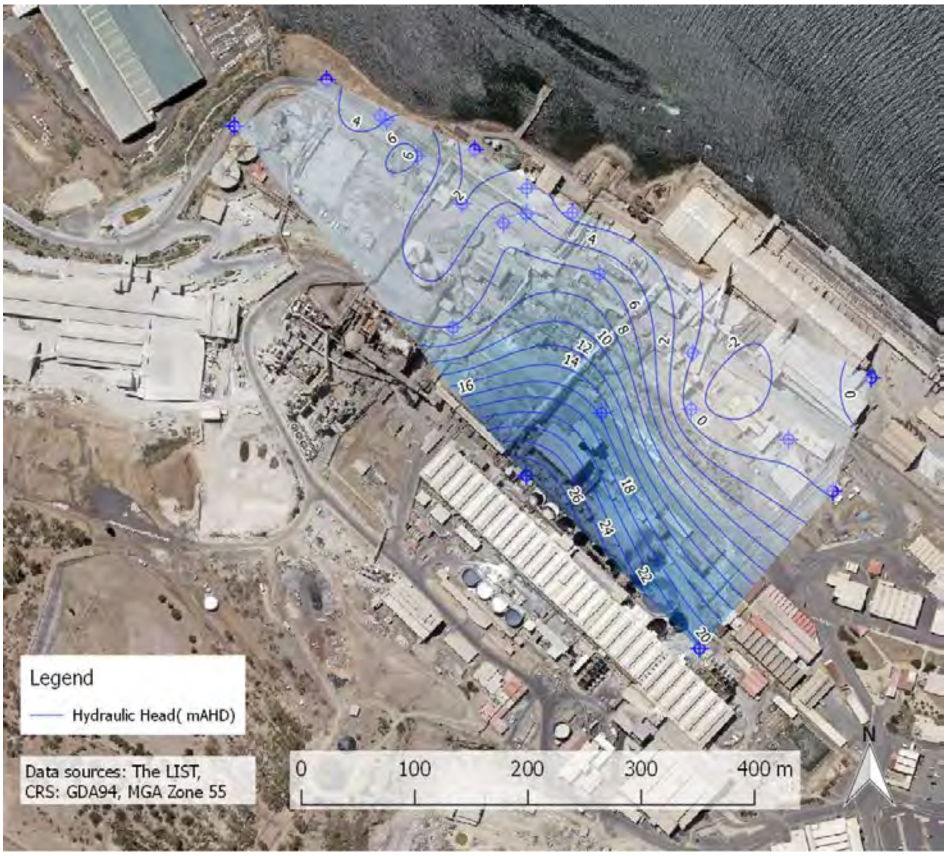


Figure 4-23 Hydraulic Head within the deep aquifer Q4 2021

Groundwater Quality in Site Monitoring Bores

As per the requirements of EPN 7043/5 section GW5, groundwater quality across site is, at a minimum, measured biennially. Across the reporting period, the following sampling events took place:

- May/June/July/August 2019, sampling of 20 bores
- November/December 2019, sampling of 94 bores
- May/June/July 2020, sampling of 62 bores
- November/December 2020 plus January 2021, sampling of 48 bores
- June 2021, sampling of 49 bores
- November 2021, sampling of 101 bores

Through the above sampling programs the mandatory frequency for bore sampling was achieved, each bore was sampled at or above the minimum frequency of once every two years. Provided that access to the well was not restricted and the well remains in commission.

<u>Historical Trends in Groundwater Quality</u>

Changing zinc and cadmium concentrations over the past six years within selected bores are displayed below in Figure 4.24 and Figure 4.25. The bores included within the graphs have historically contained the highest concentration of zinc and cadmium within the dataset.

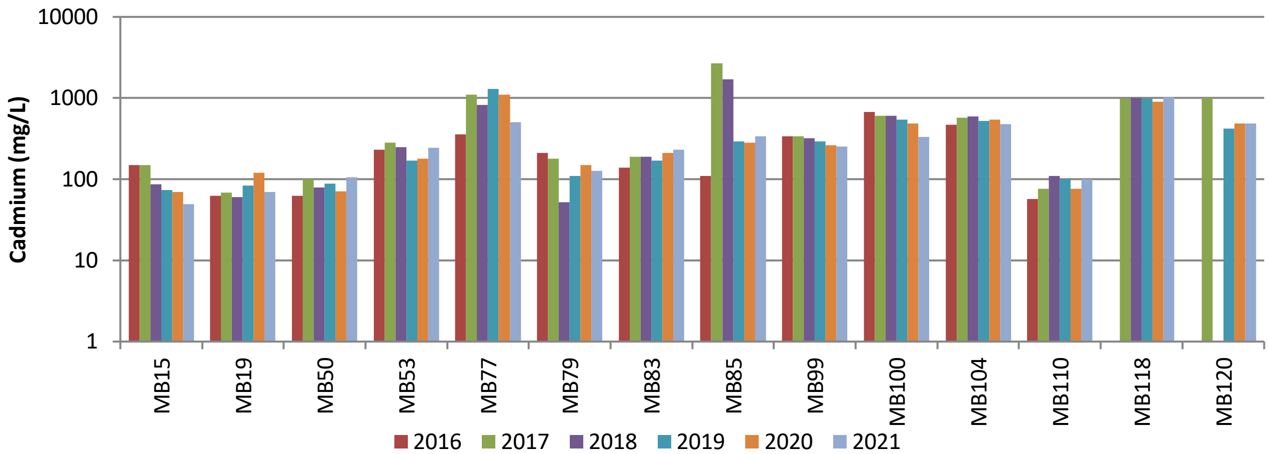


Figure 4-24 Comparison in cadmium concentrations in most contaminated bores from 2016 to 2021

Cadmium concentrations within onsite bores can be said to be variable within the bores plotted above. While some bores indicate a decline in cadmium concentrations, some indicate a positive trend across the reporting period: MB53, MB79 and MB83. Each of these bores lie directly down inferred hydrogeological gradient from the Leach/Purification Department onsite, which is responsible for removing cadmium from impure solution and processing it into market metal.

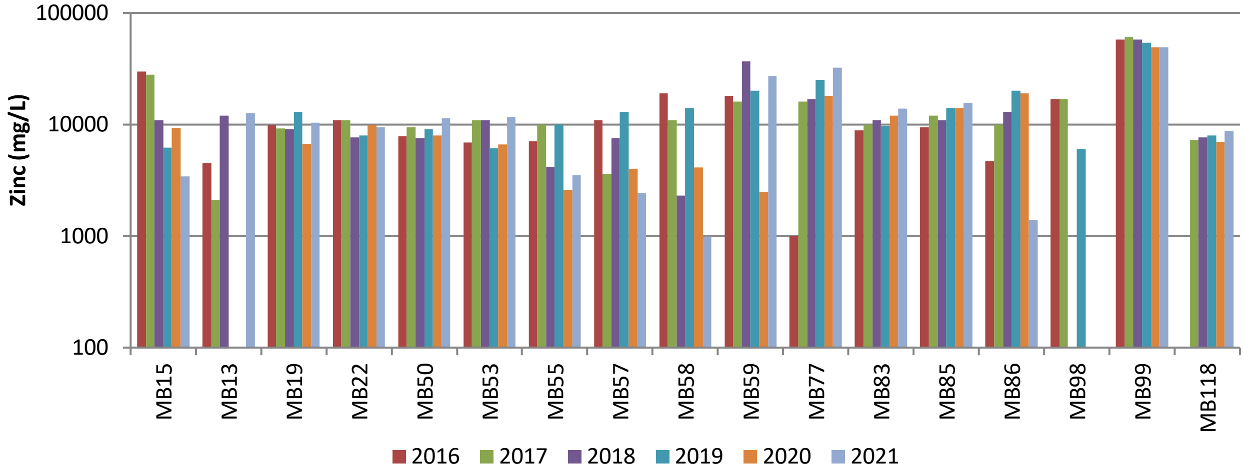


Figure 4-25 Comparison in zinc concentrations in most contaminated bores from 2016 to 2021

Zinc concentrations within key groundwater bores appear to be declining or remaining relatively consistent over the past six years, with the exception of MB22 (down gradient of Unit 5 Electrolysis), MB53 (down gradient of Leach), MB83 (down gradient of Leach) MB85 (within Purification).

Of the bores with increasing zinc or cadmium trends, all fall either within the radius of influence, or lie up hydrogeological gradient of one of the nine groundwater extraction systems operating at the site. Further information is included in the Groundwater Recovery section of this chapter.

<u>Spatial Distribution of Groundwater Contaminants</u>

The distribution of contaminant concentrations within groundwater bores is depicted in the box and whisker plots on the following pages. The results have been segregated into two groups;

- Upgradient 'source' bores
- Downgradient foreshore bores

Comparison of the two datasets can be used to compare and contrast the distribution of contaminant concentrations within groundwater between; onsite bores situated in operational areas - where contaminants are expected to be higher, against peripheral, down gradient bores along the Site's boundary.

It is acknowledged that the spatial comparison of contaminant concentration data is somewhat simplistic, given the complex hydrogeological systems assessed. The adoption of such a method however enables a high level review of key areas of environmental concern relating to groundwater quality onsite.

Figure 4-26 Groundwater monitoring bore locations, upgradient vs foreshore.

Data collected over the reporting period has been collated by calendar year and is presented within the three box and whisker plots below. The red line represents ANZECC (2000) guidelines for 80% protection in marine waters[1]. Green line represents the laboratory limit of reporting (LOR). It should be noted in 2021, NH changed laboratories for groundwater analysis and was able to achieve a lower LOR for the analysis.

[1] ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

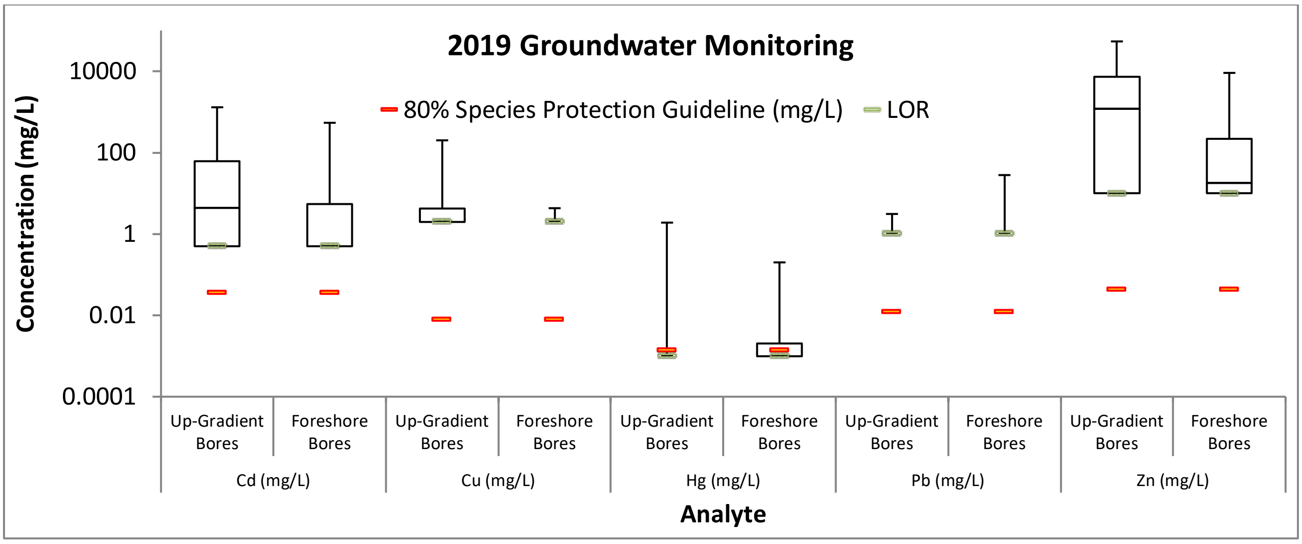


Figure 4-27 Summary of groundwater quality in monitoring bores located up gradient (n=45) and bores located on the boundary of site (n=47) sampled during 2019

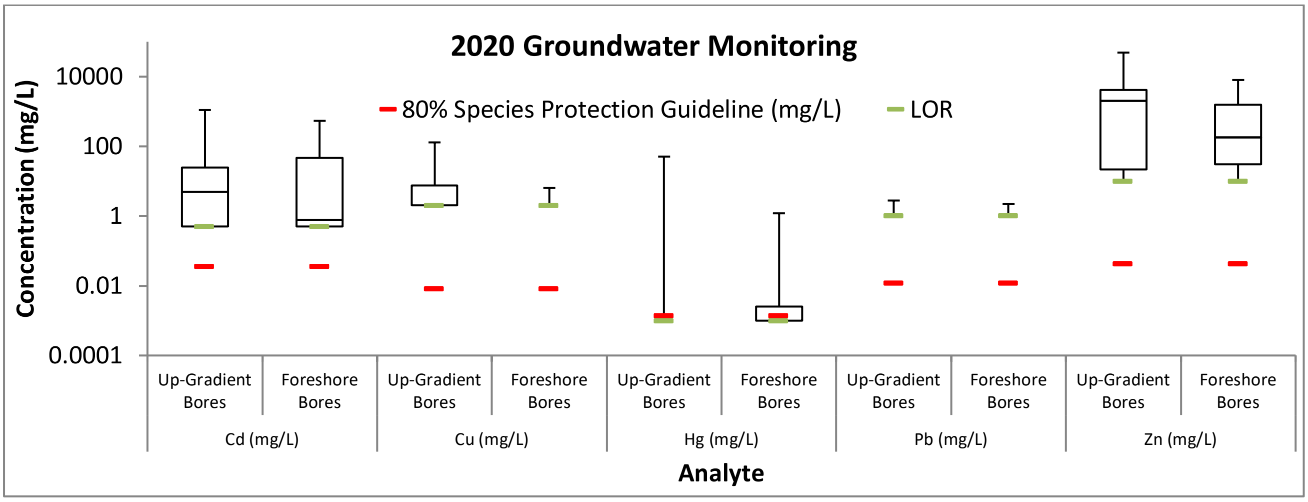


Figure 4-28 Summary of groundwater quality in monitoring bores located up gradient (n=42) and bores located on the boundary of site (n=24) sampled during 2020

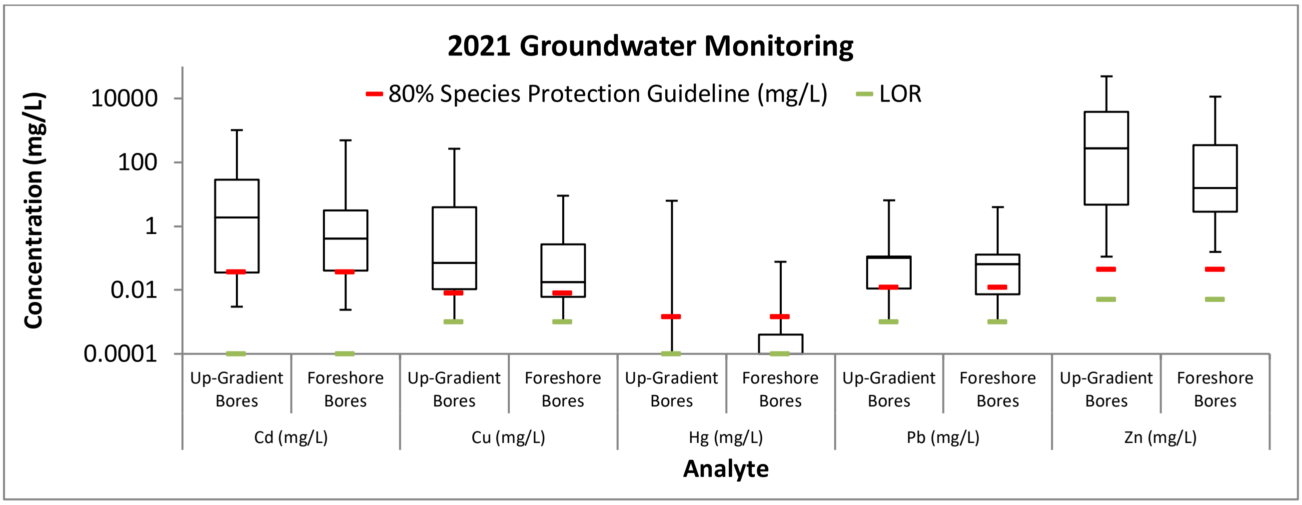


Figure 4-29 Summary of groundwater quality in monitoring bores located up gradient (n=51) and bores located on the boundary of site (n=44) sampled during 2021

The results of the three monitoring campaigns plotted above, found that typically the concentration of contaminants within groundwater was found to be lower within peripheral, foreshore monitoring bores. This can be identified by a lower maximum concentration and interquartile range. This general reduction in contaminant concentrations indicates that the groundwater extraction programs operating across the site are likely assisting in the reducing the mass of contaminants being discharged into the Derwent estuary via groundwater seepage.

It is relevant to note that in 2019 and 2020 the LOR for many analytes lie above the 80% Species Protection Criteria, indicating that it is possible that the actual concentration of contaminants may lie below the criteria. However given the limitations of the dataset and the analysis method employed by the analysing laboratory over this sampling period, this cannot be effectively quantified. In 2021, NH changed laboratories to achieve lower LOR for the required analyses meaning there can be greater confidence in the actual concentration of contaminants. By achieving a lower LOR, it is possible to identify that in 2021, contaminant concentrations were found to be below the 80% Species Protection Criteria in many wells.

Contaminant Concentration Mapping

Within the following pages, several figures have been prepared indicating the concentration of individual metal contaminants within groundwater across the site. The data originates from groundwater samples collected during the Q4 2021 sampling event where all available and accessible groundwater bores were sampled at the time.

The cadmium concentrations measured in the site's monitoring bores (Figure 4.30) is consistent with previous reporting periods, identifying the main hotspots to be in the area of the Old Leach Plant, and the current Cadmium Plant.

Figure 4-30 Cadmium (mg/L) in groundwater beneath the NH site from 2021 groundwater monitoring data

The distribution of mercury within groundwater across the site is presented within Figure 4.31. The area displaying the highest concentrations of mercury is downgradient of the acid plants, where mercury liquors are stored as part of the process. The results are consistent with previous years.

Figure 4-31 Mercury (mg/L) in groundwater beneath the NH site from 2021 groundwater monitoring data

The concentration of lead within groundwater during the 2021 monitoring year is provided within Figure 4.32. Concentrations are greatest within areas down hydrogeological gradient of the Leach department, where lead is removed from the hydrometallurgical circuit.

Figure 4-32 Lead (mg/L) in groundwater beneath the NH site from 2021 groundwater monitoring data

The mapped concentration of zinc within groundwater (refer Figure 4.33) identifies the most contaminated areas to be those within the Purification and Leach Departments, which are located down hydrogeological gradient of the Cellhouse. This is consistent with previous year's results.

Figure 4-33 Zinc (mg/L) in groundwater beneath the NH site from 2021 groundwater monitoring data

In general, the mapped concentrations clearly show that the most significant areas of contamination are located downgradient of the Electrolysis Department. This entire area is subject to groundwater extraction, whereby large volumes of contaminated groundwater is pumped to the onsite Effluent Treatment Plant, which recovers the metal from groundwater. Each of the groundwater extraction systems are described within the following pages.

Groundwater Recovery

Groundwater is recovered from strategic locations and targets known hot spots of contamination across the site in accordance with the Groundwater Management Strategy. Ten groundwater extraction systems have been established, each are detailed in the sections below.

The location of each extraction system is identified within Figure 4.34 and Figure 4.35.

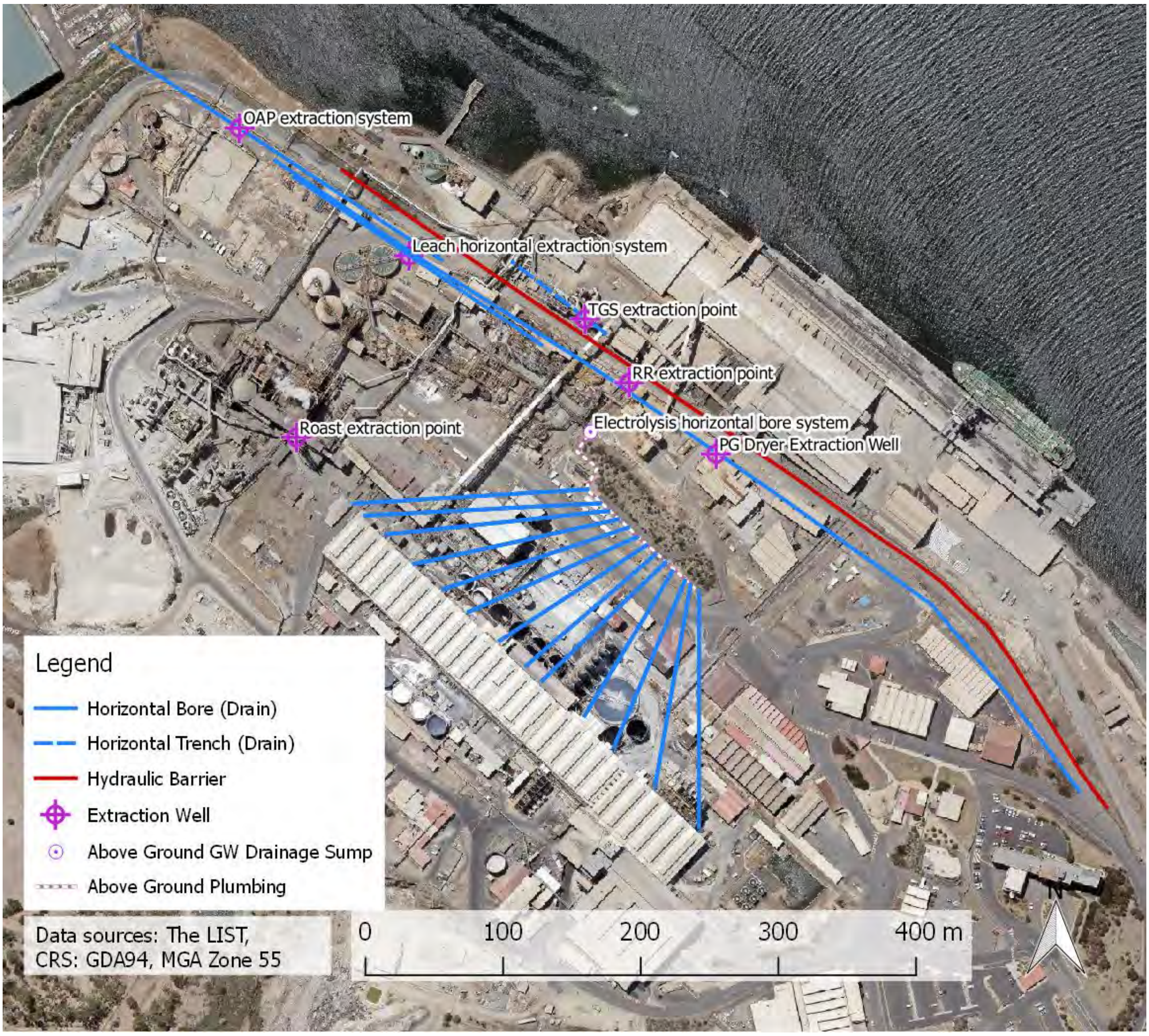


Figure 4-34 Location of operational site area groundwater extraction systems

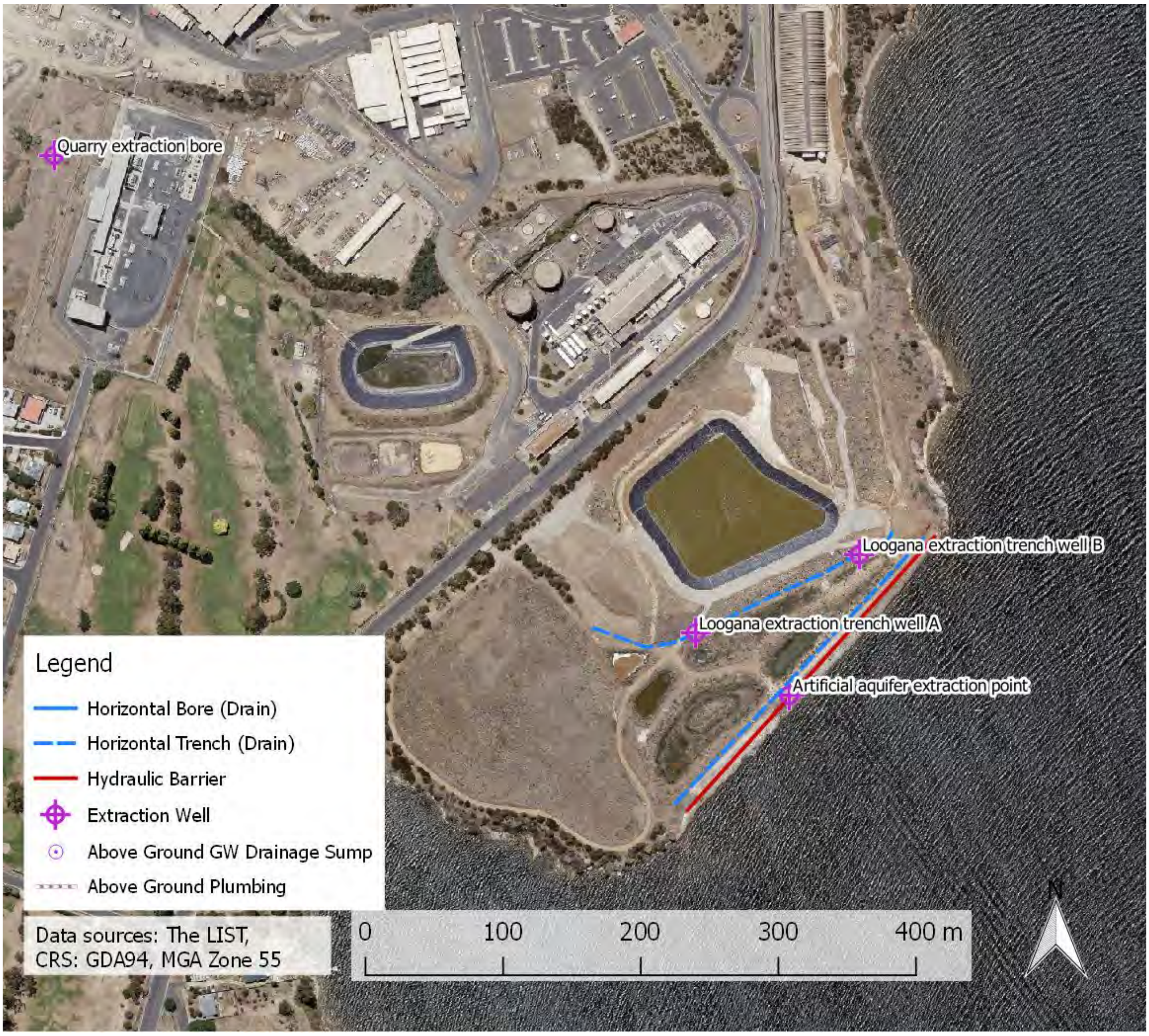


Figure 4-35 Location of southern groundwater recovery systems

All extracted groundwater reports to the CWP for treatment by the ETP to remove heavy metals prior to discharge through the permitted foreshore outfall point (FSO) or is recycled within the plant.

The established recovery systems continue to deliver good performance throughout the reporting period, however in 2021, many of the extraction pumps experienced extended periods of downtime. The recovered volume and metal load for the reporting period is shown in Table 4-11. For comparison purposes, the previous sampling periods are also included.

Table 4-11 Summary of estimated loads extracted from groundwater recovery points during the reporting period

Year	Volume (m^3)	Zinc (kg)	Cadmium (kg)
2021 CY Total	27,223	67,000	1,511
2020 CY Total	40,041	83,846	1,698
2019 CY Total	41,713	82,575	1,966
2018 CY Total	40,904	85,395	2,329
2017 CY Total	45,826	85,032	2,478
2016 CY Total	58,275	151,897	3,053

Groundwater and metal recovery was fairly consistent throughout the reporting period except for a decline in 2021. This decline can be attributed to infrastructure failure with long replacement and repair periods. Replacement pumps are on order and are expected to be operational in early 2022.

<u>Roast Vertical Extraction Bore (EB01)</u>

The Roast extraction bore is a 300 mm diameter well installed in August 2000, 40.5 m into dolerite bedrock with a 28.5 m, 150 mm diameter screen.

Metal concentrations within the Roast Extraction Bore have generally declined since 2001, as shown in the graphs on the following page. Data collected over the reporting period indicates that the concentration of both zinc and cadmium within the area of the Roast Extraction Bore have increased. This may be due to the sub-optimal performance of the pump within the well, resulting in poor flows.

Due to the lack of sufficient observation wells surrounding this extraction point, insufficient data is available to determine the radius of influence created through the continual pumping within the vertical Roast Extraction Bore.

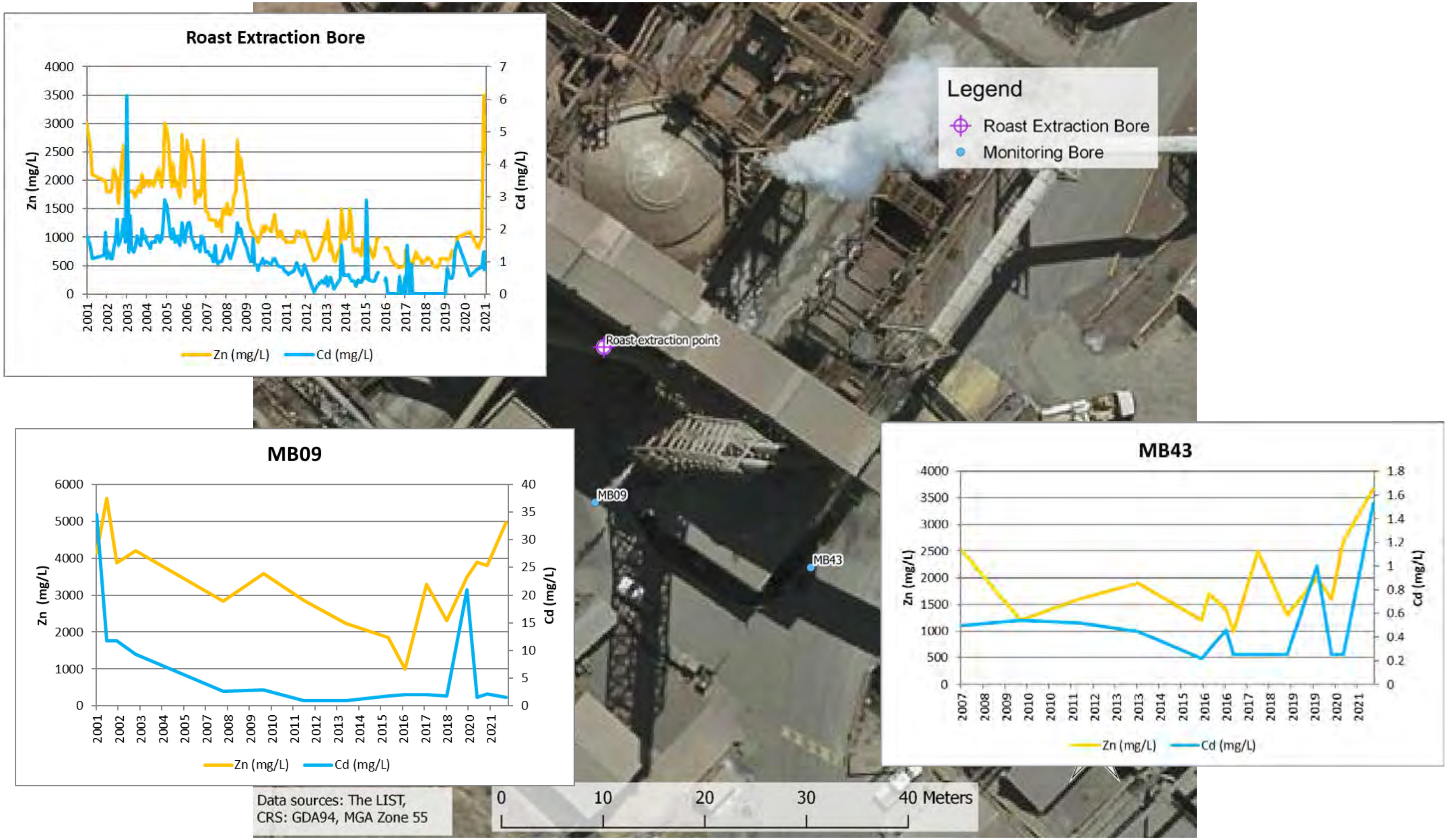


Figure 4-36 Metal concentrations in the Roast extraction bore and associated monitoring bores

Leach Horizontal Extraction Bore (EB02)

The Leach extraction bore is a 16 m deep, 380 mm diameter bore, intersecting the horizontally drilled groundwater drain that extends approximately 220 m in a northwest/southeast direction below the Neutral Leaching section and Mercury Removal Plant to the northwest and the Paragoethite section to the southeast. The horizontal collection drain lies within dolerite and extends towards, but does not intersect the contact with the Triassic sandstone to the southeast. The typical depth of the horizontal drain is approximately 5 m below sea level, approximately 16 m below ground level at the extraction point. The 112 mm open hole collection drain was installed in June/July 2001, while the vertical extraction point was installed prior to this in May 2001.

Since the commissioning date, the concentration of zinc and cadmium within extracted water remained relatively consistent until 2008, where it declined steadily until 2009. Following this time, the concentration of each contaminant has proved to be somewhat variable, however a slight negative trend is evident, indicating a potential depleting source.

The concentration of zinc and cadmium within three bores located down hydrogeological gradient of the extraction system are presented on the following page. While many bores surround the extraction system, MB11, MB12 and MB53 have been selected due to their spatial distribution across the length of the extraction system.

Over the reporting period zinc has remained reasonably consistent, albeit with a noticeable increase in late-2018 and mid-2019. Cadmium has been quite inconsistent, with a number of spikes and troughs recorded. There has been an increase in zinc and cadmium recorded in MB12 and MB53, located within close proximity of the leach extraction bore. It is considered that the inconsistent cadmium concentrations, and the increase in contamination recorded in the surrounding area may be a result of damaged bunds and sumps in the Leach Plant. Investigations carried out throughout the reporting period have identified and rectified some of the damaged infrastructure.

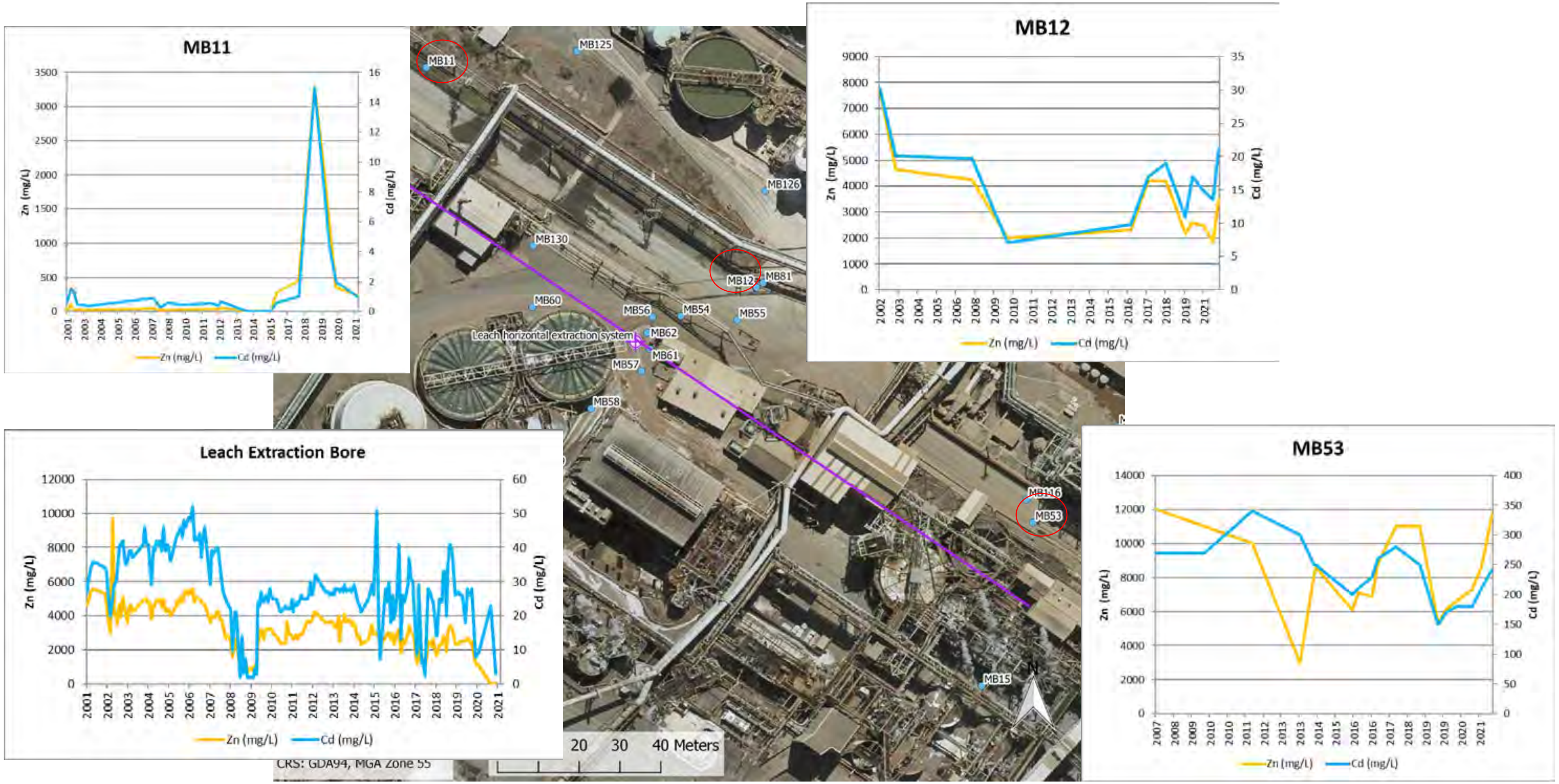


Figure 4-37 Metal concentrations in groundwater extracted from the Leach recovery system

Loogana-Inshallah Seawall System and Recovery Trench System

Initially, the Loogana-Inshallah extraction system comprised a groundwater pump, coupled with a 278 m long bentonite grout seawall acting as a hydraulic barrier, preventing the migration of groundwater into New Town Bay. The hydraulic head on the landward side of the cut-off wall is maintained below that of the seaward side, ensuring the hydraulic gradient falls towards the pumping system, rather than New Town Bay. The layout of the system is provided in Figure 4.38.

During the construction of the Loogana Dam in 2013-2014, a groundwater recovery trench was installed with a linear length of approximately 250 m, situated between the newly constructed stormwater dam and the Loogana wetlands. The base of the collection trench was installed at an elevation of -1.99 to -2.33 mAHD, draining to two collection pits. The installation of the extraction trench creates a hydraulic sink within the centre of the Loogana area, establishing a hydraulic flow towards the collection system, reducing the volume of contaminated groundwater that may discharge into New Town Bay. The potentiometric surface, based on hydraulic head observations within monitoring bores taken during Q4 2021 is presented in the figure below. Whilst there are relatively few wells across the approximately 9 ha area, it is apparent within the modelled surface below that there is an area of depression towards the centre of the Loogana area.

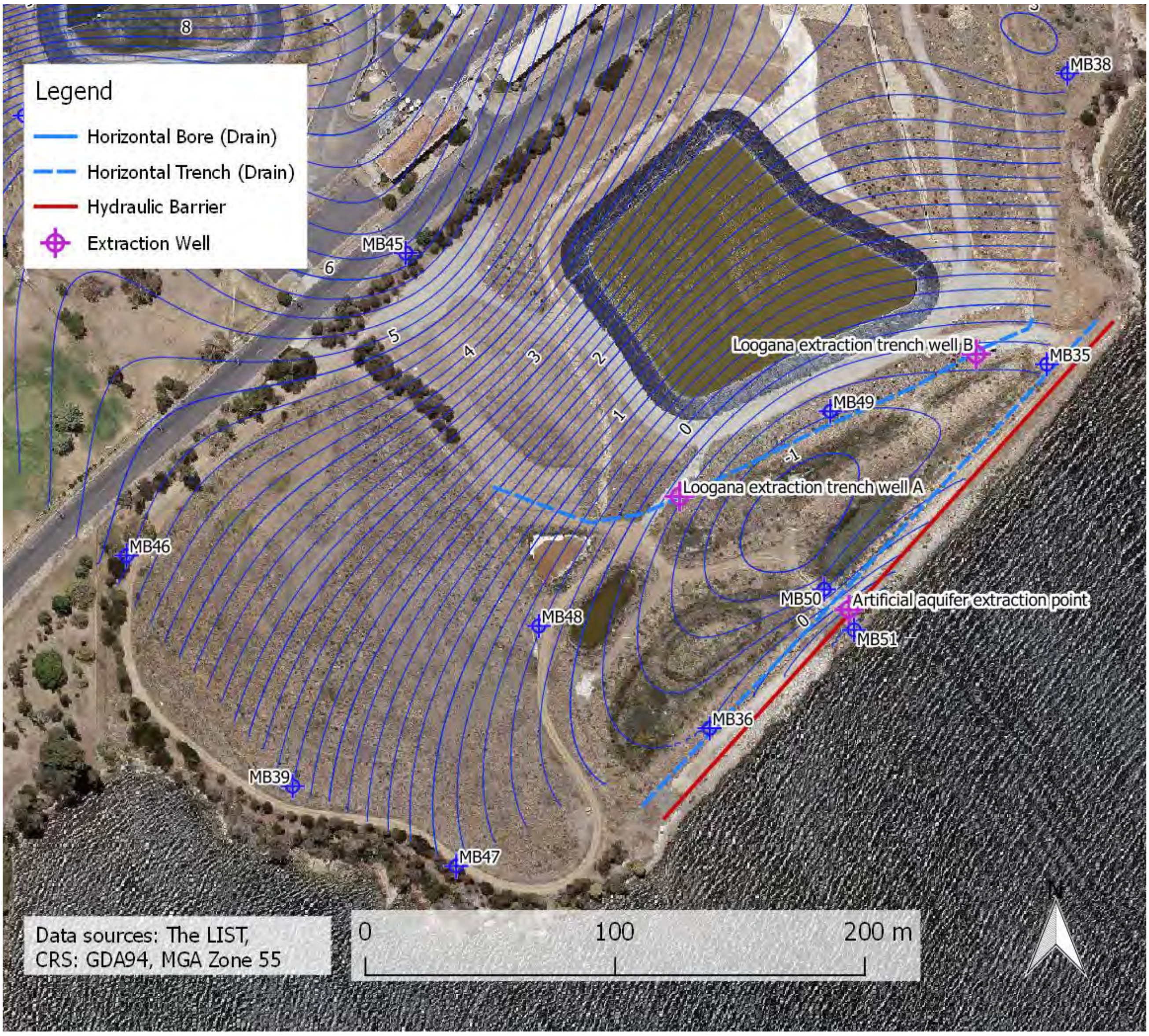


Figure 4-38 Loogana Cut-off wall and Collection Sump

The concentration of metals within groundwater recovered from the Loogana-Inshallah foreshore cut off wall system was relatively low throughout the reporting period, other than a sporadic increases found in May 2020 and January 2021. Groundwater quality within the artificial aquifer has been steadily increasing since 2010, This can be seen within Figure 4.39 below as a reduction in metal load within extracted water.

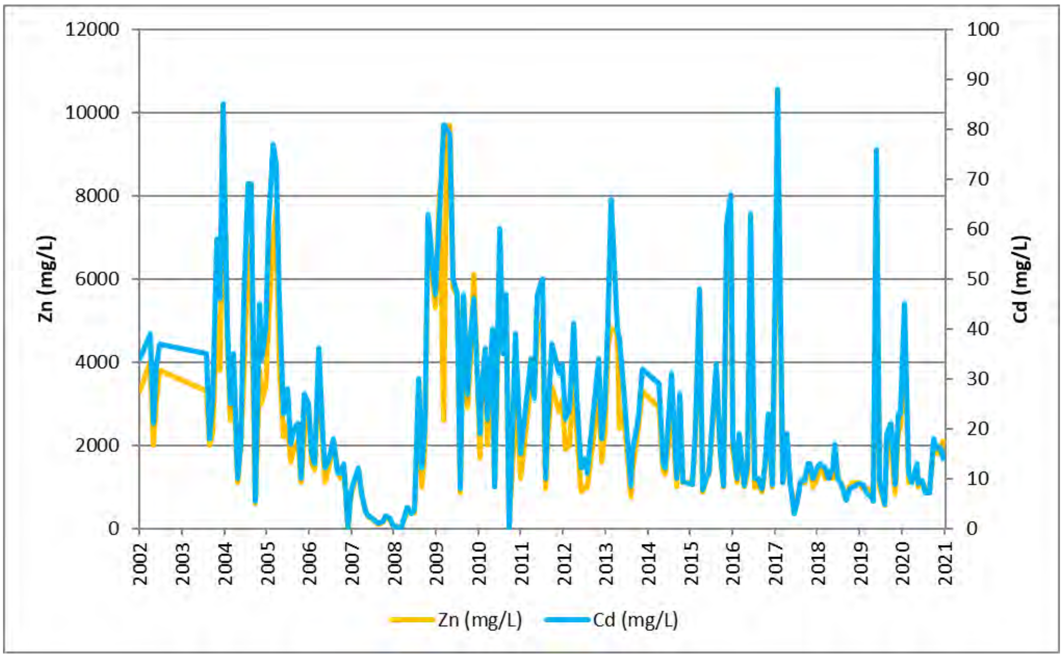


Figure 4-39 Metal concentrations in groundwater extracted from the Loogana–Inshallah recovery system

The concentration of zinc and cadmium within groundwater recovered within the Loogana Dam Trench is presented within the below figure. The concentration of both zinc and cadmium within RT1 (Trench Well B) appears to generally be declining over time, whilst the concentration within RT2 (Trench Well A) is somewhat variable.

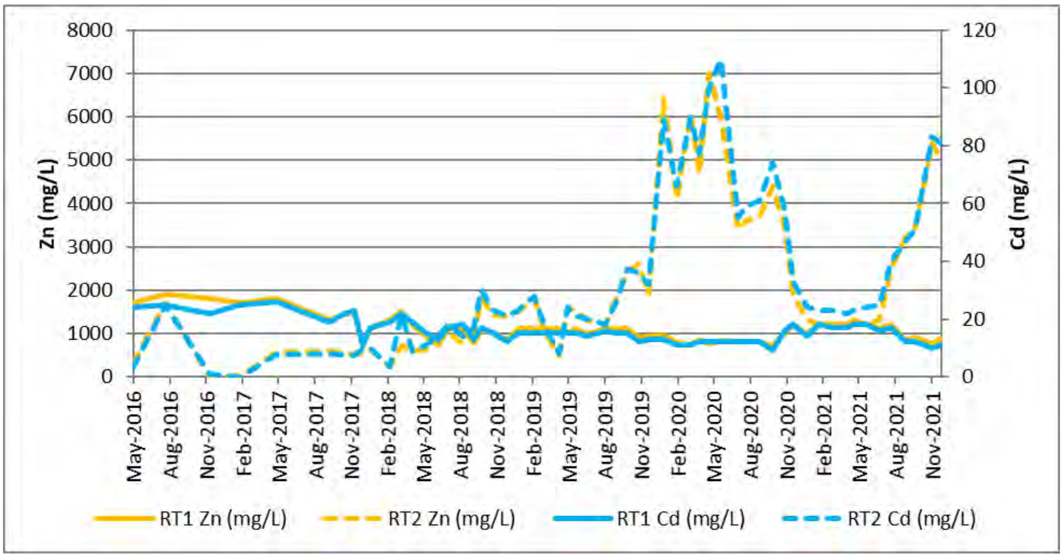


Figure 4-40 Metal concentrations within groundwater extracted from the Loogana Dam Recovery Trench

Risdon Road Extraction System

The contaminant load within groundwater extracted from the Risdon Road extraction system has been steadily decreasing over the past 20 years. This can be clearly seen within Figure 4.41 below. During the reporting period, the concentration of metals has continued to trend downwards, with the exception of cadmium within samples taken in late May 2019 and June 2019.

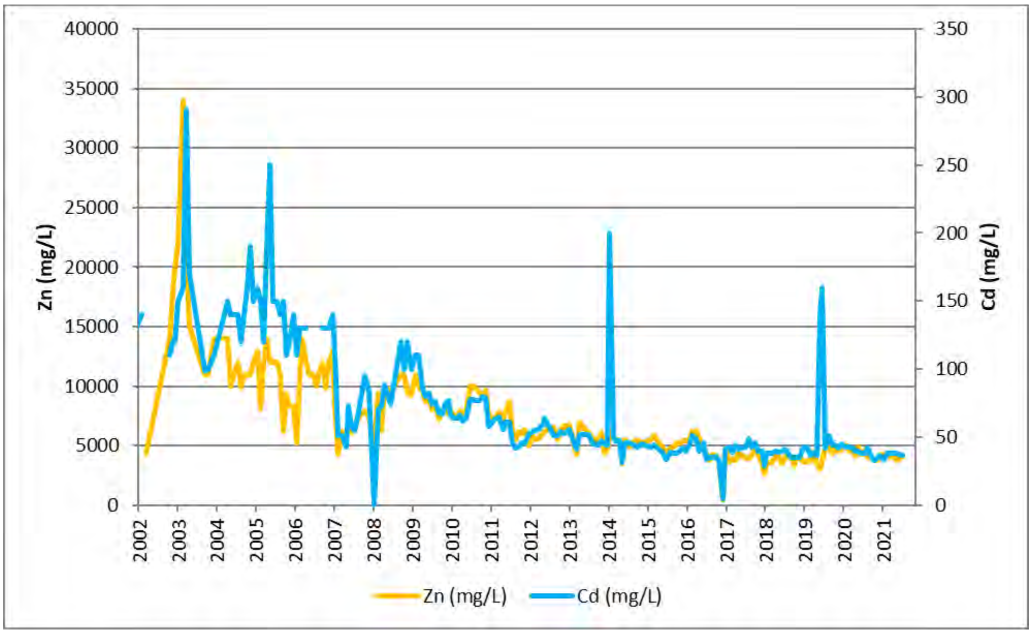


Figure 4-41 Metal concentrations in groundwater extracted from the Risdon Road recovery system

Tail Gas Scrubber Extraction Trench

The Tail Gas Scrubber extraction system comprises of a trench approximately 80 m long excavated typically 1-2 m below ground surface. A drainage pipe lies at the base, surrounded with coarse gravelly fill. A sump approximately 2.5 m in depth acts as a collection point for groundwater extraction. The system, that was commissioned in 2001 targets the unconfined aquifer onsite, as the collection trench largely site within poorly consolidated sediments or fill over the underlying dolerite.

Figure 4-42 Location of Tail Gas Scrubber Trench Extraction System

The concentration of contaminants in recovered groundwater has been highly variable since the system was commissioned. Both zinc and cadmium concentrations have been declining since 2015 with some variability, as can be seen in Figure 4.43.

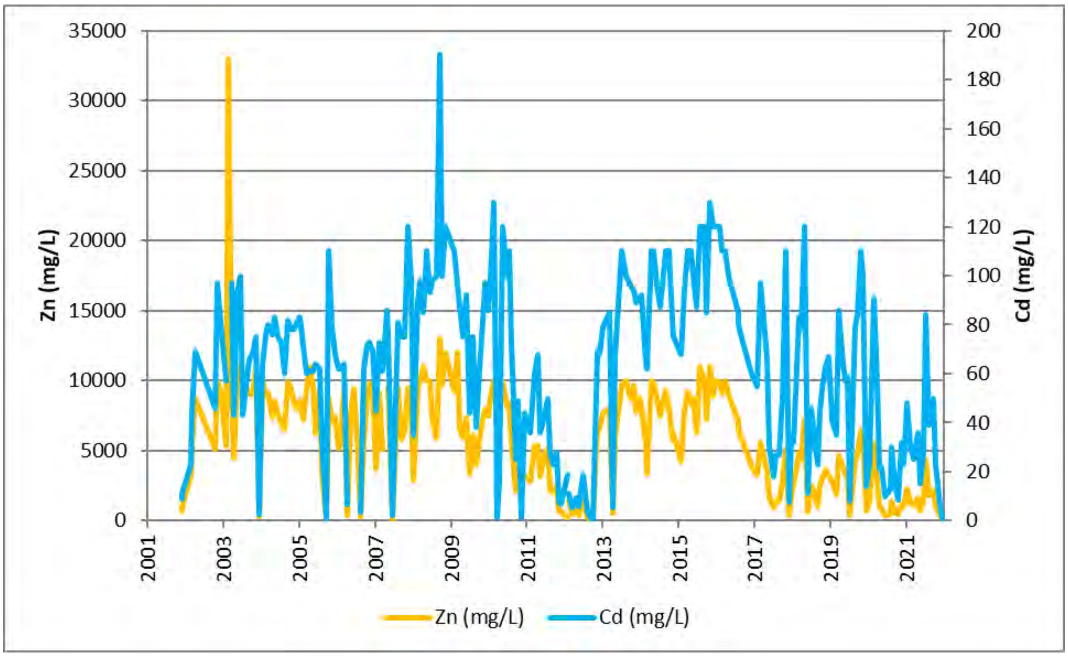


Figure 4-43 Metal concentrations in groundwater extracted from the TGS recovery system

__Electrolysis Horizontal Extraction Bores__

In 2008, 13 horizontal bores were drilled with an inclination of approximately 0.7 degrees from the horizontal in a fan-like manner extending from the historical leaching section of the Site towards the operational Electrolysis Department. The layout of these bores is included within Figure 4.44 below. Each of the bores are connected via a manifold to a common drain and flows via gravity to the site contaminated water system.

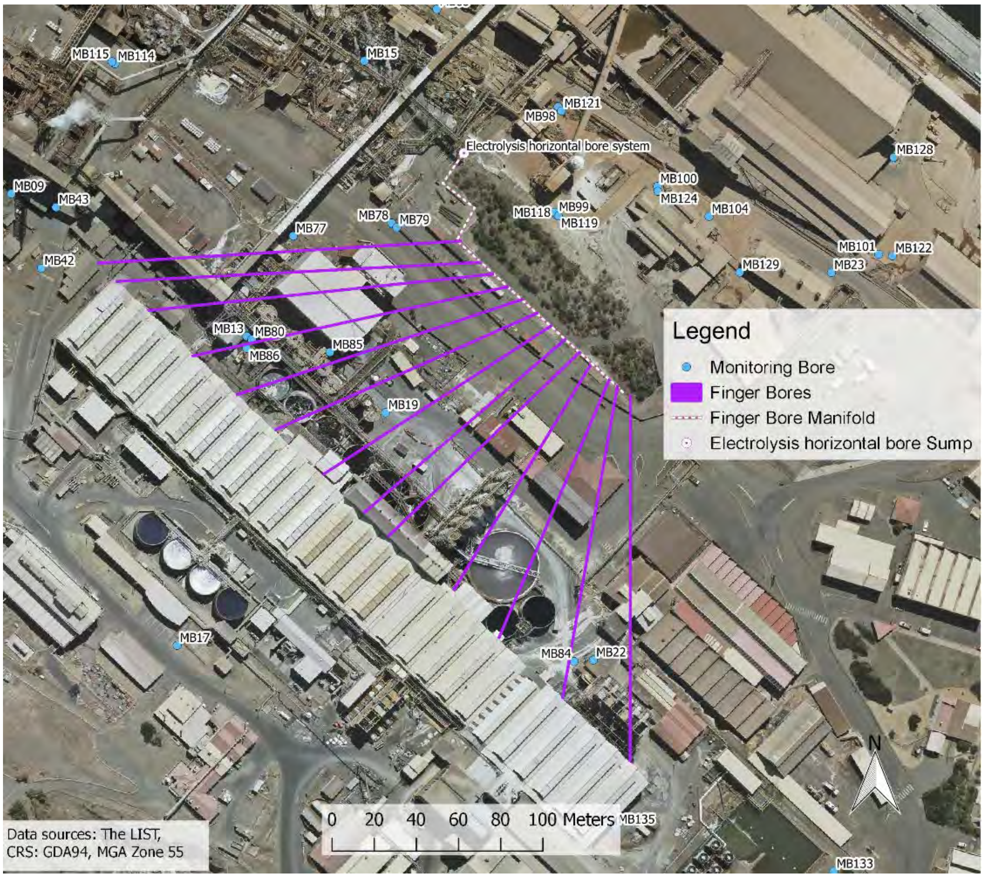


Figure 4-44 Location of Electrolysis Finger Bores

Metal concentrations in the horizontal extraction bore system were variable over the reporting period (refer Figure 4.45). While the concentration of zinc appears to be increasing within recovered groundwater, the concentration of cadmium has been relatively stable over the reporting period. This is likely due to repairs to containment infrastructure within the purification department, which is responsible for the removal of cadmium from impure solution.

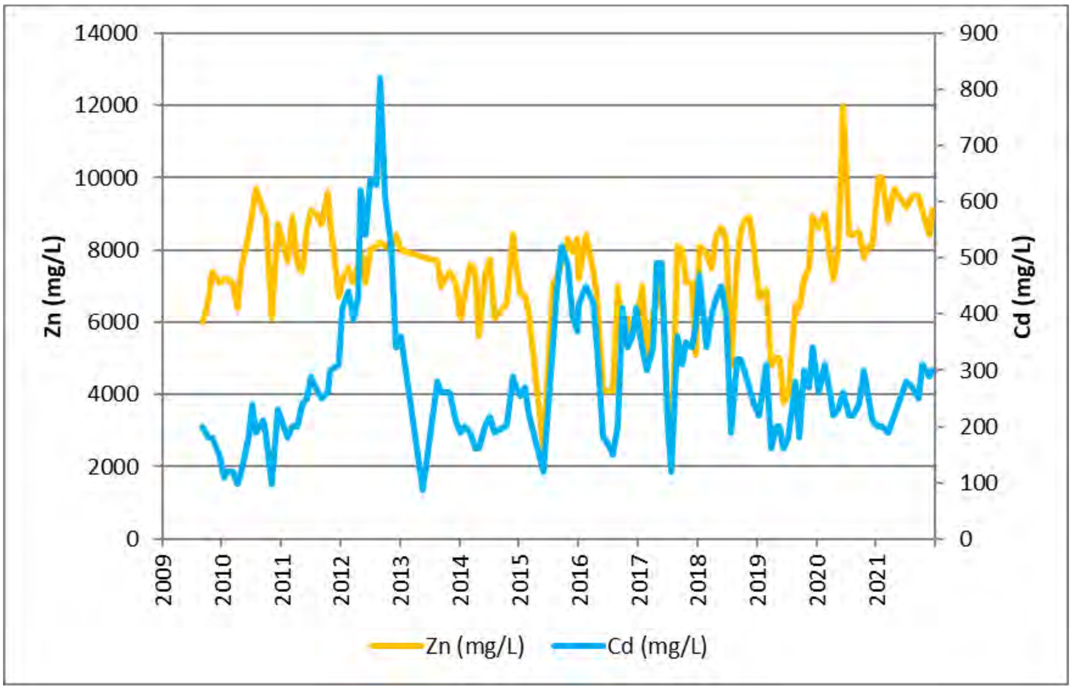


Figure 4-45 Metal concentrations in groundwater extracted from the combined Electrolysis horizontal bore system

Quarry Vertical Extraction Bore (EB03)

The Quarry Vertical Extraction Bore was installed in 2010 to a total depth of 28.6 m below ground surface. The bore is located down hydraulic gradient of a historical dolerite quarry that has been used as a storage repository for contaminated soil and contaminated timber, resulting from various demolition projects that have occurred at the site.

Figure 4-46 Location of the Quarry Vertical Extraction Bore

Results from the Quarry bore reveal no discernible trends during the current, or previous reporting periods (refer Figure 4.47). The Quarry bore intercepts the lowest contamination load of the extraction systems on the site.

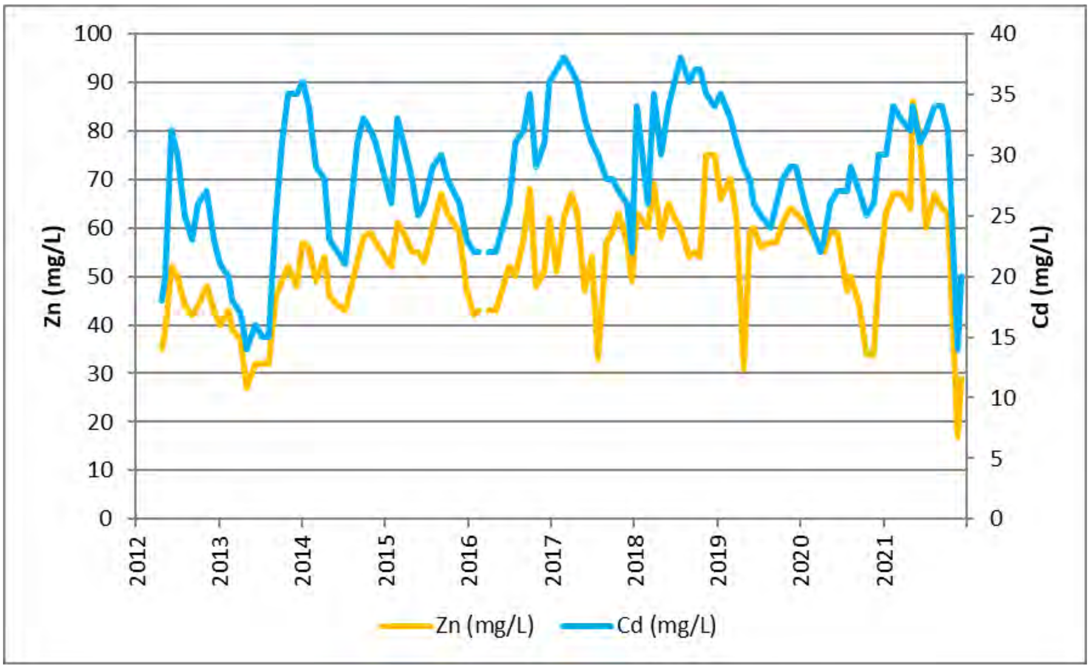


Figure 4-47 Metal concentrations in groundwater extracted from the Quarry recovery system

Old Acid Plant Horizontal Extraction Bore (EB04)

The Old Acid Plant Horizontal Extraction Bore as the name suggests lies within a section of the Site previously occupied by a sulphuric acid plant. The bore was constructed to extend the capture zone of groundwater along the site frontage at a depth of approximately 5 m below sea level. The bore was drilled from the neighbouring INCAT property and follows a roughly parabolic path, with an extraction well intersecting the horizontal path at the lowest section of the curve. The location of the extraction system is provided in the figure below.

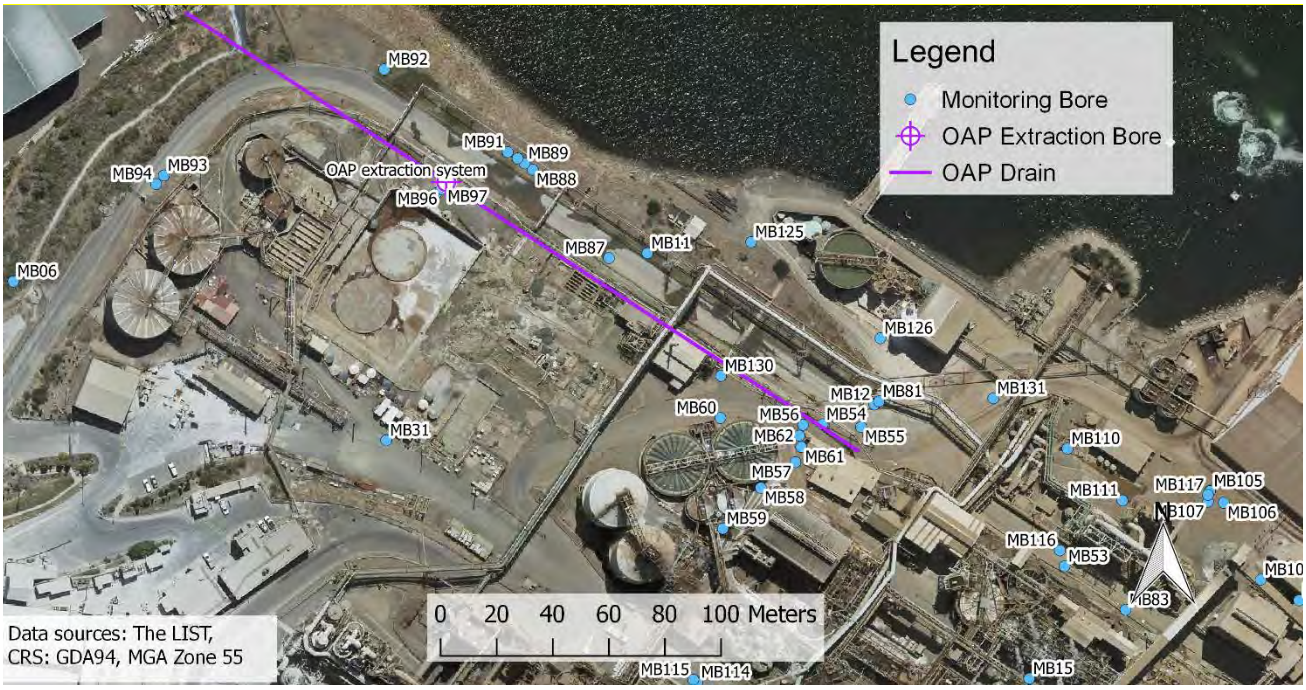


Figure 4-48 Location of Old Acid Plant Extraction System

Figure 4.49 below plots the concentration of cadmium and zinc since 2015. The concentration of both zinc and cadmium remained relatively constant until July 2018. The increase apparent within 2018 is considered to be a result of the use of the emergency acid bund located immediately up gradient of the horizontal bore to temporarily store neutral leach liquor from late 2017 to mid-2018. This practice has since been abandoned and the issues with the emergency bund rectified. The concentration of zinc and cadmium have since been declining indicating that the cause of the concentration spike has largely been resolved.

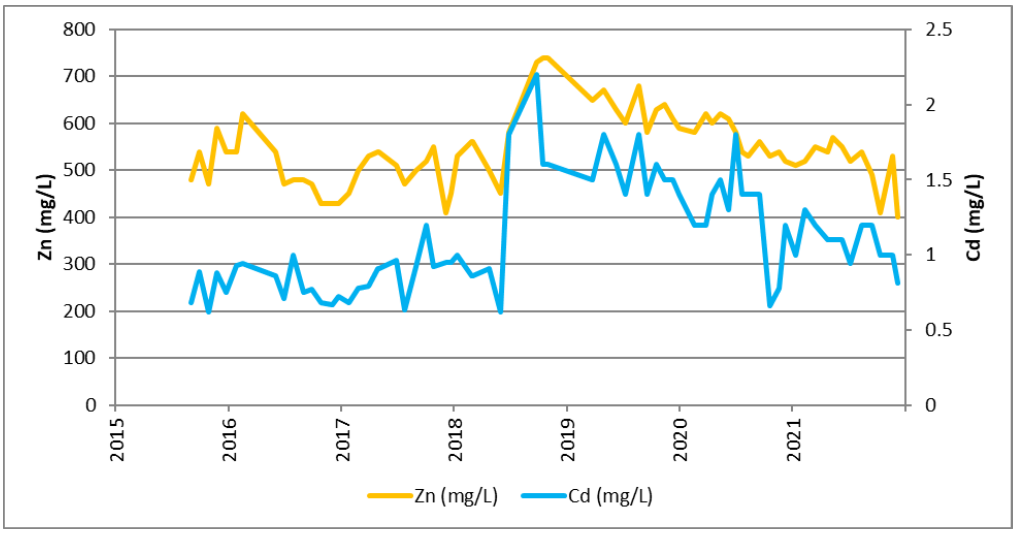


Figure 4-49 Metal concentrations in groundwater extracted from the Old Acid Plant recovery system

PG Dryer Extraction Well (EB05)

At the time of publication, the tenth groundwater extraction system to operate at the site was in the post-commissioning, optimisation phase.

The project involved the construction of a 730 m long pressure-injected grout curtain, and a directionally drilled groundwater drain, approximately 750 m in length. These two components were installed from early 2020 through to mid-2021.

The grout curtain is located on the fringe of the natural shoreline, acting as a hydrogeological barrier. The function of the curtain is twofold:

- Retarding the flow of groundwater between contaminant source zones (the production areas on site) and the down hydrogeological gradient receptor – the Derwent estuary
- Impeding saltwater incursion into the extraction zone of influence.

The curtain itself was constructed via the drilling of bore holes, with a grout mix injected into void sealing the horizontal and vertical fractures through which groundwater travels. Each hole was advanced to a nominal depth of 30 m below ground surface.

Following the completion of the grout curtain, the horizontal bore was drilled up hydrogeological gradient of the curtain, to collect the groundwater dammed by the grout curtain.

The horizontal collection drain is 140 mm wide, and is intersected by a 600 mm vertical extraction well from where the groundwater is pumped to the site's contaminated water circuit.

Once the system has been optimised and is operating in steady state, modelling predicts the stabilised groundwater yield will be 83 m^3/d. During pre-commissioning trials, the system was operated for 7 consecutive days between 3 and 10 November 2021. The average daily yield measured during this time was 103 m^3/d, however without running the system for an extended duration, it is yet unknown what the stabilised abstraction rate will be, as this will decline following prolonged pumping.

This is a function of groundwater being removed from storage in the upper part of the shallow aquifer until steady state is reached. The results of the 7 day trial are presented in Figure 4.50 below.

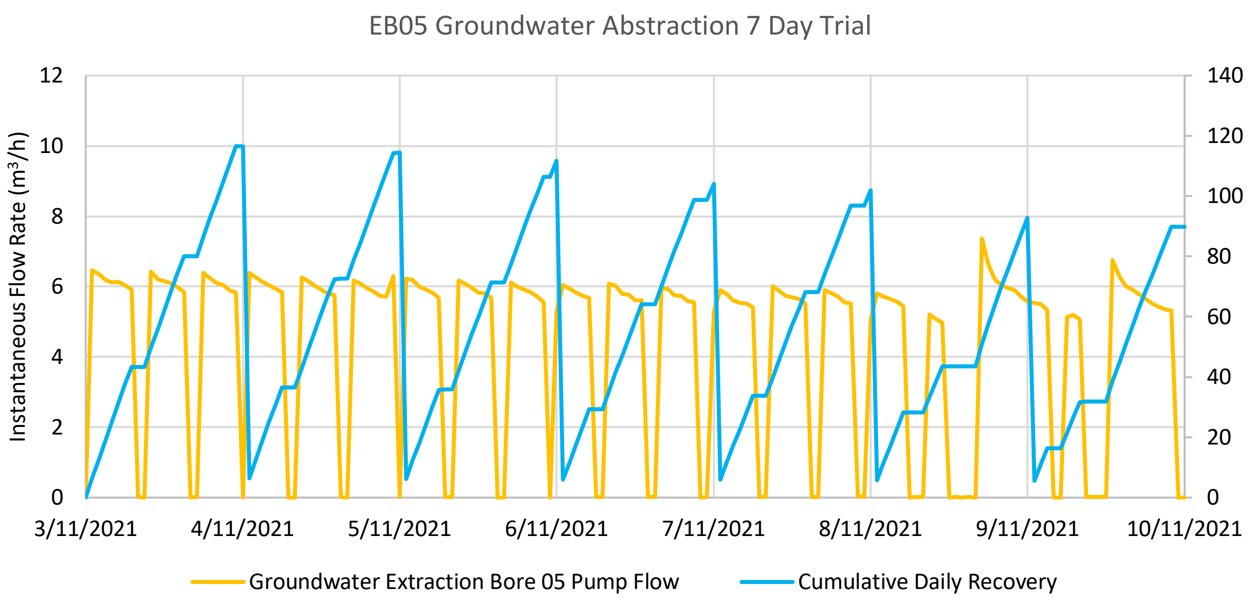


Figure 4-50 Groundwater Abstraction Trial, November 2021

The modelled capture zone of the PG Dryer extraction system/EB05 is presented in Figure 4.51. Groundwater flow paths are represented as red lines, while groundwater collection drains are presented as thick green lines.

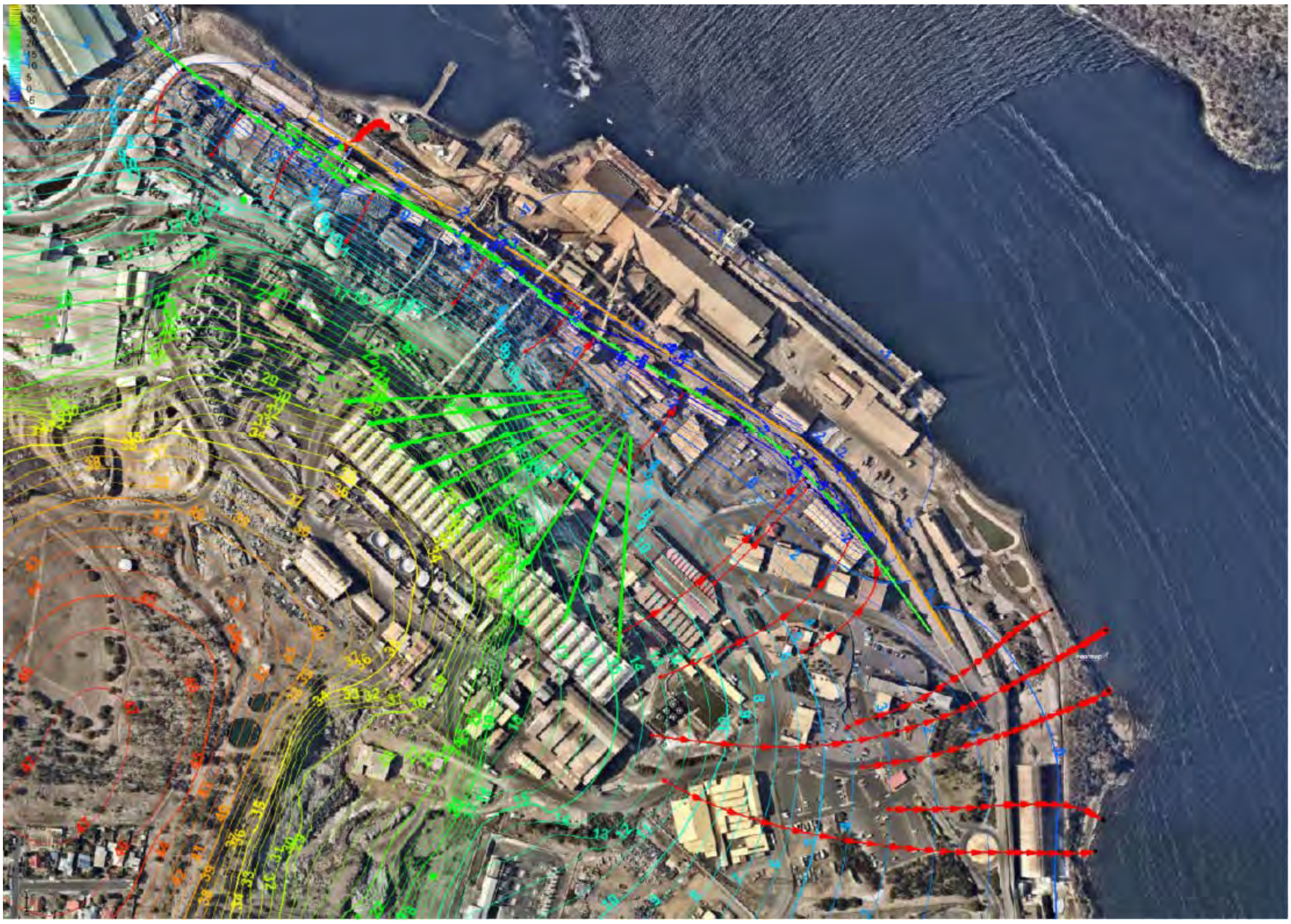


Figure 4-51 Modelled groundwater flow for the central and southern section of the site with the new grout curtain and horizontal drain in place

4.3 Receiving Waters

4.3.1 Water Quality Monitoring

4.3.1.1 Water Quality Monitoring Background

NH interacts with the Derwent estuary in a number of ways, including:

- Estuarine water extraction for tail gas scrubbing;
- Effluent discharged from the tail gas scrubbers and effluent treatment plant (ETP); and
- Passive discharge of contaminated groundwater.

Substantial resources have been allocated to address contaminant sources and improve estuarine health. These have included the construction of the ETP to address point sources and major stormwater and groundwater projects to address diffuse sources.

NH is a key member of the Derwent Estuary Program (DEP). The DEP was established in 1999 as a partnership between state and local government and industry partners (NH, Norske Skog, Entura (Hydro Tasmania) and TasWater) to provide a management framework for the restoration and protection of the Derwent estuary. NH has a strong involvement in the program through collaborative monthly monitoring, attendance at regular taskforce meetings and commitment of resources and funding.

NH monitors the potential impact of site operations by sampling estuarine water quality and estuarine benthic sediments in accordance with EPN 7043/5 Sections M2, M4, M5, WW1 and WW3. The receiving water quality and sediment sampling program is integrally linked with the NH estuarine biota monitoring program (refer Section 4.3.2– Biota).

To assess the impact of the point source discharge from the site, NH maintains a mixing zone sampling program around the permitted discharge point at the foreshore outfall (Figure 4.52). The aim of this program is to confirm that sufficient dilution of effluent has occurred within the mixing zone in order to meet Tasmanian State Water Quality Objectives at the boundary of that zone. Sampling sites within the mixing zone were used to define the mixing zone in 2001.

Figure 4-52 Point source mixing zone boundary

NH monitors pH levels monthly at the boundary of the defined mixing zone to ensure the minimum pH requirement of 7.0 (as the indicator of dispersion) is being met in accordance with EPN requirements (refer to Table 4-12).

Table 4-12 River Monitoring program parameters

Emission point / monitoring location	Monitoring and sampling frequency	Monitoring parameters	Regulatory limits that must not be exceeded	Reporting
Derwent estuary interim mixing zone boundary	Monthly Minimum of four samples at boundary locations likely to be impacted by mixing plume.	pH	Not less than pH 7 under any degree of influence of NH treated waste water	Annually *
Water quality: U3, U4, U5, U7, PWB, NTB1, NTB2, NTB5	Monthly	Zn, Cd, Hg, TSS, Cu, Pb	None specified	Annually *
New Town Bay sediments: NTB01, NTB02, NTB08, NTB10, NTB12	Annually	Zn, Cd, Hg	None specified	Annually *

* If results indicate non-compliance with regulatory limits, reporting must be within 24 hours of monitoring results becoming available. Report on an annual basis via Annual Environmental Review.

4.3.1.2 Water Quality Monitoring Program Details

Water grab samples are collected monthly in the Derwent estuary from two depths: 0.1 m below the water surface and 1 m above the estuary floor (benthos). The monitoring sites are shown in Figure 4.53 (additional samples are collected from New Town Bay (NTB13 – see Figure 4.54) and Geilston Bay (GB)). Samples are analysed at a NATA certified laboratory for total zinc, cadmium, mercury and suspended solids.

Results for these parameters are assessed with respect to ANZECC guidelines[2] using the 80% protection level for highly disturbed ecosystems as given in Table 4-13.

Additional physio-chemical field measurements (pH, salinity, temperature and dissolved oxygen) are taken using a MiniSonde™ Hydrolab at 1 m intervals through the water column starting at the water surface.

Monitoring is conducted in accordance with the procedure Estuarine Sampling (HP-826-00731), which includes duplicate sampling and field blanks for quality control purposes and ensures compliance with relevant Australian Standards[3].

Sediment samples are collected annually at five NTB locations, with sampling protocols also outlined in the estuarine sampling procedure. Sediment grab samples are collected using a pipe dredge, which samples the top 3–4 cm of sediment.

Samples are sent to the NH laboratory for analysis of total zinc, total cadmium and total mercury. Results are viewed with respect to the ANZECC guidelines for sediment quality given in Table 4-13.

[2] Australian and New Zealand Environment and Conservation Council, Australian Water Quality Guidelines for Fresh and Marine Waters, 2000.
[3] AS/NZS 5667.9; 1998 Water Quality – Sampling, Part 9; Guidance on Sampling from Marine Waters and Part 12; Guidance on Sampling of Bottom Sediments.

Table 4-13 ANZECC water quality guidelines for marine waters (2000)

Analyte	Sediments		Water
	Effects range low (adverse effects 10% of the time) mg/kg	Effects range high (adverse effects 50% of the time) mg/kg	80% protection level µg/L
Total zinc	200	410	43
Total cadmium	1.5	10	36
Total mercury	0.15	1	1.4

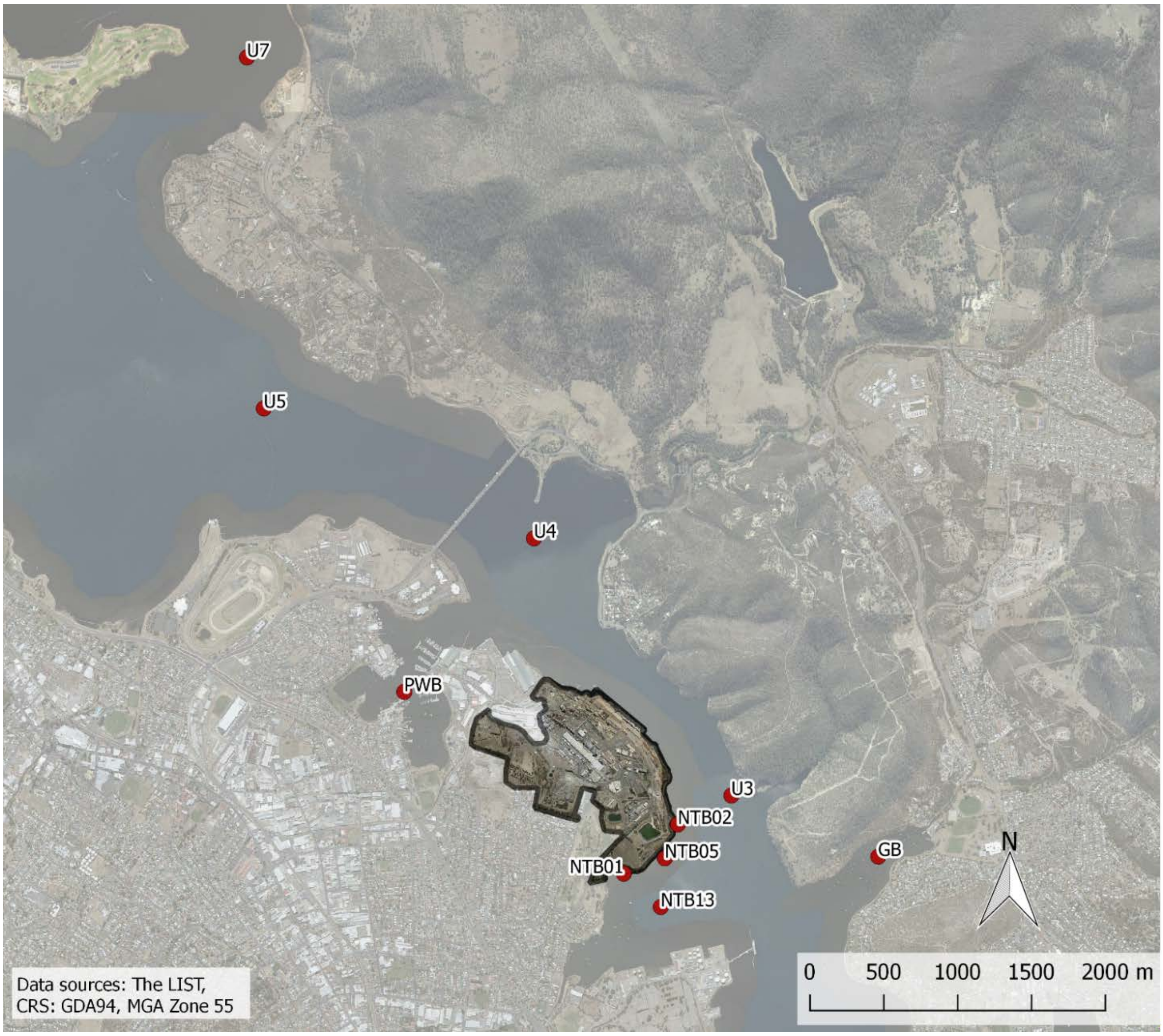


Figure 4-53 Derwent estuary water quality monitoring sites

Figure 4-54 New Town Bay water and sediment quality monitoring sites

4.3.1.3 Water Quality Monitoring Results & Discussion

Ambient Water Quality Monitoring

The monthly surface water quality monitoring across the 2019-2021 reporting period showed typically higher heavy metal concentrations in surface waters in comparison to benthic samples at NTB sites with less stratification evident in the estuary proper (Figure 4.55). This pattern of metal concentration has been evident since monitoring began.

Average zinc concentrations across all estuarine monitoring sites were found to be below the ANZECC 80% protection level trigger value of 43 μg/L at both surface and depth, with respective surface and depth values of 28.51 μg/L and 14.48 μg/L (2019), and 28.45 μg/L and 15.41 μg/L (2020), 31.61μg/L and 15.73 μg/L (2021). There is a reasonable consistency in the average surface sample concentrations year on year with a standard deviation of 2.39 μg/L within the reporting period. The average depth sample concentration was relatively constant between 2019 and 2021 with a standard deviation of 0.65 μg/L between 2019 - 2021. These results also represent a continued consistency when compared to the 2016-2018 sampling period.

The average NTB (four sites) zinc concentration at the surface was greater during 2019-2021 than in the 2016 – 2018 sampling period. The average NTB surface sample concentrations exceeded the guideline value of 43 μg/L with zinc concentrations at 48.19 μg/L (2019), 46.06 μg/L (2020) and 58.73 μg/L (2021). The NTB02 site recorded the most instances where zinc concentration exceeded the guideline value in 28 monitoring events during the reporting period closely followed by NTB05 on 21 separate monitoring events. NH will continue to monitor and assess these concentrations and determine if further assessment is required in order to manage the increased surface zinc concentrations. Concentration levels at depth at NTB were found to be considerably lower than those recorded at the surface. A slight decrease in average concentrations was observed during the reporting period, with an average reduction of 2.24 µg/L from the 2016-2018 sampling period.

A recent report published by DEP[4] found an overall declining zinc concentration across 77% of ambient water quality monitoring sites in the Derwent estuary between 2007 and 2019. After further analysis, the DEP surmise that this was likely due to a combination of factors including the gradual burial of heavily contaminated sediments, high summer river discharge between 2018 – 2020 and significantly, the proactive site remediation efforts by NH. These remediation actions include the ongoing improved plant operations and the interception and treatment of stormwater and groundwater.

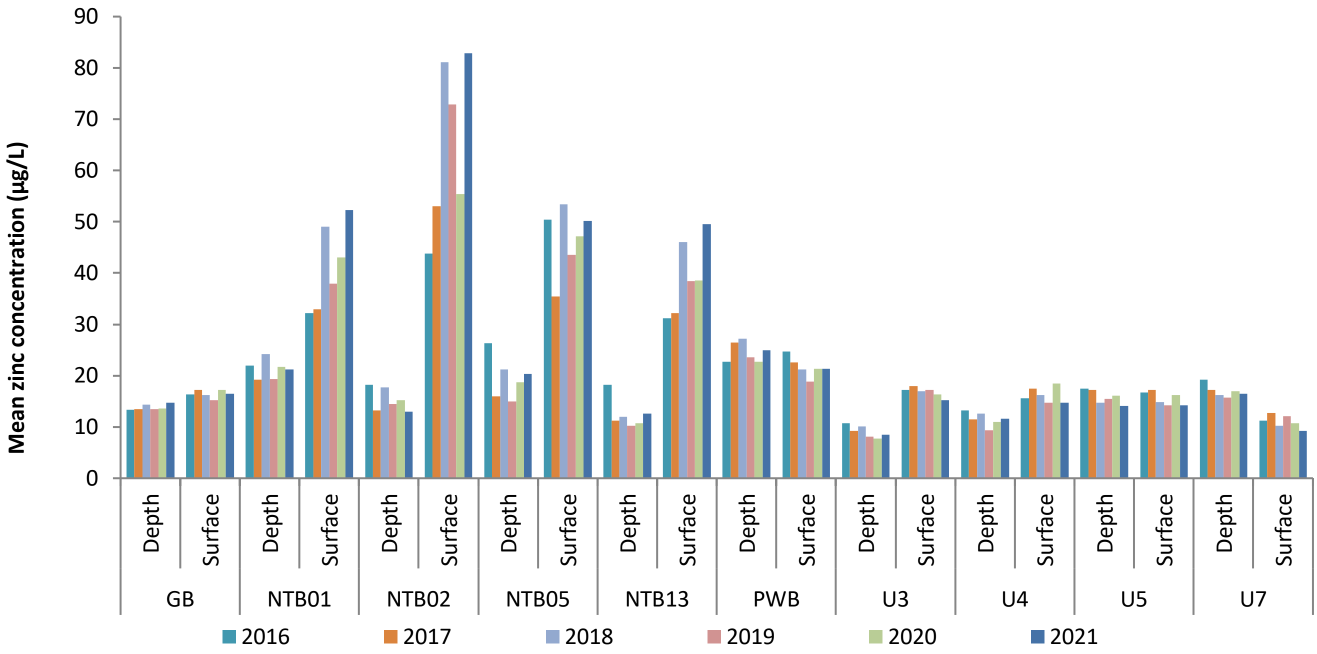


Figure 4-55 Total zinc in surface and bottom water quality samples at estuarine monitoring sites

As depicted in Figure 4.56, there has been a general downward trend in the average concentrations of total suspended solids (TSS) across the monitoring sites since 2016 with the exception of some sites increasing in TSS in 2020 and 2021. The average concentration of TSS was elevated in 2016 where a correlation was found between rainfall and TSS at depth. The average values recorded during the current reporting period demonstrate a slight increase in TSS concentrations from 2019 to 2021 with limited evidence to suggest a difference between average surface and average depth concentrations (standard deviation 0.52 mg/L).

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[4] State of the Derwent Estuary 2020 Update

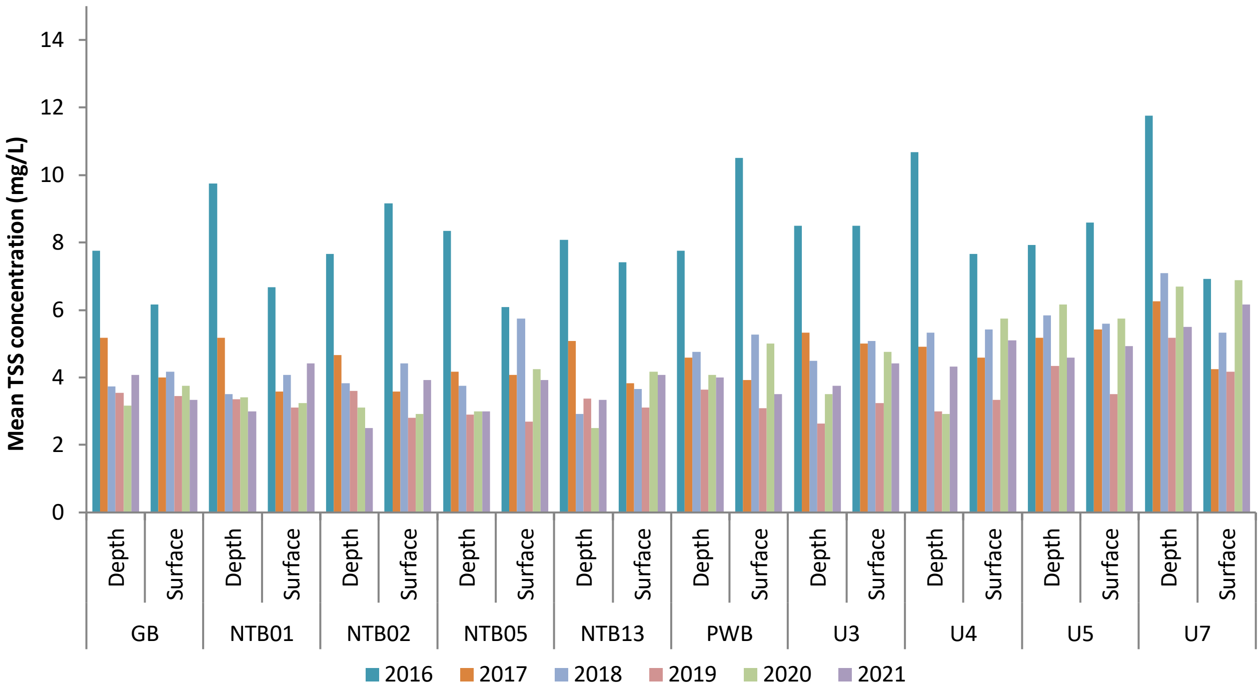


Figure 4-56 Total TSS in surface and bottom water quality samples at estuarine monitoring sites

Mercury, copper, cadmium and lead are monitored monthly in line with the River Monitoring program parameters (refer Table 4-12). The following instances where metals were recorded above the laboratory limit of reporting (LOR) and ANZECC 80% protection level trigger value are listed below and compared to the 2016-2018 samples where possible.

- 2019-2021: 6 results of mercury > LOR. Concentrations ranged between 0.06 – 0.17 mg/L and were recorded at three surface of sites and two depth sites.
- 2016–2018: 14 results of mercury > LOR.
- 2019 – 2021: 3 results of copper > ANZECC 80% guideline value of 8 mg/L. Concentrations ranged between 17 – 68 mg/L.
- 2016-2018: 6 results of copper > ANZECC 80% guideline value.
- The elevated copper concentration is however not related to zinc works rather, indicative of natural estuarine processes.
- 2019-2021: 1 result of cadmium > LOR. Concentration of 3 mg/L recorded at the surface of NTB01.
- 2019-2021: 1 result of lead > LOR. Concentration of 13 mg/L recorded at NTB02.
- 2016-2018: 6 results of lead > LOR.

Point Source Discharge: Mixing Zone pH

Routine monthly sampling of pH is undertaken at the mixing boundary zone. The yearly pH results demonstrate that during normal plant operating conditions, adequate dispersion of foreshore scrubber outfall (FSO) effluent is being achieved at the boundary of the mixing zone under all monitored tidal and plant operations. The pH ranged between 7.2-8.2 at the upstream and downstream boundaries of the mixing zone during the 2019-2021 reporting period. This overall range does not include those monitoring rounds where results were recorded that were not in accordance to the EPN requirements. These events occurred during May and June 2020. Refer to Appendix 6.2 for further details of these incidents.

New Town Bay Sediment Quality

Results from annual monitoring of NTB sediment samples in relation to past years are shown in Figure 4.57 to Figure 4.59.

Routine sampling since 2000 has shown concentrations of zinc, mercury and cadmium in NTB sediments to be substantially higher than the ANZECC guidelines. Despite this, testing carried out by DEP[5] in 2007, has shown that although heavy metal contamination in estuarine sediments is high in NTB, heavy metals are typically chemically bound to the sediment or other organic materials and are not usually biologically available (hence the lower heavy metal content in bottom water in the bay as compared to surface waters).

The source of these contaminants was also shown to be predominantly historical contamination, although fugitive dust, diffuse groundwater inflows and point source inflows do currently add to the bound and soluble metal levels within the estuary.

Results from the annual sampling program indicated that total zinc, mercury and cadmium levels all showed some variability with no observable definitive trends through time.

In a recent report published in 2020 by DEP[6] , it was notably reported that sediment coring and surface sediment sampling from a site adjacent to NH found decreased zinc concentrations to 13% of the recorded historical maximum for this location. Overall, the testing gave evidence that zinc and lead concentrations were steadily decreasing, indicating the successful reduction efforts in reducing metal-contaminated effluent entering the estuary since the 1970s. This could likely be contributed to the gradual burial of metal-contaminated sediments along with other NH actions to reduce metal input loads.

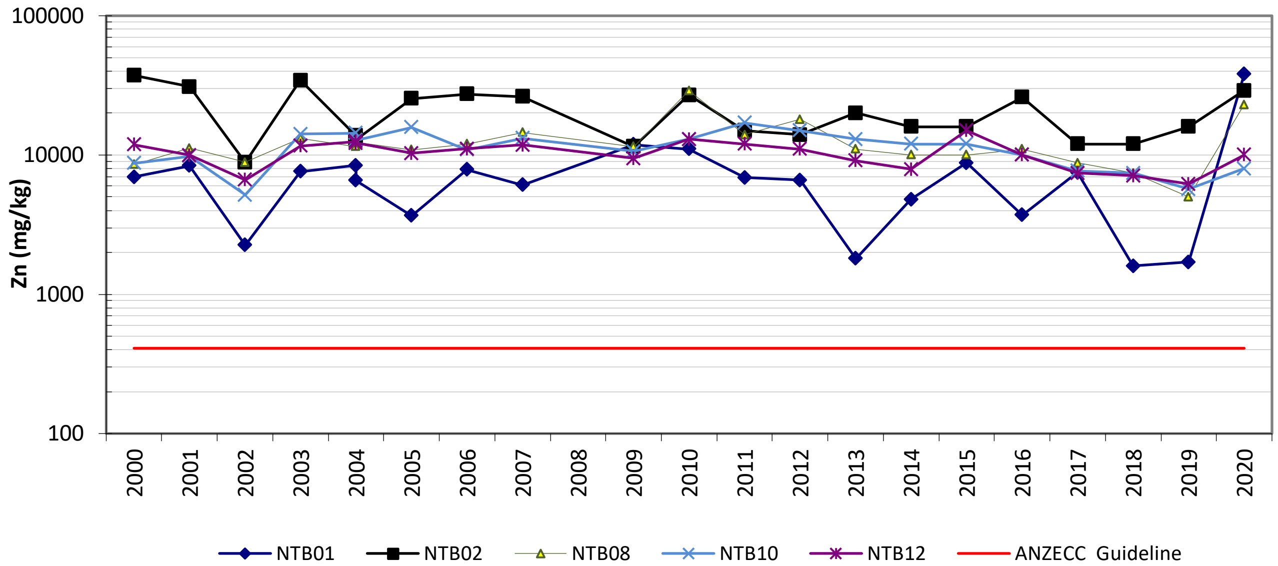


Figure 4-57 Total zinc concentrations in New Town Bay sediment

[5] DEP (Derwent Estuary Program), 2007, Derwent Estuary Water Quality Improvement Plan Stage 2: Heavy Metals and Nutrients.
[6] State of the Derwent Estuary 2020 Update

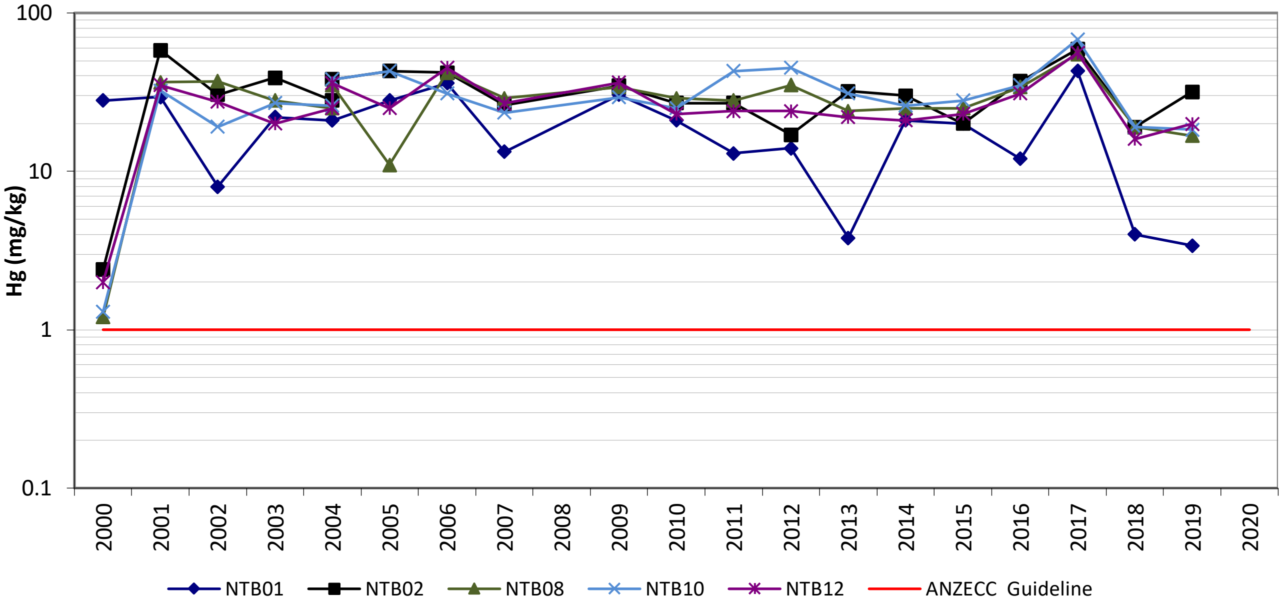


Figure 4-58 Total mercury concentrations in New Town Bay sediment

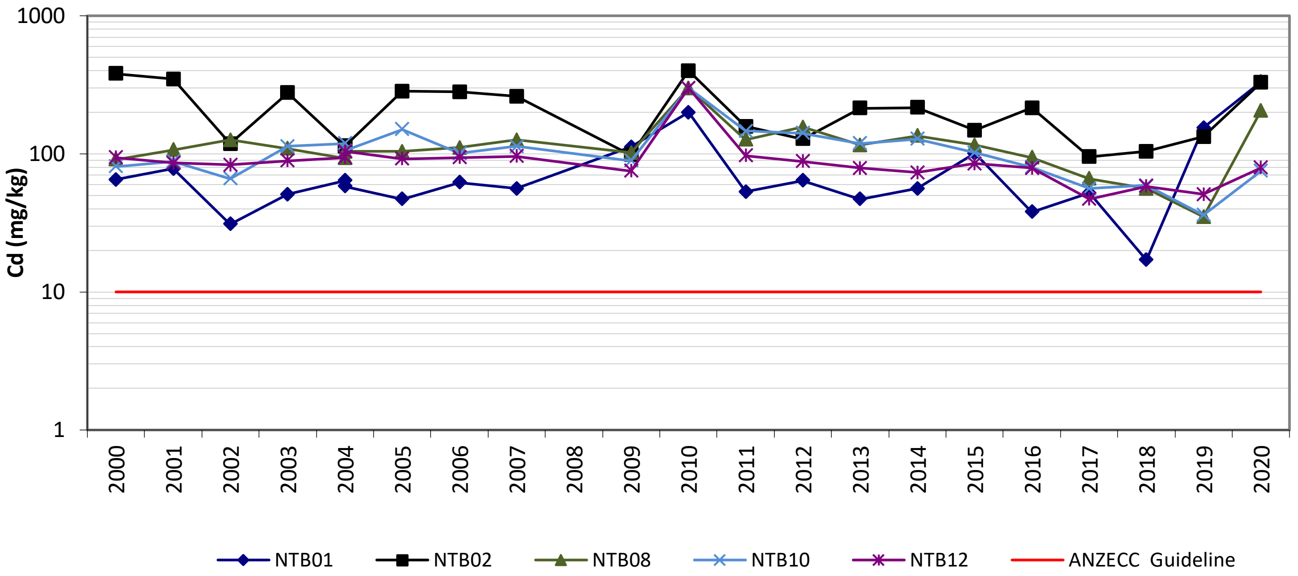


Figure 4-59 Total cadmium concentrations in New Town Bay sediment

4.3.2 Biota

4.3.2.1 Biota Monitoring Program Background

The NH biota monitoring program is comprised of three components – annual deployed oyster monitoring, biennial wild fish sampling, and triennial wild shellfish sampling. The purpose of the program is to assess the concentrations of various heavy metals in seafood, and thus collect data on bioavailability of the metals, and assess the potential impact from NH operations on the various species. The information recorded has also been used to provide seafood consumption advisory notices to the general public.

4.3.2.2 Biota Monitoring Program Details

Deployed Oysters

Oysters of the same known age are sourced from a commercial shellfish operation on the north-west coast of Tasmania (to ensure sound baseline conditions). A minimum of 20 individuals are analysed with no estuarine deployment to give a baseline for accumulation of metals.

The remaining oysters were housed in plastic mesh cages with approximately 25–30 individuals per cage (with the additional 5–10 oysters to account for any mortality). Cages are deployed at nine nominated locations in the middle estuary and one background location at Bruny Island (refer Table 4-15 and

Figure *4.60*). The oysters are secured sub-tidally to existing structures as close to the bottom as possible.

Triple deployment through the water column is conducted at three locations with cages secured at the bottom, mid-point and surface (remaining sub-tidal to ensure 100% exposure) of the water column.

Deployed oyster cages are retrieved after six weeks. Twenty oysters are shucked, flushed with distilled water and combined to form a single sample for each location. Retrieved samples plus the control sample are then submitted to a NATA accredited laboratory and analysed for heavy metals including zinc, cadmium, lead, mercury and copper.

Fish

The common sand flathead (*Platycephalus bassensis)* was selected as a target species as they are resident in the estuary for their entire life cycle (i.e. they are not migratory).

Fish are caught under a permit issued under Section 14 of the *Living Marine Resources Management Act 1995* specifically granted for the purposes of heavy metal monitoring.

Flathead sampling is conducted during the same months every even numbered year (August–September) to minimise seasonal variations in hydrology and life cycles.

In 2015, the flathead monitoring program was reviewed by scientific officers with the Derwent Estuary Program. The review resulted in the program moving from annual to biennial, with the addition of selenium analysis and fish aging by assessment of otoliths. New catch sites were recommended, with these shown in Table 4-15. The sampling program consists of obtaining a minimum of 20 P. bassensis individuals by handline fishing, at each of the five sampling regions (refer Table 4-15 and Figure 4.61).

Individual fish were measured from snout to tail fin base, filleted (no gut tissue included), then frozen and sent for metal analysis at a NATA certified laboratory. Results for the individual samples were averaged to give a single result for the different metals at each of the five sampling regions.

Results are compared to the Food Standard Australia New Zealand (FSANZ) *Food Standards Code* (2016) and the Food Standards Code *Additional Guidelines for Generally Expected Levels (GELs) for Metal Contaminants* (2001) (refer Table 4-14). The heads of each fish was retained, frozen, and send to the University of Tasmania (Institute of Marine and Antarctic Studies division) for aging by the processing of the otoliths. Previously, the size of the fish was taken as an indicator of age. However, this is not considered to be reliable indicator, and thus, the accurate age information obtained from the otoliths will enable a better understanding of bioaccumulation of metals in fish flesh.

Wild Shellfish

Wild oysters and mussels are collected on a triennial basis to determine long-term trends in heavy metal accumulation.

Wild oysters are collected from 26 locations, and wild mussels from 30 locations throughout the estuary and surrounding waters (refer Table 4-15).

Wild oysters are sampled by randomly taking twenty individuals from the species *Ostrea angasi* or *Crassostrea giga* at each sampling location specified and combining them to form a single sample for that site.

Similarly, twenty individuals of the mussel species *Mytilus galloprovincialis* are taken from each specified sampling location and combined to give a single mussel sample for each site. Composite sampling assists in smoothing variability between individuals to give a representative result.

Samples are then submitted to a NATA accredited laboratory and analysed for zinc, cadmium, lead, mercury and copper. Results are compared to the Food Standard Australia New Zealand (FSANZ) *Food Standards Code* (2016) and the Food Standards Code *Additional Guidelines for Generally Expected Levels (GELs) for Metal Contaminants* (2001) (refer Table 4-14).

The program was conducted in 2020.

Table 4-14 National food guidelines for metal levels in seafood (FSANZ, 2016)

Food Category	***Maximum Levels (mg/kg)***			***Generally Expected Levels median/ 90th percentiles (mg/kg)***	
	Cadmium	**Lead**	**Mercury**	**Copper**	**Zinc**
Mollusc	2	2	0.5	3 / 30	130 / 290 **
Fish	*	0.5	0.5	0.5 / 2	5 / 15

***** No level prescribed in FSANZ guidelines

** Specific for oysters only

Table 4-15 Biota monitoring locations and target species.

Region and location	Location code	Target species: F=fish, DO=deployed oyster, M=wild mussel, O=wild oyster
Upstream Tasman Bridge		
Geilston Bay	GB	DO
Elwick Bay Red Pylon	EBP	DO, M, O
Dowsing's Point	DP	DO, O
Dogshear Point	DSP	M, O, F
Pavilion Point	PP	DO
Bedlam Walls	BW	DO, O, M
Nyrstar Wharf	ZHW	DO
Beltana Beacon	BB	DO, M, O
New Town Bay	NTB	DO, F, M
Cornelian Bay	CB	DO, M, O
Eastern Shore		
Bellerive	BEL	F
Opossum Bay	OB	F
Tranmere Point	TMP	M
Trywork Point	TWP	M, O
Gellibrand Point	GLBP	O
White Rocks	WR	O
Pigeon Holes	PH	M, O
Iron Pot	IP	M, O
Western Shore		
Kingston Beach North	KBN	F
Sandy Bay Beach	SBB	F
John Garrow Light	JGL	M
Cartwright Point	CWP	M
Taroona Beach	TAR	M, O
Blackmans Bay	BLB	O
Fossil Cove	FC	M
Dennes Point	DNP	O, M
Ralph's Bay		
Ralph's Bay Spit	RBS	F
Ralph's Bay	RB	F
Gibsons Point	GBP	M, O
Richardsons Beach (Nth)	RBN	M, O
Maria Point	MAP	M, O
Mortimer Bay	MTB	M, O
Old Lease	OL	M, O
Ice House Bluff	IHB	M, O
Frederick Henry Bay		
Black Jack Rock	BJR	M
Seven Mile Beach	SMB	M, O
Sloping Island	SPI	M
Spectangle Island	STI	M
Carlton River	CR	M, O
Apollo Bay	APB	M, O
Aiken Point	AKP	M, O
Old Ferry Terminal, Barnes Bay	BBFT	M, O
Mickey's Bay	MB	DO, F, M, O

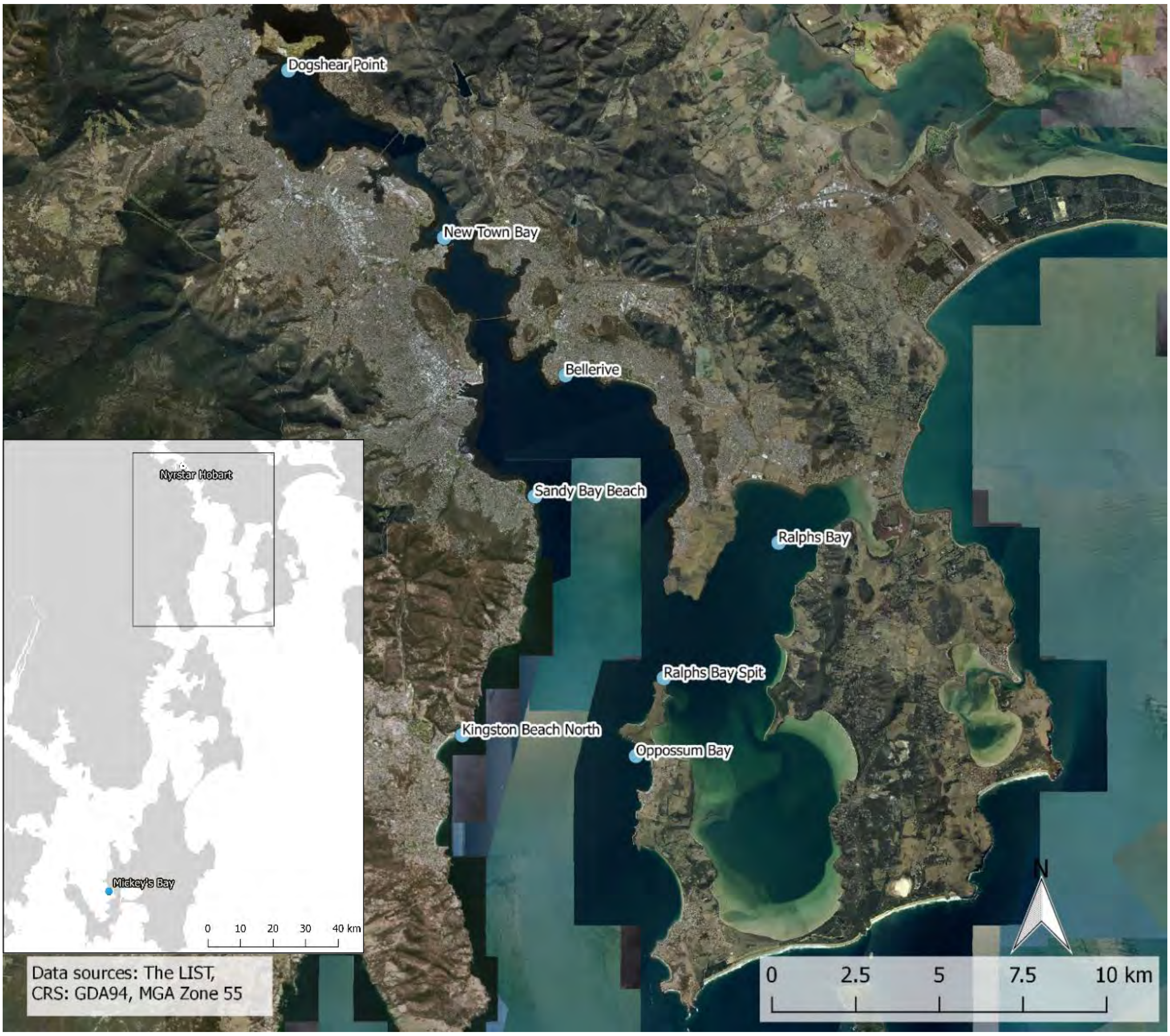


Figure 4-60 Deployed oyster monitoring locations

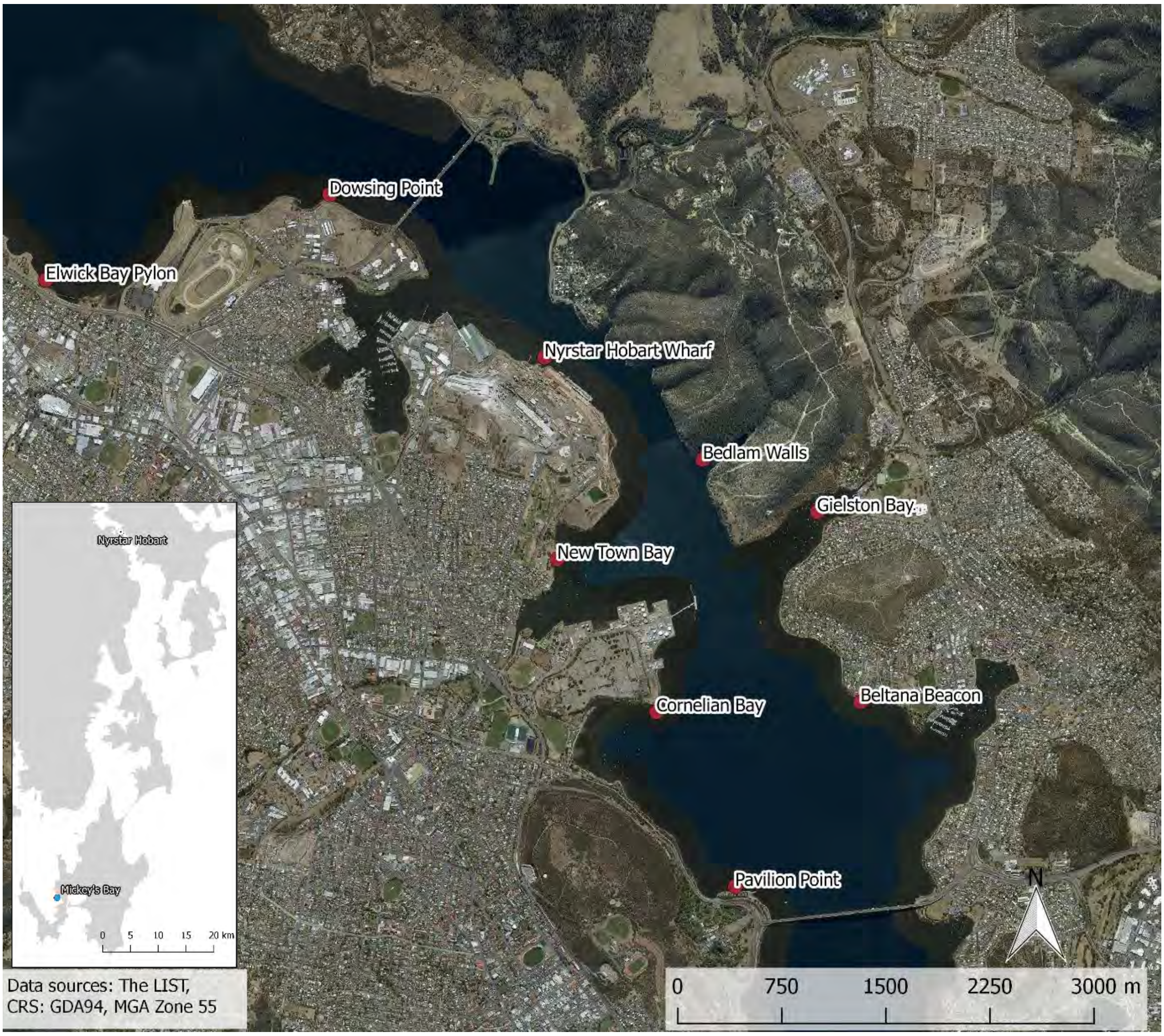


Figure 4-61 Flathead monitoring locations

4.3.2.3 Biota Results & Discussion

Deployed Oysters

Figure 4.62 to Figure 4.66 show the accumulation of zinc, mercury, cadmium, lead and copper over the exposure period from the baseline level (deployed oyster control site). No oysters were collected in the 2021 deployment from the Bedlam Walls site as the oyster cage was reported missing. For the reporting period, the data indicates that concentrations of zinc, copper and cadmium increased throughout the estuary in 2019 compared to previous years, then proceeded to decline in 2020 and increase again in 2021. As there was no noticeable site operations or rainfall conditions at the time, these results demonstrate the high variability of the Derwent River and continues to support the concept that the broader estuarine environmental conditions play a strong role in uptake rates. The DEP[7] also notes the unexplained increase in zinc concentrations in 2019 compared to 2018 data. There was a noticeable decrease in zinc concentrations in oysters deployed across the estuary in 2020 with the exception of Mickey's Bay. Despite the noticeable decrease in zinc, copper and cadmium concentrations in 2020, the increase in these concentrations in 2021 as well as the increase in lead concentration demonstrate the variability and requirement for close monitoring.

There appears to have been a significant increase in mercury concentrations throughout the estuary over the past three years with the exception of Mickey's Bay. The greatest mercury concentrations were observed in 2018 with concentrations reaching similar rates in 2021. As noted in previous years, the overall variability in the trend continues to support the concept that the broader estuarine environmental conditions play a strong role in uptake rates.

The recent DEP report positively comments on the decline in zinc, mercury and lead in oysters deployed upstream of NH at Elwick Bay and decline in zinc concentrations downstream of NH in Cornelian Bay and Bedlam Walls.

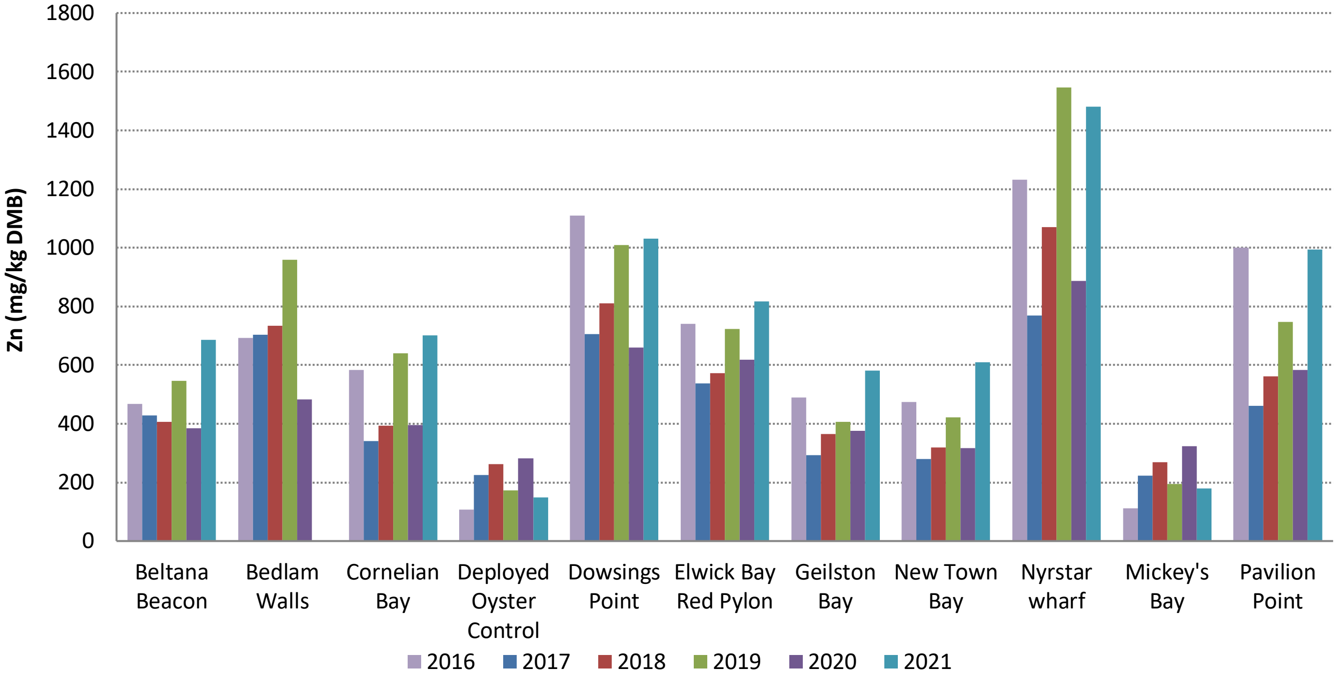


Figure 4-62 Zinc concentration in oyster deployments 2016–2021

[7] State of the Derwent Estuary 2020 Update

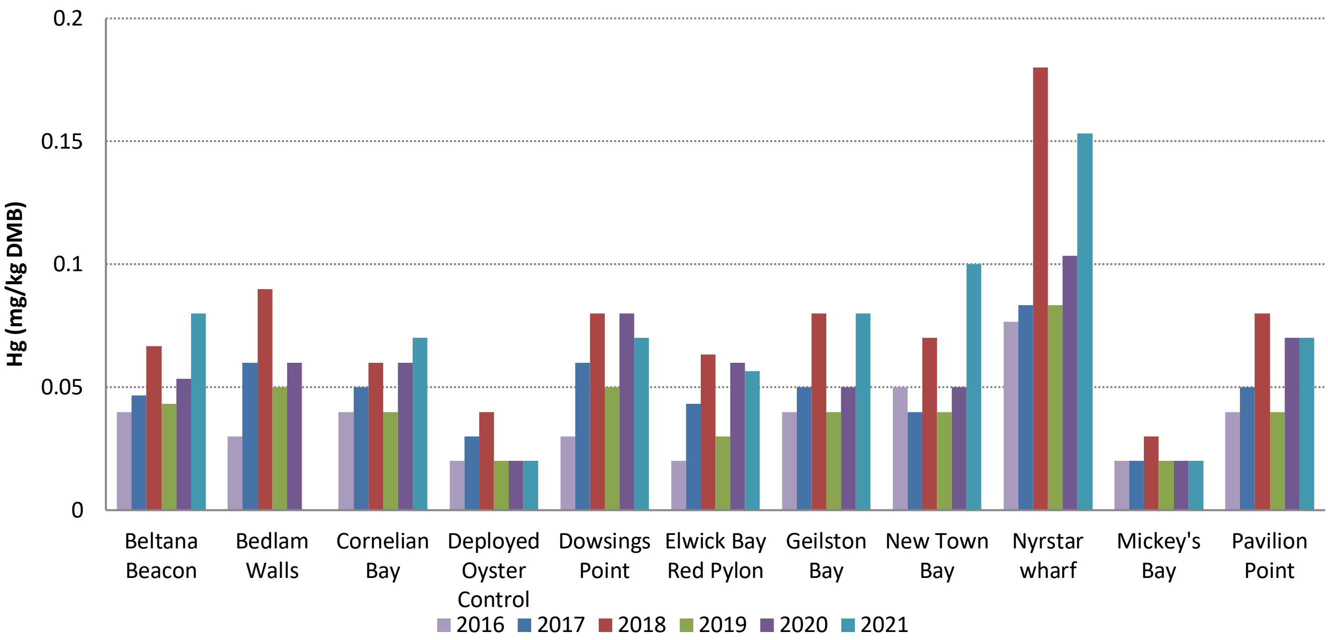


Figure 4-63 Mercury concentration in oyster deployments 2016–2021

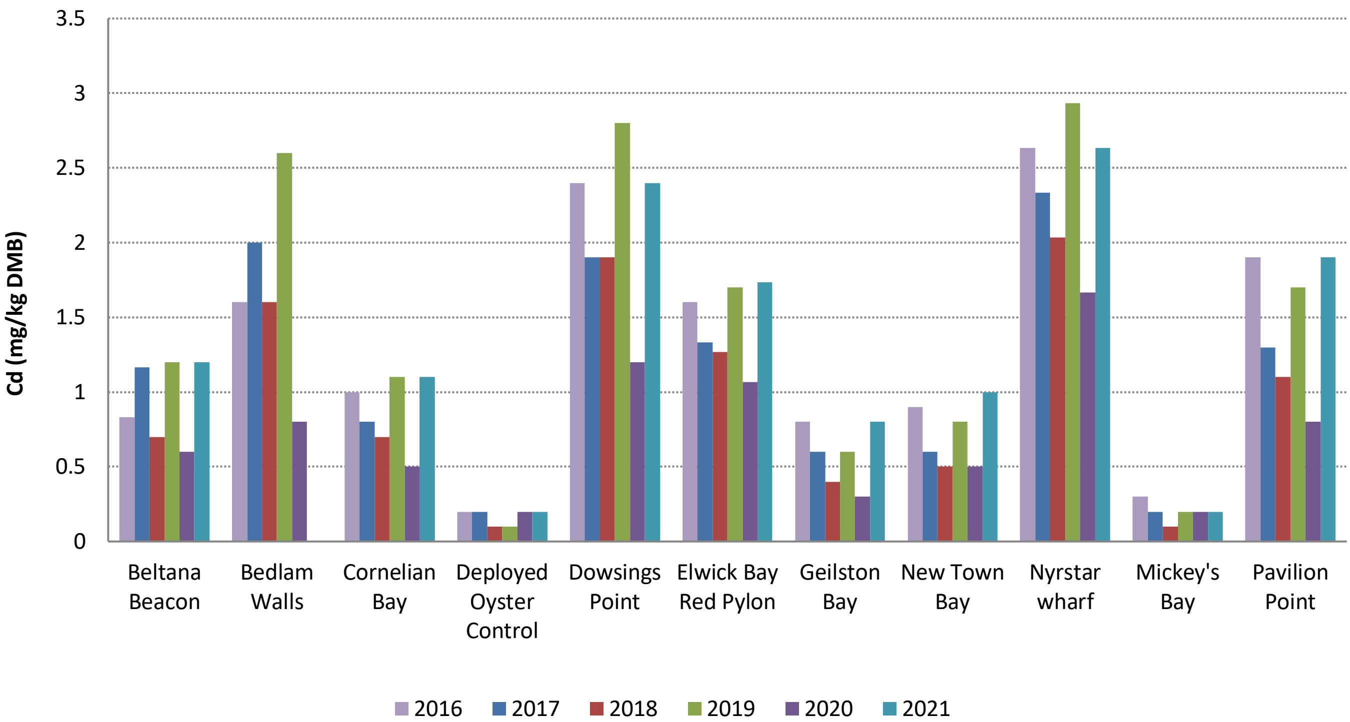


Figure 4-64 Cadmium concentration in oyster deployments 2016–2021

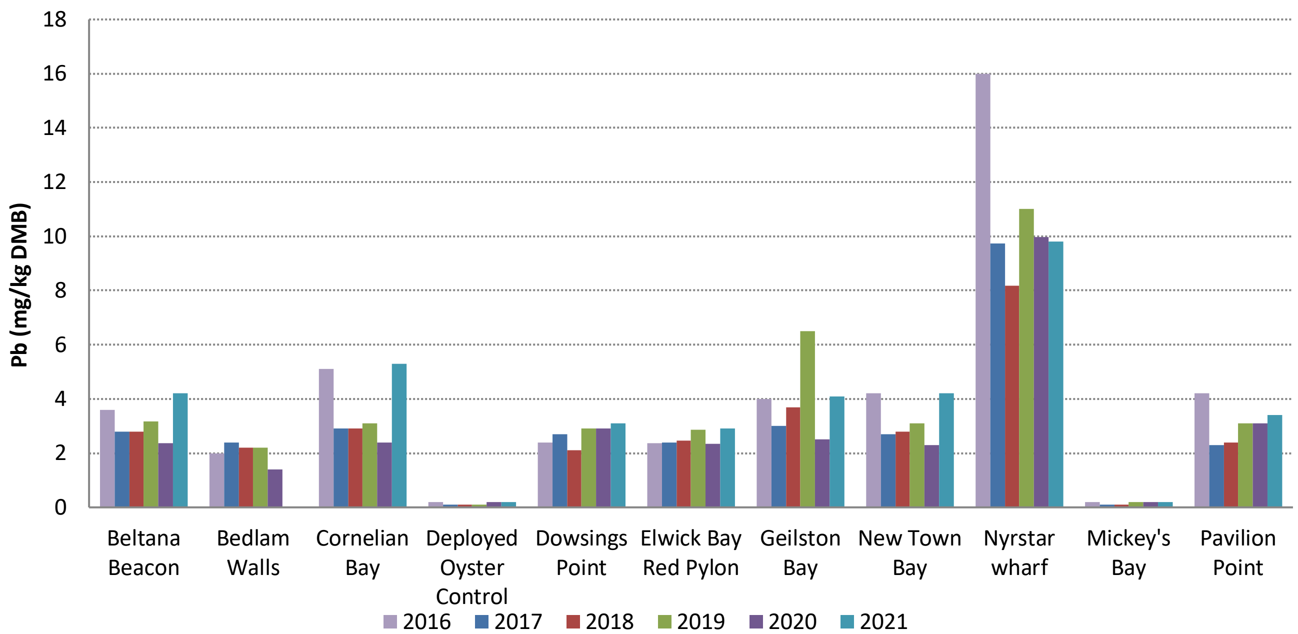


Figure 4-65 Lead concentration in oyster deployments 2016–2021

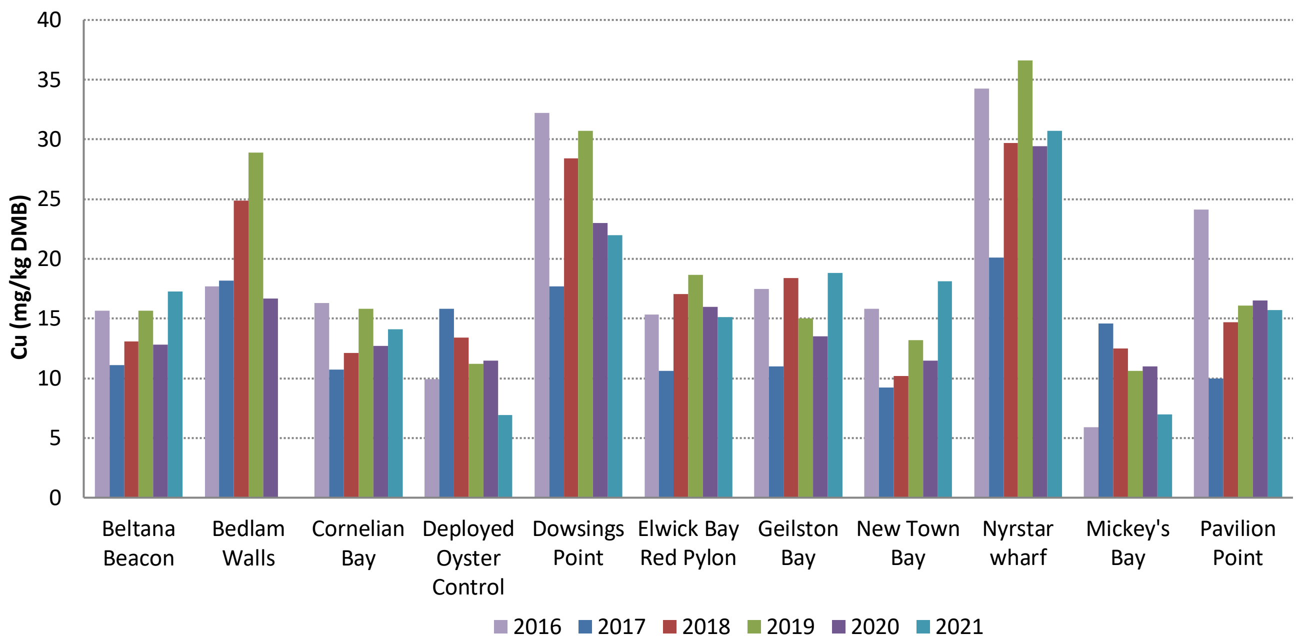


Figure 4-66 Copper concentration in oyster deployments 2016–2021

The results from triple deployment of oysters through the water column reflect the aforementioned trends where zinc and mercury concentrations were greatest in 2019 and 2021 (Figure 4.67 and Figure 4.68). The surface zinc concentration recorded at the NH wharf increased significantly in 2019 and 2021, whilst the concentrations recorded at Elwick Bay and Beltana Bay remained relatively stable between the surface, middle and benthos zones.

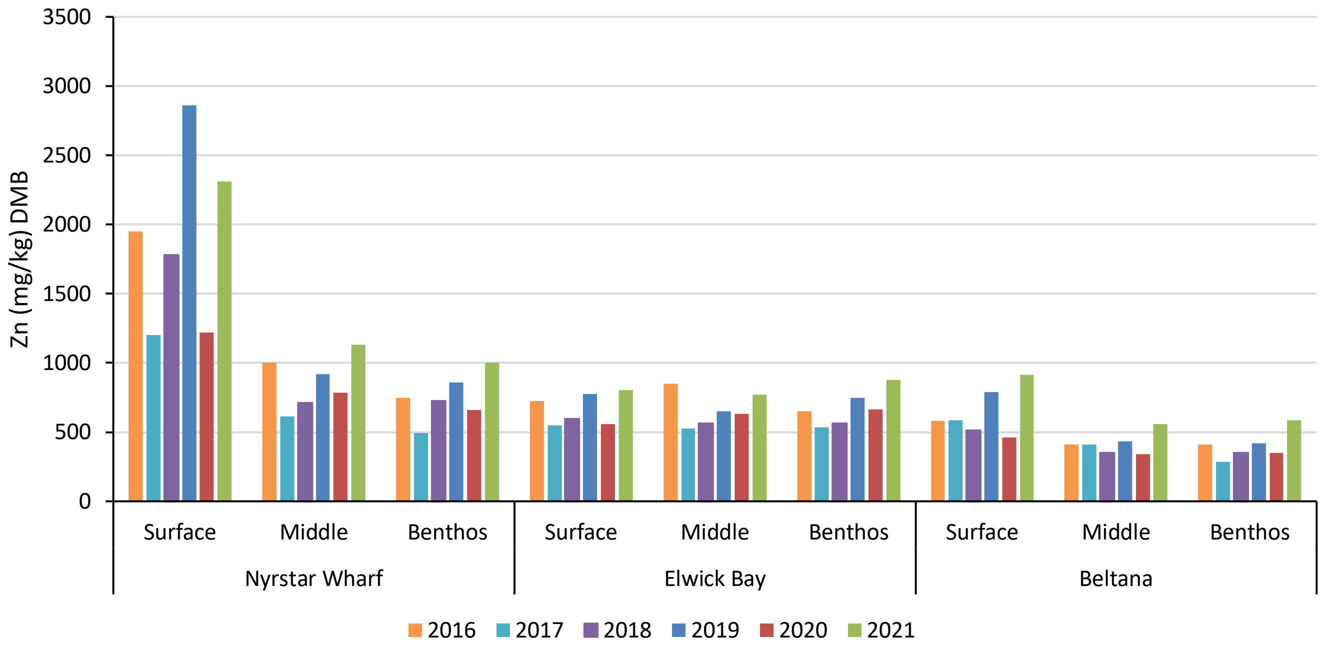


Figure 4-67 Zinc levels from triple deployment of oysters through the water column 2016-2021

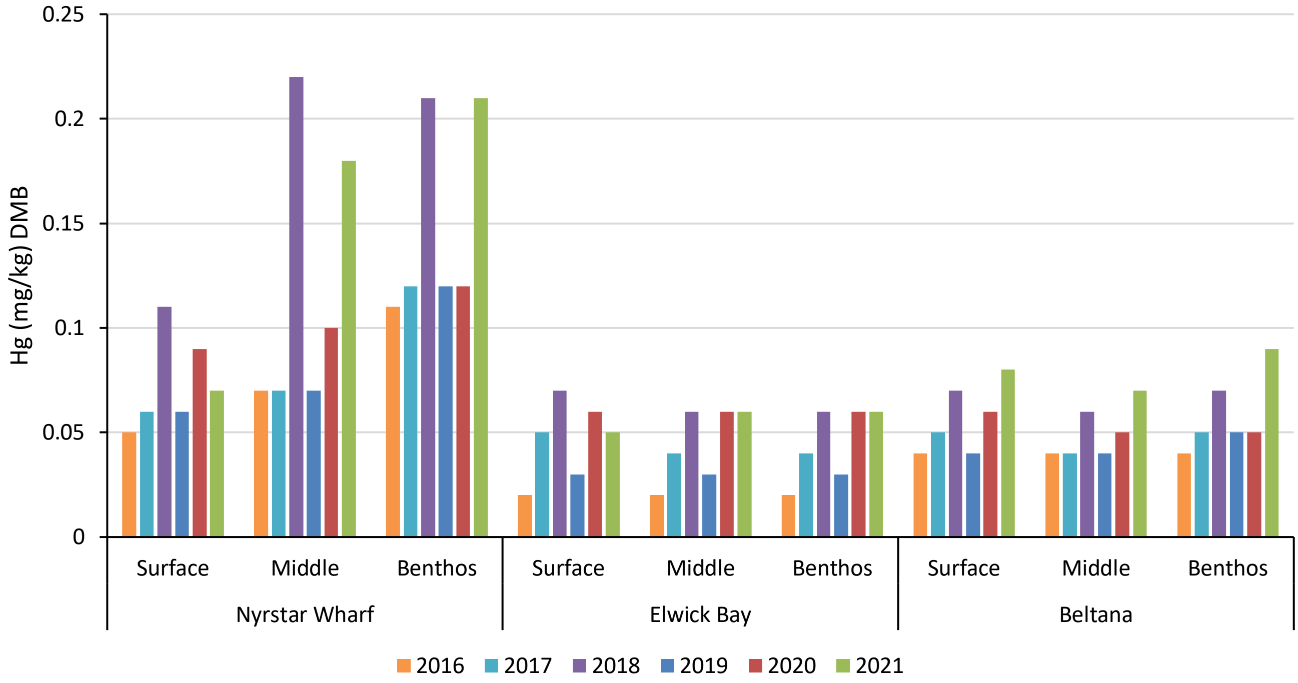


Figure 4-68 Mercury levels from triple deployment of oysters through the water column 2016-2021

Flathead

With the inclusion of fish aging in the biennial flathead monitoring program, a meaningful analysis of the data has become a complex task. Consequently, NH has approached the Derwent Estuary Program for assistance in the assessment, and understanding of the data. This section summarises the information provided by the State of the Derwent Estuary 2020 Update[8] however as biennial flathead monitoring was completed in 2020, the results were not received before the 2020 update was released. The 2020 and 2023 Flathead monitoring results will be published in the next available State of the Derwent report due to be published in 2025. Figures included within this section were compiled by the Derwent Estuary Program, and are included in the aforementioned report.

As in previous years, a review of the mercury data did not reveal any significant trends in mercury concentrations in flathead. Mercury concentrations have declined in the last two rolling five-year periods indicating a gradual improvement (Figure 4.69). However, 72% of flathead collected in 2018 exceeded the maximum level for mercury and there was high variability within the data meaning the findings should be viewed with cautious optimism.

Figure 4.70 shows the five-yearly rolling average of zinc concentrations in the flathead where 2016 and 2018 had increased zinc levels. This was mainly attributed to a combined analysis of fish samples with skin on versus former analysis of samples with skin off.

It should be noted that the DEP advises the public to not consume any shellfish from the Derwent including Ralphs Bay and other fish from the Derwent should not be eating more than twice a week. Further information regarding the consumption of seafood from the area can be found at:

https://www.derwentestuary.org.au/fishing-and-seafood-safety/

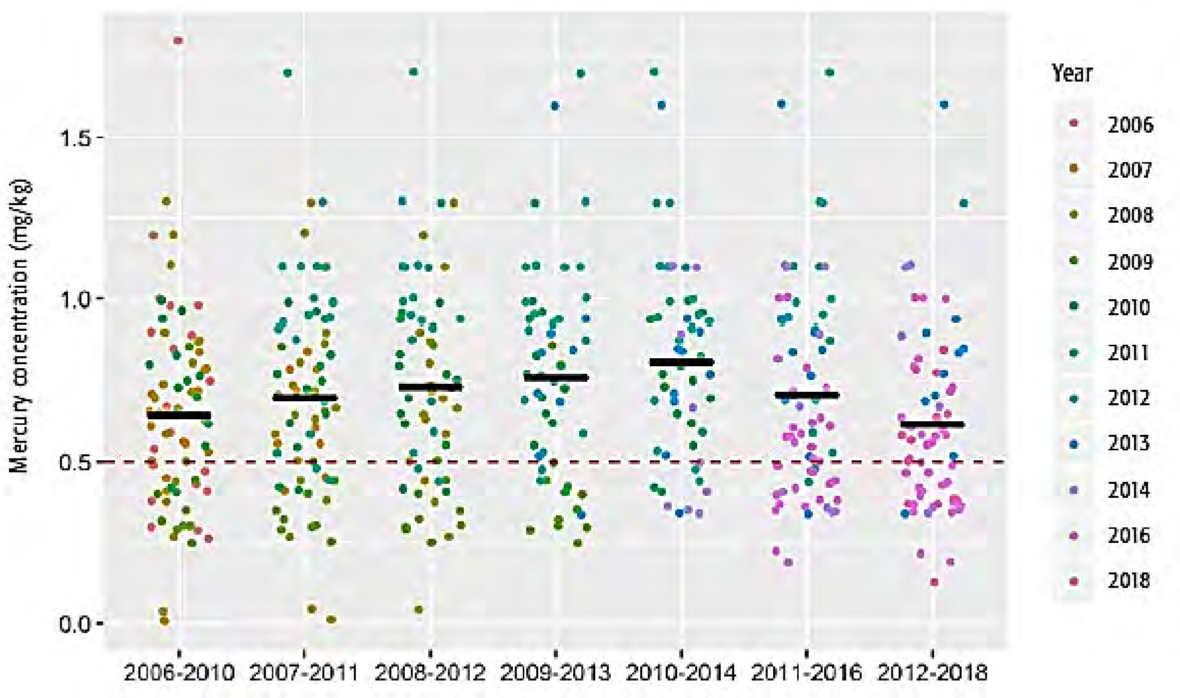


Figure 4-69 Five-yearly rolling average mercury concentration from flathead monitoring where the red line indicates maximum level (credit: Derwent Estuary Program)

[8] State of the Derwent Estuary 2020 Update

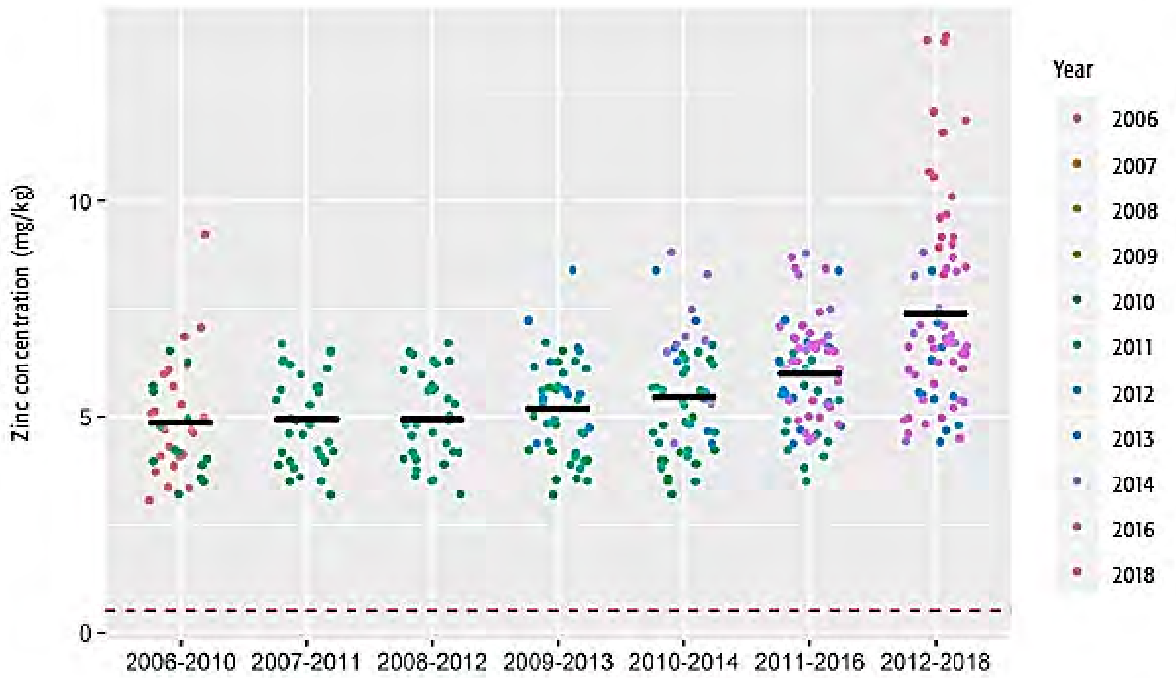


Figure 4-70 Five-yearly rolling average zinc concentration from flathead monitoring where the red line indicates generally expected level (credit: Derwent Estuary Program)

Wild Shellfish Survey

The triennial wild shellfish survey was conducted in 2020.

Over the past 20 years, mercury and lead levels can be observed to have declined in wild oysters. Cadmium and zinc levels are declining since 2014 compared to the relatively consistent concentrations observed since 2001 (refer Figure 4.71 - Figure 4.74). 2020 recorded the lowest median cadmium and zinc concentrations since the program's inception.

Over the same time period, the median concentrations of mercury in wild mussels has seen little variation as shown in Figure 4.75 (with the exception of a significant decrease in mercury levels between 2001 and 2002). The cadmium and lead levels have decreased in 2020 despite typical somewhat consistent levels (Figure 4.76 and Figure 4.77). The cadmium concentration in 2020 has returned to levels observed in 2005 and the recent lead level was the lowest median concentration since the program's inception. The median concentration of zinc decreased between 2001 and 2008, however then increased each sample round in 2011 and 2014. A decline in zinc concentrations is now being observed in 2017 and 2020 (refer Figure 4.78).

Wild mussel and oyster populations continue to display lead levels in excess of FSANZ maximum levels, and the oysters continue to record zinc levels well in excess of the FSANZ 'generally expected level' (no such guideline is available for mussels).

The metal distribution within the oysters and mussels collected across the estuary were highly variable and no clear trend could be drawn for the spatial distribution of metals.

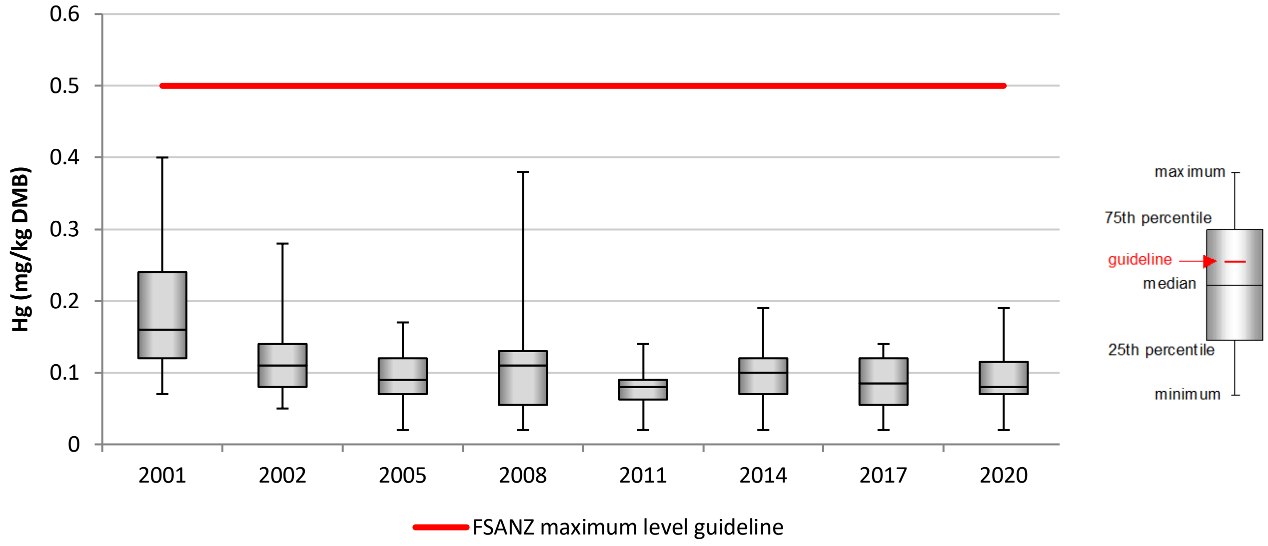


Figure 4-71 Mercury in wild oysters 2001 – 2020

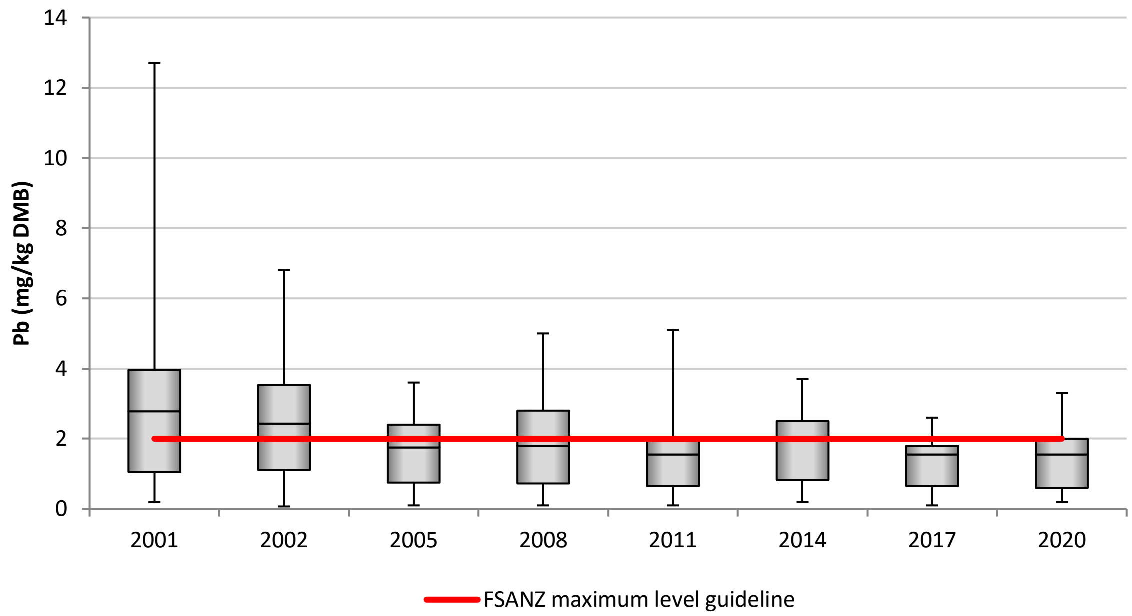


Figure 4-72 Lead in wild oysters 2001 – 2020

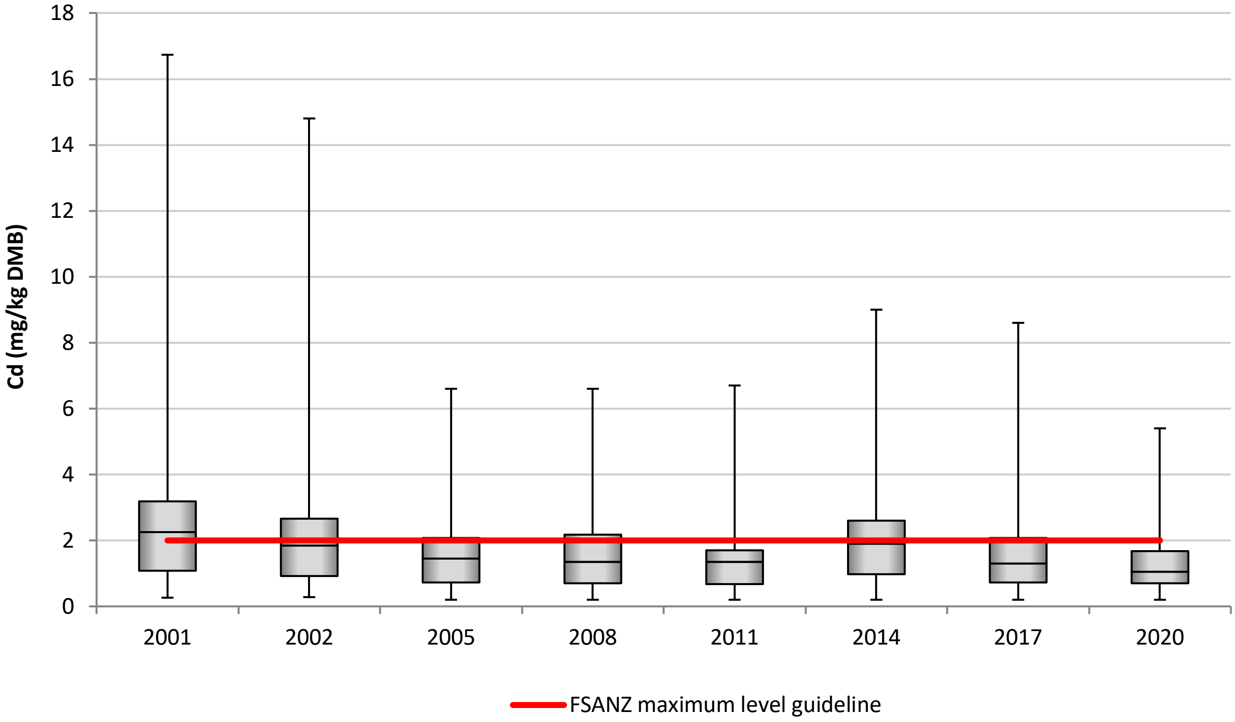


Figure 4-73 Cadmium in wild oysters 2001 – 2020

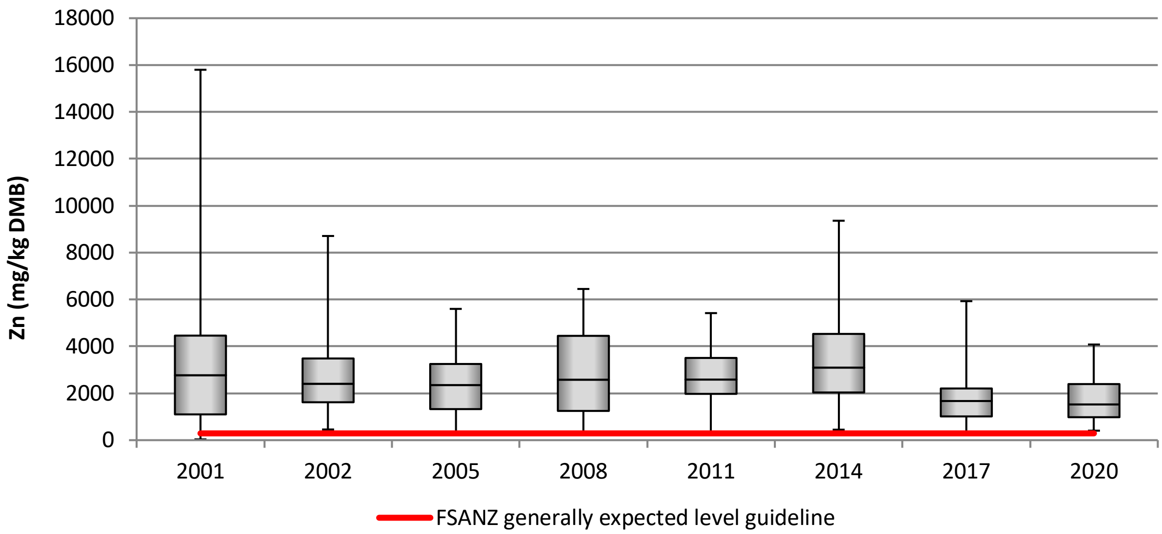


Figure 4-74 Zinc in wild oysters 2001 – 2020

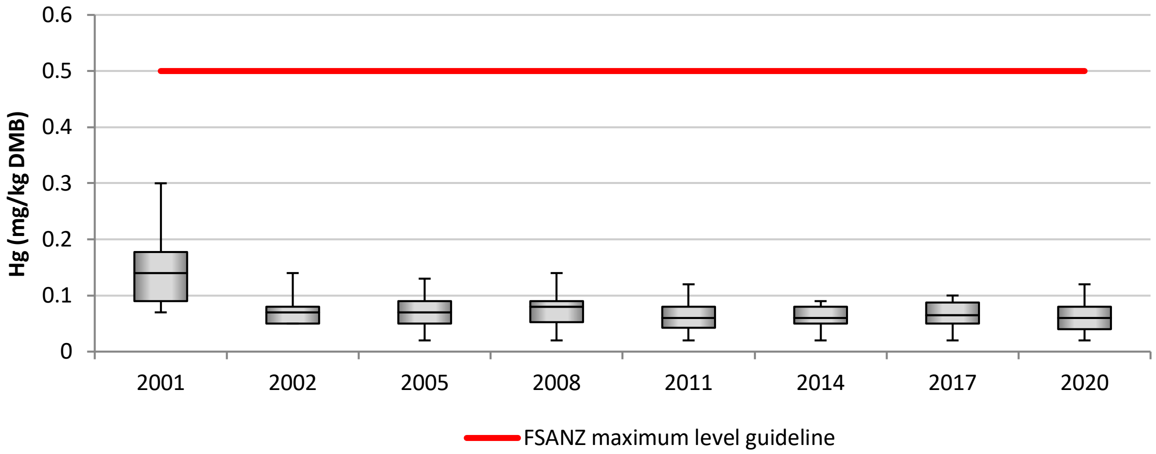


Figure 4-75 Mercury in wild mussels 2001 – 2020

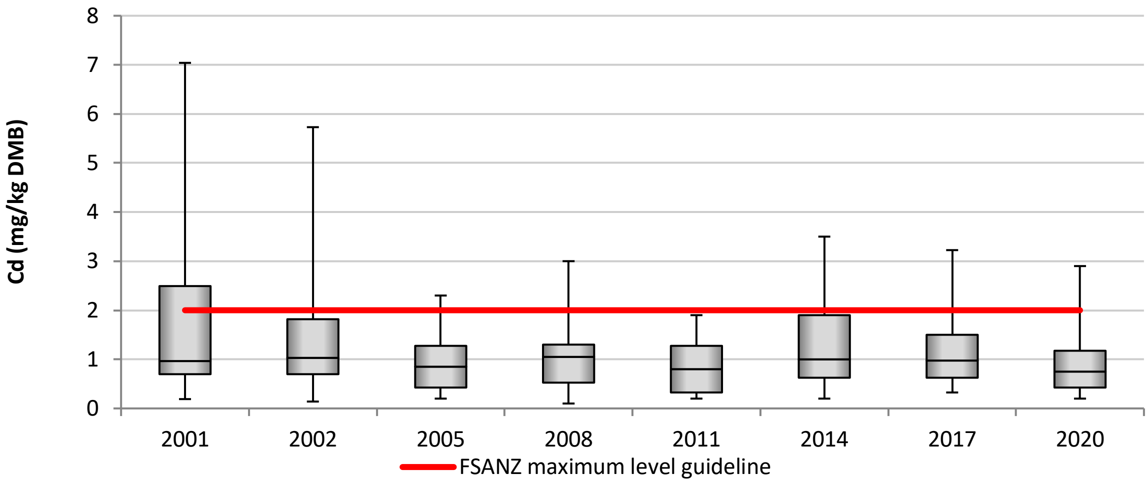


Figure 4-76 Cadmium in wild mussels 2001 – 2020

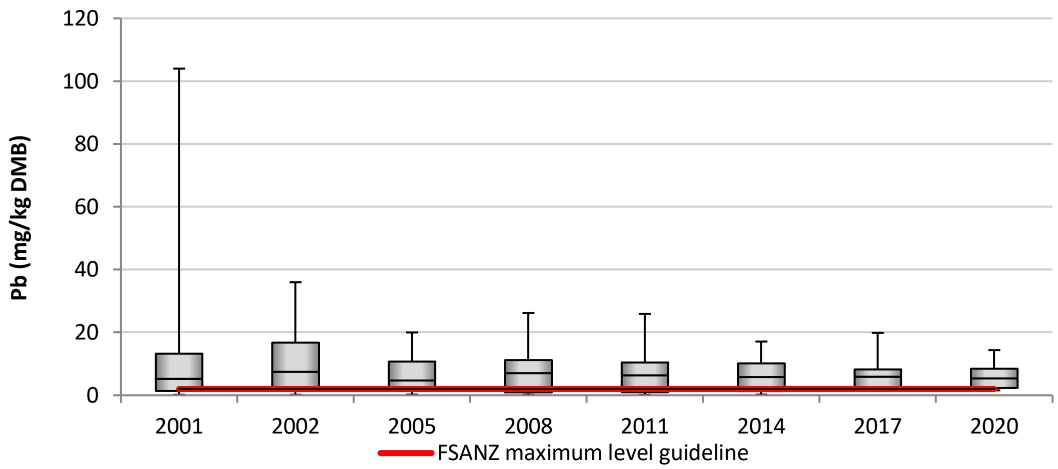


Figure 4-77 Lead in wild mussels 2001 – 2020

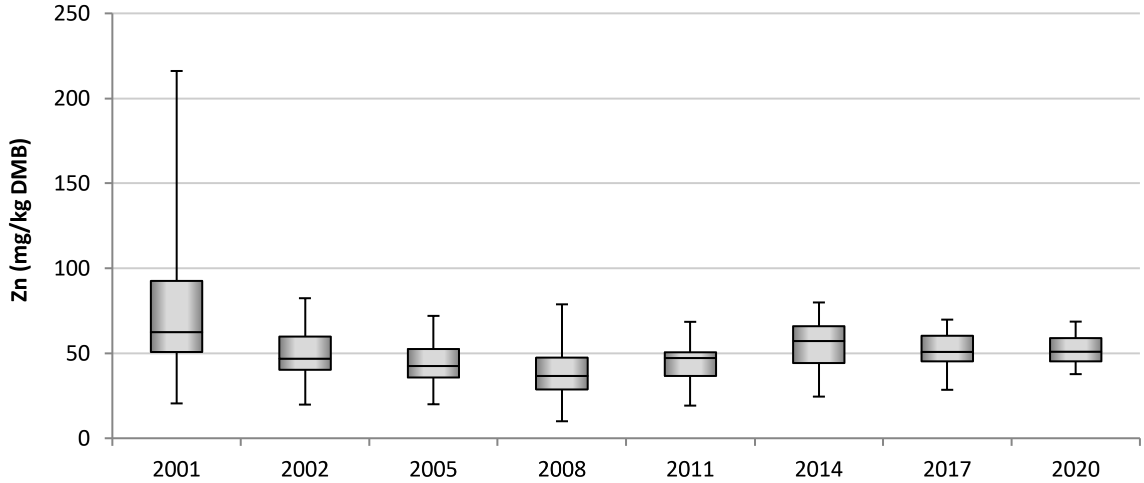


Figure 4-78 Zinc in wild mussels 2001 – 2020

4.4 Noise

NH monitors noise continuously at three stations within the neighbouring community. The stations are located in Birch Road and Delwood Drive, Lutana and at Saundersons Road, East Risdon (Figure 4.79).

Figure 4-79 Noise monitoring locations

The EPN specifies noise emissions limits from site activities, both as measured by the aforementioned community noise monitors, and when measured at any noise sensitive premises in the neighbouring communities. These limits are shown in Table 4-16 . In addition to continuous monitoring, NH is required to undertake a three yearly site wide comprehensive noise survey to identify noise sources. The most recent report was completed in October 2020 based on measurements conducted between August and October 2020. The results of this survey are discussed in Section 4.4.2.

Table 4-16 EPN limits for noise levels in the receiving environment

Monitoring location	**Test frequency**	**Emission limits**
Test Parameter - A-weighted sound pressure L_{90} & L_{EQ}		
Birch Road, Lutana	Continuous	Monthly median L_{90} 52 dB(A)
	Attended	10-20 minute average 52 dB(A) if 5d B(A) > Ambient
Delwood Drive, Lutana	Continuous	Monthly median L_{90} 52 dB(A)
	Attended	10-20 minute average 52 dB(A) if 5dB(A) > Ambient
Saundersons Road, East Risdon	Continuous	Monthly median L_{90} 56 dB(A)
	Attended	10-20 minute average 56 dB(A) if 5 dB(A) > Ambient

4.4.1 Noise Monitoring Program Details

In 2020 NH replaced the three previous noise monitors, the Larson Davis 870 Sound Level Meters, with contemporary noise monitors, SV 307 Integrated Noise Monitoring Stations. The installation of new monitors improved the reliability and capability of the NH noise monitoring network and also increased our capacity to collect additional meaningful data. The three noise monitors operate continuously, sampling A-weighted sound pressure levels in L-value measurements. Each unit is attached to a power pole at 3 m above ground level to reduce the risk of vandalism and to facilitate the supply of mains power to the monitors.

All continuous noise monitoring is conducted in accordance with Australian Standard 1055.1-1997 Acoustics – Description and Measurement of Environmental Noise – General Procedures.

Noise may be classified into two categories; continuous noise and nuisance noise. Continuous noise contributes to a relatively constant background and is usually described by L90 where Ln is the sound pressure level that is exceeded for n% of the time. Nuisance noise is intermittent and raises ambient noise above usual background levels and L10 describes these noise events during the interval. Of greatest relevance to the community are nuisance noise sources, which pose the greatest management challenge, given their intermittent and changeable nature. Nuisance noise can also be subjective within the community.

Sources of noise on site depend on operational activities, including but not limited to:

- Vehicles including heavy vehicles and fork lift trucks;
- Fans on cooling and ventilation systems;
- Conveyors such as rubber belts, walking beams, and chain conveyors;
- Materials handling such as stacking zinc or excavating concentrates;
- Minor explosions from the cell house and roast boiler cleaning;
- Power tools including grinders, impact guns, and construction equipment;
- Steam emissions from heating and venting operations;
- Warning alarms or PA announcements that indicate vehicle movement or process communications; and
- Sirens during emergencies or emergency drills.

Over time, site wide noise surveys have been conducted to identify specific noise sources that contribute to impacts around the smelter. These studies have supported work toward ameliorating major noise sources.

NH specifies strict hours of operation for non-routine tasks or those that produce excessive noise, and proactively considers the management of potential noise issues when planning on site work. NH encourages feedback regarding noise issues from the local community. In the event of a noise complaint, investigative procedures are initiated in an attempt to identify and mitigate the source of the noise. External noise monitoring experts are engaged where in-depth analysis of noise impacts is required.

4.4.2 Noise Results and Discussion

Results

Figure 4.80 shows monthly median L_{90} values at the monitoring sites for the reporting period. These show variable measurements across the community noise monitoring locations, with a sharp increase in the monthly median L90 sound levels from July 2019 to August 2019. This was due to a complete loss of data for the 35 day period between July 23rd 2019 and August 27th 2019 which was a result of a communications fault preventing the transmission of data from the monitors to the site's data server. This matter was investigated and subsequently resolved. The overall trends show that the regulatory limit was not exceeded at any time during the reporting period which aligns with results recorded during the 2016-2018 sampling period.

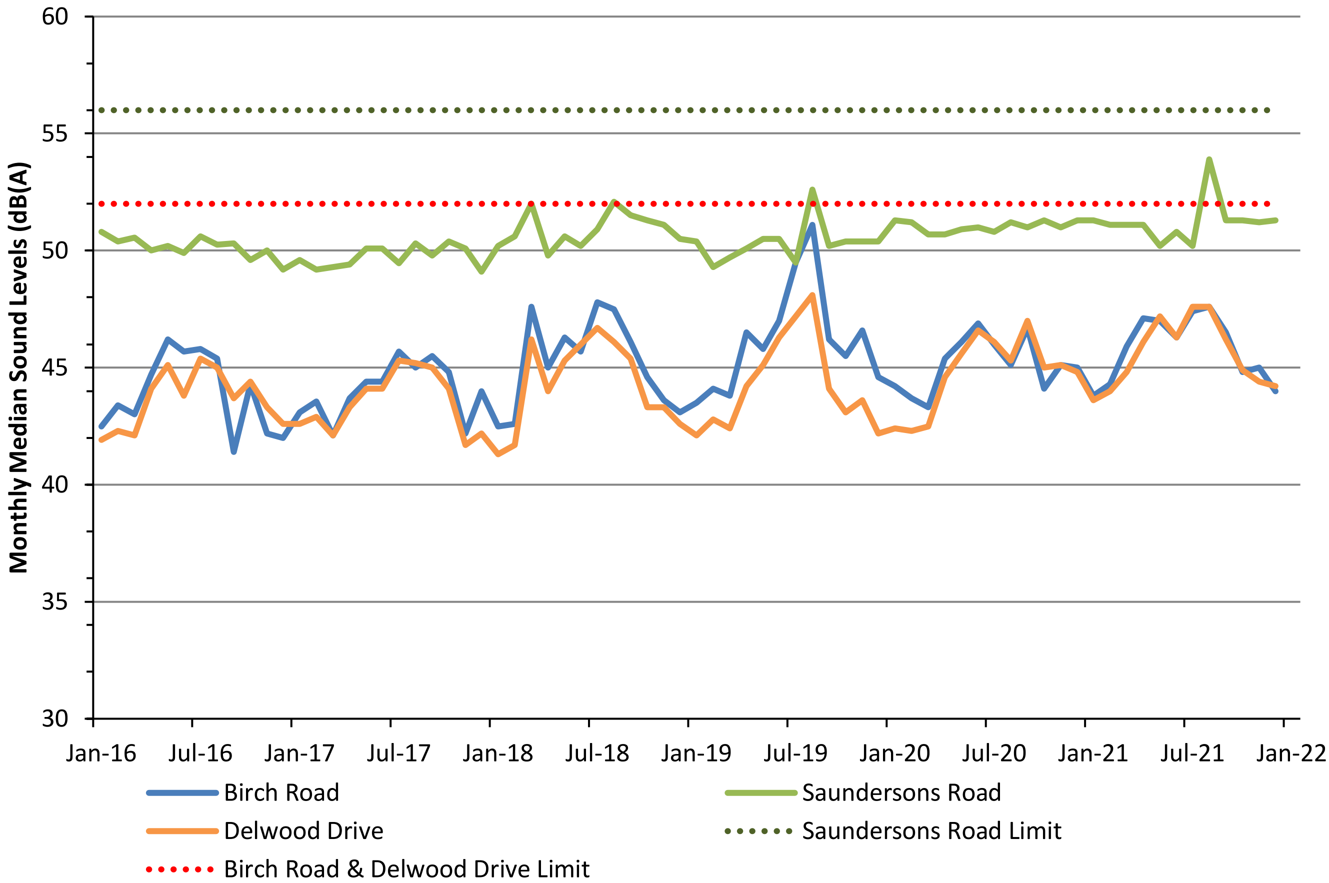


Figure 4-80 Monthly median L_{90} noise dB(A) results for Birch Road, Delwood Drive, Saundersons Road 2016–2021

Community

Fifteen noise complaints resulting from NH operations were received during the reporting period. This is similar to the 18 noise based complaints received during 2016-2018. The full public complaints register is provided in Appendix 6.1 and includes complaints relating to nuisance noise, and NH's response.

As in the past, general site noise is addressed both as issues arise in connection with particular activities, and also proactively, by reinforcing protocols for considering noise before and during routine and non-routine tasks.

Most of the noise complaints are related to noise at night (such as banging, reversing beepers and alarms) and the activity of steam venting in the Roasting department. NH places significant importance of managing operational noise afterhours as well as prolonged noise events.

Proactive management of site activities is a priority for NH and is critical to the mitigation of any new noise sources. All new capital work projects and significant maintenance activities on site are required to consider potential noise emission sources during design, construction and operational phases. A risk assessment approach ensures due consideration is given to minimising impacts of potential noise emissions at all stages through:

- Specifically understanding noise that would be generated from new plant and equipment or as the result of a new process or maintenance activity;
- Using the opportunity to 'design' out new noisy operational aspects where possible;
- Using JSEAs to ensure specific noise emissions controls were identified and implemented during construction activities (including baseline and activity noise monitoring where considered necessary); and
- Allowing sufficient time to give the community advance warning of a potential increase in noise and what it may be associated with.

NH is committed to working with the local community to address noise concerns. In the event of a complaint, NH makes every effort to respond by immediately investigating the specific source of the noise and subsequently ceasing or changing the offending operation where possible. In some instances, where there are no feasible solutions for specific nuisance noise sources, NH is proactively seeking to better understand and identify practical ways to manage these sources.

Lastly, it is important to note that while NH activities are a significant contributor to noise in the local area, weather conditions, time of day, season and local community activities can also contribute to noise data collected at community monitoring sites.

Triennial Noise Survey

A community noise survey was conducted by Noise Vibration Consulting (NVC) between August and October 2020, in compliance with EPN 7043/5 Section N2, N3 and N4. The survey was conducted using the six measurement locations and control site of the previous surveys, with measurements carried out at day, evening and night times at each location. The results of this survey demonstrated that:

- Nyrstar noise emissions have changed very little over the last three years. The four site monitoring points show a reduction in noise from Roast 6 years ago that has been maintained, with the remainder stable over the last 12 years.
- Noise levels from the NH continuous monitoring system, NVC personally attended data, and modelling, are all in general agreement, and show NH long term noise emissions are below the EPN criteria.
- In the surrounding community of Lutana and East Risdon, NH noise levels control the background noise and are marginally quieter at night than day time.

Measurements from the survey show NH noise is generally broad band with some minor tones, mainly in Lutana.

The survey showed that many sources contribute to the community noise levels, and hence meaningful noise reduction of the continuous noise community noise levels would require noise control to many sources. For example, the 2020 shutdown in the Roast /Acid plant (#5 Roast and #5 Acid Plant off) caused no change in Lutana noise and only a 0.5 dB reduction in East Risdon noise. Reduction in nuisance noise, therefore, will be most effective if focused on tonal noises. As a part of the report, narrow band analysis was performed to identify major tonal sources on site, and a number of potential noise abatement opportunities were identified. These recommendations help focus NH's work toward ameliorating nuisance noise sources, and will directly inform future noise management projects.

In 2008 an acoustic model of NH was constructed in order to better understand individual contributions of noise generating equipment to overall noise emissions. The 2020 survey found that there have been subtle, but no major changes, to site noise sources. The noise model has been updated in order to migrate it to the iNoise platform.

4.5 Process and Non-process Waste

4.5.1 Process Waste and By-products

The production process at NH uses raw materials (concentrates), which contain zinc as well as other metals and sulphide. Metals do not degrade so the principle of 'mass balance' applies to the smelting process whereby all metals entrained in concentrates will present as a residue or by-product. Figure 4.81 shows a schematic of the NH process flow sheet highlighting key by-products and wastes that are generated as part of zinc production. Materials are removed from the process as either products for direct sale, by-products for potential reuse and / or sale, or process wastes requiring disposal. Some stockpiled waste residues that are no longer produced are still present on NH land as described in the following sections.

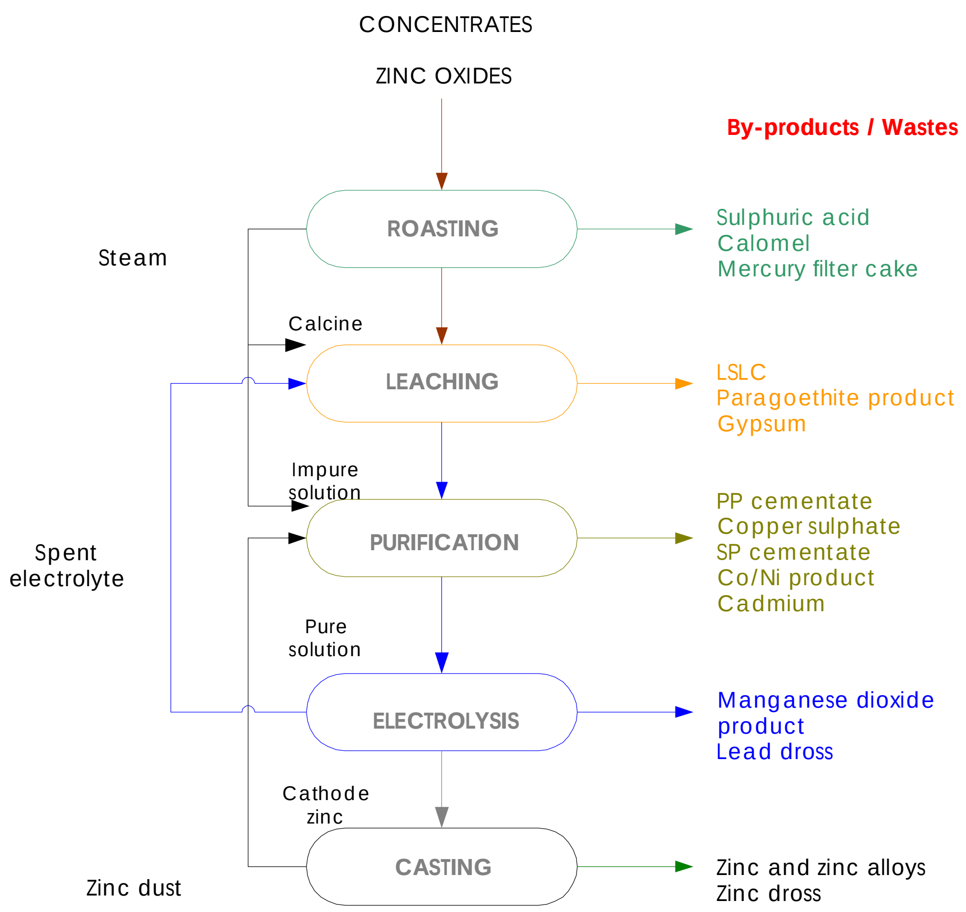


Figure 4-81 By-product flow sheet

4.5.1.1 Process Waste Description and Management

Hobart Leach Product No. 1 (HLP1)

HLP1 is no longer produced at NH, though two known areas of HLP1 material remain in the Loogana precinct after the 2013 removal project. These are in close proximity to TasNetworks power infrastructure adjacent to the 2014 rehabilitation area (Figure 4.82), and in a section of the foreshore at Woodman's Point. During rehabilitation works, the material near the TasNetworks infrastructure was delineated with geofabric between the HLP and the rehabilitated area. The parcel at Woodman's Point was found during exploratory potholing on the foreshore embankment and further investigative work will be required to define the product boundaries. Recovery and rehabilitation in this area is challenged by the proximity of the material to indigenous midden artefacts.

Figure 4-82 Remaining HLP1, shown on far right

Jarosite

The temporary secure landfill cells for jarosite (Figure 4.83 and Figure 4.84) are monitored so as to ensure that no environmental harm results from the temporary stockpiling of the material. The monitoring results from the Loogana–Inshallah area continue to indicate that the original jarosite landfill performance is satisfactory with no leakage detected.

Future management options for the material in the jarosite cell have been broadly assessed; however no management decision has yet been taken. NH recognise that any decisions made in regards to the management of the jarosite would need to be made in consultation with the relevant stakeholders.

Management options investigated to date have included:

- Reuse – it is considered that jarosite reuse technology is not readily available in a form that would support the application of this option. Considerable evidence would be required to demonstrate a reuse option that is safe for health and environment, low-risk from a legal perspective, and logistically and economically feasible.
- Reprocessing - technical constraints associated with each of the reprocessing options assessed limit the feasibility of reprocessing jarosite either locally or through another smelter.
- Extraction of high value metals – a desirable option, however the cost involved to extract the high value metals is significantly more than the value of the metals extracted. This is due to the relatively low concentrations of high value metals in the jarosite and also the lack of local infrastructure to pursue this option.

- Construction of a new storage site at NH – one location on the NH site is considered to be potentially suitable for long term storage of the material. Investigations into this option commenced again in 2020 and will continue throughout the next reporting period.
- Off-site disposal - not currently considered to be a feasible option without prior treatment.
- Assessment of treatment technologies – in 2011, three specialist contracting companies conducted treatment trials on the jarosite. The trials indicated that the leachable fraction of metals within the material could be successfully immobilised using a range of different reagents.

Figure 4-83 Jarosite secure landfill

Figure 4-84 Jarosite secure landfill

Effluent Treatment Solids

All stormwater and process water collected on site is treated in the Effluent Treatment Plant (ETP). The heavy metals are precipitated with the resulting underflow slurry from the thickener generally being returned to the Leach plant. However, return of the underflow slurry to the Leach process is limited by the accumulation of fluorine, magnesium and manganese in the circuit. When the operational fluorine, magnesium and manganese limit is reached in Leach, the ETP underflow slurry is diverted through a filter bed system in ETP. The resulting ETP underflow solids are temporarily stockpiled in a covered bunded area. The solids are then transported by truck to the Paragoethite (PG) shed to be blended directly with PG, and sent to the Nyrstar Port Pirie multi-metal smelter for further processing and recovery of valuable metals.

Mercury Filter Cake and Mercury Contaminated Materials

Mercury Filter Cake (MFC) is generated through the mercury removal process at the Mercury Removal Plant. MFC is securely stored in closed containers in a dedicated bund (Figure 4.85). Chemical stabilisation of the material followed by disposal at an approved facility is the current management method for MFC. Success of the chemical stabilisation program has been variable due to changes in the composition of MFC over time.

In early 2020, approximately 25 t of MFC was sent to a mercury recycling plant in Melbourne, in order to trial the transport and recycling of the material. The transport of the MFC proved to be extremely challenging, due to the classification of the material as a Dangerous Good, and the limitations of the containers in which the material is stored.

In 2021, laboratory trials were successful in combining MFC with magnesium oxide (MGO) to successfully treat the material for disposal as a level 3 contaminated soil under IB105 classification. In April and June NH disposed of a total of approximately 128 t of treated MFC to the Copping C Cell. NH plans to continue treating and disposing of the stockpiled waste whilst continuously investigating various treatment options.

Figure 4-85 Purpose built containers containing Mercury Filter Cake, pre-treatment

4.5.2 Non-Process Waste Materials

NH's non-process waste refers to waste materials that are generated during normal plant operations or projects and are not by-products from the process. The non-process waste hierarchy at NH is based around segregation of waste streams depending on opportunities for reuse, recycling and where no such opportunities exist, disposal. An overview of the non-process waste types delineated at NH follows.

4.5.2.1 Non-Process Waste Materials Description & Management

Reusable / Recyclable Materials

Non-process reuse / recycling initiatives include:

- Oil, grease and lubricants (dedicated waste oil collection area);
- Scrap steel (dedicated steel bins);
- Cardboard (dedicated blue bins with lids);
- Office paper (dedicated yellow wheelie bins);
- Security shredding (dedicated red wheelie bins);
- Toner cartridges (dedicated collection boxes);
- Soft plastic packaging (dedicated collection bins in departments generating this type of waste);
- Timber pallets (collected and stored for reuse);
- E-waste (dedicated collection bin);
- Battery recycling (dedicated collection bin);
- Mobile phones, charges and accessories (dedicated collection box);
- Clean timber and green waste (dedicated collection bin); and
- Fluorescent tubes and lamps.

General Waste

Domestic and inert waste is collected by a cleaning contractor and placed into department based general waste bins for disposal at an approved waste disposal site (refer Figure 4.87). This waste consists of office, crib room and change house refuse and inert materials such as packaging, strapping, scrap wire and clean electrical conduit.

All non-process waste materials that may have had contact with process materials must be cleaned prior to placement in the general waste bins located around the site for disposal at an approved waste disposal site.

Redundant Chemicals

Redundant chemicals that cannot be utilised in NH production processes are stored on site for collection by a registered agent for disposal every six months or when specifically requested.

Management Systems

In addition to the classification and segregation of materials to determine the suitable recycling or disposal option, the site maintains a tracking procedure for off-site movement of materials. The system is an authorisation process, which:

- Ensures contaminated items are not taken off site;
- Ensures non-contaminated materials are authorised for transport off site; and
- Tracks the quantities of wastes and recyclable materials being generated.

Figure 4-86 Non-process waste recycling at Nyrstar Hobart

Figure 4-87 General waste bin

4.5.2.2 Non-Process Waste Materials Results & Discussion

Quantities of waste materials requiring off-site disposal, treatment or recycling at an approved waste facility for the past three years is tabulated in Table 4-17 and presented graphically in Figure 4.88. The amount of hazardous waste to landfill during the reporting period is mainly attributed to the disposal to the Copping C Cell of the following waste streams:

- 226 tonnes of contaminated fibreglass, plastic and rubber
- 275 tonnes of contaminated bulka bags / filter cloths / baghouse bags
- 620 tonnes of contaminated soil
- 1141 tonnes of stabilised MFC

Approximately 842 tonnes of general non-hazardous waste collected from around the site was disposed of as general waste at the Copping landfill.

Table 4-17 Total tonnes of waste materials recycled for the period 2019 to 2021

Material	2019	2020	2021
Cardboard & Paper - recycled	7.6	11.6	9.55
Scrap metal - recycled	332.8	384.8	588.26
Clean timber & Greenwaste - recycled	26.1	33.5	26.78
Oil – recycled	11.7	14.9	40.2
Demolition waste - recycled	0.0	90.9	621.2
Co-mingled - recycled	0.2	0.0	3.9
E-Waste - recycled	1.0	1.4	1.98
Fluorescent tubes - recycled	0.0	1.7	1.25
Oil Filters - recycled	1.0	0.3	0.805
Total waste recycled (t)	**380.44**	**539.04**	**1293.92**

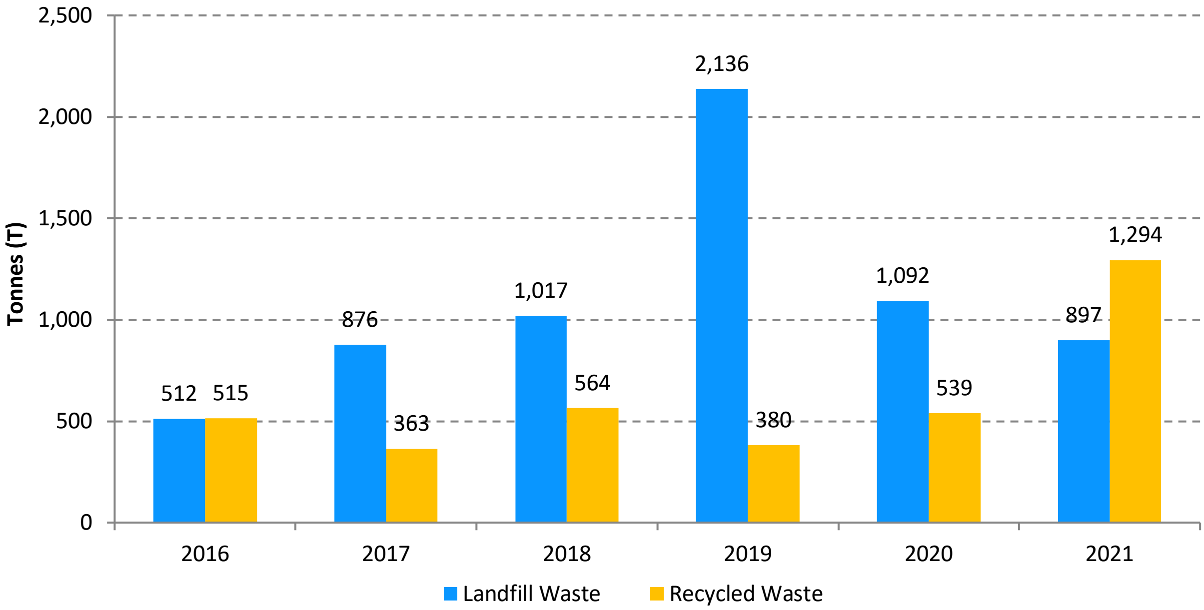


Figure 4-88 Waste to landfill and recycled for the period 2016 - 2021

An inventory of stockpiles of process and non-process waste remaining on the site is shown in Table 4-18, and a map of all of the non-process waste storage locations is shown in Figure 4.89.

Table 4-18 Non-process and process waste inventory as at 31 December 2021

Waste / By-Product	Type	Storage Location	Outlet / disposal route identified	Ground	Storage	Inventory as at 01/01/19 (t)	2019-2021 produced volume (t)	2019-2021 Recovery / Disposal (t)	Inventory as at 31/12/21 (t)
Jarosite	Process Waste	Jarosite Cells	No	Sealed	Covered	206,328	0	0	206,328
Neutralised Acid Sludge (screened)		Pad upriver of Dome	Yes	Sealed	Uncovered	1,300	300	0	1,300
MFC, mercury bearing waste (stabilised)		Environment bund	Yes	Sealed	Uncovered	1000	0	1000	0
MFC (untreated)		MFC Pad	Yes	Sealed	Covered	298	415	128	585
Contaminated soil	Non Process Waste	Quarry	No	Unsealed	Uncovered	31,658	0	0	31,658
Contaminated soil		Environment Bund area	Yes	Unsealed	Uncovered	914	620	1,130	403
Contaminated timber		Quarry	No	Unsealed	Uncovered	12,073	775	0	12,402
Bulka bags		Waste Transit Yard Shed	Yes	Sealed	Covered	39	237	250	26
Rubber		Waste Transit Yard	Yes	Sealed	Uncovered	24	30	75	0
Asphalt		Quarry	No	Unsealed	Uncovered	4628	498	0	5126
Fibreglass		Waste Transit Yard	Yes	Sealed	Uncovered	11	32	45	0
Grease mix		Waste Transit Yard Shed	Yes	Sealed	Covered	9	4	8	5
Oil (tonnes)		Waste Transit Yard Shed	Yes	Sealed	Covered	24	4	67	3
Filter media, baghouse bags		Waste Transit Yard	Yes	Sealed	Uncovered	16	38	30	24
Venturi tower sludge		Environment bund	Yes	Sealed	Uncovered	10	0	0	10
Refractory bricks		Environment bund	Yes	Sealed	Uncovered	620	465	0	1065
Demolition waste		MRP storage pad	Yes	Sealed	Uncovered	405 (estimated)	0	713 (actual)	0
Vanadium pentoxide - spent catalyst		Zinc shed, Waste Transit Yard, Riggers' locker	No	Sealed	Covered	260	30	0	290
Contaminated concrete		MRP storage pad	Yes	Sealed	Uncovered	40	160	132	70

Figure 4-89 Non-process waste storage locations

4.6 Review of the Storage and Handling of Environmentally Hazardous Materials

In 2021, NH submitted a report to the EPA detailing the storage and handling of environmentally hazardous materials at the site. This report included an assessment of the storage facilities, and identified any high risk locations, requiring improvement works. It was a requirement of the acceptance of the report that progress updates on the works were to be provided to the EPA on an annual basis. Table 4-19 below provides information on each of the assessed storage locations.

Table 4-19 List of Environmentally Hazardous Materials storage locations

Area	Environment Risk Rating			Actions as at 14/04/2021	Update as at 31/12/2021
General Site	**Likelihood**	**Consequence**	**Rating**		
Waste Oil	C	2	Low	No actions required	None
Mercury Filter Cake	C	2	Low	Continue with the project to remove stockpiled mercury filter cake from the site	128 t of mercury filter cake treated and disposed of as hazardous waste to landfill. A significant treatment campaign is to be undertaken in 2022.
Sodium Hydroxide	C	2	Low	No actions required	None
Hydrogen Peroxide No.1	C	2	Low	Repair crack in bund Include in existing 2 yearly hazardous material storage (packages) inspection program	None
Hydrogen Peroxide No.2	C	2	Low	Repair crack in bund Include in existing 2 yearly hazardous material storage (packages) inspection program	None
Environment Bund	C	2	Low	Inspect again once cleaned out	Bund not yet fully cleaned out.
Old Riggers Locker	C	2	Low	No actions required	None
Site Oil Store	C	2	Low	No actions required	None
Roast	**Likelihood**	**Consequence**	**Rating**		
No. 5 Acid Plant Mercury Bund	C	2	Low	No actions required	None
No. 6 Acid Plant Mercury Bund	F	4	Very High	Replace the recently removed bund floor. Include in maintenance plan for 2021	Investigative works are underway to source a suitable work method to achieve a temporary solution. Options such as concrete and rubber lagging have been assessed and deemed not suitable. The current option is plastic overlay. The timeframe for completion is 31 July 2022. The permanent solution requires a complete relocation of the mercury

					tower, located within the bunded area. This is in the feasibility stage, and can only be completed during an annual major shutdown. A timeframe for completion has not yet been assigned.
Acid	**Likelihood**	**Consequence**	**Rating**		
Acid Tank 4 Bund	C	2	Low	No actions required	None
Acid Tank 8 bund	D	2	Medium	Conduct regular inspections for the ongoing assessment of the bund floor	None
Acid Tanks 9 and 10 bund	C	2	Low	No actions required	None
Acid Bund	C	2	Low	Repairs to the wall have recently been completed. Repairs to the floor and sump are required to address groundwater ingress. Expected to be completed in 2021.	Repairs have been completed to the floor and sump, however have not been successful in preventing groundwater ingress. Trials for alternative means of sealing the bund will be completed in 2022.
Leach	**Likelihood**	**Consequence**	**Rating**		
Leach Diesel Storage Bund	C	2	Low	No action required	None
Cadmium Plant Bund	B	3	Medium	No action required	None
Ex Weak Acid Leach	C	2	Low	No action required	None
Calcine Grinding	D	2	Medium	Continue with the project to install a dedicated slurry pump. Inspect when the bund has been emptied	The slurry pump has been installed and is operational, and the bund is now being kept clear of material. A complete inspection of the bund will be completed in 2022.
NL Thickeners/Clarifiers	D	2	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2023-24	None
NL Reactors	D	2	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2023-2024	None
PG Filters Tank Farm	D	3	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2022-2023	None

PG U/F Storage	D	3	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2022-2023	None
PG Thickeners	D	3	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2022-2023	None
PG Reactors	D	3	Medium	Include in maintenance plan to fully inspect, and if required, repair in 2022-2023	None
HAL Reactors	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
HAL Thickeners	C	2	Low	Investigate the material that is underneath the acid proof bricks to assess potential impact, and seepage of liquor from the bund	None
PN Re-Pulp Thickener	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
PN Thickener	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
PN Reactor	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
SAL flocculant mixing	C	2	Low	No action required	None
SAL	D	3	Low	Investigate the material that is underneath the acid proof bricks to assess potential impact, and seepage of liquor from the bund	None
Effluent Treatment Emergency Storage Bund	C	2	Low	No action required	None
Effluent Treatment Underflow Bund	C	2	Low	Joints to be re-sealed	None
Spent Heater	E	2	Medium	Include in maintenance plan for 2021	The spent heater bund has undergone a complete refurbishment
Cadmium Cementate Shed	D	2	Medium	Work with operations to understand issue of excess material and develop plan for how is can be stored undercover.	None

Purification	Likelihood	Consequence	Rating		
PP Tank Farm	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
SP Tank Farm	D	3	Medium	The bund is to be repaired as part of the overall refurbishment project underway for the Secondary Purification reactors and bund. The project is due for completion in 2023	Works are continuing with the refurbishment of the Secondary Purification reactors, with one reactor completed and works to commence on a second in July 2022. All six of the reactors are to be refurbished, with this project now expected to be completed in FY26. The interruption to the process each time a reactor is taken off-line has proven to be significant, with an increase in risk to the process as a result. Thus, the works have had to be widely spaced, so as to negate this risk.
Zn/Cd Leach	D	2	Medium	Include in maintenance plan to repair in 2024	None
Antimony Storage	C	2	Low	No action required	None
Process Building Basement	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
Dilute Acid Tank Bund	C	2	Low	No action required	None
Cadmium cementate storage bunkers	C	2	Low	No action required	None
SP Cementate shed	D	3	Medium	The action required here is not associated with the shed, but rather with the storage of material outside of the shed. Work with operations to understand how often material is stockpiled outside of the shed, and if required, assess options for constructed undercover storage.	None
Area	**Environment Risk Rating**			**Actions**	
Electrolysis	**Likelihood**	**Consequence**	**Rating**		
Premix and flocculant tanks bunds	D	2	Medium	Include in maintenance plan to repair in 2024	None

Thickener Overflow bund	C	2	Low	No actions required	None
Spent Recirculation Bund	D	2	Medium	No immediate actions required - wait on new cellhouse decision	Planning and approvals works continued throughout 2021 of the construction of a new cellhouse. It is expected that any works associated with this action will be delayed until the future of the tanks is fully understood.
No.4 Sump	D	2	Medium	Assess options to undertake minor repairs as general maintenance in 2021	None
Feed tank bund	C	2	Low	Undertake jointing repairs as general maintenance in 2021	None
Mix tank bund	C	2	Low	No action required	None
Reagent Bund	C	2	Low	No action required	None
Launder Bund - Northern Section	C	2	Low	No action required	None
Launder Bund - Southern Section	D	3	Medium	Include in maintenance plan to repair in 2022-2023.	None
8-9 Spent Tank bunds	D	2	Medium	Include in maintenance plan to repair in 2024	None
1-7 Spent Tank bunds	F	3	High	Assess options for installing a containment system	Planning and approvals works continued throughout 2021 of the construction of a new cellhouse. At this stage, it is anticipated that the 1 – 7 spent tanks will remain in place, however the design for this is still being finalised. It is expected that any works associated with this action will be delayed until the future of the tanks is fully understood.
Manganese bund	D	2	Medium	Include in maintenance plan to repair in 2024. New cellhouse may resolve the issues identified with new infrastructure.	None
8-9 Sump pump bund	D	3	Medium	Include in maintenance plan to repair in 2022-2023	None
Electrolysis oil store	C	2	Low	No action required	None

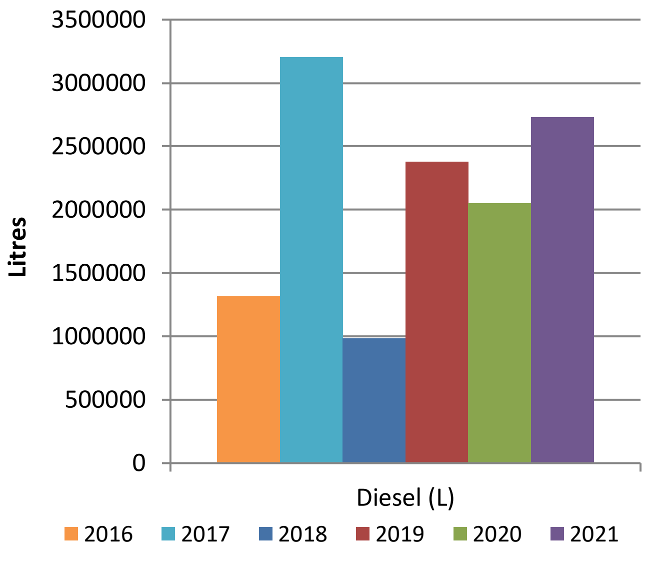
Wharf	Likelihood	Consequence	Rating		
Concentrate and Residue shed	C	2	Low	No action required	None
Cobalt-Nickel residue shed	C	2	Low	No action required	None
The Dome	E	2	Medium	A project is in progress to repair the holes to the roof of the Dome.	Repairs to the roof of the Dome have been completed.
The Zinc Shed	C	2	Low	No action required	None

4.7 Energy Management & Climate Change

The production of zinc involves the consumption of large amounts of energy in various forms. Although metal production is an energy intensive industry, Nyrstar supports current international action on climate change. We recognise that we have a responsibility to reduce our carbon footprint while also meeting society's need for zinc and other resources, as reflected in our Position Statement on Climate Change and Energy, and that working toward resolving the issue of energy efficiency and greenhouse gas emissions will be crucial to the long-term sustainability of the business.

Nyrstar zinc smelters are amongst the most energy efficient in the industry, and we continually investigate opportunities for further improvement. Most of our greenhouse gas emissions relate to the electricity we use rather than from direct emissions from our production plants, so our carbon footprint is in fact highly dependent on the regional electricity generation source. The electricity used at the Hobart smelter is mostly generated from hydroelectric sources (a form of renewable energy), resulting in lower greenhouse emissions than other Nyrstar sites. Greenhouse gas emissions are also generated through the use of LPG, diesel, natural gas and reagents.

NH tracks energy consumption on a monthly basis. Annual consumption for the current, and previous reporting period is shown below in Figure 4.90. Diesel consumption has been included as a separate graph for optimal data display.



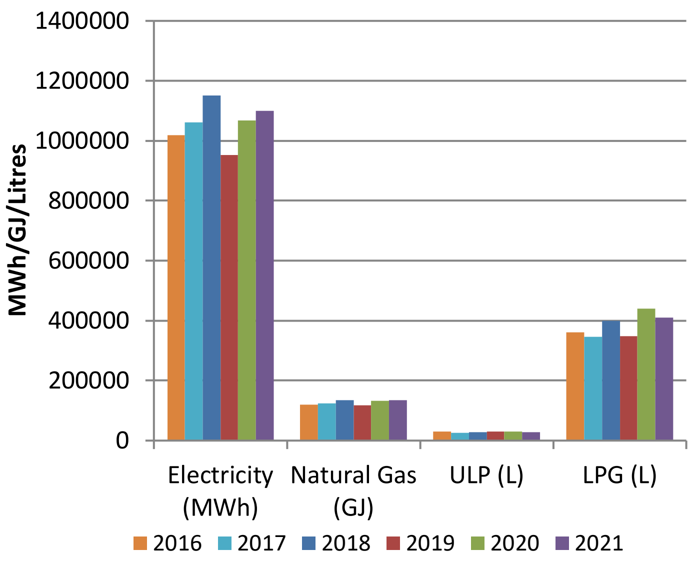


Figure 4-90 2016 – 2021 energy consumption

With the exception of diesel, energy consumption has remained reasonably stable over the current reporting period. The bulk of the diesel consumption on site is a result of significant shutdown events. The roasting process generates a significant volume of steam which is used to power other parts of the plant. When the roasters are not operating, as is the case during shutdowns, the steam must be produced using diesel fuelled package boilers. In addition, it requires a significant amount of diesel to start up the roasters after a shutdown. Even with the shutdown, the energy content of the waste heat recovery (in the form of steam) equates to approximately 616,000 GJ per year. This equates to almost five times the energy consumed in the form of natural gas for the year, and thus represents a significant energy recovery program.

Both zinc and lead products of Nyrstar smelters make an important contribution to sustainable development and reducing CO_2 emissions: zinc through the galvanising of steel to prevent corrosion and extend its useful life; and lead through batteries, which power electric vehicles and facilitate the storage of electricity from alternative energy sources.

4.8 Flora and Fauna

A search of the EPBC Act Protected Matters Database identified 41 threatened fauna species and 9 threatened flora species listed under the EPBC Act database as potentially present within the site (within 1 km) (DoE, 2018). There are no EPBC Act-listed threatened ecological communities in the vicinity of the Nyrstar Hobart site.

The operational area of the Nyrstar Hobart site contains minimal to no suitable habitat for EPBC Act-listed threatened fauna or flora species and it is considered highly unlikely that any threatened species have the potential to be present on the smelter site. The company owns substantial buffer zones, 90 ha of which are located on the eastern shore of the Derwent River, in which there may be the potential for the presence of some EPBC Act-listed threatened fauna or flora species. The buffer zones were put in place primarily to prevent residential development within too close of a proximity to the smelter.

In 2007, a Natural and Cultural Values Inventory of the buffer zone on the eastern shore was conducted (Hydro Tasmania Consulting 2007 – Natural and Cultural Values Inventory Pegara). The site was described as being comprised of dry vegetation types, with 4 native vegetation communities and a small area of exotic pasture land. The vegetation types and area were listed as follows;

- *Eucalyptus amygdalina* forest on mudstone – 36ha
- Eucalyptus risdonii forest – 27ha
- Eucalyptus globulus dry forest – 10ha
- Lowland grassland complex – 2ha

A fire had been through in the preceding months, however it was also noted that the understorey is expected to be sparse due to shallow soil conditions.

The dry forest is mostly regrowth trees, as a result of past farming activities and wildlife. Few trees with hollows were noted, and little fallen timber. Thus, the fauna habitat value of the site is considered to be low to moderate, due to paucity of nesting and shelter sites for hollow dwelling fauna, and little fallen timber to provide habitat for ground dwelling species.

Lowland grassland areas provide foraging habitat for some species, where the dry forest would not be suitable, due to the thin soils associated with them.

NH maintains an operating procedure to provide guidance on the protection of known threatened species and habitat associated with their occurrence. The document describes actions to be taken in the event of the following:

- A new species suspected to be of threatened status is identified on land owned by NH; and
- A species known to occur on the site is elevated to threatened status; or the status of a known threatened species changes.

A review of the Commonwealth threatened species database is undertaken each year to assess changes to threatened species lists for the area surrounding the smelter, and to enable NH to determine if any changes to management of the buffer zones are required.

4.9 Cultural Heritage

The NH site is home to a number of identified sites of cultural heritage value. Aboriginal middens have been mapped along the southern foreshore area on the operating site and various items of cultural heritage value have been observed on the Pegara property on the eastern shore of the estuary. A site procedure outlines corporate responsibilities relating to the management of known cultural heritage sites within the NH footprint, and actions to be taken in the event of the discovery of any previously unrecognised cultural heritage sites. This procedure does not provide instructions for developing action plans for management of a relic or heritage site. The Department of Natural Resources and Environment (NRE) is consulted if there is a need for such a plan to be developed.

5. GLOSSARY

AER	Annual Environmental Review
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZFA	Australia New Zealand Food Authority
ARI	Average recurrence interval
As	Arsenic
Cd	Cadmium
CO_2	Carbon dioxide
Cu	Copper
$CuSO_4$	Copper sulphate – secondary product sold to external parties
CWP	Contaminated water pond
dB(A)	Unit to measure 'A-weighted' sound pressure levels. A weighting is an adjustment made to approximate the frequency response of the human ear.
DCS	Distributed Control System
DEP	Derwent Estuary Program
DMS	Document management system
EMPCA	Environmental Management & Pollution Control Act 1994
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPN	Environment Protection Notice
ETP	Effluent Treatment Plant
F	Fluorine
Fe	Iron
FSO	Foreshore scrubber outfall
GLC	Ground level concentration
HAL	Hot acid leaching
Hg	Mercury
HLP1	Hobart Leach Product No. 1
NH	Nyrstar Hobart
HVAS	High volume air sampler
JSEA	Job Safety and Environment Analysis
Kg/d	Kilograms per day
L_{90}	Static noise level
L_{eq}	Equivalent continuous sound level
LSLC	Lead sulphate leach concentrate – high lead containing product from strong acid leach stage of filtration
m^3/h	Cubic meters per hour
MFC	Mercury filter cake – material left on filter after MRF is bled off
mg/L	Milligrams per litre
mg/m^3	Milligrams per metre cubic
ML	Megalitre
Mn	Manganese

MRF	Mercury removal filtrate
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NOHSC	National Occupational Health and Safety Commission
NOx	Oxides of Nitrogen
NH	Nyrstar Hobart
NPP	Nyrstar Port Pirie
OAP	Old acid plant
Pb	Lead
PG	Paragoethite – iron by-product reprocessed at Port Pirie Smelter
PM	Preventative maintenance
Ppb	Parts per billion
ppm	Parts per million
RIMS	Risk information management system
RL	River level – mean high tide level
SAL	Strong Acid Leaching
SHEQ	Safety Health Environment and Quality
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
SO_4	Sulphate
SSR	Site strategic review
SWL	Standing water level
t	Tonnes
TCLP	Toxicity characteristic Leach procedure
TGS	Tail gas scrubber
TSPM	Total suspended particulate matter
TSS	Total suspended solids
μg	Micrograms
μg/g	Micrograms per gram
$\mu g/m^3$	Micrograms per cubic meter
Zn	Zinc

6. APPENDICES

6.1 Appendix 1 – Community Complaints 2019 – 2021

Date raised & RIMS ref	Type	Nature of contact	Nyrstar response
26/03/2019 CTC-1502	Noise Dust	Resident of East Risdon complained of a siren that kept going off throughout the evening of Monday 25 March 2019. It kept him awake. Resident stated that he often hears the alarm, however not usually so often, or in the evenings. The resident also commented that a few months ago he noted some dust during ship unloading activities. He asked for some plants (she-oaks) to be given to him to screen the dust. He stated that he had previously been given some plants a number of years ago.	The alarms were a result of a power spike, tripping the system and causing the alarms to go off. This occurred in the middle of the night on Sunday 24 March, and again at 6:55pm on Monday 25 March. This information was provided to the resident. No plants were provided.
01/06/2019 CTC-1524	Dust	Resident contacted the ERO's at approximately 1045 am on Saturday morning in regards to a large emission from the site. The resident also contacted the EPA, who passed the complaint along on the Monday morning.	The incident was a result of zinc and zinc alloy dross screening activities that take place in the grit blast shed located at the rear of the site. At approximately 1030 am on Saturday 29 May, a Casting operator transported a barrel of zinc alloy dross to the shed and emptied it to ready it for screening. Sufficient time had not been allowed for the material to cool, and the result was a large and prolonged cloud of smoke being emitted from the shed. The action implemented from the event is that additional dross barrels have been put in to rotation. This means that each barrel of dross now has more time to cool prior to emptying for screening. Observations made over subsequent days are that there have been no further significant emission events.
02/06/2019 CTC-1525	Dust	Person contacted the ERO's in regards to a large emission from the site. A observation came in via the EPA also. An EPA officer was playing golf on Sunday afternoon and	The incident was a result of zinc and zinc alloy dross screening activities that take place in the grit blast shed located at the rear of the site. This incident was similar, however not as significant as the incident that occurred on the 01/06/2019. The same actions put in place following that incident apply.

		noted an emission from the site. We are unsure if the person who contacted the ERO's was the EPA officer as they would not leave their details with the ERO's.	
05/02/2020 CTC-1576	Noise	Resident felt that noise from the site has been increasing in recent months. Specifically they mentioned high pitched squealing (considered by the resident to be caused by conveyors), banging, and the ships engines (specifically the 'Stolt' – resident complained that the ship left the engine running for 24 hours). She also told the EPA that she had been unable to get a hold of anyone at Nyrstar as we never answer our phones.	In regards to the high pitched squeal – we don't believe this is the result of the conveyors. Mid-January we investigated an increase in noise levels being recorded by our East Risdon monitor. The increase ended up being caused by a faulty microphone, and not actual noise. However in the course of the investigations, we turned off individual conveyors to assess any change in noise or noise characteristics. None were identified. There was an excavator working down at the wharf on and off for a couple of weeks, up until mid-January. Maybe there was some squealing caused by the excavator moving and turning on the concrete pad. It would be interesting to obtain information from the community member as to whether the noise has now stopped and whether the noise was only during the day. In regards to the banging noise coming from the vessels, this may be a result of the grab making contact with the bottom of the vessel during unloading. This is a standard occasional noise associated with unloading concentrates from the vessels, and has not altered in the past 6 months. It is standard practice for all ships to leave their engines running when alongside. The 'Stolt' is an acid vessel and acid vessels are alongside for a maximum of 18 hours. A difference in the engine noise from the 'Stolt' as compared to other vessels has not been noted. Another idea is the percussion drilling which started on the 30th of January along Risdon Road. This activity is taking place during the day only, however it is quite loud. Confirmed that the phone number listed on google is correct. If the community member calls during office hours, the receptionist will answer and will put the person through to the Environment team. If they call outside of office hours, the phone diverts to the Emergency Response Officer who will take a message and pass it on to us. Past 9 months of noise data from the East Risdon monitor assessed. There is not an increasing trend. It is noted that this monitor has been out of action for a period of time during the past 9 months for external calibration, and due to the recent issue of the faulty microphone.
20/10/2020 CTC-1621	Dust	Person complained to the EPA of dust observed during loading of the vessel that was alongside on 14 October 2020. Complaint was made on 20 October 2020.	Some dusting was observed when they commenced loading of the lead sulphate leach concentrate (LSLC). Immediate action was taken in the form of mixing in some lower limed material to reduce the dusting. The dusting was under control within 10-15 minutes. It took this long as the hopper contains 50 - 60 tonnes of material, so it took 10-15 minutes for the hopper to empty of the dusty material.

			The dust was caused by the lime ratio of the material. Depending on the constituents of the material, and the performance of the filter that presses the majority of the moisture out, the material can exceed the transportable moisture limit. When this occurs, lime is mixed in with the material to reduce the moisture limit to enable shipping. Once the material is in the stockpile and the pre-shipment sample has been taken we cannot add any moisture on loading due to AMSA safety regulations. Thus we are reliant on final adjustments to the ship loading hopper and chute which were conducted in this instance, as well as attempting to selectively blend in material to lessen dusting. We have reduced the lime ratio post this shipment from 2.0 to 1.5 to minimise dusting on the forthcoming shipments. We will reduce it further if we are able to do so.
11/11/2020 CTC-1626	Noise	Resident contacted the site to complain of noise of the past few days. He has lived in the area for 20 years, and stated that the noise had never been so bad. He described it as hundreds of cars on a busy highway, and felt that it was a completely new noise from the site. He also stated that it was going all night.	We were venting steam that day (being a Wednesday), and had started at approx. 615 am. The jump in noise levels was evident via the Saundersons Road noise monitor. We had test run turbines for 3 - 4 hours on the Monday. This is a similar noise to steam venting. We had test run one of the turbines on the Tuesday for a short period of time. None of these works occurred during the night. Environment team members visited East Risdon on the day of the complaint to assess the noise first hand. The steam venting was very loud. The weather conditions were very calm. The resident was contacted and the source of the noises explained. The resident was informed that the venting was scheduled to finished at 630 pm. Contact was made with the resident again the following day to check in and see how things were. Resident reported that the steam venting had finished up around 9 pm. The noise levels on Wednesday night were back to normal and the resident was content.
03/03/2021 CTC-1639	Noise	A long-time resident of East Risdon range to report noise had been increasing for the last 6 months with issues including; High pitched squealing noise from 22 - 24 Feb sounding like metal on metal, elevated noise on weekends - starting at around 3 pm on a Friday and diminishing on the Monday morning, the 'Stolt' vessel not switching off its main engine, banging at night time from the wharf - said it sounds like they are putting covers back on the ships and steam pressure blasting from the wharf at 6 am one day.	The Environment Team contacted the resident the following day with a follow up on their concerns. The relevant departments were contacted and notified of the complaints of noise and assured resident that actions will be taken.
03/06/2021 CTC-1658	Noise	Lutana resident called ERO office at 10:15pm to complain about excessive use of	The ERO office contacted Electrolysis immediately and requested they reduce noise levels.

		the PA system in Electrolysis. He hoped the PA system could be turned down as low as reasonably practical and it's use minimised outside of standard work hours. Resident was upset and annoyed with the loud noise.	The Environment team contacted the resident the following day and made an apology for the excessive noise. Discussed with resident challenges of containing noise within the current cell room building and the requirement for the PA system. Resident was happy with the response, but commented that should the noise escalate again, another complaint to the business will be made.
15/06/2021 CTC-1656	Smoke	A complaint was made via the EPA regarding the amount of 'smoke' coming from the site at 11 pm on 14/06/2021. The resident felt that is was considerably more than normal, and they had concerns that there was a fire, and concerns about what is in the emissions.	Discussion had with the EPA immediately regarding the 'smoke' being steam, and that the weather conditions may have played a part in making it appear there was more than usual. A formal response was provided in which there were no fires or incidents, the emissions the resident observed would most likely have been steam from the various cooling towers we have on the site. The emissions from the cooling towers are in the range of 30 – 40 degrees Celsius. Thus, when these emissions come in contact with the cooler air, water vapour starts to condense out of the air, and this visually appears as the white clouds, the steam is more apparent on cold, still days. Relevant data was attached in the formal response.
04/08/2021 CTC-1665	Noise	Resident in Lutana complained via the EPA of excessive noise over the past 8 months describing noises like a street sweeper, the PA noise from the cellhouse and specifically stated that they could hear singing and laughing at night.	The issue was discussed with the EPA. Questions posed by the EPA were responded to by email, with 12 months of noise monitoring data, and audio recorded for short periods of time provided to assist with their response to the resident. The EPA will be attending the resident's property on Wednesday 11 August to place a monitor in their backyard. They will then attend the site to investigate further.
24/08/2021 CTC-1676	Noise	Resident of East Risdon complained of ongoing steam venting noise stating that they had been trying to tolerate it for the past 4 weeks. It was affecting their sleep, and their time in the house in general. She also stated that the noise from emptying the boast was significant - clanging from hitting the bottom of the boat with the ship grab as well as a noise that sounds like high pressure water blasting.	The issues were discussed at length the resident was informed that it was going to be worse on the following day, as we were shutting down the Leach to try and find, and resolve the issue that had been causing the steam venting. The issue was a faulty water control valve supplying the LP1 de-superheating valve. The resident was called on 27/08/2021 and it was confirmed that the steam venting noise was no longer an issue, that it was back to normal, however then stated that since the 2020 Roast turnaround, there was a fan noise that had been louder than pre-2020. We discussed the upcoming community meeting and the resident will try to attend.
25/08/2021 CTC-1678	Noise	Resident contacted NH reception to complain of the noise coming from the roasters starting that there was so much noise it was disturbing his sleep.	The Environment department tried to return the call however did not receive an answer as at 27/08/2021. The issue was most likely the steam venting that had been going on for a number of weeks. The issue was addressed on 26/08/21.
26/08/2021 CTC-1675	Noise	Resident contacted the EROs at 4pm regarding noise. The ERO's were busy at the time, and so they took his details, and then called him back within the hour to	The Environment department contacted the resident the following day. They confirmed that the noise levels were back to normal. The noise started early on the morning of 26/08/21, and was still going when they got home in the afternoon. The noise was steam venting, which was occurring due to the Leach being shut down.

		discuss the issue. The resident reported that the noise has ceased by that time. The ERO's emailed the relevant department.	
26/08/2021 CTC-1677	Noise	A resident of East Risdon called via Reception to complain of noise coming from the Roast area. The Environment Principal discussed the steam venting with them, and let them know if was a result of a section of the plant being shutdown, and hopefully it would be resolved that day. They stated that it had been going on for a couple of weeks and it was affecting their sleep.	After discussion, they were very understanding of the fact that it was an issue within the plant, and was happy that it would hopefully soon be resolved.
8/10/2021 CTC-1691	Dust	Compliant was raised via the EPA. EPA contacted Nyrstar at 8:33am to seek an explanation on why there was excessive dust being generated at our wharf facility. It was noted that large amounts of dust was observed being generated on their commute to work in the morning.	Wharf area investigated at 8:45 and discussions were held with the wharf work area owner and a representative of the stevedores. The discussion revealed that the problem had already been rectified (at approximately 7:30-7:45). The issue appears to be the accumulation of oversize material within the ship loader dust suppression box, diminishing its performance. The deflector cone was raised and the blockage was cleared. The discharge (and associated dust levels) returned to normal. This information was verbally relayed to the EPA as per their request. They requested that further details be provided in writing via email.
8/11/2021 CTC-1709	Noise	A resident called the ERO's in the evening to complain about the steam venting noise.	The ERO's passed the message on to the Environment Principle. The resident was contacted the following day. We talked about the reason for the recent steam venting, and what to expect over the next two weeks. The resident asked about the hours during which the site is permitted to make noise. We discussed the noise limits within the EPN, and that there are not time limits on noise generation, however there is a 30 day median limit. The resident was thankful for the information.
9/11/2021 CTC-1708	Noise	An East Risdon resident called to complain of the steam venting noise and issues with the Stolt vessel. This resident has raised concerns with the vessel before stating that there is a lot of banging when the vessel arrives.	Discussions were had about the reason for the recent steam venting, and what to expect over the next two weeks. Discussed recent vessel movements. The resident was reasonable and well receptive.
3/12/2021 CTC-1713	Noise	A resident contacted reception complaining of: siren going off in the morning from 6 am; PA in the middle of the night - singing and playing music "this is only a recent thing".	The issues were investigated. Re the PA system. The Electrolysis Superintendent stated that he has asked the Team Leaders not to play music. On the day of the complaint, support requested from maintenance to place a fixed limit on volume level, and to remove the AM/FM tuner. This information was provided to the resident on 03/12/21. The Principal Metallurgist visited Lennox Avenue, and by listening to the noise, worked out that it was coming from the EMP's. The cause of the noise was found, and partially

			addressed. A permanent repair is required and has been committed to by the Roast Coordinator. This information was provided to the resident on 06/12/21. Stakeholder was happy with the feedback provided.
14/12/2021 CTC-1714	Noise	Compliant was made about audible noise being emitted from site since the early hours of the morning. They noted that the noise has been getting worse over the past 10 years.	Discussed the cause of the non-typical noise (steam venting due to leach shutdown). Provided context for why it is occurring and the expected duration based on advice from onsite Technical team. Site contact visited East Risdon to further investigate. Clearly evident that the noise was coming from the roast department steam vents. Called complainant back to confirm the source and the expected duration. at this time, steam was being taken up by purification, so was able to suggest that noise would soon reduce. Also provided feedback that NH was in process of acquiring additional equipment to assist in noise reduction from SH24 and LP14. They really appreciated feedback and the time taken to provide additional information.
14/12/2021 CTC-1715	Noise	Complainant left voicemail raising their concerns of the noise and the regard for the neighbours. They mentioned the noise going into the night and pleaded to when it was going to stop.	Environment department visited East Risdon area where complainant lives. Easily identified noise as arising from steam venting from Roast, due to L/P shutdown. Attempted to call complainant on following day to respond to voice message, no answer with follow up call on 16/12/21 with no answer.

6.2 Appendix 2 – Notifiable and Reportable Environmental Incidents 2019 – 2021

RIMS No. & Date	Incident summary	Cause(s)	Summary of corrective actions
21/01/2019	The 90 day rolling average for ground level concentration of lead at the Risdon Road North TSPM increased to 0.0016 mg/ m^3.	During a three week period in late January 2019, the 90 day average TSPM-Pb concentration reached 0.0016 mg/m^3. This was unfortunately not noted at the time. During this time period, the site suffered from a cyber-attack, and the entire business system was shut down. As such, access to the monitoring data was not available for a period of time. The data was reviewed once it became available, however it also was not noted at the time that one sample from February has been included by the Laboratory software within January. Due to the February sample recording a low lead result, when included erroneously within the 90 day rolling average calculation, the result was lower than it should otherwise have been.	No specific actions were put in place following this incident due to the incident going unrecognised for a significant period of time.
HEN-577302 30/09/2019	High-volume sampling event not completed within statutory timeframe.	High-volume sampling event not completed within statutory timeframe. The filter papers were not placed out the day prior as per the laboratory's procedure and thus, no samples were collected. The incident was found to be a result of human error, whereby the person responsible for placing the filter papers out could not view the electronic calendar, and referred to the incorrect month on the paper schedule.	A new application was set up on the laboratory computers to enable relevant laboratory staff to be able to view the electronic schedule. The TSPM schedule was included in the laboratory staff roster.
HEN-597066 04/01/2020	Hi-vol air samplers date re-set to 2000 instead of switching to 2020. As a result, samplers did not run on scheduled date	Samplers were hit by Y2K2020 bug - on 1 January 2020, the date re-set back to 2000. As a result, the samplers did not run on the scheduled day. This is a breach of the sites environmental permit, which requires the samplers to run every 6 days.	The samplers were re-set manually so that they would continue to run until a software solution was delivered by the manufacturer. This software solution was provided, and installed by the on-site instrumentation technicians.
HEN-590771 09/02/2020	High-volume sampling event not completed within statutory timeframe.	High-volume sampling event not completed within statutory timeframe. The filter papers were not placed out the day prior as per the laboratory's procedure and no samples were collected. There incident was found to be a result of human error, whereby the person responsible for placing the filter papers out could not view the electronic calendar, and did not refer to the hard copy schedule.	The electronic schedule was expanded to be sent to more people within the laboratory team with detailed instructions of requirements.
HEN-591764 15/02/2020	On 15/02/2020 ground level concentration (GLC) of lead in air of 0.005754 mg/m^3 was recorded at the Risdon Road North (RRN) monitoring site. This value increased the RRN	The increase in the 90 day lead in air rolling average can be attributed to a combination of the following contributors: Storage and handling practices have contributing to fugitive release of lead bearing materials. Specifically, the escape of dust from conveyance infrastructure and road surfaces.	Clean roadway adjacent to RRN sample point. Increase site's ability to monitor ambient air quality. Review trafficking of raw materials Improve roadway housekeeping

	90 day average lead GLC to 0.00184 mg/m^3, a result which constitutes an exceedance the EPN limit by 0.00034 mg/m^3.	The increased lead content of raw materials and by-products (concentrates, Port Pirie Fume, Calcine, Paragoethite) observed across 2018 and 2019. Ambient weather conditions have been shown to have a significant bearing on the site's TSPM results. Whilst the majority of the site's sample results will invariably have been collected during prevailing North-Westerly winds, the result collected on the 15th of February was visibly influenced by the moderate South-Easterly winds recorded during the sample period. This influence will require consideration in the development of future dust management strategies. It should be noted that the RRN sample site is located within the NH site boundary and sample results are indicative of onsite conditions only. Accordingly, it is not anticipated that the elevated GLC of lead poses a risk of impact beyond the site boundary. It is therefore deemed unlikely that this exceedance of the EPN has caused material environmental harm or nuisance to NH's surrounding community or environs.	Improve state of site storages Increase visibility of lead in air results Housekeeping of the Roast department Storage/spillage of products in various areas in leach department Investigate the current state of the sprinkler system that operates along the northern reach of Risdon Road North
HEN-604814 25/04/2020	Stack emission testing was conducted on 25/04/2020 between 08:45am and 09:45 am. The reported combined toxic metals result was 6.8 mg/m^3 at the Paragoethite Dryer Baghouse, which exceeds the limit of 5 mg/m^3 stipulated by EPN 7043/5. All other reportable parameters remained within compliance limits for the sampling round. The total particulate concentration was 55 mg/m^3 on 25/04/2020. This result remained compliant with the EPN limit (100 mg/m^3) was markedly higher than the typical values observed for the PGDB (less than 10 mg/m^3).	**Primary Cause** Four damaged bags were identified within the PGDB unit 2 on May 13 2020 – only 18 days after stack testing was completed. The most recent inspection prior to this was completed six months before, in November 2019. Given the results of the testing, it is reasonable to assume that the bags were damaged at the time of sampling. The damaged bags reduced the capacity of the baghouse collection system to effectively capture metalliferous particulate emissions. This is evidenced by the elevated concentrations of toxic metals in the emissions stream and also by the increased total particulate concentration recorded during testing. It is felt that the scheduling of more frequent inspections would significantly increase the potential for detection and replacement of damaged bags. **Secondary Cause** Upon commencement of the investigation a number visual inspections of the internal and external surfaces of the PGDB ductwork were completed. As detailed, these inspections identified a build-up of residual particulate material in sections of the flue ducting between the baghouse outlet and the stack emission point. The residue is deemed to have passed through the PGDB and settled in the ducting. It is likely that this material is progressively liberated from the ductwork when disturbed, becoming entrained within the gas stream, thereby increasing metalliferous particulate and total particulate concentrations in the emission profile.	Remove residue material from the baghouse inlet ductwork Remove residue material from the baghouse out ductwork Undertake full baghouse inspection Arrange a retest of the PGDB stack Review inspection and maintenance plan for the PGDB and associated ductwork Review filter bag management procedure

		Given the minor magnitude of the extent of exceedance of the EPN limits, it is reasonable to suggest that the incident did not result in material environmental harm or nuisance to NH's surrounding environment or community.	
HEN-601342 17/05/2020	Routine mixing zone monitoring was undertaken on 17/05/2020. At monitoring location OF42, at a depth of 2.0 m, a pH reading of 6.8 was recorded. This lower than expected value prompted the contractor to repeat the profile run. The second profile, completed immediately after the initial profile, recorded similar readings, with a pH of 6.8 recorded at 2.1 m. The Hydrolab was then recalibrated and monitoring conducted at location OF47. All pH readings at monitoring locations OF40, OF41 and OF47 were above pH 7.	Low pH recorded at the mixing zone boundary was likely a result of the low pH in outfall discharged on 15 May 2020, and the current condition of the outfall pipe. The following outfall pH conditions were recorded in the days and hours preceding the monitoring event: • The pH of the outfall dropped below the internal threshold value of pH 2.4 on 15 May 2020 from 9:52 am to 10:46 am and again from 7:45 pm to 9:20 pm. • On the day of the monitoring, the 24 hour average of the outfall was pH 2.71. • The minimum pH recorded during the 24 hours preceding the monitoring event was pH 2.43. The low pH of the outfall recorded on 15 May 2020 is not unexpected during a start-up of the #6 Fluid Bed Roaster. It is considered feasible that if dispersion of the effluent was taking place as designed, the low pH conditions at the boundary of the mixing zone may not have occurred. Whilst the pH of the outfall did drop below the internal threshold of pH 2.4, the current condition of the outfall pipe is considered to be a contributing factor to the low pH conditions at the boundary of the mixing zone. In 2019 the outfall pipe came away from the ballast blocks that anchored the pipe to the estuary floor. The outfall pipe was floating, with the effluent being discharged at the surface of the estuary. At the time of writing, the approvals were in the final stage.	Works to be completed to secure outfall pipe.
HEN-601820 20/05/2020	Blockage occurred on 20/05/2020 between two reactors in Neutral Leach department resulting in process solution overflowing into the bund. Overflows from the bund were diverted to the Loogana dam which was receiving water from the Contaminated Water Ponds (CWP) before being treated in ETP. Solids were being imported from the CWP and human error in the pumping rate resulted in thickener	Two overflow events partially filled the reactor bund on Tuesday May 19th, reducing its capacity to manage future overflow events. These overflow events are attributed to a build-up of FRP in an interconnector as a result of a partial collapse of the internal wall of the NL3 reactor tank. Further wall collapse in the NL3 reactor tank resulted in solution borne FRP blocking the NL3-NL4 interconnector NL4 reactor tank reached full capacity and was unable to discharge to NL3 due to the blocked interconnector. NL4 subsequently overflowed to the full bund below, resulting in the bund overflowing to ground, with the solution ultimately reporting to ETP via the A-drain and Loogana. The CWP to ETP recovery rate was high, depleting the ponds to a point where significant volumes of solids were being transferred into the ET thickener. This occurred whilst the A-drain network was diverted to Loogana. Allowing A-drain liquor to report to the CWP directly may have provided sufficient supernatant volume to prevent solids from being drawn into the ETP.	Increased surveillance of reactor bund Review the ET operations procedure Solids removal from the Contaminated Water Ponds Automation of recycling ET overflow when contaminant parameters are outside of specification Review suitability of the analyser currently installed to monitor ET overflow. Complete a Root Cause Analysis investigation for the blocked interconnector

	overflows reporting directly to the Derwent estuary via the TGS. This ultimately resulted in elevated zinc and cadmium concentrations in the outfall.	Night shift ETO had the opportunity to either place the ETP into a state of recycle or to reduce the recovery rate from the CWP to the thickener down to 50m3/hr. Ideally this would have been actioned as soon as it was identified that the thickener clear space wasn't recovering sufficiently. Placing the ETP into recycle early in the event timeline would have significantly mitigated the risk of contaminated solids entering the outfall discharge. The online overflow analyser failed at approximately 6:50am due to a blockage of the sample line. This removed the ETO's ability to monitor the overflow's quality from the control room. This meant that only visual assessments were possible, greatly reducing the ETO's capacity to accurately determine the quality of the thickener overflow solution.	
HEN-604267 05/06/2020	Non-routine mixing zone monitoring was undertaken on 05/06/2020 in response to the need to shut down the #6 acid plant for emergency repairs. Monitoring was conducted upstream with no readings below pH 7 and downstream with low pH readings recorded at locations OF42 and OF47. Monitoring continued downriver in a parallel line with the original monitoring location until the pH was recorded above 7 throughout the water column. For monitoring location OF42, this occurred at approximately 410 m from the original monitoring site, and for OF47, approximately 350 m.	The following outfall pH conditions were recorded in the days and hours preceding the monitoring event: • The pH of the outfall dropped below the internal threshold value of pH 2.4 on 5 June 2020 at 3:05 am. It remained below pH 2.4 until 9:30 am on 6 June 2020. • During the aforementioned times, the minimum pH recorded was 1.7, the maximum was 2.4 and the average was 2.0. The low pH conditions experienced on 5 June 2020 were due to an emergency shutdown of the #6 acid plant. Whilst the pH of the outfall did drop below the internal threshold of pH 2.4, the current condition of the outfall pipe is considered to be a contributing factor to the low pH conditions at the boundary of the mixing zone. In 2019 the outfall pipe came away from the ballast blocks that anchored the pipe to the estuary floor. The outfall pipe was floating, with the effluent being discharged at the surface of the estuary. NH had been working through the Local Council and Property Services (aka Crown Land) approvals process since December 2019. The final approval was received on 15 June 2020, and NH planned for the repair works. The works were weather dependant, however at the time of writing, they were scheduled to commence in early August 2020. The low pH recorded was likely as a result of the low pH in outfall discharged on 5 June 2020, and the current condition of the outfall pipe.	With the relevant regulatory approvals obtained, NH will re-sink the outfall pipe within a matter of weeks, securing it in the original location, and thus the outfall effluent will again be dispersed as intended.
HEN-605417 21/06/2020-23/06/2020	Over a 14 hour period starting at 7:00pm on 21/06/2020, 77.5 mm was recorded at NH. As a result, approximately 156 m^3 of untreated storm	The infrastructure was not sufficient to deal with the volume of water generated during the recorded 20% AEP rainfall event. Under these heightened conditions the catchment area overwhelmed the Wharf Stormwater ponds. In early 2020, infrastructure was installed on, and around the wharf apron to incorporate this area into the site's closed stormwater system. The stormwater	Review the site's Stormwater Model and determine if an update and review is required in context of the additional inputs from the wharf apron catchment.

This incident was reportable under the conditions of EPN 7043/5, however was not a non-compliance	water overflowed from the Wharf Stormwater ponds for over 12 hours commencing at 8:00pm 22/06/2020. Analysis of rainfall data showed a greater than 20% Annual Exceedance Probability (AEP) rain event occurred during the incident period.	from this area was reporting to the Wharf Stormwater ponds, increasing the demand on that system. Pumps and pipework had been installed to enable the flow from the wharf apron to be diverted to the Loogana Dam, however this infrastructure had not yet been fully commissioned and automated. It was not until the afternoon of 22 June 2020 that the Project Engineer manually altered the parameters of the pumps so that stormwater from the apron was pumped directly to Loogana Dam, bypassing the Wharf Stormwater ponds. Long period, 20% AEP (1:5 ARI) rainfall event resulted in significant volumes of runoff into the Wharf Stormwater ponds.	Organise for the model to be updated should it be considered necessary.
HEN-617697 **06/10/2020**	TSPM (dust) monitor failed to run on 6/10/20 due to no power to the equipment.	TSPM (dust) monitor failed to run on 6/10/20 due to no power to the equipment. The monitor was inspected and the issue found to be a of loose power lead. The unit was serviced on the 23/9/20 with the instrument running successfully on 24/9/20 and 30/9/20.The instrument was operational when the filter cartridges were loaded. It is considered that the orange threaded cover was not fully tightened after the sampler was returned from service and the spring loaded cover applied pressure to the lead slowly working it loose over a number of weeks.	Manual sampling was undertaken for 24 hrs from 2pm 7/10/20. The maintenance procedure for the instruments (HFA-759-00052) was updated to include a step of ensuring power connection to the TSPM monitors is firmly made and locking ring correctly threaded on and secure.
HEN-629489 **09/12/2020**	Stack emission testing was conducted on 10/12/2020 between 5:20pm and 6:40pm. The report received on 3/02/2021 found a combined toxic metals concentration of 5.35 mg/m^3 at the Paragoethite Dryer Baghouse, which exceeds the limit of 5 mg/m^3 stipulated by EPN 7043/5. All other reportable parameters remained within compliance limits for the sampling round.	**Primary Cause** While some minor holes were identified within the bags within #1, significant integrity issues were identified within #3. A large crack, approximately 200mm in length and 5-10mm wide had formed between two locking ring seals. A large pile of soft dust was apparent adjacent to this crack. Fluorescent testing of #3 was performed after tube sheet crack repairs were complete. The test found integrity issues in 8 bags or their associated seals. While fluorescent testing was performed on both baghouses #1 and #3, 9 days prior to stack testing, it is apparent that some, of these integrity issues developed during that intervening time. It is likely that following the adoption of the recommended actions previously identified from the incident in April 2020, baghouse breakthrough will become less common, and more readily identifiable by the Leach Department, whilst keeping the plant operating and reducing the requirement for workers to enter into confined spaces for fluorescent testing. **Secondary Cause** Due to the observed reduction in particle size filtered PG delivered to the dryer, it is expected that the quantity of dust entrained within the dryer exhaust has increased appreciably over the past five years. To compound the issue, the	Repair pulse airline in #1 Repair cracked tube sheet in #3 Optimise baghouse reverse air pulse rate frequency Assess if current filtration bags are fit for purpose Investigate alternative means of baghouse 'health'/performance checks, other than onstream analysers (instrumentation) Arrange a retest of the PGDB Stack Replace online dust monitor Implement planned inspections inside the 'clean space' within the baghouse Review filter bag replacement strategy

		concentration of lead within PG has nearly doubled over the past three years. On this basis it is reasonable to assume that the volume of particulate lead reaching the baghouse has increased dramatically over a relatively short period of time. It is expected that planned upgrades to the lead residue section of the plant will reduce the concentration of lead within PG, which will likely reduce the discharge of lead to atmosphere via the PGDB stack. It is likely that following the adoption of the recommended actions baghouse breakthrough will become less common, and more readily identifiable by the Leach Department.	
HEN-644241 **11/06/2021**	During the unloading of a supply ship, a blockage occurred within C1/C1A crossover chute on 11/06/2021 resulting in the spillage of zinc concentrate into the Derwent Estuary. Approximately 2.2 m3 of concentrate material was lost over the wharf into the estuary	**Primary Cause** A blockage within the conveyor system caused the material to be deposited in an uncontrolled manner, eventually resulting in the loss to the Derwent Estuary. The blockage has been linked to heavy rainfall occurring during the discharge of the wettest portion of the cargo, the trimmings. The wet concentrates can become sticky and likely adhered to the sides of the conveyor chute. Continual throughput via C1 caused the wet concentrates to eventually bridge over the chute, leading to an overflow from the conveyor system. **Secondary Cause** Three secondary causes are linked to failed defences which failed to prevent the concentrates reaching the Derwent immediately following the chute blockage. These include a failed chute sensor, absence of an oversight of conveyor controls and absence of bunding.	Include instantaneous rainfall intensity readouts within the Wharf Control Room system and develop action thresholds. Upgrade existing diaphragm blockage sensor Install secondary sensor to provide dual redundancy Install solid barrier across the spillage location.
HEN-646026 **27/06/2021-** **28/06/2021**	On Monday 28 June 2021, NH became aware that the outfall liquor released into the Derwent estuary on Sunday 27 June exceeded the Discharge Limits. Due to the delay in resolving the problem, outfall liquor released on Monday 28 June also exceeded discharge limits. The composite sample collected during Tuesday 29 June identified that outfall liquor had returned to permitted concentrations as a result of the corrective actions taken.	The critical factor which led to the incident was found to be a failed valve. This valve was responsible for isolating metal laden slurry from exiting NH's effluent management system. The Teflon tubing found to be wrapped around the valve shutters originated from the On Stream Analyser (OSA) used to monitor discharge liquor quality further up in the treatment circuit.	Redesign overflow tank OSA sample system to prevent failure and transport of sample line to outfall. Raise an Engineering Work Order (EWR) to redesign E.T. Investigate best assay method to monitor outfall. Review the risk of the current monitoring method of outfall composition and update critical risk register as required.

HEN-652544 02/09/2021	On Friday 3 September 2021, NH became aware that the outfall liquor released into the Derwent estuary on Thursday 2 September 2021 exceeded the Discharge Limits of cadmium.	It is believed the cause of the incident was Effluent Treatment (ET) Thickener bed material entering plant overflow, which was subsequently discharged to the estuary. The bed material became entrained within supernatant due to high wind across the surface of the Thickener. During normal plant operation high wind should not lead to such an outcome, however build-up of residue within the overflow launder of the ET Thickener exacerbated two contributing factors; The increase in liquid level within the Thickener resulting from the residue build up intensified the effect of wind shear across the thickener surface leading to the destabilisation of the thickener bed and this created an uneven distribution of supernatant flow across the Thickener bed, restricting all of the overflow across only one third of the Thickener bed, increasing the velocity of liquor across the bed surface, leading to bed destabilisation. This situation is not uncommon, however at the time of the incident, the ET Operator was fulfilling their duties elsewhere in the plant. Accordingly, the flow was not diverted to the site's Contaminated Water Ponds (CWP) sooner.	Clean the overflow launder within the E.T. Thickener Introduce Planned Maintenance schedule for Overflow weir Link OSA to valve pair control logic Increase sample frequency on clear space sensor Implement alarm conditions Update Site procedure to include E.T. Operator contacting Leach Control Room to handover monitoring during planned absence from E.T. Control Panel
HEN-659833 15/10/2021	Stack emission testing was conducted on 15/10/2021 between 8:20am and 9:40am. The report received on 15/11/2021 found particulate matter concentration of 120 mg/m3 at the Anode Casting stack, which exceeds the limit of 100 mg/m3 stipulated by EPN 7043/5. All other reportable parameters remained within compliance limits for the sampling round.	The primary cause of the event is believed to be due to unscrubbed anodes being charged through the furnace at the time of testing. The data from the stack testing indicated most elements were elevated compared to the last two testing rounds. Metals including zinc, lead and copper had increased by a factor of approximately 10 - 20. Most noticeably, manganese was elevated by a factor of 170. The elevated manganese concentration supports an operator's statement suggesting a higher proportion of unscrubbed anodes were charged (i.e. added) to the furnace at the time of testing, and indicates that the melting of the unscrubbed anodes was potentially the cause of the elevated particulate matter.	Manually clean anodes unsuitable for Anode Scrubber Additional testing to better quantify charging rate and capability of fume scrubber Complete the installation and online set-up of the dust sensor
AUD-111196 25/09/2019	Three nominated exhaust points (Casting Ventilation 1-V1, Casting Ventilation 2-V2 and Anode Casting) do not comply with the Standard, as the stacks do not have a sufficient number of sampling ports.	Condition A3 requires all nominated exhaust points to have sampling positions that are in accordance with Australian Standard AS4323.1 (Stationary source emissions – selection of sampling positions). The evidence gathered during the audit found that three nominated exhaust points (Casting Ventilation 1-V1, Casting Ventilation 2-V2 and Anode Casting) do not comply with the Standard, as the stacks do not have a sufficient number of sampling ports.	To address the non-compliance with condition A3, should the opportunity arise, and it is practical to do so, Nyrstar is to retrofit the three stacks to meet the requirements of the Standard.

		As stack emissions for the non-compliant stacks were well within the limits set by condition A1, the low sampling port number is not considered likely to result in a false impression of low emissions.	
AUD-111196 25/09/2019	EPN 7043/5 Condition H1: Storage and handling of hazardous materials. Not all hazardous materials are being stored and handled in compliance with the EPN.	The storage of discrete volumes of hazardous substances is not being undertaken in accordance with best practice. In the Acid Storage area chemicals are located within a contained area, but are intermixed, acids next to bases, and are stored in the open allowing labels to be weathered away. Also observed in this area was an open Intermediate Bulk Container (IBC) containing an unknown brown liquid stored on open ground. Oil and lubricant drums were observed in a number of locations being stored on wooden pallets in the open. The main Waste Oil Store forms part of a building. Drums within the store are held either directly on the concrete floor, on wooden pallets, or on spill trays. The back wall of the Store is not bunded. Bunding of process tanks varies in condition across the site. The types of bunding ranges from fibreglass lined, acid proof bricks, to unlined concrete with holes and a bund in the Purification Plant that has been dug out waiting to be repaired. The Secondary Purification bund has a hole in the floor. The floor of the bund was dry at the time of the inspection. Spikes in metals have been recorded in groundwater from the horizontal finger groundwater extraction bores, which extend under this area. This demonstrates contamination reaching the groundwater due to the condition of this bund.	Advise the EPA when repairs to the dilute acid bund were completed, or expected to be completed. Submit for the Director's approval, a program of works to conduct repairs and improvements to the secondary purification bunding. Submit for the Director's approval, a program of works to improve the standard of bunding within the waste oil store, located in the waste transit yard. Conduct a risk assessment of the storage and handling of all environmentally hazardous materials on site and submit the results to the EPA. The assessment needs to determine the condition of bunding and containment systems, the environmental risk posed and actions to reduce the identified risks. All IBCs containing unknown substances must be relocated within a containment area or disposed of in an appropriate manner. All discrete volumes of environmentally hazardous substances must be relocated to within a containment area or on a spill tray.

			All spill trays must be maintained in such a manner that the spill containment volume is maintained.
AUD-111196 25/09/2019	EPN 7043/5 Condition H2: Spill kits Evidence gathered during the audit found spill kits in limited locations, and not in all locations where environmental hazardous materials are stored in significant volumes.	The site maintains one spill response trailer than is used to respond to all significant spills. It was considered insufficient to address the risk of spills in some of the areas of the site.	Increase the number of spill kits located on site to supplement the spill trailer.
AUD-111196 25/09/2019	EPN 7043/5 Condition OP1: Storage of materials. Dust (a pollutant) was being emitted through holes in the roof of the Zinc Concentrate Store and further concentrate had escaped through holes in the wall of the building.	There are significant holes in the walls and roof of the Concentrate Store. Noted dust being emitted from the holes in the roof of the concentrate shed during the inspection.	Submit for the Director's approval a program of works to prevent the escape of dust and concentrate from the Concentrate Store.
AUD-113523 08/07/2021	EPN 7043/5 Condition H1: Storage and handling of hazardous materials.	Two intermediate bulk containers (IBCs) containing sodium hydroxide were being stored outside a bunded area.	Place the IBC's within the bunded area and provide the EPA with photographic evidence that the sodium hydroxide IBCs are being stored in a compliant manner.
AUD-113523 08/07/2021	EPN 7043/5 Condition H2: Spill kits	Spill kits must be kept in appropriate locations to assist with the containment of spilt environmentally hazardous materials. EPA noted that a previously identified non-compliance with permit condition H2 remains unresolved. During the inspection EPA observed there was no spill kit in the area of the Waste Oil Store or a spill kit at the Electrolysis Oil Store (where the spill kit had been redeployed to another location). Because of the higher risks of spills in the Waste Oil Store and the Electrolysis Store, spill kits must be kept at these locations at all times.	Place permanent spill kits at the Waste Oil Store and the Electrolysis Oil Store and provide the EPA with photographic evidence

6.3 Appendix 3 – Environment Protection Notice 7043/5

ENVIRONMENT PROTECTION NOTICE No. 7043/5

Issued under the *Environmental Management and Pollution Control Act 1994*

Issued to:	**NYRSTAR HOBART PTY LTD** **ACN 124 818 113** **RISDON ROAD** **LUTANA TAS 7009**
Environmentally Relevant Activity:	**The operation of a zinc smelter (ACTIVITY TYPE: Metallurgical Works)** **HOBART ZINC SMELTER, 300 RISDON ROAD** **LUTANA TAS 7010**

GROUNDS

I, Darryl Cook, Delegate for the Director, Environment Protection Authority, being satisfied in accordance with section 44(1)(d) of the *Environmental Management and Pollution Control Act 1994* (EMPCA) that in relation to the above-mentioned environmentally relevant activity that it is desirable to vary the conditions of a permit (see table below) hereby issue this environment protection notice to the above-mentioned person as the person responsible for the activity.

Permit No.	Date Granted	Granted By
3314	28 June 1996	Director of Environmental Management

PARTICULARS

The particulars of the grounds upon which this notice is issued are:

1. The permitted quantity of materials processed and/or produced by the activity needs to be varied to reflect production capacity.

2. The Permit conditions need to be varied to reflect updated terminology and regulatory practice, to reflect continuous improvement consistent with the objectives of EMPCA and/or to clarify the meaning of the conditions.

3. It is desirable to remove conditions in the permit because the conditions contain requirements that have become legal obligations under EMPCA and Regulations thereunder.

4. Permit conditions need to reflect that specific requirements are no longer applicable because they reference documents relating to the activity that have been superseded or are now redundant.

5. The Permit conditions refer to The Environment Protection Act 1973 which has been repealed and replaced by the EMPCA. It is necessary to vary condition(s) to remove references to the repealed Act.

6. It is desirable to vary permit conditions for atmospheric emissions; effluent quality for water

being discharged from The Land; or noise emissions from the activity. Conditions are needed to control emissions from the activity and to impose limits upon those emissions to reflect current State Policies or Environment Protection Policies.

7 A condition requiring notification of a change of ownership of The Land is needed because this Notice may affect title to the land and the new owner's interests may be affected by pollutants emitted or disturbed by the activity.

8 It is desirable to add a condition requiring notification of the Director prior to the change in responsible person for the activity so that the Director is aware of changes to the person responsible for environmental management of the activity.

9 It is necessary to add a condition requiring a public complaints register to be maintained so that the Director can appraise the frequency and characteristics of complaints which may indicate nuisance, should any complaints be received.

10 It is desirable to add a condition requiring odour management. Odour management consideration is part of best practice environmental management.

11 It is desirable to add conditions to inform the Director of the levels of contamination of The Land and advise the Director of action to progressively reduce the contamination of The Land.

12 The permit does not contain conditions in relation to the adequate management of the activity and/or The Land should the activity temporarily suspend operations. It is necessary to add a condition requiring management of the activity during temporarily suspended operations.

13 It is desirable to add a condition requiring a Groundwater Management Plan to ensure best practice environmental management in regard to groundwater contamination.

14 It is desirable to add conditions in relation to the installation and maintenance of groundwater monitoring bores to ensure that bores are in good working order so that representative samples are able to be collected.

15 The permit does not have a condition requiring the provision of spill kits. It is desirable to add a condition requiring provision, in suitable locations, of spill kits appropriate for the environmental hazardous substances held on The Land for use in any incident to minimise the emission of a pollutant into the environment.

16 It is desirable to add a condition to the permit to require the establishment and maintenance of an inventory of environmentally hazardous substances so that the potential environmental harm arising from any escape of such substances into the environment can be properly assessed and/or responded to.

17 It is desirable to add a condition requiring the Director to be notified when emission limits are exceeded to allow the Director to evaluate whether environmental harm and/or nuisance has occurred as a result of the regulatory limit being exceeded and to appraise the frequency and characteristics of exceedances.

18 Monitoring and reporting requirements set out in the permit conditions need to be varied to reflect current best practice environmental management and to require accurate measurement of emissions and their impact upon the receiving environment and to consistently inform the

Director of the results of monitoring.

19 It is desirable to add conditions to require the maintenance of atmospheric and noise emission models to ensure the appropriate management of atmospheric and noise emissions and to inform the Director of potential impacts from the activity.

20 It is desirable to add conditions requiring the implementation of management plans and actions, such as reprocessing or treatment for disposal to ensure best practice environmental management is applied to waste generated on The Land.

21 It is desirable to add a condition requiring the appropriate management and treatment of sewage generated on The Land to reduce the potential for human pathogens to enter the environment.

DEFINITIONS

Unless the contrary appears, words and expressions used in this Notice have the meaning given to them in Schedule 1 of this Notice and in the EMPCA. If there is any inconsistency between a definition in the EMPCA and a definition in this Notice, the EMPCA prevails to the extent of the inconsistency.

REQUIREMENTS

The person responsible for the activity must comply with the varied permit conditions as set out in Schedule 2 of this Notice.

INFORMATION

Attention is drawn to **Schedule 3**, which contains important additional information.

PENALTIES

If a person bound by an environment protection notice contravenes a requirement of the notice, that person is guilty of an offence and is liable on summary conviction to a penalty not exceeding 1000 penalty units in the case of a body corporate or 500 penalty units in any other case (at the time of issuance of this Notice one penalty unit is equal to $163.00).

NOTICE TAKES EFFECT

This notice takes effect on the date on which it is served upon you.

APPEAL RIGHTS

You may appeal to the Appeal Tribunal against this notice, or against any requirement contained in the notice, within 14 days from the date on which the notice is served, by writing to:

The Chairperson
Resource Management and Planning Appeal Tribunal
GPO Box 2036
Hobart TAS 7001

Signed: Larry Cook

DELEGATE FOR THE DIRECTOR, ENVIRONMENT PROTECTION AUTHORITY

Date: 11 APR 2019

Table Of Contents

Attachments

Schedule 1: Definitions

Activity means any environmentally relevant activity (as defined in Section 3 of EMPCA) to which this document relates, and includes more than one such activity.

Annual Exceedance Probability means the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year, as defined by the Bureau of Meteorology's latest design rainfall statistical dataset.

Authorized Officer means an authorized officer under section 20 of EMPCA.

Control Location (Noise) means a location chosen to represent the general ambient sound without contribution from noise sources at the activity.

Controlled Waste has the meaning described in Section 3(1) of EMPCA.

Decommissioning means the dismantling and removal of structures and equipment and the removal or control of pollutants or processes that may cause environmental harm undertaken subsequent to the cessation of the activity or part thereof.

Decommissioning and Rehabilitation Plan means the document titled Decommissioning and Rehabilitation - Scope of Works, by Nyrstar Hobart Pty Ltd, dated 10 May 2016 and includes any amendment to or substitution of this document approved in writing by the Director.

Decommissioning and Rehabilitation Scope of Works or **DRSW** means the document titled *Decommissioning and* Rehabilitation - *Scope of Works*, by Nyrstar Hobart Pty Ltd, dated 10 May 2016 and includes any amendment to or substitution of this document approved in writing by the Director.

Derwent Estuary Mixing Zone is the area which extends 200 metres upstream, 200 metres downstream and 200 metres northeasterly into the Derwent Estuary from the activity's Foreshore (Tail Gas Scrubber) Stack Outfall diffuser; and is the area as shown in Attachment 6 of this Notice.

Director means the Director, Environment Protection Authority holding office under Section 18 of EMPCA and includes a person authorised in writing by the Director to exercise a power or function on the Director's behalf.

DRP means Decommissioning and Rehabilitation Plan

Dust Management Plan means the document that forms Appendix 2 of *Triennial Environmental Management Plan 2014-17 & Annual Environmental Review 2013-14, by Nyrstar Hobart Pty Ltd,* dated October 2014 and includes any amendment to or substitution of this document approved in writing by the Director.

East Risdon Community Area is the area as shown in Attachment 7 of this Notice.

EMPCA means the *Environmental Management and Pollution Control Act 1994.*

Environmental Harm and **Material Environmental Harm** and **Serious Environmental Harm** each have the meanings ascribed to them in Section 5 of EMPCA.

Environmental Nuisance and **Pollutant** each have the meanings ascribed to them in Section 3 of EMPCA.

Environmentally Hazardous Material means any substance or mixture of substances of a nature or held in quantities which present a reasonably foreseeable risk of causing serious or material environmental harm if released to the environment and includes fuels, oils, waste and chemicals but excludes sewage.

Fuel Burning Emission Source means an emission point that exhausts atmospheric emissions from a boiler that has a heating capacity of 100 megajoules (27.7 Kw) per hour or more.

GLC means Ground Level Concentration.

Groundwater Management Plan or **(GMP)** means the document titled *Groundwater Remediation Plan*, by Nyrstar Hobart Pty Ltd, dated October 2016 and includes any amendment to or substitution of this document and approved in writing by the Director.

In-Stack Concentration has the meaning ascribed to it in the *Environment Protection Policy (Air Quality) 2004.*

Leachate means any liquid that is either released by or has percolated through jarosite in the temporary secure landfill cell located on The Land.

Noise Sensitive Premises means residences and residential zones (whether occupied or not), schools, hospitals, caravan parks and similar land uses involving the presence of individual people for extended periods, except in the course of their employment or for recreation.

Nominated Ambient TSPM Locations means the following locations: Risdon Road North (42°49'43.05"S, 147°18'48.83"E), at the activity's northern exit; Tennis Courts, Risdon Road (42°50'32.76"S, 147°19'1.17"E); and Birch Road (42°50'9.29"S, 147°18'45.54"E), as depicted in Attachment 3 of this Notice.

Nominated Community GLC SO_2 Monitoring Locations means the following locations: Technopark, Dowsings Point (42°49'23.87"S, 147°18'12.51"E), Goodwood; Tennis Courts, Risdon Road (42°50'32.76"S, 147°19'1.17"E); and Birch Road (42°50'9.30"S, 147°18'45.57"E), as depicted in Attachment 4 of this Notice.

Nominated Community Noise Monitoring Locations means Birch Road (42°50'7.61"S, 147°18'43.77"E) and Delwood Drive (42°50'21.06"S, 147°18'46.79"E), Lutana, and Saundersons Road, East Risdon (42°49'33.69"S, 147°19'11.78"E), as depicted in Attachment 8 of this Notice.

Nominated Discharge Point means the Foreshore (Tail Gas Scrubber) Outfall (42°49'43.67"S, 147°18'59.94"E) to the Derwent Estuary from the effluent treatment plant located on The Land, depicted as TGS Foreshore Outfall in Attachment 9 of this Notice.

Nominated Exhaust Points means the following emission point sources: Anode Casting Plant Exhaust Stack, Cadmium Smelter Plant Scrubber Stack, Copper Sulphate Crystalliser Plant Vent Stack, Foreshore (Tail Gas Scrubber) Stack, Package Boiler 1 Stack, Package Boiler 2 Stack, Paragoethite (PG) Dryer Baghouse Stack, Roaster Baghouse Stack, Start-up Scrubber Stack, V1 Furnace Baghouse Stack, V2 Furnace Baghouse Stack, Zinc Dust Plant 1 (ZP1) Baghouse Stack and Zinc Dust Plant 3 (ZP3) Baghouse Stack; as depicted in Attachment 2 of this Notice.

Nominated Groundwater Monitoring Bores means unless otherwise specified in writing by the Director, the groundwater monitoring bores as depicted in Attachment 5 of this Notice.

Nominated Stormwater Discharge Points means the following points: No. 2 Contaminated Water Pond Outfall (42°49'47.61"S, 147°19'9.84"E), New Town Bay Outfall (42°50'22.69"S, 147°19'7.16"E), B Drain Outfall (42°49'46.09"S, 147°19'5.07"E), C Drain Outfall (42°49'49.41"S, 147°19'12.53"E), Wharf Stormwater Pond Overflow (42°49'58.46"S, 147°19'23.17"E) and Loogana Overflow (42°50'23.18"S, 147°19'18.53"E), as depicted in Attachment 9 of this Notice.

Non-process Waste Management Plan means the document titled *Non-process Waste Management Plan*, by Nyrstar Hobart Pty Ltd, dated May 2017, and any amendment to or substitution of this document and approved in writing by the Director.

Nyrstar Hobart Procedure: Estuarine Water, Sediment and Biota Sampling means the document titled *Nyrstar Hobart Procedure: Estuarine Water, Sediment and Biota Sampling*, by Nyrstar Hobart Pty Ltd, Document Version: 06, Document No. HP-826-00731, and any amendment to or substitution of this document and approved in writing by the Director.

Person Responsible is any person who is or was responsible for the environmentally relevant activity to which this document relates and includes the officers, employees, contractors, joint venture partners and agents of that person, and includes a body corporate.

Planning Authority means the Council(s) for the municipal area(s) in which The Land is situated.

PM $_{10}$ means particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less.

Procedure For: Environmental Monitoring in the Loogana-Inshallah Area means the document titled *Procedure For: Environmental Monitoring in the Loogana-Inshallah Area*, by Nyrstar Hobart Pty Ltd, Document Version: 02 Identifying Number HP-826-03536, and any amendment to or substitution of this document and approved in writing by the Director.

Reporting Period means the 12 months ending on 31 December of each year.

Stack Test means the taking of measurements and the collection of samples for analysis from within a chimney, stack or flue.

Stormwater means water traversing the surface of The Land as a result of rainfall.

Stormwater Strategy Report means the document titled *Stormwater Strategy Report*, by Nyrstar Hobart Pty Ltd, dated September 2010 and includes any amendment to or substitution of this document and approved in writing by the Director.

Strainer Backwash Outfall means the wastewater discharge point located at approximately 42°49'46.14"S,147°18'57.56"E, as depicted in Attachment 9 of this Notice.

Structural Upgrade of the Activity's Wharf means the project described in document titled *Wharf Structural Upgrade- Development Proposal and Environmental Management Plan* prepared by Nyrstar Hobart Pty Ltd dated December 2012 and includes supplementary information presented in the document titled *Structural Upgrade- Development Proposal and Environmental Management Plan - Revision 01 - Supplement* prepared by Nyrstar Hobart Pty Ltd dated March 2013 and includes any amendment to or substitution of these documents approved in writing by the Director.

Tasmanian Noise Measurement Procedures Manual means the document titled *Noise Measurement Procedures Manual*, by the Department of Environment, Parks, Heritage and the Arts, dated July 2008, and any amendment to or substitution of this document.

The Land means the land on which the activity to which this document relates may be carried out, and includes: buildings and other structures permanently fixed to the land, any part of the land covered with water, and any water covering the land. The Land falls within the area defined by:

1. the map shown in Attachment 1 of this Notice; and
2. is part of the land covered by Property ID: 7855159.

TSPM means Total Suspended Particulate Monitoring.

Waste has the meaning ascribed to it in Section 3 of EMPCA.

Wastewater means spent or used water (whether from industrial or domestic sources) containing a pollutant and includes leachate and stormwater that is contaminated or potentially contaminated with pollutants or which becomes mixed with wastewater.

Schedule 2: Conditions

Maximum Quantities

Q1 Regulatory limits

1 The activity must not exceed the following limits :

1.1 600,000 tonnes per year of raw materials.

General

G1 Access to and awareness of conditions and associated documents

A copy of these conditions and any associated documents referred to in these conditions must be held in a location that is known to and accessible to the person responsible for the activity. The person responsible for the activity must ensure that all persons who are responsible for undertaking work on The Land, including contractors and sub-contractors, are familiar with these conditions to the extent relevant to their work.

G2 Incident response

If an incident causing or threatening environmental nuisance, serious environmental harm or material environmental harm from pollution occurs in the course of the activity, then the person responsible for the activity must immediately take all reasonable and practicable action to minimise any adverse environmental effects from the incident.

G3 No changes without approval

1 The following changes, if they may cause or increase the emission of a pollutant which may cause material or serious environmental harm or environmental nuisance, must only take place in relation to the activity if such changes have been approved in writing by the EPA Board following its assessment of an application for a permit under the *Land Use Planning and Approvals Act 1993*, or approved in writing by the Director:

1.1 a change to a process used in the course of carrying out the activity; or

1.2 the construction, installation, alteration or removal of any structure or equipment used in the course of carrying out the activity; or

1.3 a change in the quantity or characteristics of materials used in the course of carrying out the activity.

G4 Change of ownership

If the owner of The Land upon which the activity is carried out changes or is to change, then, as soon as reasonably practicable but no later than 30 days after becoming aware of the change or intended change in the ownership of The Land, the person responsible must notify the Director in writing of the change or intended change of ownership.

G5 Change of responsibility

If the person responsible for the activity intends to cease to be responsible for the activity, that person must notify the Director in writing of the full particulars of any person succeeding him or her as the person responsible for the activity, before such cessation.

G6 Complaints register

1 A public complaints register must be maintained. The public complaints register must, as a minimum, record the following detail in relation to each complaint received in which it is alleged that environmental harm (including an environmental nuisance) has been caused by the activity:

1.1 the date and time at which the complaint was received;
1.2 contact details for the complainant (where provided);
1.3 the subject-matter of the complaint;
1.4 any investigations undertaken with regard to the complaint; and
1.5 the manner in which the complaint was resolved, including any mitigation measures implemented.

2 Complaint records must be maintained for a period of at least 3 years.

G7 Annual Environmental Review

1 Unless otherwise specified in writing by the Director, a publicly available Annual Environmental Review for the activity must be submitted to the Director each year within three months of the end of the reporting period.

2 Without limitation, each Annual Environmental Review must include the following information:

2.1 a statement by the General Manager, Chief Executive Officer or equivalent for the activity acknowledging the contents of the Annual Environmental Review;
2.2 subject to the *Personal Information Protection Act 2004*, a list of all complaints received from the public during the reporting period concerning actual or potential environmental harm caused by the activity and a description of any actions taken as a result of those complaints;
2.3 details of environment-related procedural or process changes that have been implemented during the reporting period;
2.4 a summary of the amounts (tonnes or litres) of both solid and liquid wastes produced and treatment methods implemented during the reporting period. Initiatives or programs planned to avoid, minimise, re-use, or recycle such wastes over the next reporting period should be detailed;
2.5 a summary of the quantities of controlled wastes being held on The Land;
2.6 details of all non-trivial environmental incidents and/or incidents of non compliance with permit or environment protection notice conditions that occurred during the reporting period, and any mitigative or preventative actions that have resulted from such incidents;
2.7 a summary of the monitoring data and record keeping required by these conditions. This information should be presented in graphical form where possible, including comparison with the results of at least the preceding reporting period. Special causes and system changes that have impacted on the parameters monitored must be noted. Explanation of significant deviations between actual results and any predictions made in previous reports must be provided;
2.8 identification of breaches of limits specified in these conditions and significant variations from predicted results contained in any relevant management plan, an explanation of why each identified breach of specified limits or variation from predictions occurred and details of the actions taken in response to each identified breach of limits or variance from predictions;
2.9 a list of any issues, not discussed elsewhere in the report, that must be addressed to improve compliance with these conditions, and the actions that are proposed to address any such issues;
2.10 a summary of fulfilment of environmental commitments made for the reporting period. This summary must include indication of results of the actions implemented and explanation of any failures to achieve such commitments; and

2.11 a summary of any community consultation and communication undertaken during the reporting period.

Atmospheric

A1 Stack emission limits

1 The in-stack concentrations in emissions from all nominated exhaust points of substances listed in Column 1 of table 1 below must not exceed the limits specified in Column 4 when measured in the units specified in Column 2 and adjusted to the reference gas value specified in Column 3.

2 **Table 1: Atmospheric Emission Limits**

Column 1: Substance	Column 2 : Unit of Measure	Column 3: Reference Gas Value	Column 4: Emission Limit
Metals - antimony (Sb), arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg), or any compound thereof	mg/m^3		5 for combined total, 1 for Cd or Hg
Oxides of nitrogen (NO_x)	g/m^3	7% oxygen by volume for fuel burning emission sources	2 (as NO_2)
Particulate matter	mg/m^3 dry gas at 0°C and 101.325 kPa	7% oxygen by volume for fuel burning emission sources	100
Sulphur dioxide (SO_2)	g/m^3 dry gas at 0°C and 101.325 kPa		7.2
Sulphur trioxide (SO_3)	mg/m^3		100

3 Notwithstanding the above, the limit for SO_2, when measured by the Continuous (air) Emission Monitoring device, is not considered breached unless the limit is exceeded continuously for greater than 15 minutes.

A2 Maximum ground level concentrations

1 The maximum ground level concentration (GLC) for the substances listed in Column 1 of the table 2 below must not exceed the GLC specified in Column 2, under the conditions specified in Column 3 beyond the boundary of The Land.

2 **Table 2: Maximum Ground Level Concentrations**

Column 1: Substance	Column 2: Ground Level Concentration	Column 3 : Conditions
Lead (Pb)	0.0015 mg/m^3	90 day average
Sulphur Dioxide (SO_2)	0.20 ppm	1 hour average
Sulphur Dioxide (SO_2)	0.080 ppm	24 hour average

A3 Stack testing facilities

1 The following stack testing facilities must be available at all nominated exhaust points when undertaking stack testing required by these conditions:

1.1 sampling positions must be in accordance with Australian Standard AS 4323.1 (*Stationary source emissions - selection of sampling positions*), or as approved in writing by the Director;

1.2 safe sampling platforms must be located to allow access to the sampling positions and safe access to these sampling platforms must be provided; and

1.3 all necessary services required for the test method prescribed must be provided.

A4 Stack monitoring requirements

1 Unless otherwise specified in writing by the Director, stack tests must be undertaken in accordance with table 3:

1.1 Table 3: Emission Point Source Monitoring

Nominated Exhaust Point	Monitoring Parameters	Monitoring Frequency
Foreshore (Tail Gas Scrubber) Stack	SO_3, NOx, Particulates	6 monthly
Start Up Scrubber Stack	SO_2, Metals, Particulates	At least once during any period where the stack is utilised for greater than three (3) months in any 12 month period and at least once every three (3) years.
Package Boiler 1 Stack	SO_2, NOx, Particulates	At least once during any period where the stack is utilised for greater than three (3) months in any 12 month period and at least once every three (3) years.
Package Boiler 2 Stack	SO_2, NOx, Particulates	At least once during any period where the stack is utilised for greater than three (3) months in any 12 month period and at least once every three (3) years.
Anode Casting Plant Exhaust Stack	Metals and Particulates	6 monthly
Cadmium Smelter Plant Scrubber Stack	Metals and Particulates	6 monthly
Copper Sulphate Crystalliser Plant Vent Stack	Metals and Particulates	6 monthly
Paragoethite Dryer Baghouse Stack	Metals and Particulates	6 monthly
Roaster Baghouse Stack	Metals and Particulates	6 monthly
V1 and V2 Furnace Stacks	Metals and Particulates	6 monthly
Zinc Dust Plant 1 Baghouse Stack	Metals and Particulates	6 monthly
Zinc Dust Plant 3 Baghouse Stack	Metals and Particulates	6 monthly

1.2 Monitoring for all parameters in the above table must be determined in g/min and mg/m^3 and for fuel burning emission sources particulates and NOx must be adjusted to 7% O_2 level.

2 Stack tests must be carried out while the activity is operating under normal conditions.

A5 Stack monitoring reports

1 A Stack Monitoring Report(s) must be provided as part of the Annual Environmental Review required by these conditions.

2 Each report must include:

2.1 the results of the stack test;

2.2 the date on which the stack test was conducted;

2.3 weather information at the time the stack test was conducted;

2.4 relevant operating conditions including the fuel feed rate at the time the stack test was conducted;

2.5 the stack test methods employed; and

2.6 identification of breaches of limits specified in these conditions, an explanation of why each breach of specified limits occurred and details of actions that have or will be taken in response to each identified breach of limits.

3 Where total particulate matter testing is carried out reporting must be done in accordance with Section 9 of Australian Standard AS 4323.2 Stationary source emissions - Determination of total particulate matter - Isokinetic manual sampling - Gravimetric method.

A6 Continuous Emission Monitoring

A Continuous (air) Emission Monitoring (CEM) device must be installed and maintained in the Foreshore (Tail Gas Scrubber) Stack to continuously record the in-stack concentration of sulphur dioxide (SO_2) at the frequency of at least one reading recorded per minute.

A7 Maintain an atmospheric model

1 Unless otherwise approved in writing by the Director, an atmospheric model for the activity must be maintained.

2 The model must be updated upon replacement, repair or addition of equipment that is a significant source of atmospheric emissions and where replacement, repair or addition of equipment may increase or adversely alter the level or character of the atmospheric emissions from the activity.

3 It is not necessary to re-measure atmospheric emissions unless emission characteristics have changed since a previous measurement accepted by the Director. New or modified atmospheric emission sources must be measured within 6 months of commissioning or re-commissioning the emission sources.

A8 Ambient particulate monitoring

1 Unless otherwise approved in writing by the Director, ambient air quality Total Suspended Particulate Monitoring (TSPM) stations must be maintained at the nominated ambient TSPM locations.

1.1 The TSPM stations may be temporarily removed from operations for maintenance and/or calibration purposes. The Director must be advised of the need to temporarily remove the TSPM stations for a time period that is greater than eight (8) hours.

2 The TSPM stations must monitor and sample for Total Suspended Particulate and Lead (Pb), at a frequency of a continuous 24 hour period once every six (6) days.

A9 Community sulphur dioxide monitoring

1 Unless otherwise approved in writing by the Director, community Ground Level Concentration (GLC) of sulphur dioxide (SO_2) monitoring stations must be maintained at the nominated community GLC SO_2 monitoring locations.

1.1 The community GLC SO_2 monitors may be temporarily removed from operations for maintenance and/or calibration purposes. The Director must be advised of the need to temporarily remove the community GLC SO_2 monitors for a time period that is greater than eight (8) hours.

2 The GLC SO_2 monitoring stations must continuously monitor for SO_2 and must be able to produce results that are able to be used to determine one (1) day and one (1) hour averages of SO_2 GLC.

A10 Odour management

The person responsible must institute such odour management measures as are necessary to prevent odours causing environmental nuisance beyond the boundary of The Land.

A11 Control of dust emissions

1 The activity must be undertaken in accordance with the Dust Management Plan, as amended from time to time with written approval of the Director.

2 Notwithstanding the above, dust emissions from The Land must be controlled to the extent necessary to prevent environmental harm and/or environmental nuisance.

3 When required by the Director, the Dust Management Plan must be revised and resubmitted to the Director by a date specified in writing by the Director.

Decommissioning And Rehabilitation

DC1 Assessment of Site Contamination

1 Unless otherwise specified in writing by the Director, an evaluation of changes in the extent or degree of contamination of The Land or caused by the activity must be undertaken and a revised Assessment of Site Contamination Report (ASCR) based on the evaluation must be submitted to the Director by 31 October 2021 and at three (3) yearly intervals thereafter.

2 The ASCR must include a statement by the General Manager, Chief Executive Officer or equivalent for the activity acknowledging the contents of the ASCR.

3 The evaluation of contamination must be done in accordance with the NEPM.

4 The revised ASCR must clearly demonstrate whether or not there has been a change in contamination between each evaluation of contamination undertaken.

5 A revised ASCR may be submitted in the form of changes to the previous such document or as a substitute ASCR.

DC2 Decommissioning and Rehabilitation Scope of Works

1 Unless otherwise specified in writing by the Director, a review of the Decommissioning and Rehabilitation Scope of Works (DRSW) for the activity must be undertaken and a revised DRSW must be submitted to the Director within six (6) months of the Director having approved a revised ASCR required by these conditions.

2 The DRSW must include a statement by the General Manager, Chief Executive Officer or equivalent for the activity acknowledging the contents of the DRSW.

3 The DRSW must address the contamination identified in the ASCR most recently approved by the Director.

4 The DRSW must address any changes to the activity that have the potential to alter the liabilities for the decommissioning of the activity and the rehabilitation of The Land.

5 The DRSW must provide details on the progress of any decommissioning or rehabilitation that has taken place.

6 The DRSW must provide details of resources, both physical and financial, required for the decommissioning of the activity and rehabilitation of The Land.

7 A revised DRSW may be submitted in the form of changes to the previous such document or as a substitute DRSW.

DC3 Notification of cessation

Within 30 days of becoming aware of any event or decision which is likely to give rise to the permanent cessation of the activity, the person responsible for the activity must notify the Director in writing of that event or decision. The notice must specify the date upon which the activity is expected to cease or has ceased.

DC4 Decommissioning and Rehabilitation Plan

1 Unless otherwise approved in writing by the Director, a Decommissioning and Rehabilitation Plan (DRP) must be submitted to the Director within 180 days of the notification of permanent cessation of the activity.

2 The DRP must:

2.1 be written in accordance with any guidelines provided by the Director; and

2.2 include details of contamination from the most recently approved ASCR, action proposed by the most recently approved DRSW.

DC5 Implementation of the DRP

Following permanent cessation of the activity, the decommissioning of the activity and the rehabilitation of The Land must be carried out in accordance with the most recent Decommissioning and Rehabilitation Plan (DRP) approved by the Director, as may be amended from time to time with written approval of the Director.

DC6 Temporary suspension of activity

1 Within 30 days of becoming aware of any event or decision which is likely to give rise to the temporary suspension of the activity, the person responsible for the activity must notify the Director in writing of that event or decision. The notice must specify the date upon which the activity is expected to suspend or has suspended.

2 During temporary suspension of the activity:

2.1 The Land must be managed and monitored by the person responsible for the activity to ensure that emissions from The Land do not cause serious environmental harm, material environmental harm or environmental nuisance; and

2.2 If required by the Director a Care and Maintenance Plan for the activity must be submitted, by a date specified in writing by the Director, for approval. The person responsible must implement the approved Care and Maintenance Plan, as may be amended from time to time with written approval of the Director.

3 Unless otherwise approved in writing by the Director, if the activity on The Land has substantially ceased for 2 years or more, rehabilitation of The Land must be carried out in accordance with the requirements of these conditions as if the activity has permanently ceased.

Groundwater

GW1 Groundwater Management Plan

1 Unless otherwise specified in writing by the Director, a review of the Groundwater Management Plan (GMP) must be undertaken with the aim to reduce groundwater contamination and hydrogeologically isolate The Land from the River Derwent, and a revised GMP must be submitted to the Director for approval by 31 October 2019 and at three (3) yearly intervals thereafter.

2 The GMP must contain:

2.1 Prioritised (net environmental benefit analysis) actions for monitoring, management and/or remediation of groundwater;

2.2 Objectives of the prioritised actions;

2.3 Timeframes for the actions to be undertaken and completed;

2.4 Measures for determining the success of the completed actions; and

2.5 Reporting frequency of any monitoring.

3 Unless otherwise approved by the Director the person responsible must implement the approved GMP, as may be amended or replaced from time to time with written approval of the Director

GW2 Groundwater Monitoring Bores

1 Unless otherwise specified in writing by the Director, all new groundwater bores must have an installation and development record, which includes, but is not limited to the following:

1.1 a description of the materials used for construction;

1.2 initial field measurements of the groundwater for conductivity, pH and temperature;

1.3 details of slot screens installed, and the depth to which they were installed;

1.4 depth of gravel packing;

1.5 depth of the bentonite cap;

1.6 details of bore development during pumping (removal of drilling contamination);

1.7 aquifer levels; and

1.8 a detailed geological log.

2 The following details must be recorded when sampling groundwater bores:

2.1 standing water level;

2.2 bore volume;

2.3 time of purging;

2.4 sampling time and number; and

2.5 field water quality parameters (including conductivity, pH and water temperature).

3 Bore and piezometer placement must be carried out in consultation with and under supervision of a suitably qualified person.

GW3 Groundwater Bores

Unless otherwise approved in writing by the Director, all nominated groundwater monitoring bores on The Land must be maintained and overhauled where necessary to ensure that they are suitable for continued use. Each bore must be clearly identifiable with an intact surface seal and stable well piping.

GW4 Groundwater Monitoring

1 Unless otherwise specified in writing by the Director, monitoring and the frequency of monitoring, must be undertaken in accordance with Table 4 below. The nominated groundwater monitoring bores must be monitored for the parameters listed in Column 1 (by field measurement or by representative sampling followed by analysis), at the frequencies listed in Column 3 and the results must be reported in the units in Column 2.

2 **Table 4: Groundwater Monitoring Requirements**

Column 1 - Parameter	Column 2 - Units	Column 3 - Sampling Frequency
Water Depth	m	six (6) monthly
Zinc (Zn)	mg/L	once every two (2) years
Cadmium (Cd)	mg/L	once every two (2) years
Lead (Pb)	mg/L	once every two (2) years
Mercury (Hg)	mg/L	once every two (2) years
Copper (Cu)	mg/L	once every two (2) years
Manganese (Mn)	mg/L	once every two (2) years
Sulphate (SO_4)	mg/L	once every two (2) years
pH	pH units	once every two (2) years
conductivity	µS/cm	once every two (2) years

Hazardous Substances

H1 Storage and handling of hazardous materials

1 Unless otherwise approved in writing by the Director, environmentally hazardous materials held on The Land must be:

1.1 located within impervious bunded areas, spill trays or other containment systems; and

1.2 managed to prevent unauthorised discharge, emission or deposition of pollutants:

1.2.1 to soils within the boundary of The Land in a manner that is likely to cause serious environmental harm;

1.2.2 to groundwater;

1.2.3 to waterways; or

1.2.4 beyond the boundary of The Land.

H2 Spill kits

Spill kits appropriate for the types and volumes of materials handled on The Land must be kept in appropriate locations to assist with the containment of spilt environmentally hazardous materials.

H3 Inventory of hazardous materials

An inventory must be kept of all environmentally hazardous materials stored and handled on The Land. The inventory must specify the location of storage facilities and the maximum quantities of each environmentally hazardous material likely to be kept in storage and must include material safety data sheets for those environmentally hazardous materials.

Monitoring

M1 Samples and measurements for monitoring purposes

1 Any sample or measurement required under these conditions must be taken and processed in accordance with the following:

1.1 sampling and measuring must be undertaken by a person with appropriate training, experience, and knowledge of the relevant procedure;

1.2 the integrity of samples must be preserved prior to delivery to a laboratory;

1.3 sample analysis or measurement must be conducted by a laboratory or testing facility accredited by the National Association of Testing Authorities (NATA), or a laboratory or testing facility approved in writing by the Director, for the specified test;

1.4 details of methods employed in taking samples and measurements and results of sample analysis, and measurements must be retained for at least three (3) years after the date of collection; and

1.5 sampling and measurement equipment must be maintained and operated in accordance with manufacturer's specifications and records of maintenance must be retained for at least three (3) years.

M2 Nominated Discharge Point monitoring

1 Unless otherwise specified in writing by the Director, monitoring and the frequency of monitoring, must be undertaken in accordance with table 5 below. The Nominated Discharge Point must be monitored for the parameters listed in Column 1 (by field measurement or by representative sampling followed by analysis), at the frequencies listed in Column 3 and must be reported in the units in Column 2.

2 **Table 5: Nominated Discharge Point Monitoring Requirements**

Column 1 - Parameter	Column 2 - Units	Column 3 - Sampling Frequency
Volume of flow (L/h)	L/h	Daily 24 hour composite
Zinc (Zn)	mg/L	Daily 24 hour composite
Cadmium (Cd)	mg/L	Daily 24 hour composite
Lead (Pb)	mg/L	Daily 24 hour composite
Mercury (Hg)	mg/L	Daily 24 hour composite
Arsenic (As)	mg/L	Six (6) Monthly
Copper (Cu)	mg/L	Six (6) Monthly
Iron (Fe)	mg/L	Six (6) Monthly
Manganese (Mn)	mg/L	Six (6) Monthly
Nitrogen (N) as ammonia	mg/L	Six (6) Monthly
Fluoride (F^-)	mg/L	Six (6) Monthly
Total Suspended Solids (TSS)	mg/L	Six (6) Monthly

M3 Exceedance of emission limits

1 In the event that any of the emission limits specified in these conditions are exceeded:

1.1 The Director must be notified within 24 hours of the person responsible becoming aware of the exceedance;

1.2 A report must be forwarded to the Director within 30 days of becoming aware of the exceedance. The report must include, but not necessarily be limited to, the following:

1.2.1 the reported concentration;

1.2.2 an explanation as whether the exceedance is likely to have caused or threatens environmental harm and or nuisance;

1.2.3 an explanation as to why the emission limit was exceeded;

1.2.4 prompt actions that were undertaken to control the exceedance;

1.2.5 the results of re-sampling of the monitoring point/s at which the exceedance was recorded;

1.2.6 proposed actions to limit the likelihood of a recurrence of the exceedance; and

1.2.7 any other information that would assist the Director to understand the exceedance.

1.3 Unless otherwise approved in writing by the Director, the proposed actions to limit the likelihood of a recurrence must be implemented once approved by the Director. These actions may be amended from time to time with the written approval of the Director.

M4 Derwent Estuary Mixing Zone Monitoring

1 Unless otherwise approved in writing by the Director, the Derwent Estuary mixing zone must be monitored monthly for pH at a minimum of 4 sampling locations on the boundary of the mixing zone that are likely to be impacted by the mixing plume; and

2 The tidal flow and conditions at the time of sampling must be recorded.

M5 Estuarine water, sediment and biota monitoring

1 Estuarine water, sediment and biota monitoring must be undertaken in accordance with the *Nyrstar Hobart Procedure: Estuarine Water, Sediment and Biota Sampling*, as may be amended from time to time with written approval of the Director.

2 Where reasonably required by the Director, the Nyrstar Hobart Procedure: Estuarine Water, Sediment and Biota Sampling must be revised within the timeframe specified in writing by the Director and submitted to the Director for approval.

Noise Control

N1 Noise emission limits

1 Noise emissions from the activity when measured at any noise sensitive premises in other ownership not located in the East Risdon Community area and expressed as the equivalent continuous A-weighted sound pressure level must not exceed 52 dB(A).

2 Noise emissions from the activity when measured at any noise sensitive premises in other ownership located in the East Risdon Community area and expressed as the equivalent continuous A-weighted sound pressure level must not exceed 56 dB(A).

3 Noise emissions from the activity when measured at any neighbouring industrial or commercial activity in other ownership and expressed as the equivalent continuous A-weighted sound pressure level must not exceed 65 dB(A).

4 Where the combined level of noise from the activity and the normal ambient noise exceeds the noise levels stated above, this condition will not be considered to be breached unless the noise emissions from the activity are audible and exceed the ambient noise levels by at least 5 dB(A).

5 The time interval over which noise levels are averaged must be 10 minutes or an alternative time interval specified in writing by the Director.

6 Measured noise levels must be adjusted for tonality, impulsiveness, modulation and low frequency in accordance with the Tasmanian Noise Measurement Procedures Manual.

7 All methods of measurement must be in accordance with the Tasmanian Noise Measurement Procedures Manual.

N2 Community monitoring of noise emissions

1 Unless otherwise approved in writing by the Director, the person responsible must maintain three continuous community noise monitors at the nominated community noise monitoring locations.

1.1 The community noise monitors may be temporarily removed from operations for maintenance and/or calibration purposes. The Director must be advised of the need to temporarily remove the community noise monitors for a time period that is greater than eight (8) hours.

2 The continuous community noise monitors must be able to create an uninterrupted (to the extent reasonable and practicable) record of the results of community noise.

3 Noise emissions from the activity measured by the continuous community noise monitors, when expressed as a monthly median A-weighted L_{90} sound pressure level must not exceed:

3.1 52 dB(A) at the Birch Road location;

3.2 52 dB(A) at the Delwood Drive location; and

3.3 56 dB(A) at the Saundersons Road location.

N3 Noise survey requirements

1 Unless otherwise approved by the Director, a noise survey must be carried out:

1.1 within three (3) years since the previous noise survey;

1.2 within six (6) months from the date of any change to the activity which is likely to substantially alter the character or increase the volume of the noise emitted from The Land; and

1.3 at such other times as may reasonably be required by the Director.

N4 Noise survey method and reporting requirements

1 Noise surveys must be undertaken in accordance with a survey method approved in writing by the Director, as may be amended from time to time with written approval of the Director.

2 Without limitation, the survey method must address the following:

2.1 measurements must be carried out at day, evening and night times (where applicable) at each location; and

2.2 measurement locations, and the number thereof, must be specified, with one location established as a control location (noise).

3 Measurements and data recorded during the survey must include:

3.1 operational status of noise producing equipment and throughput of the activity;

3.2 subjective descriptions of the sound at each location;

3.3 details of meteorological conditions relevant to the propagation of noise;

3.4 the equivalent continuous (L_{eq}) and L_1, L_{10}, L_{50}, L_{90} and L_{99} A-weighted sound pressure levels measured over a period of 10 minutes or an alternative time interval approved by the Director;

3.5 one-third octave spectra over suitably representative periods of not less than 1 minute; and

3.6 narrow-band spectra over suitably representative periods of not less than 1 minute.

4 A noise survey report must be forwarded to the Director within 30 days from the date on which the noise survey is completed.

5 The noise survey report must include the following:

5.1 the results and interpretation of the measurements required by these conditions;

5.2 a map of the area surrounding the activity with the boundary of The Land, measurement locations, and noise sensitive premises clearly marked on the map;

5.3 any other information that will assist with interpreting the results and whether the activity is in compliance with these conditions and EMPCA; and

5.4 recommendations of appropriate mitigation measures to manage any noise problems identified by the noise survey.

N5 Maintain a noise model

1 Unless otherwise approved by the Director in writing, the noise model for the activity must be maintained.

2 The model must be updated upon replacement, repair or addition of equipment that is a significant source of noise and where replacement, repair or addition of equipment may increase or adversely alter the level or character of the noise emitted from the activity.

3 It is not necessary to re-measure noise sources unless their noise output has changed since a previous measurement accepted by the Director. New or modified noise sources must be measured within 6 months of commissioning or re-commissioning the sources.

Operations

OP1 Storage of materials

Unless otherwise approved in writing by the Director, the management of all raw materials and process wastes while being handled and stored on The Land must prevent the escape of pollutants.

Stormwater Management

SW1 Stormwater management

1 Unless otherwise approved in writing by the Director, the activity must operate in accordance with the approved Stormwater Strategy Report, as amended from time to time with written approval of the Director.

2 Where reasonably required by the Director, the Stormwater Strategy Report must be revised within the timeframe specified in writing by the Director.

SW2 Storm event discharges

1 Contaminated or potentially contaminated stormwater must only be discharged from The Land without treatment at the Effluent Treatment Plant where the stormwater arises from a critical duration storm event with 0.2 Annual Exceedance Probability and where the capacity of the stormwater infrastructure is exceeded.

2 In the event of the above:

2.1 the Director must be notified within 24 hours of the event;

2.2 as far as reasonably practicable stormwater must only be discharged from the Land from the nominated stormwater discharge points;

2.3 the flow rate in litres per hour (L/h) must be measured or a reasonable estimate of the flow must be calculated; and

2.4 a representative grab sample, or in the likely event of variable mass loading a composite sample or multiple grab samples, of the stormwater discharged from The Land must be analysed for the following:

2.4.1 Table 6: Storm Event Monitoring Parameters

Parameter	Unit of Measure
Total Suspended Solids (TSS)	mg/L
Total Petroleum Hydrocarbons (TPH)	mg/L
Zinc (Zn)	mg/L
Cadmium (Cd)	mg/L
Copper (Cu)	mg/L
Lead (Pb)	mg/L

3 Within one (1) month of the storm event the Director must be provided with a report on the storm event containing, at least, the following information:

3.1 A summary of the storm event, including a comparison of the intensity and duration of the event against the Annual Exceedance Probability;

3.2 Details of the actions undertaken to control the overflow;

3.3 Details of the investigations into contributing causes to the overflow;

3.4 Recommended actions to prevent a recurrence of the overflow; and

3.5 Any other information that would assist the Director to understand the event.

<u>**Waste Management**</u>

WM1 Non-process Waste Management Plan

1 Unless specified in these conditions, or approved in writing by the Director, the activity must operate in accordance with the approved Non-process Waste Management Plan, as amended from time to time with written approval of the Director.

2 Where reasonably required by the Director, the Non-process Waste Management Plan must be revised within the timeframe specified in writing by the Director, with the objective to have no stockpiles of non-process wastes on The Land.

WM2 Temporary Stockpiling of Jarosite

1 All leachate from the temporary secure jarosite landfill cell located on The Land must be collected and treated as wastewater for the purposes of these conditions.

2 Unless otherwise approved in writing by the Director, monitoring of the temporary secure jarosite landfill cell located on The Land must be undertaken in accordance with *Procedure For: Environmental Monitoring in the Loogana-Inshallah Area*, as may be amended from time to time with written approval of the Director.

3 Details of investigations into the options for treatment, reuse and/or disposal of the jarosite in the temporary secure jarosite landfill cell must be provided in each Annual Environmental Review required under these conditions.

4 If required by the Director in writing, the jarosite in the temporary secure jarosite landfill cell must be removed and reused or disposed in a manner approved by the Director.

WM3 Reprocessing of waste materials

1 Unless otherwise specified in writing by the Director only the waste materials produced on The Land listed below can be reprocessed via the Roasters:

1.1 Solids collected from screens throughout the leach process;

1.2 Contaminated soils; and

1.3 Storage and process tanks sludges, flake linings and garnet mixtures.

WM4 Treatment of mercury filter cake for disposal

The person responsible may treat mercury filter cake and other mercury contaminated waste materials for the purpose of making the waste materials suitable for disposal at a facility approved to receive such material. The treatment must take place in a bunded area.

Wastewater Management

WW1 Management of wastewater

1 Unless otherwise specified in these conditions all wastewater and contaminated or potentially contaminated stormwater must be directed to the Effluent Treatment Plant, located on The Land, for treatment prior to discharge via the nominated discharge point.

2 Notwithstanding the above, the following exceptions are permitted:

2.1 Tail Gas Scrubber Water directed to the Foreshore (Tail Gas Scrubber) Outfall;

2.2 Back-flushing water from the saltwater strainers which is discharged via the Strainer Backwash Outfall; and

2.3 Unless otherwise specified in writing by the Director, until the completion of the structural upgrade of the activity's wharf, or 1 January 2020, whichever occurs first, stormwater and dust suppression water from the wharf area of The Land that cannot be reasonably and practicably captured and directed to the Effluent Treatment Plant for treatment may be discharged to the River Derwent.

WW2 Discharge of sewage

Sewage generated on The Land must not be combined with wastewater or stormwater from the activity, and must be directed to an approved external sewage system.

WW3 Discharge limits

1 The maximum concentration of each parameter specified in Column 1 of table 7 below, in water discharged from The Land to the Derwent Estuary, must not exceed the limit specified in Column 2.

2 **Table 7: Discharge Limits**

Column 1 - Parameter	Column 2 - Maximum Concentration
Total Suspended Solids (TSS)	60 mg/L
Nitrogen (N) - as ammonia	1.50 mg/L
Fluoride (F^-)	10.00 mg/L
Arsenic (As)	0.25 mg/L
Cadmium (Cd)	0.03 mg/L
Copper (Cu)	1.00 mg/L
Iron (Fe)	5.00 mg/L
Lead (Pb)	0.20 mg/L
Manganese (Mn)	5.00 mg/L
Mercury (Hg)	0.01 mg/L
Zinc (Zn)	5.00 mg/L

3 These limits no not apply to stormwater discharged under a critical duration storm event described in these conditions, provided that stormwater generated during such an event is managed in accordance with the requirements of these conditions.

4 The pH at the boundary of the Derwent Estuary Mixing Zone, must not be less than pH 7.

4.1 The above is not considered breached if investigations demonstrate that the pH is a result of conditions in the surrounding estuary, and not a result of discharge from the nominated discharge point.

Schedule 3: Information

Legal Obligations

LO1 EMPCA

The activity must be conducted in accordance with the requirements of the *Environmental Management and Pollution Control Act 1994* and Regulations thereunder. The conditions of this document must not be construed as an exemption from any of those requirements.

Other Information

OI1 Notification of incidents under section 32 of EMPCA

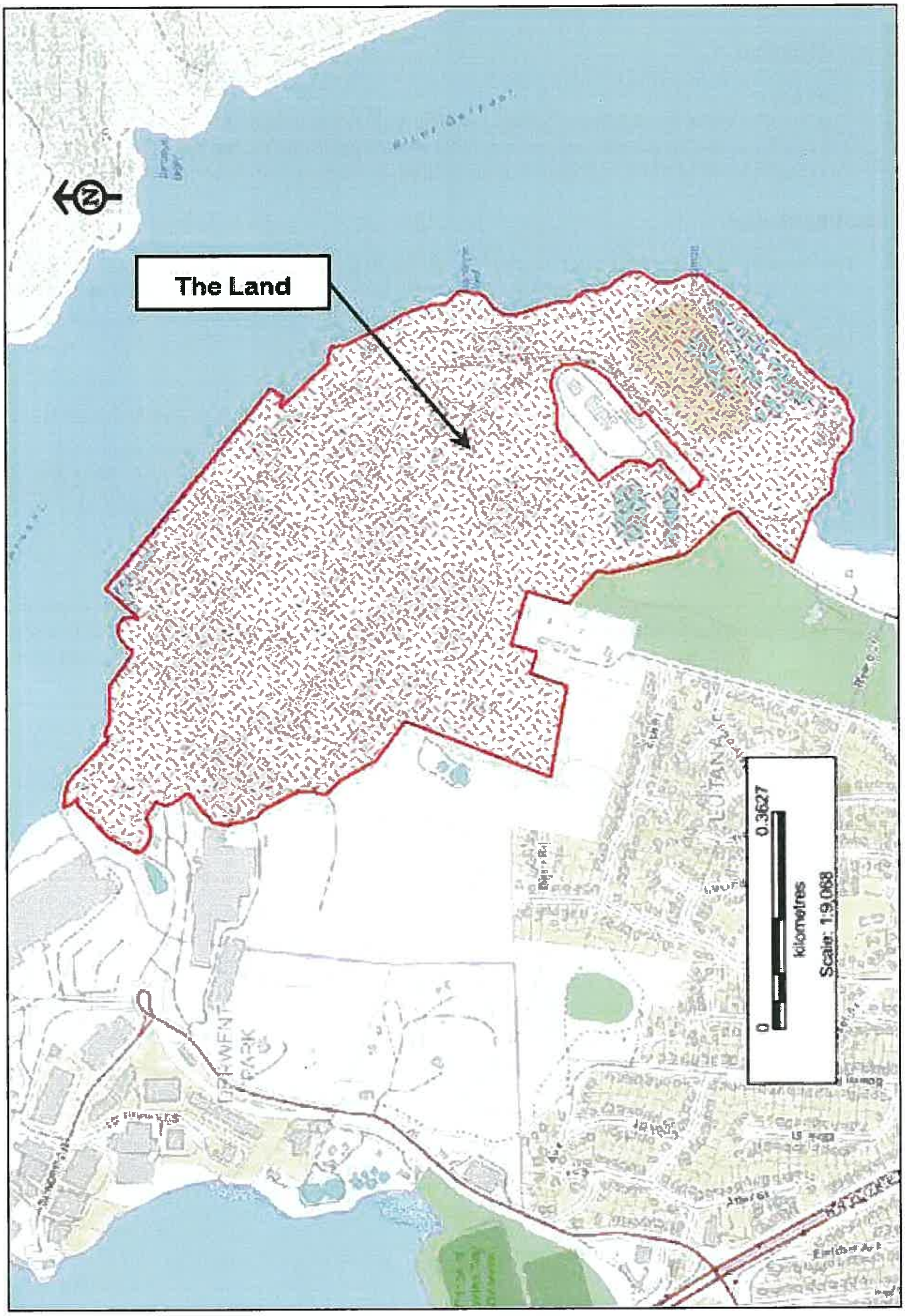
Where a person is required by section 32 of EMPCA to notify the Director of the release of a pollutant, the Director can be notified by telephoning 1800 005 171 (a 24-hour emergency telephone number).

OI2 Waste management hierarchy

1 Wastes should be managed in accordance with the following hierarchy of waste management:

- **1.1** waste should be minimised, that is, the generation of waste must be reduced to the maximum extent that is reasonable and practicable, having regard to best practice environmental management;
- **1.2** waste should be re-used or recycled to the maximum extent that is practicable; and
- **1.3** waste that cannot be re-used or recycled must be disposed of at a waste depot site or treatment facility that has been approved in writing by the relevant planning authority or the Director to receive such waste, or otherwise in a manner approved in writing by the Director.

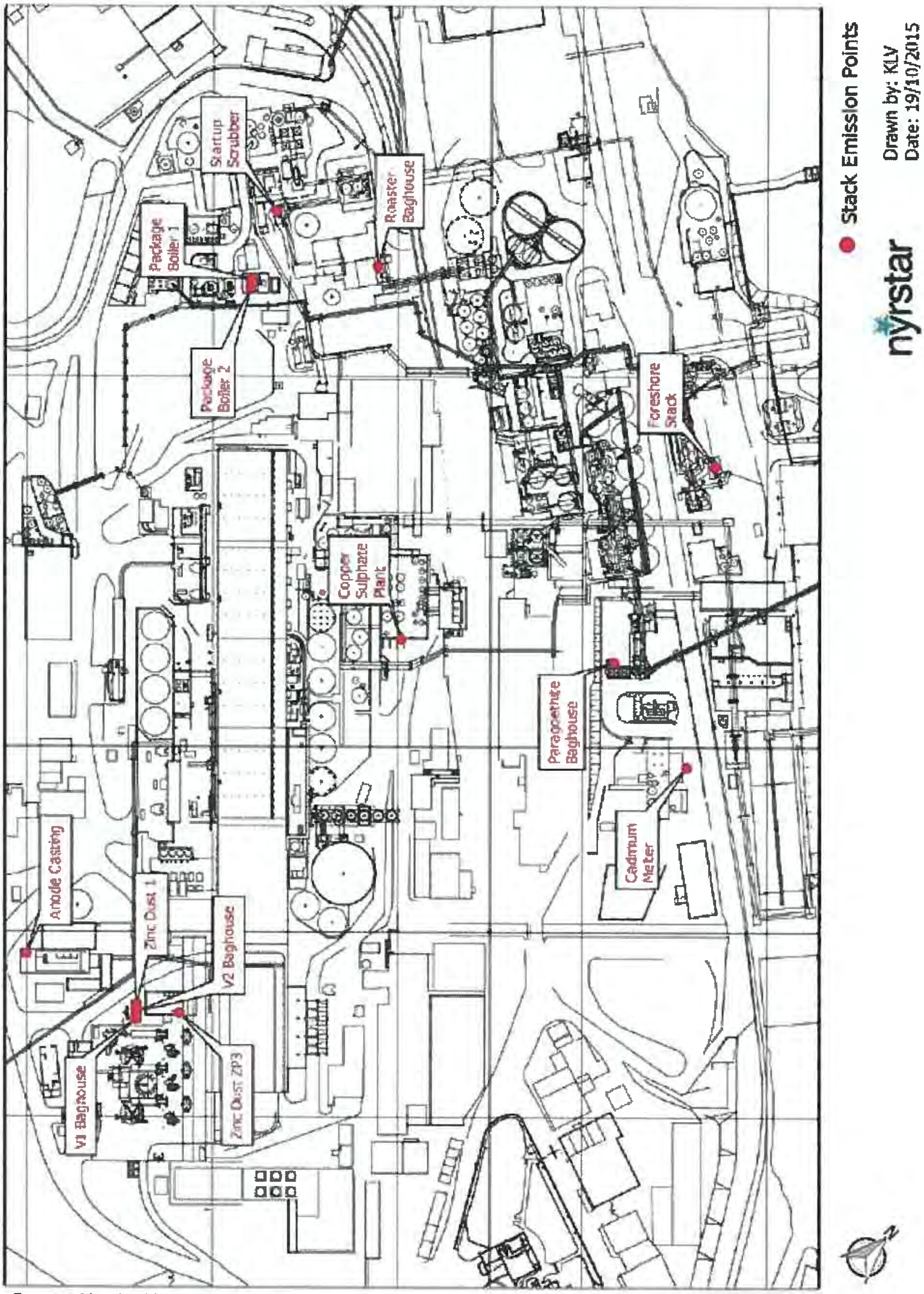
Attachment 1: The Land



DELEGATE FOR THE DIRECTOR, ENVIRONMENT PROTECTION AUTHORITY

Date of issue: 11 APR 2019

Attachment 2: Nominated Exhaust Points



Source: Nyrstar Hobart Pty Ltd

Attachment 3: Nominated Ambient TSPM Locations

Orientation	Scale	Coordinates (SE corner) (WGS84)	Date	Author
N	0 m 710 m	42° 50' 48.4146" S 147° 17' 51.4536" E	13/06/13	nyrstar

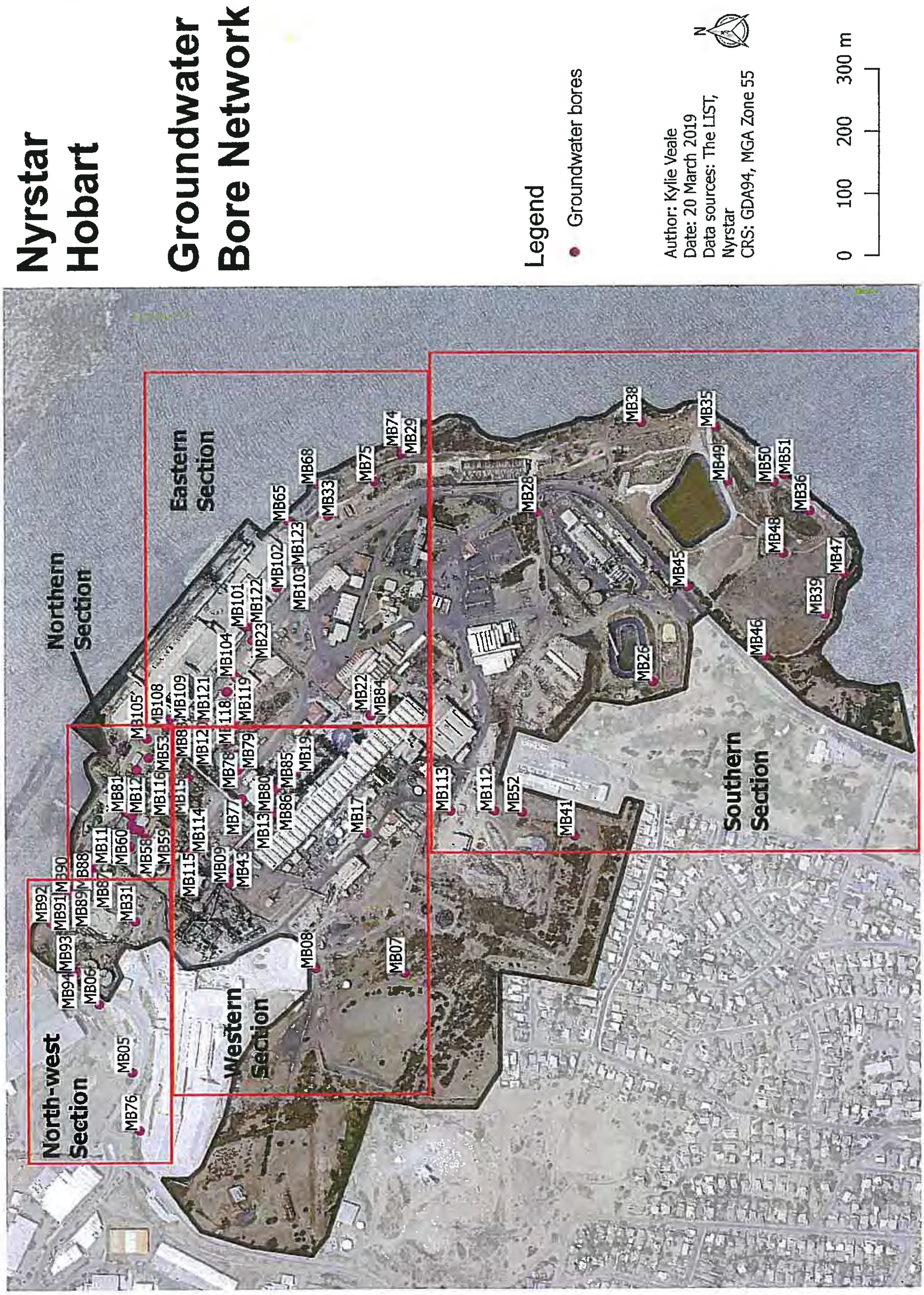
Source: Nyrstar Hobart Pty Ltd

Attachment 4: Nominated Community GLC SO2 Monitoring Locations

Orientation	Scale	Coordinates (SE corner) (WGS84)	Date	Author
N	0 m 490 m 980 m	42° 50' 26.3114" S 147° 19' 19.5636" E	13/06/13	nyrstar

Source: Nyrstar Hobart Pty Ltd

Attachment 5: Groundwater Monitoring Bores (Source: Nyrstar Hobart Pty Ltd)



Nyrstar Hobart

Groundwater Bore Network

Northern Section

Legend

- Groundwater bores

Author: Kylie Veale
Date: 20 March 2019
Data sources: The LIST, Nyrstar
CRS: GDA94, MGA Zone 55

N

0 25 50 m

Nyrstar Hobart

Groundwater Bore Network

North West Section

Legend

- Groundwater bores

Author: Kylie Veale
Date: 20 March 2019
Data sources: The LIST, Nyrstar
CRS: GDA94, MGA Zone 55

N

0 25 50 m

Nyrstar Hobart

Groundwater Bore Network

Eastern Section

Legend

- Groundwater bores

Author: Kylie Veale
Date: 20 March 2019
Data sources: The LIST, Nyrstar
CRS: GDA94, MGA Zone 55

N

0 25 50 75 100 m

DELEGATE FOR THE DIRECTOR, ENVIRONMENT PROTECTION AUTHORITY

Date of issue: 11 APR 2019


Nyrstar
Hobart
Groundwater
Bore Network
Western
Section
Legend
Groundwater bores
Author: Kylie Veale
Date: 20 March 2019
Data sources: The LIST,
Nyrstar
CRS: GDA94, MGA Zone 55
N
0
25
50
75
100
MB15
MB78
MB79
MB19
MB85
MB77
MB80
MB13
MB86
MB115
MB114
MB43
MB09
MB17
MB08
MB07

Nyrstar Hobart

Groundwater Bore Network

Southern Section

Legend

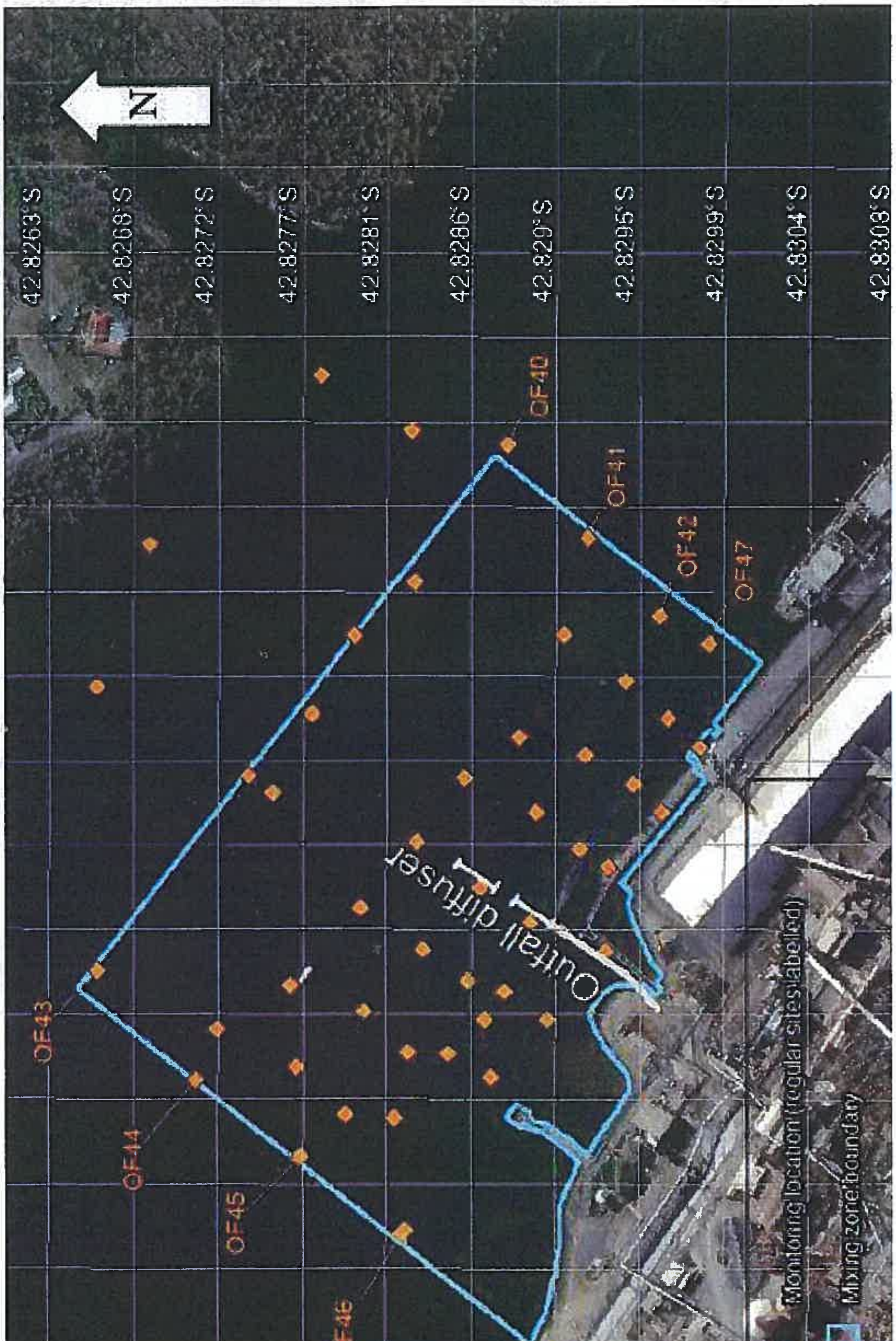
● Groundwater bores

Author: Kylie Veale
Date: 20 March 2019
Data sources: The LIST, Nyrstar
CRS: GDA94, MGA Zone 55

N

0 25 50 75 100 m

Attachment 6: Derwent Estuary Mixing Zone

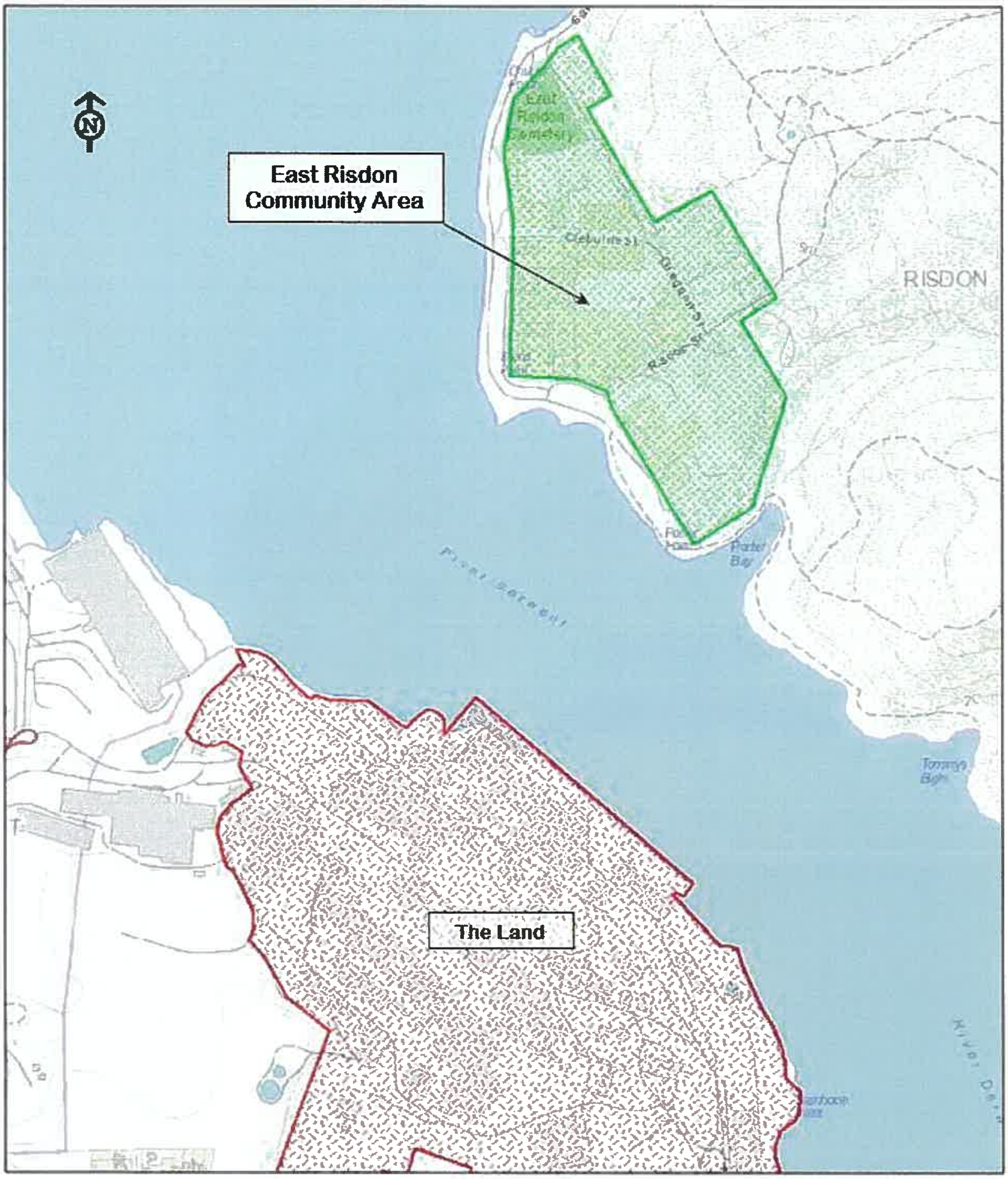


Source: Nyrstar Hobart Pty Ltd

DELEGATE FOR THE DIRECTOR, ENVIRONMENT PROTECTION AUTHORITY

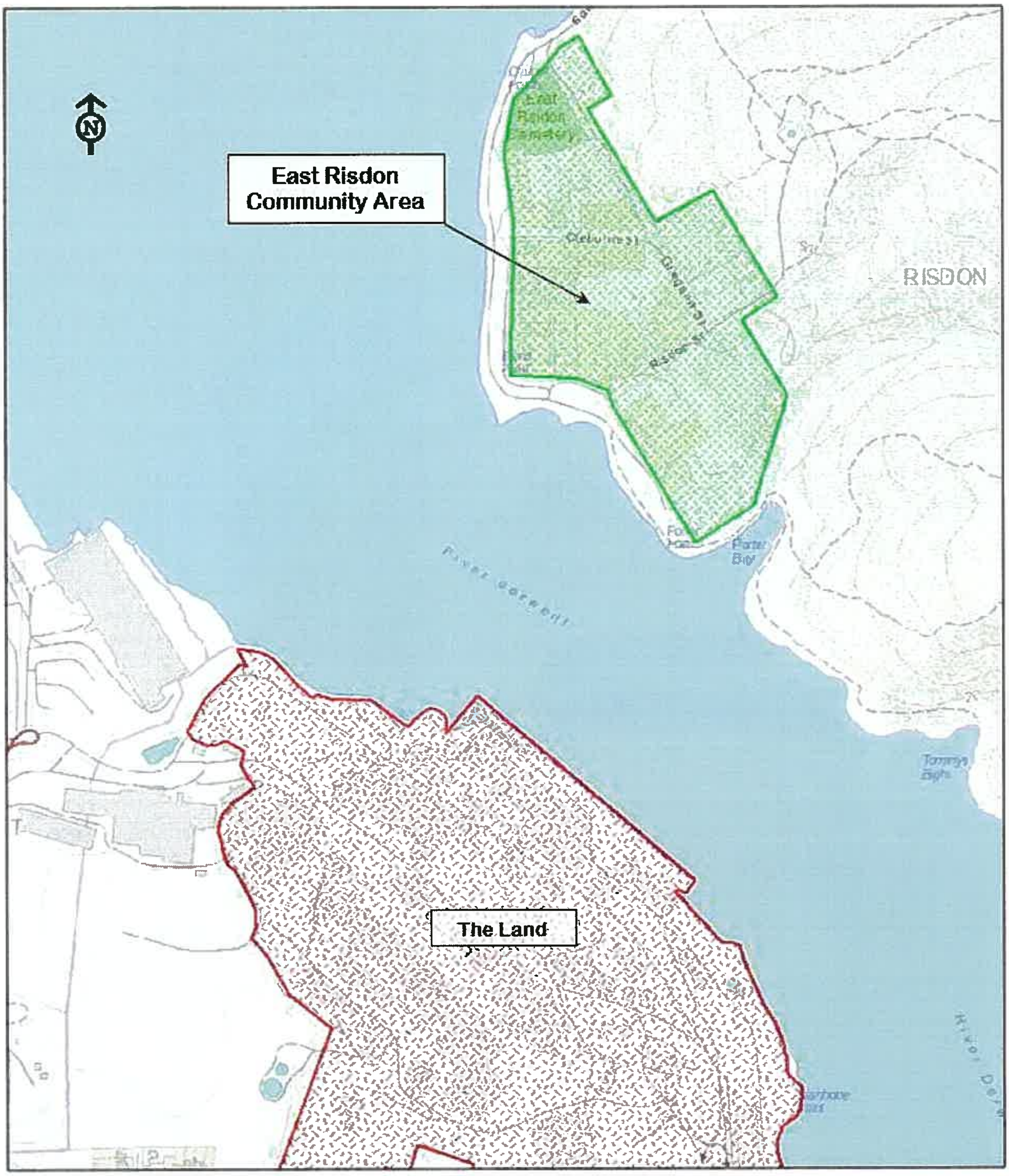
Date of issue: 11 APR 2019

Attachment 7: East Risdon Community Area



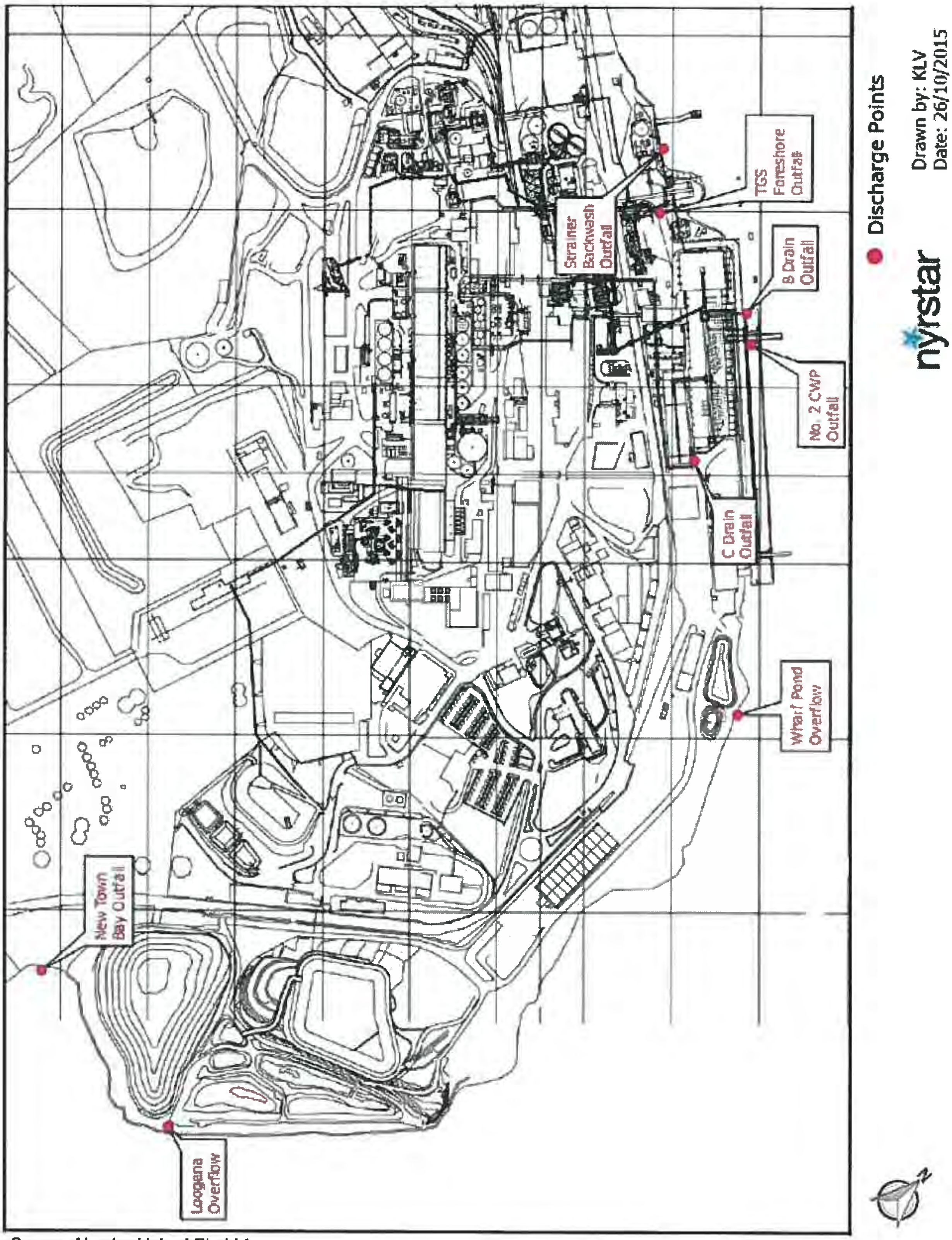
Source: Nyrstar Hobart Pty Ltd

Attachment 8: East Risdon Community Area



Source: Nyrstar Hobart Pty Ltd

Attachment 9: Discharge Points to the Derwent Estuary



Source: Nyrstar Hobart Pty Ltd

6.4 Appendix 4 – 2019 - 2021 Stack Emission Reports

Address (Head Office)
7 Redland Drive
MITCHAM VIC 3132

Office Locations
VIC NSW WA QLD

Postal Address
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COCKBURN CENTRAL WA 6164

Freecall: 1300 364 005
www.ektimo.com.au
ABN: 86 600 381 413

Report Number R006516

Emission Testing Report

EPN, NPI & Triennial Emission Testing - May & June 2019

Nyrstar Hobart , Lutana

Document Information

Client Name:	Nyrstar Hobart
Report Number:	R006516
Date of Issue:	9 August 2019
Attention:	Joel Cooper
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Status

Format	Document Number	Report Date	Prepared By	Reviewed By (1)	Reviewed By (2)
Preliminary Report	-	-	-	-	-
Draft Report	-	-	-	-	-
Final Report	R006516	9/08/2019	JWe	GTr	JCa
Amend Report	-	-	-	-	-

Template Version: 171218

Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

Report Authorisation

Glenn Trenear
Ektimo signatory

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

Ektimo was engaged by Nyrstar Hobart to perform emission monitoring.

Monitoring was performed on fourteen (14) discharge points, to meet EPN, NPI and triennial requirements for discharges to air. This formed the first round of monitoring for 2019.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Foreshore A	16 May 2019	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAH’s) Total fluoride Metals Sulfur dioxide, sulfur trioxide Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOC’s)
Foreshore B		
Parageothite Dryer	17 May 2019	Total particulate matter, Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis), Polycyclic aromatic hydrocarbons (PAH’s), Total fluoride Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOC’s)
Cadmium Smelter	20 May 2019	
Copper Sulfate Stack	24 June 2019	
Casting Ventilation 1 – V1	13 May 2019	
Casting Ventilation 2 – V2		
Roaster Baghouse	15 May 2019	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAH’s) Total fluoride Metals Sulfur dioxide, sulfur trioxide Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOC’s)
Anode Casting	14 May 2019	Total particulate matter, Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis), Polycyclic aromatic hydrocarbons (PAH’s), Total fluoride Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOC’s)

Location	Test Date	Test Parameters*
Zinc Plant 1 Baghouse – ZP1	15 May 2019	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis), Polycyclic aromatic hydrocarbons (PAH's), Total fluoride Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOC's)
Zinc Plant 3 Baghouse – ZP3	14 May 2019	
MZR Furnace Baghouse		
Package Boiler 1	5 June 2019	Total particulate matter Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Package Boiler 2	5 June 2019	

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

2 LICENCE COMPARISON

The following licence comparison table shows that all analytes highlighted in green are below the licence limit as set by the Tasmanian EPN notice 7043/5.

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.11
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.032
	Particulates	mg/m^3	100	<2
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.15
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.033
	Particulates	mg/m^3	100	1.5
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	14
V1 Furnace Stack				<3
V2 Furnace Stack				<3
Zinc Dust Plant Baghouse 1 Stack				4.3
Zinc Dust Plant Bagouse 3 Stack				3.1
Cadmium Smelter Plant Scrubber Stack				<3
Copper Sulphate Crystalliser Plant				<2
Roaster Baghouse				<3
Paragoethite Dryer Baghouse				17
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	≤0.24
V1 Furnace Stack				≤0.04
V2 Furnace Stack				≤0.05
Zinc Dust Plant Baghouse 1 Stack				≤0.07
Zinc Dust Plant Baghouse 3 Stack				≤0.018
Cadmium Smelter Plant Scrubber Stack				≤0.1
Copper Sulphate Crystalliser Plant				≤0.1
Roaster Baghouse				≤0.31
Paragoethite Dryer Baghouse				≤1.9
Anode Casting Plant Exhaust	Metals - Hg	mg/m3	1	<0.0009
V1 Furnace Stack				<0.0005
V2 Furnace Stack				<0.0005
Zinc Dust Plant Baghouse 1 Stack				<0.0005
Zinc Dust Plant Baghouse 3 Stack				<0.0007
Cadmium Smelter Plant Scrubber Stack				<0.0008
Copper Sulphate Crystalliser Plant				<0.0006
Roaster Baghouse				<0.0008
Paragoethite Dryer Baghouse				<0.0009
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	0.0083
V1 Furnace Stack				0.001
V2 Furnace Stack				0.0015
Zinc Dust Plant Baghouse 1 Stack				0.0012
Zinc Dust Plant Baghouse 3 Stack				0.0047
Cadmium Smelter Plant Scrubber Stack				0.0093
Copper Sulphate Crystalliser Plant				0.033
Roaster Baghouse				0.0073
Paragoethite Dryer Baghouse				0.0081
Package Boiler 1	Sulfur dioxide	g/m3	7.2	<0.005
	Oxides of nitrogen (as NO2) (corrected to 7% O_2)	g/m3	2	0.13
	Particulates (corrected to 7% O_2)	mg/m3	100	<2
Package Boiler 2	Sulfur dioxide	g/m3	7.2	<0.005
	Oxides of nitrogen (as NO2) (corrected to 7% O2)	g/m3	2	0.13
	Particulates (corrected to 7% O2)	mg/m3	100	<1

(1) Total concentration of metal(s) combined.

3 RESULT

3.1 Foreshore A

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore A
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		190410

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)

Gas Analyser Results	Average	
Sampling time	0941 - 1040	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	32	61
Nitrous oxide	<1	<2
Carbon monoxide	<2	<4
	Concentration %	
Carbon dioxide	0.4	
Oxygen	11.4	

Isokinetic Results	Results	
Sampling time	0900-1040	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<3
PM10 (PSA)	<0.7	<1
PM2.5 (PSA)	<0.2	<0.3
Sulfur dioxide	54	100
Sulfur trioxide	0.11	0.21
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	96	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0850	
Final flow measurement time (hhmm)	1044	
Temperature, °C	15	
Velocity at sampling plane, m/s	18	
Velocity at exit plane, m/s	18	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	1900	
Volumetric flow rate (dry STP), m³/min	1800	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	<1	

Date	16/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Foreshore A
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		190410

Isokinetic Results	Results	
Sampling time	1440-1620	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.02	<0.04
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	91	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1435	
Final flow measurement time (hhmm)	1634	
Temperature, °C	15	
Velocity at sampling plane, m/s	18	
Velocity at exit plane, m/s	18	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	1900	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	150000	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.5	<0.9

VOC's C5-C20	Results	
Sampling time	0953-1014	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.5	<0.9
Residuals as Toluene	<0.5	<0.9

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore A
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		*190410*

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)

Metals	Results	
Sampling time	1100-1240	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.004	<0.008
Arsenic	<0.002	<0.005
Beryllium	<0.0005	<0.001
Cadmium	0.00098	0.0019
Chromium	0.0017	0.0033
Cobalt	<0.0007	<0.001
Copper	0.0045	0.0086
Lead	0.042	0.08
Manganese	0.019	0.037
Mercury	<0.0005	<0.0009
Nickel	0.0045	0.0087
Phosphorus	<0.02	<0.03
Selenium	<0.004	<0.008
Zinc	1	2
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1044	
Final flow measurement time (hhmm)	1246	
Temperature, °C	14	
Velocity at sampling plane, m/s	18	
Velocity at exit plane, m/s	18	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	2000	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	150000	
Velocity difference, %	2	

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore A
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1250 - 1430	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	10000	20000000
2-Methylnaphthalene	3800	7300000
Acenaphthylene	26	51000
Acenaphthene	210	410000
Fluorene	2200	4400000
Phenanthrene	230	450000
Anthracene	<20	<30000
Fluoranthene	88	170000
Pyrene	26	51000
Benz(a)anthracene	<20	<30000
Chrysene	<20	<30000
Benzo(b)fluoranthene	<20	<30000
Benzo(k)fluoranthene	<20	<30000
Benzo(e)pyrene	<20	<30000
Benzo(a)pyrene	<20	<30000
Perylene	<20	<30000
Indeno(1,2,3-cd)pyrene	<20	<30000
Dibenz(ah)anthracene	<20	<30000
Benzo(ghi)perylene	59	110000
Total 16 PAHs	13000	26000000
Total 19 PAHs	17000	33000000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	15	28000
Upper Bound	29	56000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	99
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1246
Final flow measurement time (hhmm)	1435
Temperature, °C	15
Velocity at sampling plane, m/s	19
Velocity at exit plane, m/s	19
Volumetric flow rate, actual, m³/min	2000
Volumetric flow rate (wet STP), m³/min	2000
Volumetric flow rate (dry STP), m³/min	1900
Mass flow rate (wet basis), kg/hour	150000

3.2 Foreshore B

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore B
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		190410

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)

Gas Analyser Results	Average	
Sampling time	1202 - 1301	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	33	62
Nitrous oxide	<1	<2
Carbon monoxide	<2	<4
	Concentration %	
Carbon dioxide	0.4	
Oxygen	11.1	

Isokinetic Results	Results	
Sampling time	1050-1230	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	1.5	2.9
PM10 (PSA)	0.72	1.3
PM2.5 (PSA)	0.18	0.33
Sulfur dioxide	46	84
Sulfur trioxide	0.15	0.28
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	106	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1037	
Final flow measurement time (hhmm)	1235	
Temperature, °C	15	
Velocity at sampling plane, m/s	18	
Velocity at exit plane, m/s	18	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	1900	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	5	

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore B
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream.		190410

Isokinetic Results	Results	
Sampling time	1435-1605	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.02	<0.03
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	102	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1430	
Final flow measurement time (hhmm)	1610	
Temperature, °C	14	
Velocity at sampling plane, m/s	18	
Velocity at exit plane, m/s	18	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	2000	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	150000	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.3

VOC's C5-C20	Results	
Sampling time	1125-1225	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.3

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	16/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Foreshore B
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid stream. 190410		

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)

Isokinetic Results	Results	
Sampling time	1245-1425	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.003	<0.006
Arsenic	<0.001	<0.003
Beryllium	<0.0004	<0.0007
Cadmium	0.00045	0.00087
Chromium	<0.0005	<0.0009
Cobalt	<0.0005	<0.0009
Copper	0.0039	0.0076
Lead	0.018	0.035
Manganese	0.012	0.023
Mercury	<0.0004	<0.0008
Nickel	0.00075	0.0015
Phosphorus	<0.01	<0.02
Selenium	<0.003	<0.006
Zinc	0.31	0.6
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1235	
Final flow measurement time (hhmm)	1430	
Temperature, °C	15	
Velocity at sampling plane, m/s	19	
Velocity at exit plane, m/s	19	
Volumetric flow rate, actual, m³/min	2000	
Volumetric flow rate (wet STP), m³/min	2000	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	150000	
Velocity difference, %	<1	

Date	16/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Foreshore B
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 92000 m3/hr of gas through the acid strea		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0855 - 1035	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	950	1700000
2-Methylnaphthalene	150	270000
Acenaphthylene	<10	<20000
Acenaphthene	77	140000
Fluorene	110	200000
Phenanthrene	470	840000
Anthracene	33	59000
Fluoranthene	170	300000
Pyrene	71	130000
Benz(a)anthracene	<10	<20000
Chrysene	<10	<20000
Benzo(b)fluoranthene	<10	<20000
Benzo(k)fluoranthene	<10	<20000
Benzo(e)pyrene	<10	<20000
Benzo(a)pyrene	<10	<20000
Perylene	<10	<20000
Indeno(1,2,3-cd)pyrene	<10	<20000
Dibenz(ah)anthracene	<10	<20000
Benzo(ghi)perylene	37	67000
Total 16 PAHs	1900	3500000
Total 19 PAHs	2100	3700000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	11	19000
Upper Bound	21	39000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	97
Velocity difference, %	1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	852
Final flow measurement time (hhmm)	1037
Temperature, °C	14
Velocity at sampling plane, m/s	17
Velocity at exit plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1800
Mass flow rate (wet basis), kg/hour	140000

3.3 Paragoethite Dryer

Date	17/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Paragoethite Dryer
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	10.1 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum. Changed at 10AM and 1015AM.		190410

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	27	
Gas molecular weight, g/g mole	26.2 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.17 (wet)	1.30 (dry)

Gas Analyser Results	Average	
Sampling time	0833 - 0932	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	50	14
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.6
	Concentration %	
Carbon dioxide	3	
Oxygen	15.7	

Isokinetic Results	Results	
	0938-1038	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	17	5
PM10 (PSA)	8.5	2.4
PM2.5 (PSA)	2.3	0.65
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0935	
Final flow measurement time (hhmm)	1044	
Temperature, °C	75	
Velocity at sampling plane, m/s	12	
Velocity at exit plane, m/s	12	
Volumetric flow rate, actual, m³/min	490	
Volumetric flow rate (wet STP), m³/min	390	
Volumetric flow rate (dry STP), m³/min	290	
Mass flow rate (wet basis), kg/hour	27000	
Velocity difference, %	<1	

Date	17/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Paragoethite Dryer
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	10.1 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum. Changed at 10AM and 1015AM.		190410

Isokinetic Results	Results	
Sampling time	0830-0930	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.36	0.1
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	110	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0810	
Final flow measurement time (hhmm)	0935	
Temperature, °C	75	
Velocity at sampling plane, m/s	12	
Velocity at exit plane, m/s	12	
Volumetric flow rate, actual, m³/min	490	
Volumetric flow rate (wet STP), m³/min	390	
Volumetric flow rate (dry STP), m³/min	290	
Mass flow rate (wet basis), kg/hour	27000	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.6	<0.2

VOC's C5-C20	Results	
Sampling time	0839-0855	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.6	<0.2

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	17/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Paragoethite Dryer
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	10.1 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum. Changed at 10AM and 1015AM. 190410		

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	27	
Gas molecular weight, g/g mole	26.2 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.17 (wet)	1.30 (dry)

Isokinetic Results	Results	
Sampling time	0938-1038	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.007	<0.002
Arsenic	0.057	0.016
Beryllium	<0.0009	<0.0003
Cadmium	0.0081	0.0023
Chromium	0.0042	0.0012
Cobalt	<0.001	<0.0004
Copper	0.17	0.049
Lead	1.8	0.51
Manganese	0.11	0.031
Mercury	<0.0009	<0.0003
Nickel	0.0041	0.0012
Phosphorus	<0.06	<0.02
Selenium	<0.008	<0.002
Zinc	2.3	0.65
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	92	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0935	
Final flow measurement time (hhmm)	1044	
Temperature, °C	75	
Velocity at sampling plane, m/s	12	
Velocity at exit plane, m/s	12	
Volumetric flow rate, actual, m³/min	490	
Volumetric flow rate (wet STP), m³/min	390	
Volumetric flow rate (dry STP), m³/min	290	
Mass flow rate (wet basis), kg/hour	27000	
Velocity difference, %	<1	

Date	17/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Paragoethite Dryer
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	10.1 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum. Changed at 10AM and 1015AI		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0830 - 0930	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2200**	620000
2-Methylnaphthalene	130	37000
Acenaphthylene	<20	<6000
Acenaphthene	95	27000
Fluorene	200	56000
Phenanthrene	930	270000
Anthracene	28	8100
Fluoranthene	560	160000
Pyrene	170	50000
Benz(a)anthracene	43	12000
Chrysene	82	23000
Benzo(b)fluoranthene	35	10000
Benzo(k)fluoranthene	<20	<6000
Benzo(e)pyrene	<20	<6000
Benzo(a)pyrene	<20	<6000
Perylene	<20	<6000
Indeno(1,2,3-cd)pyrene	<20	<6000
Dibenz(ah)anthracene	<20	<6000
Benzo(ghi)perylene	45	13000
Total 16 PAHs	4400	1200000
Total 19 PAHs	4500	1300000
BaP-TEQ		
Lower Bound	8.6	2500
Middle Bound	26	7400
Upper Bound	43	12000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	100
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	810
Final flow measurement time (hhmm)	0935
Temperature, °C	75
Velocity at sampling plane, m/s	12
Velocity at exit plane, m/s	12
Volumetric flow rate, actual, m³/min	490
Volumetric flow rate (wet STP), m³/min	390
Volumetric flow rate (dry STP), m³/min	290
Mass flow rate (wet basis), kg/hour	27000

3.4 Cadmium Smelter Plant Scrubber Stack

Date	20/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Cadmium Smelter
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		190410

Sampling Plane Details	
Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1632 - 1731	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.4
Sulfur dioxide	<5	<0.5
Carbon monoxide	2.5	0.3
	Concentration %	
Carbon dioxide	0.5	
Oxygen	20.4	

Isokinetic Results		Results	
Sampling time		1510-1610	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.4
PM10	(PSA)	<1	<0.2
PM2.5	(PSA)	<0.4	<0.04
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		94	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1505	
Final flow measurement time (hhmm)		1615	
Temperature, °C		21	
Velocity at sampling plane, m/s		12	
Velocity at exit plane, m/s		12	
Volumetric flow rate, actual, m³/min		130	
Volumetric flow rate (wet STP), m³/min		120	
Volumetric flow rate (dry STP), m³/min		120	
Mass flow rate (wet basis), kg/hour		9100	
Velocity difference, %		1	

Date	20/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Cadmium Smelter
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Fume extraction while furnace in operation.		190410

Isokinetic Results	Results	
Sampling time	1630-1730	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.06	<0.007
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	94	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1615	
Final flow measurement time (hhmm)	1733	
Temperature, °C	21	
Velocity at sampling plane, m/s	13	
Velocity at exit plane, m/s	13	
Volumetric flow rate, actual, m³/min	130	
Volumetric flow rate (wet STP), m³/min	120	
Volumetric flow rate (dry STP), m³/min	120	
Mass flow rate (wet basis), kg/hour	9400	
Velocity difference, %	5	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.5	<0.06

VOC's C5-C20	Results	
Sampling time	1600-1620	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.5	<0.06

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	20/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Cadmium Smelter
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		190410

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1510-1610	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.008	<0.0009
Arsenic	<0.005	<0.0005
Beryllium	<0.0009	<0.0001
Cadmium	0.0093	0.0011
Chromium	<0.002	<0.0002
Cobalt	<0.001	<0.0001
Copper	0.019	0.0022
Lead	0.084	0.0097
Manganese	0.029	0.0033
Mercury	<0.0008	<0.00009
Nickel	0.0039	0.00045
Phosphorus	<0.03	<0.003
Selenium	<0.008	<0.0009
Zinc	1.3	0.15
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1505	
Final flow measurement time (hhmm)	1615	
Temperature, °C	21	
Velocity at sampling plane, m/s	12	
Velocity at exit plane, m/s	12	
Volumetric flow rate, actual, m³/min	130	
Volumetric flow rate (wet STP), m³/min	120	
Volumetric flow rate (dry STP), m³/min	120	
Mass flow rate (wet basis), kg/hour	9100	
Velocity difference, %	2	

Date	20/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Cadmium Smelter
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1630 - 1730	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1900	220000
2-Methylnaphthalene	630	75000
Acenaphthylene	34**	4000
Acenaphthene	59	7000
Fluorene	140	17000
Phenanthrene	1000	120000
Anthracene	5400	640000
Fluoranthene	71	8500
Pyrene	35	4100
Benz(a)anthracene	19	2300
Chrysene	81	9700
Benzo(b)fluoranthene	28	3300
Benzo(k)fluoranthene	<20	<2000
Benzo(e)pyrene	17	2000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	<20	<2000
Dibenz(ah)anthracene	<20	<2000
Benzo(ghi)perylene	<20	<2000
Total 16 PAHs	8700	1000000
Total 19 PAHs	9400	1100000
BaP-TEQ		
Lower Bound	5.5	660
Middle Bound	19	2300
Upper Bound	33	3900

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	93
Velocity difference, %	4.6
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1615
Final flow measurement time (hhmm)	1713
Temperature, °C	21
Velocity at sampling plane, m/s	13
Velocity at exit plane, m/s	13
Volumetric flow rate, actual, m³/min	130
Volumetric flow rate (wet STP), m³/min	120
Volumetric flow rate (dry STP), m³/min	120
Mass flow rate (wet basis), kg/hour	9400

3.5 Copper Sulphate Crystalliser Plant Vent Stack

Date	24/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J Cacchioni	**State**	TAS
Process Conditions	Production rate - 14.2 tonnes/day, Dryer Outlet Temperature - 43.5 deg C, Feed rate into Dryer - 44%		

190410

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	6.3	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1209 - 1308	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.6
Sulfur dioxide	<5	<0.8
Carbon monoxide	<2	<0.3
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.6	

Isokinetic Results	Results	
Sampling time	1045-1145	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.4
PM10 (PSA)	<1	<0.2
PM2.5 (PSA)	<0.3	<0.06
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1040	
Final flow measurement time (hhmm)	1149	
Temperature, °C	39	
Velocity at sampling plane, m/s	17	
Velocity at exit plane, m/s	17	
Volumetric flow rate, actual, m³/min	210	
Volumetric flow rate (wet STP), m³/min	180	
Volumetric flow rate (dry STP), m³/min	170	
Mass flow rate (wet basis), kg/hour	14000	
Velocity difference, %	-2	

Date	24/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J Cacchioni	**State**	TAS
Process Conditions	Production rate - 14.2 tonnes/day, Dryer Outlet Temperature - 43.5 deg C, Feed rate into Dryer - 44%		

190410

Isokinetic Results	Results	
Sampling time	1200-1300	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.69	0.12
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1149	
Final flow measurement time (hhmm)	1305	
Temperature, °C	39	
Velocity at sampling plane, m/s	17	
Velocity at exit plane, m/s	17	
Volumetric flow rate, actual, m³/min	210	
Volumetric flow rate (wet STP), m³/min	180	
Volumetric flow rate (dry STP), m³/min	170	
Mass flow rate (wet basis), kg/hour	14000	
Velocity difference, %	3	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.3	<0.06

VOC's C5-C20	Results	
Sampling time	1211-1226	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.3	<0.06

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Note: Acetone result removed due to expected contamination issue

Date	24/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J Cacchioni	**State**	TAS
Process Conditions	Production rate - 14.2 tonnes/day, Dryer Outlet Temperature - 43.5 deg C, Feed rate into Dryer - 44%		

190410

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	6.3	
Gas molecular weight, g/g mole	28.3 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1200-1300	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.005	<0.0009
Arsenic	<0.003	<0.0005
Beryllium	<0.0007	<0.0001
Cadmium	0.033	0.0056
Chromium	0.0014	0.00024
Cobalt	0.0014	0.00024
Copper	0.052	0.0089
Lead	0.041	0.0069
Manganese	0.03	0.005
Mercury	<0.0006	<0.0001
Nickel	0.085	0.014
Phosphorus	<0.02	<0.004
Selenium	<0.005	<0.0009
Zinc	0.59	0.1
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	109	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1149	
Final flow measurement time (hhmm)	1305	
Temperature, °C	39	
Temperature, K	312	
Velocity at sampling plane, m/s	17	
Velocity at exit plane, m/s	17	
Volumetric flow rate, actual, m³/min	210	
Volumetric flow rate (wet STP), m³/min	180	
Volumetric flow rate (dry STP), m³/min	170	
Mass flow rate (wet basis), kg/hour	14000	
Velocity difference, %	3	

Date	24/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J Cacchioni	**State**	TAS
Process Conditions	Production rate - 14.2 tonnes/day, Dryer Outlet Temperature - 43.5 deg C, Feed rate into Dryer - 44%		

190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1045 - 1145	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	5600**	950000
2-Methylnaphthalene	1300	220000
Acenaphthylene	54**	9100
Acenaphthene	64	11000
Fluorene	200**	35000
Phenanthrene	1000	170000
Anthracene	130	22000
Fluoranthene	340	58000
Pyrene	200	35000
Benz(a)anthracene	<20	<4000
Chrysene	50	8600
Benzo(b)fluoranthene	<20	<4000
Benzo(k)fluoranthene	<20	<4000
Benzo(e)pyrene	<20	<4000
Benzo(a)pyrene	<20	<4000
Perylene	<20	<4000
Indeno(1,2,3-cd)pyrene	<20	<4000
Dibenz(ah)anthracene	<20	<4000
Benzo(ghi)perylene	<20	<4000
Total 16 PAHs	7600	1300000
Total 19 PAHs	8900	1500000
BaP-TEQ		
Lower Bound	0.5	86
Middle Bound	20	3400
Upper Bound	39	6700

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	99
Velocity difference, %	-2
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1040
Final flow measurement time (hhmm)	1149
Temperature, °C	39
Velocity at sampling plane, m/s	17
Velocity at exit plane, m/s	17
Volumetric flow rate, actual, m³/min	210
Volumetric flow rate (wet STP), m³/min	180
Volumetric flow rate (dry STP), m³/min	170
Mass flow rate (wet basis), kg/hour	14000

3.6 Casting Ventilation 1 – V1

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Sampling Plane Details	
Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	0.8	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1159 - 1258	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.9
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.5
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.9	

Isokinetic Results	Results	
Sampling time	1130-1230	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<3	<0.6
PM10 (PSA)	<1	<0.3
PM2.5 (PSA)	<0.3	<0.08
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1125	
Final flow measurement time (hhmm)	1233	
Temperature, °C	27	
Velocity at sampling plane, m/s	15	
Velocity at exit plane, m/s	15	
Volumetric flow rate, actual, m³/min	280	
Volumetric flow rate (wet STP), m³/min	260	
Volumetric flow rate (dry STP), m³/min	250	
Mass flow rate (wet basis), kg/hour	20000	
Velocity difference, %	1	

Date	13/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Casting Ventilation 1 - V1
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Casting area in normal operation.		190410

Isokinetic Results	Results	
Sampling time	1355-1455	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.17	0.043
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	97	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1345	
Final flow measurement time (hhmm)	1459	
Temperature, °C	28	
Velocity at sampling plane, m/s	15	
Velocity at exit plane, m/s	15	
Volumetric flow rate, actual, m³/min	280	
Volumetric flow rate (wet STP), m³/min	260	
Volumetric flow rate (dry STP), m³/min	250	
Mass flow rate (wet basis), kg/hour	20000	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.3	<0.08

VOC's C5-C20	Results	
Sampling time	1249-1321	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.3	<0.08

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	0.83	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1240-1340	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.006	<0.001
Arsenic	<0.003	<0.0007
Beryllium	<0.0007	<0.0002
Cadmium	0.001	0.00025
Chromium	0.005	0.0013
Cobalt	<0.0008	<0.0002
Copper	0.0032	0.00082
Lead	0.03	0.0075
Manganese	0.061	0.015
Mercury	<0.0005	<0.0001
Nickel	0.0033	0.00084
Phosphorus	0.2	0.052
Selenium	<0.006	<0.001
Zinc	0.96	0.24
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	105	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1233	
Final flow measurement time (hhmm)	1345	
Temperature, °C	28	
Velocity at sampling plane, m/s	15	
Velocity at exit plane, m/s	15	
Volumetric flow rate, actual, m³/min	280	
Volumetric flow rate (wet STP), m³/min	260	
Volumetric flow rate (dry STP), m³/min	260	
Mass flow rate (wet basis), kg/hour	20000	
Velocity difference, %	<1	

Date	13/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Casting Ventilation 1 - V1
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Casting area in normal operation.		190410

Polycyclic Aromatic Hydrocarbons (PAHs)	Results	
Sampling time	1512 - 1612	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1700**	440000
2-Methylnaphthalene	170	44000
Acenaphthylene	<20**	<6000
Acenaphthene	200	50000
Fluorene	150	38000
Phenanthrene	750	190000
Anthracene	40	10000
Fluoranthene	310	79000
Pyrene	170	44000
Benz(a)anthracene	81	21000
Chrysene	83	21000
Benzo(b)fluoranthene	38	9700
Benzo(k)fluoranthene	<20	<6000
Benzo(e)pyrene	<20	<6000
Benzo(a)pyrene	<20	<6000
Perylene	<20	<6000
Indeno(1,2,3-cd)pyrene	<20	<6000
Dibenz(ah)anthracene	<20	<6000
Benzo(ghi)perylene	120	29000
Total 16 PAHs	3700	940000
Total 19 PAHs	3800	980000
BaP-TEQ		
Lower Bound	13	3200
Middle Bound	31	7900
Upper Bound	50	13000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	101
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1459
Final flow measurement time (hhmm)	1615
Temperature, °C	28
Velocity at sampling plane, m/s	15
Velocity at exit plane, m/s	15
Volumetric flow rate, actual, m³/min	280
Volumetric flow rate (wet STP), m³/min	260
Volumetric flow rate (dry STP), m³/min	250
Mass flow rate (wet basis), kg/hour	20000

3.7 Casting Ventilation 2 – V2

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Sampling Plane Details	
Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1355 - 1454	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<1
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.6
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.7	

Isokinetic Results	Results	
Sampling time	1348-1448	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<3	<0.8
PM10 (PSA)	<1	<0.4
PM2.5 (PSA)	<0.3	<0.08
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	109	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1344	
Final flow measurement time (hhmm)	1450	
Temperature, °C	48	
Velocity at sampling plane, m/s	20	
Velocity at exit plane, m/s	20	
Volumetric flow rate, actual, m³/min	340	
Volumetric flow rate (wet STP), m³/min	290	
Volumetric flow rate (dry STP), m³/min	280	
Mass flow rate (wet basis), kg/hour	22000	
Velocity difference, %	-3	

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Isokinetic Results	Results	
Sampling time	1600-1700	
	Concentration mg/m^3	Mass Rate g/min
Total fluoride (as HF)	0.049	0.014
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	106	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1558	
Final flow measurement time (hhmm)	1702	
Temperature, °C	47	
Velocity at sampling plane, m/s	20	
Velocity at exit plane, m/s	20	
Volumetric flow rate, actual, m^3/min	340	
Volumetric flow rate (wet STP), m^3/min	290	
Volumetric flow rate (dry STP), m^3/min	290	
Mass flow rate (wet basis), kg/hour	22000	
Velocity difference, %	-2	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m^3	Mass Rate g/min
Total	<0.6	<0.2

VOC's C5-C20	Results	
Sampling time	1355-1414	
	Concentration mg/m^3	Mass Rate g/min
Detection limit(1)	<0.6	<0.2

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Sampling Plane Details	
Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1457-1557	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.005	<0.001
Arsenic	<0.002	<0.0006
Beryllium	<0.0006	<0.0002
Cadmium	0.0015	0.00043
Chromium	0.0012	0.00035
Cobalt	<0.0007	<0.0002
Copper	0.0036	0.001
Lead	0.038	0.011
Manganese	0.059	0.017
Mercury	<0.0005	<0.0002
Nickel	0.0015	0.00043
Phosphorus	0.19	0.054
Selenium	<0.005	<0.001
Zinc	1.3	0.36
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	110	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1415	
Final flow measurement time (hhmm)	1603	
Temperature, °C	48	
Velocity at sampling plane, m/s	21	
Velocity at exit plane, m/s	21	
Volumetric flow rate, actual, m³/min	340	
Volumetric flow rate (wet STP), m³/min	290	
Volumetric flow rate (dry STP), m³/min	290	
Mass flow rate (wet basis), kg/hour	22000	
Velocity difference, %	2	

Date	13/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1240 - 1340	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	4200	1200000
2-Methylnaphthalene	610	170000
Acenaphthylene	170	46000
Acenaphthene	190	52000
Fluorene	660	190000
Phenanthrene	3600	1000000
Anthracene	280	78000
Fluoranthene	500	140000
Pyrene	230	64000
Benz(a)anthracene	59	16000
Chrysene	68	19000
Benzo(b)fluoranthene	40	11000
Benzo(k)fluoranthene	<20	<6000
Benzo(e)pyrene	21	5800
Benzo(a)pyrene	<20	<6000
Perylene	<20	<6000
Indeno(1,2,3-cd)pyrene	<20	<6000
Dibenz(ah)anthracene	<20	<6000
Benzo(ghi)perylene	49	14000
Total 16 PAHs	10000	2800000
Total 19 PAHs	11000	3000000
BaP-TEQ		
Lower Bound	11	3000
Middle Bound	27	7600
Upper Bound	44	12000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	95
Velocity difference, %	1.8
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1230
Final flow measurement time (hhmm)	1343
Temperature, °C	48
Velocity at sampling plane, m/s	20
Velocity at exit plane, m/s	20
Volumetric flow rate, actual, m³/min	340
Volumetric flow rate (wet STP), m³/min	280
Volumetric flow rate (dry STP), m³/min	280
Mass flow rate (wet basis), kg/hour	22000

3.8 Roaster Baghouse

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Roaster Baghouse
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Roaster 6 - 46 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		190410

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1041 - 1140	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.08
Carbon monoxide	<2	<0.05
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.6	

Isokinetic Results		Results	
Sampling time		1015-1119	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.07
PM10	(PSA)	<2	<0.04
PM2.5	(PSA)	<0.4	<0.01
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		96	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1014	
Final flow measurement time (hhmm)		1120	
Temperature, °C		35	
Velocity at sampling plane, m/s		3.9	
Velocity at exit plane, m/s		3.9	
Volumetric flow rate, actual, m³/min		27	
Volumetric flow rate (wet STP), m³/min		24	
Volumetric flow rate (dry STP), m³/min		24	
Mass flow rate (wet basis), kg/hour		1900	
Velocity difference, %		<1	

Date	15/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Roaster Baghouse
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Roaster 6 - 46 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		190410

Isokinetic Results	Results	
Sampling time	1238-1342	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.03	<0.0007
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	92	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1236	
Final flow measurement time (hhmm)	1344	
Temperature, °C	35	
Velocity at sampling plane, m/s	4	
Velocity at exit plane, m/s	4	
Volumetric flow rate, actual, m³/min	28	
Volumetric flow rate (wet STP), m³/min	25	
Volumetric flow rate (dry STP), m³/min	24	
Mass flow rate (wet basis), kg/hour	1900	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.3	<0.007

VOC's C5-C20	Results	
Sampling time	1202-1239	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.3	<0.007

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Roaster Baghouse
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Roaster 6 - 46 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		190410

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1130-1234	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	830	20
Sulfur trioxide	0.4	0.0096
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	99	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1120	
Final flow measurement time (hhmm)	1236	
Temperature, °C	36	
Velocity at sampling plane, m/s	4	
Velocity at exit plane, m/s	4	
Volumetric flow rate, actual, m³/min	28	
Volumetric flow rate (wet STP), m³/min	25	
Volumetric flow rate (dry STP), m³/min	24	
Mass flow rate (wet basis), kg/hour	1900	
Velocity difference, %	3	

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Roaster Baghouse
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Roaster 6 - 46 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		190410

Sampling Plane Details

Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	28.9 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1130-1234	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.005	<0.0001
Arsenic	0.0063	0.00015
Beryllium	<0.0006	<0.00001
Cadmium	0.0073	0.00018
Chromium	0.0027	0.000066
Cobalt	<0.0007	<0.00002
Copper	0.012	0.00029
Lead	0.29	0.007
Manganese	0.021	0.00052
Mercury	<0.0008	<0.00002
Nickel	0.0083	0.0002
Phosphorus	<0.01	<0.0003
Selenium	<0.005	<0.0001
Zinc	1.5	0.036
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	97	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1120	
Final flow measurement time (hhmm)	1236	
Temperature, °C	36	
Velocity at sampling plane, m/s	4	
Velocity at exit plane, m/s	4	
Volumetric flow rate, actual, m³/min	28	
Volumetric flow rate (wet STP), m³/min	25	
Volumetric flow rate (dry STP), m³/min	24	
Mass flow rate (wet basis), kg/hour	1900	
Velocity difference, %	3	

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Roaster Baghouse
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Roaster 6 - 46 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1015 - 1119	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1200	30000
2-Methylnaphthalene	69	1700
Acenaphthylene	<20	<400
Acenaphthene	89	2100
Fluorene	170	4100
Phenanthrene	700	17000
Anthracene	<20	<400
Fluoranthene	1400	34000
Pyrene	98	2300
Benz(a)anthracene	20	470
Chrysene	200	4900
Benzo(b)fluoranthene	180	4300
Benzo(k)fluoranthene	28	660
Benzo(e)pyrene	52	1200
Benzo(a)pyrene	<20	<400
Perylene	<20	<400
Indeno(1,2,3-cd)pyrene	<20	<400
Dibenz(ah)anthracene	<20	<400
Benzo(ghi)perylene	37	870
Total 16 PAHs	4200	100000
Total 19 PAHs	4300	100000
BaP-TEQ		
Lower Bound	25	590
Middle Bound	38	910
Upper Bound	51	1200

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	95
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1014
Final flow measurement time (hhmm)	1120
Temperature, °C	35
Velocity at sampling plane, m/s	3.9
Velocity at exit plane, m/s	3.9
Volumetric flow rate, actual, m³/min	27
Volumetric flow rate (wet STP), m³/min	24
Volumetric flow rate (dry STP), m³/min	24
Mass flow rate (wet basis), kg/hour	1900

3.9 *Anode Casting*

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Anode Casting
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in full operation during testing.		190410

Sampling Plane Details	
Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	0749 - 0848	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.3
Sulfur dioxide	<5	<0.4
Carbon monoxide	<2	<0.2
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.9	

Isokinetic Results	Results	
Sampling time	0740-0840	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	14	1.2
PM10 (PSA)	5.2	0.47
PM2.5 (PSA)	1.4	0.13
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	97	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0725	
Final flow measurement time (hhmm)	0843	
Temperature, °C	23	
Velocity at sampling plane, m/s	10	
Velocity at exit plane, m/s	10	
Volumetric flow rate, actual, m³/min	99	
Volumetric flow rate (wet STP), m³/min	91	
Volumetric flow rate (dry STP), m³/min	90	
Mass flow rate (wet basis), kg/hour	7000	
Velocity difference, %	<1	

Date	14/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Anode Casting
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Casting area in full operation during testing.		190410

Isokinetic Results	Results	
Sampling time	0845-0945	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.049	0.0044
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0843	
Final flow measurement time (hhmm)	0955	
Temperature, °C	24	
Velocity at sampling plane, m/s	10	
Velocity at exit plane, m/s	10	
Volumetric flow rate, actual, m³/min	99	
Volumetric flow rate (wet STP), m³/min	91	
Volumetric flow rate (dry STP), m³/min	90	
Mass flow rate (wet basis), kg/hour	7000	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.4	<0.04

VOC's C5-C20	Results	
Sampling time	0856-0920	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.4	<0.04

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Anode Casting
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	0850-0950	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.009	<0.0008
Arsenic	<0.004	<0.0003
Beryllium	<0.001	<0.0001
Cadmium	0.0083	0.00075
Chromium	<0.002	<0.0002
Cobalt	<0.001	<0.0001
Copper	0.0051	0.00046
Lead	0.22	0.02
Manganese	0.082	0.0074
Mercury	<0.0009	<0.00008
Nickel	<0.003	<0.0003
Phosphorus	0.21	0.019
Selenium	<0.009	<0.0008
Zinc	0.73	0.066
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0843	
Final flow measurement time (hhmm)	0955	
Temperature, °C	24	
Velocity at sampling plane, m/s	10	
Velocity at exit plane, m/s	10	
Volumetric flow rate, actual, m³/min	99	
Volumetric flow rate (wet STP), m³/min	91	
Volumetric flow rate (dry STP), m³/min	90	
Mass flow rate (wet basis), kg/hour	7000	
Velocity difference, %	<1	

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Anode Casting
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0740 - 0840 Concentration ng/m³	Mass Rate ng/min
Naphthalene	1800	160000
2-Methylnaphthalene	580	52000
Acenaphthylene	140**	12000
Acenaphthene	210	19000
Fluorene	820	74000
Phenanthrene	2500	230000
Anthracene	130	11000
Fluoranthene	560	50000
Pyrene	330	29000
Benz(a)anthracene	200	18000
Chrysene	780	70000
Benzo(b)fluoranthene	310	28000
Benzo(k)fluoranthene	120	10000
Benzo(e)pyrene	150	14000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	82	7400
Dibenz(ah)anthracene	80	7200
Benzo(ghi)perylene	88	7900
Total 16 PAHs	8200	730000
Total 19 PAHs	8900	800000
BaP-TEQ		
Lower Bound	110	9900
Middle Bound	120	11000
Upper Bound	130	12000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	97
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	725
Final flow measurement time (hhmm)	0843
Temperature, °C	23
Velocity at sampling plane, m/s	10
Velocity at exit plane, m/s	10
Volumetric flow rate, actual, m³/min	99
Volumetric flow rate (wet STP), m³/min	91
Volumetric flow rate (dry STP), m³/min	90
Mass flow rate (wet basis), kg/hour	7000

3.10 Zinc Plant 1 Baghouse – ZP1

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		190410

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1536 - 1635	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.3
Sulfur dioxide	<5	<0.4
Carbon monoxide	<2	<0.2
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.9	

Isokinetic Results	Results	
Sampling time	1515-1615	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	4.3	0.38
PM10 (PSA)	2.1	0.18
PM2.5 (PSA)	0.53	0.047
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	102	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1500	
Final flow measurement time (hhmm)	1616	
Temperature, °C	29	
Velocity at sampling plane, m/s	8.4	
Velocity at exit plane, m/s	8.4	
Volumetric flow rate, actual, m³/min	99	
Volumetric flow rate (wet STP), m³/min	91	
Volumetric flow rate (dry STP), m³/min	89	
Mass flow rate (wet basis), kg/hour	7000	
Velocity difference, %	<1	

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		190410

Isokinetic Results	Results	
Sampling time	1620-1720	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.05	<0.005
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	102	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1616	
Final flow measurement time (hhmm)	1721	
Temperature, °C	29	
Velocity at sampling plane, m/s	8.5	
Velocity at exit plane, m/s	8.5	
Volumetric flow rate, actual, m³/min	100	
Volumetric flow rate (wet STP), m³/min	92	
Volumetric flow rate (dry STP), m³/min	90	
Mass flow rate (wet basis), kg/hour	7100	
Velocity difference, %	2	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.7	<0.06

VOC's C5-C20	Results	
Sampling time	1657-1712	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.7	<0.06

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		190410

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1620-1720	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.005	<0.0005
Arsenic	<0.003	<0.0002
Beryllium	<0.0006	<0.00006
Cadmium	0.0012	0.0001
Chromium	<0.001	<0.00009
Cobalt	<0.0008	<0.00007
Copper	0.0034	0.0003
Lead	0.06	0.0053
Manganese	0.024	0.0022
Mercury	<0.0005	<0.00005
Nickel	<0.002	<0.0002
Phosphorus	<0.02	<0.002
Selenium	<0.005	<0.0005
Zinc	3.3	0.3
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	96	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1616	
Final flow measurement time (hhmm)	1721	
Temperature, °C	29	
Velocity at sampling plane, m/s	8.5	
Velocity at exit plane, m/s	8.5	
Volumetric flow rate, actual, m³/min	100	
Volumetric flow rate (wet STP), m³/min	92	
Volumetric flow rate (dry STP), m³/min	90	
Mass flow rate (wet basis), kg/hour	7100	
Velocity difference, %	2	

Date	15/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1515 - 1615	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	6700	600000
2-Methylnaphthalene	4400	390000
Acenaphthylene	<20	<2000
Acenaphthene	200	18000
Fluorene	240	21000
Phenanthrene	470	42000
Anthracene	<20	<2000
Fluoranthene	110	9600
Pyrene	42	3800
Benz(a)anthracene	26	2300
Chrysene	<20	<2000
Benzo(b)fluoranthene	<20	<2000
Benzo(k)fluoranthene	<20	<2000
Benzo(e)pyrene	<20	<2000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	<20	<2000
Dibenz(ah)anthracene	<20	<2000
Benzo(ghi)perylene	<20	<2000
Total 16 PAHs	7800	690000
Total 19 PAHs	12000	1100000
BaP-TEQ		
Lower Bound	2.6	230
Middle Bound	19	1700
Upper Bound	36	3200

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	98
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1500
Flow measurement time (hhmm)	1616
Temperature, °C	29
Velocity at sampling plane, m/s	8.4
Velocity at exit plane, m/s	8.4
Volumetric flow rate, actual, m³/min	99
Volumetric flow rate (wet STP), m³/min	91
Volumetric flow rate (dry STP), m³/min	89
Mass flow rate (wet basis), kg/hour	7000

3.11 Zinc Plant 3 Baghouse – ZP3

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		190410

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.8	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1123 - 1222	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Sulfur dioxide	10	0.49
Carbon monoxide	<2	<0.1
	Concentration %	
Carbon dioxide	<0.3	
Oxygen	20.9	

Isokinetic Results		Results	
	Sampling time	1118-1222	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		3.1	0.15
PM10	(PSA)	1.6	0.075
PM2.5	(PSA)	0.42	0.02
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		107	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1100	
Final flow measurement time (hhmm)		1224	
Temperature, °C		70	
Velocity at sampling plane, m/s		16	
Velocity at exit plane, m/s		16	
Volumetric flow rate, actual, m³/min		62	
Volumetric flow rate (wet STP), m³/min		50	
Volumetric flow rate (dry STP), m³/min		48	
Mass flow rate (wet basis), kg/hour		3800	
Velocity difference, %		-1	

Date	14/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		190410

Isokinetic Results	Results	
Sampling time	1225-1329	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.035	0.0017
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	108	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1224	
Final flow measurement time (hhmm)	1330	
Temperature, °C	71	
Velocity at sampling plane, m/s	16	
Velocity at exit plane, m/s	16	
Volumetric flow rate, actual, m³/min	62	
Volumetric flow rate (wet STP), m³/min	49	
Volumetric flow rate (dry STP), m³/min	48	
Mass flow rate (wet basis), kg/hour	3800	
Velocity difference, %	<1	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.7	<0.03

VOC's C5-C20	Results	
Sampling time	1300-1315	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.7	<0.03

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		190410

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	3	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1225-1329	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.006	<0.0003
Arsenic	<0.003	<0.0001
Beryllium	<0.0008	<0.00004
Cadmium	0.0047	0.00023
Chromium	<0.001	<0.00005
Cobalt	<0.001	<0.00005
Copper	0.0038	0.00018
Lead	0.17	0.0082
Manganese	0.034	0.0016
Mercury	<0.0007	<0.00003
Nickel	<0.002	<0.0001
Phosphorus	0.064	0.0031
Selenium	<0.006	<0.0003
Zinc	13	0.61
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1224	
Final flow measurement time (hhmm)	1330	
Temperature, °C	71	
Velocity at sampling plane, m/s	16	
Velocity at exit plane, m/s	16	
Volumetric flow rate, actual, m³/min	62	
Volumetric flow rate (wet STP), m³/min	49	
Volumetric flow rate (dry STP), m³/min	48	
Mass flow rate (wet basis), kg/hour	3800	
Velocity difference, %	<1	

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1118 - 1222	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2600	120000
2-Methylnaphthalene	280	14000
Acenaphthylene	<20	<1000
Acenaphthene	250	12000
Fluorene	260	12000
Phenanthrene	690	33000
Anthracene	<20	<1000
Fluoranthene	190	9200
Pyrene	200	9800
Benz(a)anthracene	<20	<1000
Chrysene	44	2100
Benzo(b)fluoranthene	23	1100
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<1000
Perylene	<20	<1000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	4200	200000
Total 19 PAHs	4500	220000
BaP-TEQ		
Lower Bound	2.7	130
Middle Bound	22	1100
Upper Bound	41	2000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	102
Velocity difference, %	-1.2
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1100
Final flow measurement time (hhmm)	1224
Temperature, °C	70
Velocity at sampling plane, m/s	16
Velocity at exit plane, m/s	16
Volumetric flow rate, actual, m³/min	62
Volumetric flow rate (wet STP), m³/min	50
Volumetric flow rate (dry STP), m³/min	48
Mass flow rate (wet basis), kg/hour	3800

3.12 MZR Furnace Baghouse

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	MZR Furnace
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		190410

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Analyser Results	Average	
Sampling time	1448 - 1547	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	4.8	0.25
Sulfur dioxide	14	0.75
Carbon monoxide	7.7	0.4
	Concentration %	
Carbon dioxide	0.5	
Oxygen	20	

Isokinetic Results	Results	
Sampling time	1440-1540	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	2.5	0.13
PM10 (PSA)	1.2	0.062
PM2.5 (PSA)	0.3	0.016
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	108	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1435	
Final flow measurement time (hhmm)	1542	
Temperature, °C	70	
Velocity at sampling plane, m/s	4.5	
Velocity at exit plane, m/s	4.5	
Volumetric flow rate, actual, m³/min	67	
Volumetric flow rate (wet STP), m³/min	53	
Volumetric flow rate (dry STP), m³/min	52	
Mass flow rate (wet basis), kg/hour	4100	
Velocity difference, %	<1	

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	MZR Furnace
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		190410

Isokinetic Results	Results	
Sampling time	1550-1650	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.04	<0.002
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	108	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1542	
Final flow measurement time (hhmm)	1653	
Temperature, °C	69	
Velocity at sampling plane, m/s	4.4	
Velocity at exit plane, m/s	4.4	
Volumetric flow rate, actual, m³/min	66	
Volumetric flow rate (wet STP), m³/min	53	
Volumetric flow rate (dry STP), m³/min	52	
Mass flow rate (wet basis), kg/hour	4100	
Velocity difference, %	-2	

Total Speciated VOCs	Results	
Lower Bound		
	Concentration mg/m³	Mass Rate g/min
Total	<0.7	<0.04

VOC's C5-C20	Results	
Sampling time	1559-1614	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.7	<0.04

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	14/05/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	MZR Furnace
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & N Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		190410

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.7	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1550-1650	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.004	<0.0002
Arsenic	<0.002	<0.0001
Beryllium	<0.0005	<0.00003
Cadmium	<0.0008	<0.00004
Chromium	<0.0006	<0.00003
Cobalt	<0.0006	<0.00003
Copper	0.0022	0.00011
Lead	0.02	0.001
Manganese	0.014	0.0007
Mercury	<0.0004	<0.00002
Nickel	<0.001	<0.00007
Phosphorus	<0.01	<0.0006
Selenium	<0.004	<0.0002
Zinc	1	0.052
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	104	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1542	
Final flow measurement time (hhmm)	1653	
Temperature, °C	69	
Velocity at sampling plane, m/s	4.4	
Velocity at exit plane, m/s	4.4	
Volumetric flow rate, actual, m³/min	66	
Volumetric flow rate (wet STP), m³/min	53	
Volumetric flow rate (dry STP), m³/min	52	
Mass flow rate (wet basis), kg/hour	4100	
Velocity difference, %	-2	

Date	14/05/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	MZR Furnace
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & N Heatley	State	TAS
Process Conditions	MZR Furnace in operation.		190410

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1440 - 1540	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1900	99000
2-Methylnaphthalene	340	18000
Acenaphthylene	<20	<900
Acenaphthene	250	13000
Fluorene	230	12000
Phenanthrene	670	35000
Anthracene	<20	<900
Fluoranthene	300	15000
Pyrene	130	6800
Benz(a)anthracene	<20	<900
Chrysene	34	1800
Benzo(b)fluoranthene	<20	<900
Benzo(k)fluoranthene	<20	<900
Benzo(e)pyrene	<20	<900
Benzo(a)pyrene	<20	<900
Perylene	<20	<900
Indeno(1,2,3-cd)pyrene	<20	<900
Dibenz(ah)anthracene	<20	<900
Benzo(ghi)perylene	34	1800
Total 16 PAHs	3500	180000
Total 19 PAHs	3900	200000
BaP-TEQ		
Lower Bound	0.34	18
Middle Bound	16	830
Upper Bound	32	1600

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	103
Velocity difference, %	<1
Gas Flow Parameters	
Initial flow measurement time (hhmm)	1435
Final flow measurement time (hhmm)	1542
Temperature, °C	70
Velocity at sampling plane, m/s	4.5
Velocity at exit plane, m/s	4.5
Volumetric flow rate, actual, m³/min	67
Volumetric flow rate (wet STP), m³/min	53
Volumetric flow rate (dry STP), m³/min	52
Mass flow rate (wet basis), kg/hour	4100

3.13 Package Boiler 1

Date	5/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Package Boiler 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J.Cacchioni	**State**	TAS
Process Conditions	16.5 tonnes/hr of steam		190410

Sampling Plane Details	
Sampling plane dimensions	980 mm
Sampling plane area	0.754 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Stairs & fixed ladder 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Connection 6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1

Stack Parameters		
Moisture content, %v/v	9.5	
Gas molecular weight, g/g mole	29.1 (wet)	30.2 (dry)
Gas density at STP, kg/m³	1.30 (wet)	1.35 (dry)
% Oxygen correction & Factor	7 %	0.87

Gas Analyser Results	Average		
Sampling time	1623 - 1722		
Combustion Gases	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	150	130	30
Sulfur dioxide	<5	<4	<0.9
Carbon monoxide	<2	<2	<0.4
	Concentration %		
Carbon dioxide	11.8		
Oxygen	4.9		

Date	5/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Package Boiler 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J.Cacchioni	**State**	TAS
Process Conditions	16.5 tonnes/hr of steam		190410

Isokinetic Results	Results		
Sampling time	1618-1718		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Total particulate matter	<2	<2	<0.5
Antimony	<0.005	<0.004	<0.001
Arsenic	<0.003	<0.002	<0.0006
Beryllium	<0.0006	<0.0005	<0.0001
Cadmium	0.019	0.017	0.0039
Chromium	0.0049	0.0042	0.00097
Cobalt	0.0015	0.0013	0.00031
Copper	0.031	0.027	0.0062
Lead	0.061	0.053	0.012
Manganese	0.025	0.021	0.0049
Mercury	<0.0005	<0.0005	<0.0001
Nickel	0.0053	0.0047	0.0011
Phosphorus	<0.02	<0.02	<0.004
Selenium	<0.005	<0.004	<0.001
Zinc	0.8	0.69	0.16
Isokinetic Sampling Parameters			
Sampling time, min	60		
Isokinetic rate, %	94		
Gas Flow Parameters			
Initial flow measurement time (hhmm)	1613		
Final flow measurement time (hhmm)	1722		
Temperature, °C	198		
Velocity at sampling plane, m/s	8.3		
Velocity at exit plane, m/s	8.3		
Volumetric flow rate, actual, m³/min	380		
Volumetric flow rate (wet STP), m³/min	220		
Volumetric flow rate (dry STP), m³/min	200		
Mass flow rate (wet basis), kg/hour	17000		
Velocity difference, %	-4		

3.14 Package Boiler 2

Date	5/06/2019	**Client**	Nyrstar Hobart
Report	R006516	**Stack ID**	Package Boiler 2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & J.Cacchioni	**State**	TAS
Process Conditions	16.5 tonnes/hr of steam		190410

Sampling Plane Details	
Sampling plane dimensions	980 mm
Sampling plane area	0.754 m²
Sampling port size, number & depth	4" Flange (x2), 180 mm
Access & height of ports	Stairs & fixed ladder 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Connection 6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1

Stack Parameters		
Moisture content, %v/v	8.5	
Gas molecular weight, g/g mole	29.3 (wet)	30.3 (dry)
Gas density at STP, kg/m³	1.31 (wet)	1.35 (dry)

Gas Analyser Results	Average		
Sampling time	1512 - 1611		
Combustion Gases	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	160	130	32
Sulfur dioxide	<5	<4	<0.9
Carbon monoxide	<2	<2	<0.4
	Concentration %		
Carbon dioxide	12.6		
Oxygen	3.9		

Date	5/06/2019	Client	Nyrstar Hobart
Report	R006516	Stack ID	Package Boiler 2
Licence No.	7043/5	Location	Hobart
Ektimo Staff	G Trenear & J.Cacchioni	State	TAS
Process Conditions	16.5 tonnes/hr of steam		190410

Isokinetic Results	Results		
Sampling time	1509-1609		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Total particulate matter	<2	<1	<0.4
Antimony	<0.005	<0.004	<0.001
Arsenic	<0.003	<0.002	<0.0005
Beryllium	<0.0005	<0.0004	<0.0001
Cadmium	0.028	0.023	0.0057
Chromium	0.0037	0.0031	0.00077
Cobalt	0.0022	0.0018	0.00045
Copper	0.055	0.045	0.011
Lead	0.072	0.059	0.015
Manganese	0.033	0.027	0.0067
Mercury	<0.0004	<0.0003	<0.00009
Nickel	0.003	0.0024	0.00061
Phosphorus	<0.02	<0.01	<0.003
Selenium	<0.005	<0.004	<0.0009
Zinc	0.88	0.72	0.18
Isokinetic Sampling Parameters			
Sampling time, min	60		
Isokinetic rate, %	101		
Gas Flow Parameters			
Initial flow measurement time (hhmm)	1500		
Final flow measurement time (hhmm)	1611		
Temperature, °C	210		
Velocity at sampling plane, m/s	8.7		
Velocity at exit plane, m/s	8.7		
Volumetric flow rate, actual, m³/min	400		
Volumetric flow rate (wet STP), m³/min	220		
Volumetric flow rate (dry STP), m³/min	210		
Mass flow rate (wet basis), kg/hour	18000		
Velocity difference, %	-5		

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Nyrstar Hobart 's records for complete process conditions.

5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Sulfur dioxide	USEPA 6C	USEPA 6C	12%	✓	✓
Volatile organic compounds	Vic EPA 4230	Ektimo 344	19%	✓	✓†
Total particulate matter	AS 4323.2	AS 4323.2	5%	✓	✓
Particulate matter (PM_{10} and $PM_{2.5}$) by particle size analysis	AS 4323.2	HRL In-house	-	-	✗**
Polycyclic aromatic hydrocarbons (PAH's)	USEPA SW-846 0010	NGCMS 11.27	21%	✓	✓¶
Sulfuric acid mist and/or sulfur oxides	USEPA 8	Ektimo 235	16%	✓	✓†
Total fluoride	USEPA 13B	ALS Method QWI-EN/EA144C & Ektimo 235	17%	✓	✓#,†
Nitrous oxide	Teledyne T320 Analyser	NA	not specified	✗	✗
Metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓¶

190522

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis performed by Ektimo, NATA accreditation number 14601.
Laboratory analytical results were reported on 7 June 2019 in report number R006516_SVOCs.
Laboratory analytical results were reported on 29 May 2019 in report number R006516-Halides_Halgoens.
Laboratory analytical results were reported on 30 May 2019 in report number R006516-SOx.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 31 May, 20 June &3 July 2019 in report number 218238, 219510 & 220473.

¶ Analysis performed by Australian Government National Measurement Institute, NATA accreditation number 198. Results were reported to Ektimo on 25 June & 26 July 2019 in report numbers ORG19_037, ORG19_037B & ORG19_045.

** Analysis performed by HRL Technology using a Malvern Instruments Mastersizer laser particle size analyser. NATA Accreditation does not cover the performance of this service.

Analysis (solid fluoride only) performed by Australian Laboratory Services Pty Ltd, NATA accreditation number 825. Results were reported to Ektimo on 31 May & 2 July 2019 in report number EN1903670 & EN1904414.

6 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

7 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.

8 APPENDIX 1: WEATHER OBSERVATIONS

Hobart Airport Tasmania May 2019

		Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
Date	Day	Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8^{th}		km/h	hPa	°C	%	8^{th}		km/h	hPa
13	Mo	7.6	19.9	0	2.4	8.1	NW	83	13:18	15.5	51	6	NNW	24	1016.7	18.3	34	1	NW	54	1011.9
14	Tu	9.6	16.0	1.6	4.8	7.0	NW	59	15:38	11.9	52	5	NNW	13	1020.0	15.1	46	5	NW	28	1019.5
15	We	10.9	19.3	0	3.4	7.6	WNW	41	00:09	14.4	59	6	NNW	19	1026.0	18.3	41	2	W	22	1025.5
16	Th	6.8	17.6	0	2.8	9.0	NNW	30	07:09	9.8	80	1	NW	19	1026.5	17.1	46	1	N	7	1023.0
17	Fr	6.9	18.2	0	1.8	6.5	NW	46	13:32	11.6	64	7	NNW	20	1023.8	16.0	44	7	NW	20	1022.7
20	Mo	4.4	15.5	0	1.6	3.4	N	31	16:58	9.4	76	7	NW	17	1021.2	12.3	80	7	NW	17	1016.2
Statistics for May 2019																					
Mean		7.2	16.3		2.2	5.0				11.2	66	4		16	1015.3	14.8	52	5		20	1013.6
Lowest		2.4	10.2	0	0.2	0.0				5.9	45	1	W	4	991.6	7.9	33	1	N	7	990.3
Highest		11.5	21.5	7.4	4.8	9.0	NW	83		15.7	88	7	WNW	30	1029.7	21.1	80	7	NW	54	1027.5
Total				16.8	68.6	154.9															

Hobart Airport Tasmania June 2019

		Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
Date	Day	Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8^{th}		km/h	hPa	°C	%	8^{th}		km/h	hPa
5	We	1.9	13.7	0	1.2	3.4	NW	72	13:48	9.8	59	2	WNW	31	1024.9	11.7	53	7	NW	43	1018.9
24	Mo	0.3	10.7	0.2	0.8	8.3	NNW	30	07:46	3.3	84	1	NNW	19	1034.0	10.6	54	1		Calm	1032.0
Statistics for June 2019																					
Mean		5.2	13.7		1.4	4.8				8.4	71	5		15	1021.6	12.6	58	5		16	1019.3
Lowest		0.3	10.2	0	0.4	0.0				3.3	53	1		Calm	997.9	7.5	36	1		Calm	997.9
Highest		11.7	18.3	7.2	3.2	8.3	NW	72		13.6	91	8	NW	33	1034.8	17.1	86	8	NW	43	1032.0
Total				23.4	41.2	142.8															

REPORT NUMBER R007168

Emission Testing Report

Round 2 – October/November 2019

Nyrstar Hobart , Lutana

Document Information

Template Version: 170120

Client Name:	Nyrstar Hobart
Report Number:	R007168
Date of Issue:	17 January 2020
Attention:	Joel Cooper
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

NATA Accredited Laboratory
No. 14601

Glenn Trenear
Client Manager

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 *Background*

Ektimo was engaged by Nyrstar Hobart to perform emission monitoring. This formed the second round of scheduled monitoring for 2019.

Testing was carried out in accordance with Tasmanian EPN notice 7043/5.

1.2 *Project Objectives*

The objectives of the project were to conduct a monitoring programme to quantify emissions from 12 discharge points to determine compliance with Nyrstar's Environmental Licence.

Location	Test Date	Test Parameters*
Foreshore A	18 November 2019	Total particulate matter Metals Sulfur dioxide, sulfur trioxide Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen
Foreshore B	18 November 2019	
Parageothite Dryer	8 October 2019	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Cadmium Smelter	19 November 2019	
Copper Sulphate Stack	17 November 2019	
Casting Ventilation 1 – V1	4 November 2019	
Casting Ventilation 2 – V2	4 November 2019	
Roaster Baghouse	18 November 2019	Total particulate matter Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Anode Casting	9 October 2019	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Zinc Plant 1 Baghouse – ZP1	19 November 2019	
Zinc Plant 3 Baghouse – ZP3	17 November 2019	
MZR Furnace Baghouse	17 November 2019	

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP

Plant operating conditions have been noted in the report.

1.3 *Licence Comparison*

The following licence comparison table shows that all analytes highlighted in green are below the licence limit as set by the Tasmanian EPN notice 7043/5.

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	**0.33**
	Oxides of nitrogen (as NO_2)	g/m^3	2	**0.061**
	Particulates	mg/m^3	100	**<1**
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	**2.8**
	Oxides of nitrogen (as NO_2)	g/m^3	2	**0.076**
	Particulates	mg/m^3	100	**<2**
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	**2.8**
V1 Furnace Stack				**3.3**
V2 Furnace Stack				**<2**
Zinc Dust Plant Baghouse 1 Stack				**5.5**
Zinc Dust Plant Bagouse 3 Stack				**6.5**
Cadmium Smelter Plant Scrubber Stack				**<2**
Copper Sulphate Crystalliser Plant				**3.7**
Roaster Baghouse				**9**
Paragoethite Dryer Baghouse				**37**
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	**≤0.16**
V1 Furnace Stack				**≤0.013**
V2 Furnace Stack				**≤0.022**
Zinc Dust Plant Baghouse 1 Stack				**≤0.1**
Zinc Dust Plant Baghouse 3 Stack				**≤0.083**
Cadmium Smelter Plant Scrubber Stack				**≤0.059**
Copper Sulphate Crystalliser Plant				**≤0.057**
Roaster Baghouse				**≤0.43**
Paragoethite Dryer Baghouse				**≤1.1**
Anode Casting Plant Exhaust	Metals - Hg	mg/m3	1	**<0.0002**
V1 Furnace Stack				**<0.0004**
V2 Furnace Stack				**<0.0004**
Zinc Dust Plant Baghouse 1 Stack				**0.00075**
Zinc Dust Plant Baghouse 3 Stack				**<0.0007**
Cadmium Smelter Plant Scrubber Stack				**0.00033**
Copper Sulphate Crystalliser Plant				**0.0007**
Roaster Baghouse				**<0.0005**
Paragoethite Dryer Baghouse				**<0.0004**
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	**<0.0004**
V1 Furnace Stack				**<0.0004**
V2 Furnace Stack				**<0.0009**
Zinc Dust Plant Baghouse 1 Stack				**0.0037**
Zinc Dust Plant Baghouse 3 Stack				**0.0056**
Cadmium Smelter Plant Scrubber Stack				**0.013**
Copper Sulphate Crystalliser Plant				**0.015**
Roaster Baghouse				**0.021**
Paragoethite Dryer Baghouse				**0.0065**

(1) Total concentration of metals combined.

*Please note that the measurement uncertainty associated with the test results **was not** considered when determining whether the results were compliant or non-compliant.*

Refer to the Test Methods table for the measurement uncertainties.

2 RESULTS

2.1 *Foreshore A*

Date	18/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Foreshore A
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 108000 m3/hr of gas through the acid stream.		191029

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0925, 1125 & 1323	
Temperature, °C	19	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/min	2100	
Volumetric flow rate (wet STP), m³/min	1900	
Volumetric flow rate (dry STP), m³/min	1900	
Mass flow rate (wet basis), kg/hour	150000	

Gas Analyser Results	Average	
Sampling time	1000 - 1059	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	61	120
Nitrous oxide	<1	<2
Carbon monoxide	<2	<4
	Concentration %v/v	
Carbon dioxide	0.4	
Oxygen	8.6	

Note: Nitrous Oxide as N_2O measurements are not NATA accredited.

Ektimo

Date	18/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Foreshore A
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 108000 m3/hr of gas through the acid stream.		*191029*

Isokinetic Results	Results	
Sampling time	0940-1120	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.004**	**<0.008**
Arsenic	**<0.003**	**<0.005**
Beryllium	<0.0005	<0.001
Cadmium	**0.0043**	**0.0082**
Chromium	0.00083	0.0016
Cobalt	<0.0006	<0.001
Copper	0.015	0.028
Lead	**0.041**	**0.078**
Manganese	0.069	0.13
Mercury	**0.0008**	**0.0015**
Nickel	0.0017	0.0034
Phosphorus	0.071	0.14
Selenium	<0.004	<0.008
Zinc	0.8	1.5
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	104	
Velocity difference, %	4	

Isokinetic Results	Results	
Sampling time	1130-1310	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<1	<2
Sulfur dioxide	5.8	11
Sulfur trioxide	0.33	0.62
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	95	
Velocity difference, %	-7	

NATA

2.2 *Foreshore B*

Date	18/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Foreshore B
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 108000 m3/hr of gas through the acid stream.		191029

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0930, 1123 & 1310
Temperature, °C	18
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	1800
Volumetric flow rate (wet STP), m³/min	1700
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000

Gas Analyser Results	Average	
Sampling time	1108 - 1207	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	76	130
Nitrous oxide	<1	<2
Carbon monoxide	3	5
	Concentration % v/v	
Carbon dioxide	0.5	
Oxygen	9.6	

Note: Nitrous Oxide as N_2O measurements are not NATA accredited.

Date	18/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Foreshore B
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Unit 5 producing 58000 m3/hr & Unit 6 producing 108000 m3/hr of gas through the acid stream.		191029

Isokinetic Results	Results	
Sampling time	0940-1120	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<3
Sulfur dioxide	12	20
Sulfur trioxide	2.8	4.7
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	
Velocity difference, %	-2	

Isokinetic Results	Results	
Sampling time	1125-1305	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.003**	**<0.005**
Arsenic	**0.0019**	**0.0031**
Beryllium	<0.0004	<0.0006
Cadmium	**0.0036**	**0.0061**
Chromium	<0.0005	<0.0008
Cobalt	<0.0005	<0.0008
Copper	0.012	0.02
Lead	**0.059**	**0.099**
Manganese	0.08	0.13
Mercury	**0.00066**	**0.0011**
Nickel	<0.0008	<0.001
Phosphorus	0.04	0.067
Selenium	<0.003	<0.005
Zinc	0.48	0.8
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	105	
Velocity difference, %	2	

2.3 *Parageothite Dryer*

Date	8/10/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Paragoethite Dryer
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	**State**	TAS
Process Conditions	Approx 7 m3/hr of dirt into the drum. Feed rate began dropping away towards end of test		190926

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	30	
Gas molecular weight, g/g mole	25.8 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.15 (wet)	1.30 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1535 & 1700	
Temperature, °C	88	
Velocity at sampling plane, m/s	10	
Volumetric flow rate, actual, m³/min	420	
Volumetric flow rate (wet STP), m³/min	320	
Volumetric flow rate (dry STP), m³/min	230	
Mass flow rate (wet basis), kg/hour	22000	
Velocity difference, %	3	

Gas Analyser Results	Average	
Sampling time	1556 - 1655	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	55	12
Carbon monoxide	<20	<6
	Concentration %v/v	
Carbon dioxide	2.9	
Oxygen	15.6	

Ektimo

Date	8/10/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Paragoethite Dryer
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	**State**	TAS
Process Conditions	Approx 7 m3/hr of dirt into the drum. Feed rate began dropping away towards end of test		*190926*

Isokinetic Results	Results	
Sampling time	1552-1654	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	37	8.3
Antimony	**<0.006**	**<0.001**
Arsenic	**0.057**	**0.013**
Beryllium	<0.0008	<0.0002
Cadmium	**0.0065**	**0.0015**
Chromium	0.0075	0.0017
Cobalt	<0.002	<0.0004
Copper	0.14	0.032
Lead	**1**	**0.23**
Manganese	0.26	0.059
Mercury	**<0.0004**	**<0.00009**
Nickel	0.14	0.032
Phosphorus	<0.04	<0.009
Selenium	<0.006	<0.001
Zinc	1.5	0.35
Total of Sb, As, Cd, Pb, Hg	**≤1.1**	**≤0.24**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	109	

NATA

2.4 *Cadmium Smelter*

Date	19/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Cadmium Smelter
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & B Minchinton	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		191029

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1300 & 1414
Temperature, °C	19
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	180
Volumetric flow rate (wet STP), m³/min	170
Volumetric flow rate (dry STP), m³/min	160
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	2

Gas Analyser Results	Average	
Sampling time	1320 - 1419	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.5
Carbon monoxide	<2	<0.3
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20	

Date	19/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Cadmium Smelter
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear & B Minchinton	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		191029

Isokinetic Results	Results	
Sampling time	1310-1410	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.3
Antimony	**<0.005**	**<0.0009**
Arsenic	**<0.002**	**<0.0004**
Beryllium	<0.0007	<0.0001
Cadmium	**0.013**	**0.0021**
Chromium	<0.001	<0.0002
Cobalt	<0.0008	<0.0001
Copper	0.01	0.0017
Lead	**0.038**	**0.0063**
Manganese	0.032	0.0053
Mercury	**0.00033**	**0.000053**
Nickel	<0.001	<0.0002
Phosphorus	0.1	0.017
Selenium	<0.005	<0.0009
Zinc	0.44	0.072
Total of Sb, As, Cd, Pb, Hg	**≤0.059**	**≤0.0096**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	

2.5 Copper Sulphate Stack

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Production rate - 20 tonnes/day, Dryer Outlet Temperature - 45 deg C, Feed rate into Dryer - 40%		191029

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	8.9	
Gas molecular weight, g/g mole	28.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1300 & 1410	
Temperature, °C	45	
Velocity at sampling plane, m/s	18	
Volumetric flow rate, actual, m³/min	210	
Volumetric flow rate (wet STP), m³/min	180	
Volumetric flow rate (dry STP), m³/min	160	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1319 - 1418	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.5
Carbon monoxide	17	2.7
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.5	

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Copper Sulphate Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Production rate - 20 tonnes/day, Dryer Outlet Temperature - 45 deg C, Feed rate into Dryer - 40%		191029

Isokinetic Results	Results	
Sampling time	1305-1405	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	3.7	0.6
Antimony	**<0.006**	**<0.001**
Arsenic	**<0.003**	**<0.0004**
Beryllium	<0.0008	<0.0001
Cadmium	**0.015**	**0.0023**
Chromium	0.023	0.0037
Cobalt	<0.001	<0.0002
Copper	0.035	0.0057
Lead	**0.033**	**0.0054**
Manganese	0.052	0.0084
Mercury	**0.0007**	**0.00011**
Nickel	0.033	0.0052
Phosphorus	0.063	0.01
Selenium	<0.008	<0.001
Zinc	0.21	0.033
Total of Sb, As, Cd, Pb, Hg	**≤0.057**	**≤0.0093**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	

2.6 *Casting Ventilation 1 – V1*

Date	4/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		191029

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.30 (dry)

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1100 & 1300
Temperature, °C	29
Velocity at sampling plane, m/s	10
Volumetric flow rate, actual, m³/min	190
Volumetric flow rate (wet STP), m³/min	170
Volumetric flow rate (dry STP), m³/min	170
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	5

Gas Analyser Results	Average	
Sampling time	1057 - 1156	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.7
Carbon monoxide	<20	<4
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	21	

Ektimo

Date	4/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		*191029*

Isokinetic Results	Results	
Sampling time	1155-1255	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	3.3	0.55
Antimony	**<0.004**	**<0.0007**
Arsenic	**<0.002**	**<0.0003**
Beryllium	<0.0005	<0.00008
Cadmium	**<0.0004**	**<0.00007**
Chromium	0.00099	0.00017
Cobalt	<0.0006	<0.0001
Copper	0.0015	0.00025
Lead	**0.0065**	**0.0011**
Manganese	0.014	0.0024
Mercury	**<0.0004**	**<0.00006**
Nickel	<0.001	<0.0002
Phosphorus	<0.01	<0.002
Selenium	<0.004	<0.0007
Zinc	0.56	0.094
Total of Sb, As, Cd, Pb, Hg	**≤0.013**	**≤0.0022**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	106	

NATA

2.7 Casting Ventilation 2 – V2

Date	4/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		191029

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	<0.4	
Gas molecular weight, g/g mole	29.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.30 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1105 & 1310
Temperature, °C	60
Velocity at sampling plane, m/s	22
Volumetric flow rate, actual, m³/min	370
Volumetric flow rate (wet STP), m³/min	300
Volumetric flow rate (dry STP), m³/min	300
Mass flow rate (wet basis), kg/hour	23000
Velocity difference, %	-1

Gas Analyser Results	Average	
Sampling time	1209 - 1308	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<1
Carbon monoxide	<20	<7
	Concentration %v/v	
Carbon dioxide	<0.4	
Oxygen	21	

Date	4/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		191029

Isokinetic Results	Results	
Sampling time	1203-1303	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.6
Antimony	**<0.005**	**<0.001**
Arsenic	**<0.002**	**<0.0006**
Beryllium	<0.0006	<0.0002
Cadmium	**<0.0009**	**<0.0003**
Chromium	<0.0007	<0.0002
Cobalt	<0.0007	<0.0002
Copper	0.012	0.0036
Lead	**0.014**	**0.0042**
Manganese	0.03	0.0088
Mercury	**<0.0004**	**<0.0001**
Nickel	0.006	0.0018
Phosphorus	<0.01	<0.004
Selenium	<0.005	<0.001
Zinc	0.35	0.11
Total of Sb, As, Cd, Pb, Hg	**≤0.022**	**≤0.0066**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	95	

2.8 *Roaster Baghouse*

Date	18/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Roaster Baghouse
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Roaster 6 - 49 t/hr, Roaster 5 - 20 t/hr (Conveyor all in operation), fumes were on		191029

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1340 & 1450	
Temperature, °C	39	
Velocity at sampling plane, m/s	3.6	
Volumetric flow rate, actual, m³/min	25	
Volumetric flow rate (wet STP), m³/min	22	
Volumetric flow rate (dry STP), m³/min	21	
Mass flow rate (wet basis), kg/hour	1700	

Gas Analyser Results	Average	
Sampling time	1356 - 1455	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.07
Sulfur dioxide	<5	<0.1
Carbon monoxide	<2	<0.04
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	18/11/2019	Client	Nyrstar Hobart
Report	R007168	Stack ID	Roaster Baghouse
Licence No.	7043/5	Location	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	State	TAS
Process Conditions	Roaster 6 - 49 t/hr, Roaster 5 - 20 t/hr (Conveyor all in operation), fumes were on		191029

Isokinetic Results	Results	
Sampling time	1341-1445	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	9	0.19
Antimony	**<0.005**	**<0.0001**
Arsenic	**0.0094**	**0.0002**
Beryllium	<0.0006	<0.00001
Cadmium	**0.021**	**0.00045**
Chromium	<0.0008	<0.00002
Cobalt	<0.0008	<0.00002
Copper	0.041	0.00088
Lead	**0.39**	**0.0083**
Manganese	0.11	0.0024
Mercury	**<0.0005**	**<0.00001**
Nickel	<0.001	<0.00003
Phosphorus	0.14	0.0031
Selenium	<0.005	<0.0001
Zinc	2.5	0.053
Total of Sb, As, Cd, Pb, Hg	**≤0.43**	**≤0.009**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	93	
Velocity difference, %	<1	

2.9 *Anode Casting*

Date	9/10/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Anode Casting
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	**State**	TAS
Process Conditions	Casting area in full production during testing		191008

Sampling Plane Details	
Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.30 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0815 & 0930	
Temperature, °C	24	
Velocity at sampling plane, m/s	9.6	
Volumetric flow rate, actual, m³/min	91	
Volumetric flow rate (wet STP), m³/min	85	
Volumetric flow rate (dry STP), m³/min	83	
Mass flow rate (wet basis), kg/hour	6500	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	0828 - 0927	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.3
Carbon monoxide	<20	<2
	Concentration %v/v	
Carbon dioxide	<0.4	
Oxygen	21	

Date	9/10/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Anode Casting
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	**State**	TAS
Process Conditions	Casting area in full production during testing		191008

Isokinetic Results	Results	
Sampling time	0828-0930	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	2.8	0.23
Antimony	**<0.004**	**<0.0004**
Arsenic	**<0.002**	**<0.0002**
Beryllium	<0.0005	<0.00004
Cadmium	**<0.0004**	**<0.00004**
Chromium	<0.0006	<0.00005
Cobalt	<0.0006	<0.00005
Copper	0.014	0.0011
Lead	**0.16**	**0.013**
Manganese	0.031	0.0025
Mercury	**<0.0002**	**<0.00002**
Nickel	<0.001	<0.00009
Phosphorus	<0.01	<0.0009
Selenium	<0.004	<0.0004
Zinc	0.069	0.0057
Total of Sb, As, Cd, Pb, Hg	**≤0.16**	**≤0.014**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	102	

2.10 *Zinc Plant 1 Baghouse – ZP1*

Date	19/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		191029

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	1.4	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1050 & 1205	
Temperature, °C	29	
Velocity at sampling plane, m/s	8.1	
Volumetric flow rate, actual, m³/min	95	
Volumetric flow rate (wet STP), m³/min	86	
Volumetric flow rate (dry STP), m³/min	85	
Mass flow rate (wet basis), kg/hour	6700	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1106 - 1205	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.3
Carbon monoxide	<2	<0.2
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.8	

Date	19/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Ben Minchinton	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		191029

Isokinetic Results	Results	
Sampling time	1100-1200	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	5.5	0.46
Antimony	**<0.005**	**<0.0004**
Arsenic	**<0.004**	**<0.0003**
Beryllium	<0.0006	<0.00005
Cadmium	**0.0037**	**0.00031**
Chromium	0.0019	0.00016
Cobalt	<0.0008	<0.00007
Copper	0.013	0.0011
Lead	**0.087**	**0.0074**
Manganese	0.053	0.0045
Mercury	**0.00075**	**0.000064**
Nickel	0.011	0.00092
Phosphorus	0.16	0.013
Selenium	<0.005	<0.0004
Zinc	3.3	0.28
Total of Sb, As, Cd, Pb, Hg	**≤0.1**	**≤0.0086**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

2.11 *Zinc Plant 3 Baghouse – ZP3*

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		191029

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.5	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1452 & 1602	
Temperature, °C	74	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/min	59	
Volumetric flow rate (wet STP), m³/min	46	
Volumetric flow rate (dry STP), m³/min	45	
Mass flow rate (wet basis), kg/hour	3600	
Velocity difference, %	-2	

Gas Analyser Results	Average	
Sampling time	1500 - 1559	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.1
Carbon monoxide	<2	<0.09
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		*191029*

Isokinetic Results	Results	
Sampling time	1456-1600	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	6.5	0.29
Antimony	**<0.007**	**<0.0003**
Arsenic	**<0.003**	**<0.0001**
Beryllium	<0.0009	<0.00004
Cadmium	**0.0056**	**0.00025**
Chromium	0.0027	0.00012
Cobalt	<0.001	<0.00005
Copper	0.026	0.0012
Lead	**0.067**	**0.003**
Manganese	0.028	0.0013
Mercury	**<0.0007**	**<0.00003**
Nickel	0.0025	0.00011
Phosphorus	0.12	0.0055
Selenium	<0.007	<0.0003
Zinc	3.4	0.15
Total of Sb, As, Cd, Pb, Hg	**≤0.083**	**≤0.0037**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	94	

2.12 *MZR Furnace Baghouse*

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	MZR Furnace
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	MZR Furnace in operation.		191029

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1655 & 1802	
Temperature, °C	45	
Velocity at sampling plane, m/s	5.8	
Volumetric flow rate, actual, m³/min	86	
Volumetric flow rate (wet STP), m³/min	74	
Volumetric flow rate (dry STP), m³/min	72	
Mass flow rate (wet basis), kg/hour	5700	
Velocity difference, %	-6	

Gas Analyser Results	Average	
Sampling time	1705 - 1805	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Carbon monoxide	<2	<0.1
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.3	

Date	17/11/2019	**Client**	Nyrstar Hobart
Report	R007168	**Stack ID**	MZR Furnace
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	MZR Furnace in operation.		191029

Isokinetic Results	Results	
Sampling time	1700-1800	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.1
Antimony	**<0.005**	**<0.0004**
Arsenic	**<0.002**	**<0.0002**
Beryllium	<0.0006	<0.00005
Cadmium	**0.0045**	**0.00033**
Chromium	0.0028	0.0002
Cobalt	<0.0008	<0.00006
Copper	0.014	0.001
Lead	**0.025**	**0.0018**
Manganese	0.027	0.002
Mercury	**<0.0005**	**<0.00004**
Nickel	0.0019	0.00014
Phosphorus	0.076	0.0055
Selenium	<0.005	<0.0004
Zinc	1.2	0.083
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

3 PLANT OPERATING CONDITIONS

See Nyrstar Hobart 's records for complete process conditions.

4 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Method Detection Limit	Uncertainty*	NATA Accredited	
					Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	Location specific	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	0.4%	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	0.1%	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	3 mg/m³	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	4 mg/m³	12%	✓	✓
Sulfur dioxide	USEPA 6C	USEPA 6C	6 mg/m³	12%	✓	✓
Total particulate matter	AS 4323.2	AS 4323.2††	1 mg/m³	5%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	Analyte specific	15%	✓	✓‡
Sulfuric acid mist and/or sulfur oxides	USEPA 8	Ektimo 235	0.02 mg/m³	16%	✓	✓†
Nitrous oxide	Teledyne T320 Analyser	NA	not specified	not specified	×	×

191030

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.
Results were reported to Ektimo on 2 December 2019 in report number R007168-SOx

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901.Results were reported to Ektimo on
30 October 2019 in report number 229037
25 November 2019 in report number 231063
11 December 2019 in report number 232317

5 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

6 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

7 APPENDIX 1: WEATHER OBSERVATIONS

Hobart – October 2019

Date	Day	Temps Min	Temps Max	Rain	Evap	Sun	Max wind gust Dir	Max wind gust Spd	Max wind gust Time	9:00 AM Temp	9:00 AM RH	9:00 AM Cld	9:00 AM Dir	9:00 AM Spd	9:00 AM MSLP	3:00 PM Temp	3:00 PM RH	3:00 PM Cld	3:00 PM Dir	3:00 PM Spd	3:00 PM MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Tu	3.5	16.5	0	3.4	11.4	SE	31	17:41	10.4	56	4	N	11	1027.4	15	50	1	ESE	17	1025
2	We	5	18.9	0.2	3.2	10.7	ESE	30	15:43	13	58	2	NNW	11	1023.5	17	43	2	ESE	17	1020.7
3	Th	10.6	28.2	0	3.8	10.7	N	50	15:48	18.9	39	1	NNW	20	1018.1	27	28	3	SE	9	1010.5
4	Fr	11.2	15.5	0	6.2	7.4	SSW	56	5:19	13.9	48	2	NNE	11	1017.1	13.6	47	6	SSW	20	1018.7
5	Sa	2.9	15.4	0	4	11.4	N	31	22:58	10.1	57	1	NNW	15	1025.5	13.8	53	1	ESE	19	1019.6
6	Su	9.1	17.5	0	4.4	4.2	SSW	44	18:07	12.4	67	7	N	17	1003.2	15	74	7	SE	19	996.7
7	Mo	8.3	17.1	1.4	4.6	4.4	WNW	43	11:19	12	53	5	NNW	22	1008.1	15.5	42	7	NW	20	1006.4
8	Tu	8.7	14.2	0	2.6	8.5	SSW	61	9:59	9.8	62	7	SSW	17	1014.5	13.6	48	5	WSW	13	1017.3
9	We	5.1	15.3	0.8	4	2.3	SW	46	8:48	11.6	65	6	NW	11	1024.8	13.3	66	7	SSW	20	1023.8
10	Th	7.6	14.6	0.8	2.6	8.3	SE	37	13:52	10.8	71	7		Calm	1026.1	12.6	70	7	SE	26	1025.5
11	Fr	7.4	12.9	4.2	3.4	5.1	ESE	31	15:13	10	67	6	SE	9	1027.3	12.5	56	4	ESE	17	1025.8
12	Sa	5.8	13.2	0	2.8	9.5	WNW	46	22:49	10	66	2	N	11	1026.2	12.7	59	6	ESE	20	1023.4
13	Su	3.5	16	0	3.6	10.6	ESE	30	14:48	9	69	3	NNW	15	1022	14.5	54	7	ESE	20	1018.1
14	Mo	6.9	25.1	0	4	7.1	NNW	46	7:49	11.7	61	3	NNW	33	1011.2	22.5	37	7	WNW	9	1006.8
15	Tu	8.8	12.4	1.4	3.4	1.8	ESE	28	13:32	12.1	71	7	SE	9	1011.9	10.6	87	7	SE	17	1010.7
16	We	4	17.9	7	2	8.8	N	35	12:04	7.5	86	1	NNW	15	1012	13.9	49	7	SE	22	1007.7
17	Th	4.4	15.4	0	2.2	11.6	SE	37	14:13	9.7	77	2	N	11	1006.9	14.5	68	1	ESE	24	1005.7
18	Fr	7	19.2	0	4	7.8	NW	67	15:02	13.7	51	4	NNW	28	1004.4	17.5	44	7	NW	28	996.6
19	Sa	6.1	14.3	1.2	5.6	9.6	WNW	63	15:35	9.9	59	6	NNW	20	1003.1	12.2	53	6	NW	28	1003.9
20	Su	8.6	18.8	0.4	3.4	8.8	WSW	72	10:35	13.7	54	7	NNW	24	1009.9	17.8	45	7	WSW	30	1013.3
21	Mo	8.4	22.3	0	4.4	12.9	NW	46	23:12	15	51	4	NNW	17	1021.9	20.4	39	1	SE	19	1020.4
22	Tu	6.5	21	0	6.8	12.3	SE	37	17:11	11.8	63	6	NNW	9	1025.2	16.6	55	3	SE	24	1021
23	We	10.9	23.2	0	4.8	10.5	NNW	54	3:43	16.4	31	7	NW	22	1017.6	17.5	51	3	ESE	30	1016.6
24	Th	9.7	25.4	0	4	12.2	NNW	33	9:49	16.3	59	6	NNW	24	1013.8	22.8	46	7	SE	17	1009.2
25	Fr	15.9	28	0	11	8.7	NNW	83	10:29	24.2	26	7	NNW	35	991.4	19.2	34	7	NW	41	995.2
26	Sa	9.7	16.8	0	9.6	6.7	NW	61	23:09	14	45	6	N	19	993	12.9	51	7	SW	31	993.7
27	Su	6.3	16.4	0	3	8.8	WSW	54	15:52	11.2	57	3	NNW	26	1007	12.7	66	7	NW	20	1008.6
28	Mo	6.8	20.6	0.2	3.6	5.4	NNW	59	18:40	12.2	49	7	NW	37	1018.1	19.9	28	7	NW	24	1014.7
29	Tu	11.7	28	0	7	10.3	NNW	72	2:07	16.6	22	7	N	37	1009.9	27.1	13	2	NNW	31	1006.2
30	We	9.4	16.9	0	8	7.5	SSW	44	23:03	11.3	60	7	SSE	6	1020.8	15.7	55	6	SE	20	1017.5
31	Th	8.7	26.9	0	4.6	9.7	NNW	39	7:42	15.2	63	7	NNW	30	1010.5	24.7	43	5	ESE	17	1006.6
Statistics for October 2019																					
	Mean	7.7	18.8		4.5	8.5				12.7	56	4		18	1014.6	16.6	50	5		21	1012.4
	Lowest	2.9	12.4	0	2	1.8				7.5	22	1		Calm	991.4	10.6	13	1	#	9	993.7
	Highest	15.9	28.2	7	11	12.9	NNW	83		24.2	86	7	#	37	1027.4	27.1	87	7	NW	41	1025.8
	Total			17.6	140	265															

HOBART – November 2019

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Fr	15	32.6	0	6	5.9	NNW	65	10:17	25.8	31	7	N	22	1006.1	30.4	29	7	N	28	1003.5
2	Sa	14.4	21.5	1.2	6	1.5	N	30	9:40	16.1	82	8	NNW	19	1004.8	16.7	83	8	E	9	1005.3
3	Su	8.3	21.7	7.6	3.8	8.7	NNW	46	13:15	15.8	52	6	N	9	1009.3	18.5	57	7	WSW	9	1006.5
4	Mo	9.2	17.5	2.2	4.8	9.3	WNW	50	11:31	13.2	60	6	NNW	24	1008.2	15.5	36	5	SW	15	1008.9
5	Tu	4.1	16.8	0.4	2.4	7.1	NNW	56	21:18	11.1	53	2	NNW	26	1013.6	16	36	7	WNW	26	1008.5
6	We	10.9	20	0	6.4	9.1	WNW	87	15:35	14.8	44	2	NNW	20	999	18	27	7	NW	37	991.4
7	Th	6.1	12.7	1.6	7	10.6	NW	76	6:21	9.2	74	6	NW	39	986.7	9.2	81	7	NW	31	988.5
8	Fr	5.1	12.7	7.4	4.4	4.1	SW	57	11:47	8.2	72	7	N	6	996.1	8.1	71	7	SSW	17	999.6
9	Sa	4.9	14.8	1.4	2.4	3.5	WNW	52	12:05	8.5	61	6	N	20	1003.8	11.4	60	7	NW	13	999.8
10	Su	8.5	18.7	0.2	2.2	6.8	WSW	56	11:33	13.6	51	5	SW	19	1006.4	17.2	44	6	WSW	15	1007.8
11	Mo	11.3	26.3	0	4.6	8.4	NW	74	16:32	13	50	7	NW	30	1003.7	25.6	16	3	NW	33	997.5
12	Tu	8.7	16.3	3.2	10	11	NW	65	10:25	12.3	53	3	ESE	9	996.2	13.4	45	7	NW	26	997.1
13	We	6.9	16.2	0	5.6	10.8	WNW	91	9:38	10.5	58	4	NNW	31	998.4	14.6	49	4	WSW	35	998.3
14	Th	10.1	19.9	3.6	6.4	10.1	WNW	81	16:13	15.1	55	7	N	24	1000.1	18.6	39	4	WNW	35	998.5
15	Fr	11.1	17.6	0	8	9.2	W	80	0:57	12.9	41	2	NW	28	998.7	14.4	38	5	W	44	999.2
16	Sa	7.6	17.3	0	8.4	8.3	W	76	15:08	12.5	40	4	SW	19	1006.2	16.4	30	6	WSW	37	1006
17	Su	7.3	17.8	0	7	7.6	SSW	52	9:00	9.7	57	6	W	11	1015.3	17.4	33	5	SW	19	1014
18	Mo	9.7	21.3	0	5	9.3	NW	76	9:55	14.4	53	5	NNE	20	1003.4	20.5	39	7	NW	31	1001.5
19	Tu	8.5	18.8	0	6.8	8.6	SW	39	8:25	15	40	5	NW	9	1010	14.2	60	7	ESE	24	1011.5
20	We	10.2	24.4	0	3.4	8	NNW	56	22:34	15.2	57	6	NNE	19	1014.4	19.5	51	7	ESE	19	1010.1
21	Th	14.4	36.8	0	7.4	6	NW	57	10:05	24.3	25	2	NNW	17	995.5	18.1	65	7	ESE	17	994.9
22	Fr	11.2	22.8	0	7.8	11.2	SSE	39	15:27	15.4	49	3	SE	15	1012.9	18.2	59	7	SE	26	1010.7
23	Sa	12.6	20.2	0	6.6	8.2	W	70	14:41	15.5	62	7	NNW	17	1008.6	18.7	32	3	WNW	31	1007.5
24	Su	10	21.1	0	7.4	6.5	WSW	48	20:52	13.4	51	7	NW	17	1014.5	20.5	35	7	NW	30	1010.9
25	Mo	10.3	25.6	0	6	10.5	NW	54	13:00	17.2	44	6	NW	26	1003.2	23.5	27	7	NW	26	1000
26	Tu	10.5	18.8	2.6	9.2	10.3	SSE	48	13:14	14.7	58	7	SW	20	1003.3	18.2	34	1	WSW	17	1004
27	We	9.3	20.6	0.4	7.6	2.6	NW	54	12:29	12.6	57	7	NW	24	1006.7	17.7	48	7	NW	22	1005.6
28	Th	11.2	21.1	0	5.6	10.6	WNW	46	0:56	15	34	2	NW	20	1011.7	19.8	21	3	NNW	30	1013.1
29	Fr	9.7	15.6	2.4	7.8	7.2	SE	44	13:34	12.1	73	7	E	9	1013.3	14.1	59	7	SE	30	1010.8
30	Sa	4.9	18.2	6.6	5.2	10.7	SSE	43	13:51	11.8	61	1	N	19	1010.5	14.1	66	6	S	28	1006.1
Statistics for November 2019																					
Mean		9.4	20.2		6	8.1				14	53	5		19	1005.4	17.3	45	5		25	1003.9
Lowest		4.1	12.7	0	2.2	1.5				8.2	25	1	N	6	986.7	8.1	16	1	#	9	988.5
Highest		15	36.8	7.6	10	11.2	WNW	91		25.8	82	8	NW	39	1015.3	30.4	83	8	W	44	1014
Total				40.8	181.2	241.7															

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Ektimo

REPORT NUMBER R008550

Start Up Scrubber - Triennial testing
Nyrstar Hobart , Lutana

Document Information

Template Version: 051219

Client Name:	Nyrstar Hobart
Report Number:	R008550
Date of Issue:	5 December 2019
Attention:	Joel Cooper
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

NATA Accredited Laboratory
No. 14601

Glenn Trenear
Client Manager

Ben Minchinton
Ektimo Signatory

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 *Background*

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. Testing was carried out in accordance with Tasmanian EPN notice 7043/5.

1.2 *Project Objectives*

The objectives of the project were to conduct a monitoring programme to quantify emissions from one discharge point to determine compliance with Nyrstar Hobart 's Tasmanian EPN notice 7043/5.

Location	Test Date	Test Parameters*
Start Up Scrubber Stack	6 November 2019	Total particulate matter Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

1.3 *Licence Comparison*

The following licence comparison table shows that all analytes highlighted in green are within the licence limit and all analytes highlighted in red are outside the licence limit set by the Tasmanian Environmental Protection Notice (EPN) as per licence 7043/5 (last amended on 11/04/2019).

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Start Up Scrubber Stack	Sulfur dioxide	g/m3	7.2	**0.013**
	Oxides of nitrogen (as NO2)	g/m3	2	**0.012**
	Particulates	mg/m3	100	**18**

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

Ektimo

2 RESULTS

2.1 *Start Up Scrubber Stack*

Date	6/11/2019	**Client**	Nyrstar Hobart
Report	R008550	**Stack ID**	Startup Scrubber Stack
Licence No.	7043/5	**Location**	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	**State**	TAS
Process Conditions	Start up scrubber running under load for testing		191029

Sampling Plane Details	
Sampling plane dimensions	990 mm
Sampling plane area	0.77 m²
Sampling port size, number & depth	4" Flange (x2), 90 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	3.8	
Gas molecular weight, g/g mole	28.7 (wet)	29.1 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.30 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1145 & 1305	
Temperature, °C	28	
Velocity at sampling plane, m/s	32	
Volumetric flow rate, actual, m³/min	1500	
Volumetric flow rate (wet STP), m³/min	1300	
Volumetric flow rate (dry STP), m³/min	1300	
Mass flow rate (wet basis), kg/hour	100000	

Gas Analyser Results	Average	
Sampling time	1158 - 1257	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	12	16
Sulfur dioxide	13	17
Carbon monoxide	630	800
	Concentration %v/v	
Carbon dioxide	1.2	
Oxygen	19.3	

NATA

Date	6/11/2019	Client	Nyrstar Hobart
Report	R008550	Stack ID	Startup Scrubber Stack
Licence No.	7043/5	Location	Hobart
Ektimo Staff	Ben Minchinton & Tony Bakas	State	TAS
Process Conditions	Start up scrubber running under load for testing		191029

Isokinetic Results	Results	
Sampling time	1158-1300	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	18	22
Antimony	<0.004	<0.005
Arsenic	0.0032	0.004
Beryllium	<0.0005	<0.0006
Cadmium	0.032	0.041
Chromium	0.0081	0.01
Cobalt	0.00064	0.00081
Copper	0.024	0.03
Lead	0.097	0.12
Manganese	0.15	0.19
Mercury	<0.0005	<0.0006
Nickel	0.04	0.05
Phosphorus	<0.01	<0.01
Selenium	<0.004	<0.005
Zinc	1.6	2.1
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	104	
Velocity difference, %	-4	

3 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	8%, 2%, 7%	NA	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Sulfur dioxide	USEPA 6C	USEPA 6C	12%	✓	✓
Total particulate matter	AS 4323.2	AS 4323.2††	5%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓‡
Total (gaseous and particulate) metals (Non-USEPA 29) (Co,Mg)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	×‡‡	✓‡

191030

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 25/11/19 in report number 231063.

‡‡ Specified metals are not listed in USEPA Method 29 and therefore not covered by NATA accreditation for sampling.

4 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

5 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

Ektimo

6 APPENDIX 1: WEATHER OBSERVATIONS

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8^{th}		km/h	hPa	°C	%	8^{th}		km/h	hPa
6	We	10.5	20	0	6.4	9.1	NW	72	14:55	14.2	37	2	WNW	20	999.1	19.3	21	7	NW	33	991.7
Statistics for November 2019																					
	Mean	9.3	20.1		6	8.1				14.1	49	5		22	1005.7	17.2	41	5		27	1004
	Lowest	4.1	12.4	0	2.2	1.5				8.5	20	1	W	9	987.3	9.5	12	1	NNW	2	989.2
	Highest	15	37.7	15.4	10	11.2	WNW	91		26.3	81	8	#	41	1015.5	29.6	94	8	W	43	1014.2
	Total			43.6	181.2	241.7															

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REPORT NUMBER R009155

Emission Testing Report

Round 1 – May 2020

Nyrstar Hobart , Lutana

Document Information

Template Version; 121219

Client Name:	Nyrstar Hobart
Report Number:	R009155
Date of Issue:	17 June 2020
Attention:	Joel Cooper
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Glenn Trenear
Client Manager

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 Background

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. Testing was carried out in accordance with Environmental Licence 7043/5.

1.2 Project Objectives

The objectives of the project were to conduct a monitoring programme to quantify emissions from 12 discharge points to determine compliance with Nyrstar Hobart 's Environmental Licence and meet NPI reporting requirements. Monitoring was performed as follows;

<table>
<tr><th>Location</th><th>Test Date</th><th>Test Parameters*</th></tr>
<tr><td>Foreshore A</td><td rowspan="2">24 April 2020</td><td rowspan="2">Total particulate matter
Fine particulate matter (PM10 & PM2.5 via particle sizing analysis)
Polycyclic aromatic hydrocarbons (PAHs)
Metals
Sulfur dioxide, sulfur trioxide
Total fluoride
Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen
Total & speciated volatile organic compounds (VOCs)</td></tr>
<tr><td>Foreshore B</td></tr>
<tr><td>Paragoethite Dryer</td><td>25 April 2020</td><td rowspan="5">Total particulate matter
Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis)
Polycyclic aromatic hydrocarbons (PAHs)
Metals
Total fluoride
Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, sulfur dioxide
Total & speciated volatile organic compounds (VOCs)</td></tr>
<tr><td>Cadmium Smelter Plant Scrubber Stack</td><td>23 April 2020</td></tr>
<tr><td>Copper Sulphate Crystalliser Plant Vent Stack</td><td>22 April 2020</td></tr>
<tr><td>Casting Ventilation 1 – V1</td><td rowspan="2">21 April 2020</td></tr>
<tr><td>Casting Ventilation 2 – V2</td></tr>
<tr><td>Roaster Baghouse</td><td>25 April 2020</td><td>Total particulate matter
Fine particulate matter (PM10 & PM2.5 via particle sizing analysis)
Polycyclic aromatic hydrocarbons (PAHs)
Metals
Sulfur dioxide, sulfur trioxide
Total fluoride
Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Total & speciated volatile organic compounds (VOCs)</td></tr>
<tr><td>Anode Casting</td><td>23 April 2020</td><td rowspan="4">Total particulate matter
Fine particulate matter (PM10 & PM2.5 via particle sizing analysis)
Polycyclic aromatic hydrocarbons (PAHs)
Metals
Total fluoride
Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, sulfur dioxide
Total & speciated volatile organic compounds (VOCs)</td></tr>
<tr><td>Zinc Plant 1 Baghouse – ZP1</td><td>22 April 2020</td></tr>
<tr><td>Zinc Plant 3 Baghouse – ZP3</td><td>21 April 2020</td></tr>
<tr><td>MZR Furnace Baghouse</td><td>23 April 2020</td></tr>
</table>

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation. Plant operating conditions have been noted in the report.

1.3 Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence limit and all analytes highlighted in red are outside the licence limit set by Tasmanian EPN 7043/5

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.25
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.055
	Particulates	mg/m^3	100	<1
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.17
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.056
	Particulates	mg/m^3	100	1.3
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	12
V1 Furnace Stack				<3
V2 Furnace Stack				<2
Zinc Dust Plant Baghouse 1 Stack				32
Zinc Dust Plant Bagouse 3 Stack				24
Cadmium Smelter Plant Scrubber Stack				<2
Copper Sulphate Crystalliser Plant				<3
Roaster Baghouse				<3
Paragoethite Dryer Baghouse				55
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	≤0.4
V1 Furnace Stack				≤0.04
V2 Furnace Stack				≤0.027
Zinc Dust Plant Baghouse 1 Stack				≤0.44
Zinc Dust Plant Baghouse 3 Stack				≤0.42
Cadmium Smelter Plant Scrubber Stack				≤0.42
Copper Sulphate Crystalliser Plant				0.11
Roaster Baghouse				0.35
Paragoethite Dryer Baghouse				≤6.8
Anode Casting Plant Exhaust	Metals - Hg	mg/m^3	1	0.0013
V1 Furnace Stack				<0.0006
V2 Furnace Stack				<0.0005
Zinc Dust Plant Baghouse 1 Stack				0.0026
Zinc Dust Plant Baghouse 3 Stack				<0.0006
Cadmium Smelter Plant Scrubber Stack				<0.001
Copper Sulphate Crystalliser Plant				0.047
Roaster Baghouse				0.18
Paragoethite Dryer Baghouse				<0.001
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	0.005
V1 Furnace Stack				0.00067
V2 Furnace Stack				<0.0008
Zinc Dust Plant Baghouse 1 Stack				0.018
Zinc Dust Plant Baghouse 3 Stack				<0.001
Cadmium Smelter Plant Scrubber Stack				0.093
Copper Sulphate Crystalliser Plant				0.032
Roaster Baghouse				0.0082
Paragoethite Dryer Baghouse				0.056

(1) Total concentration of metals combined.

*Please note that the measurement uncertainty associated with the test results **was not** considered when determining whether the results were compliant or non-compliant.*

Refer to the Test Methods table for the measurement uncertainties.

Ektimo

2 RESULTS

2.1 Foreshore A

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas Flow Parameters		
Temperature, °C	19	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1800	
Volumetric flow rate (wet STP), m³/min	1700	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	0906 - 1005	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrous oxide	<1	<2
Nitrogen oxides (as NO_2)	55	92
Carbon monoxide	<2	<3
	Concentration % v/v	
Carbon dioxide	0.5	
Oxygen	10.1	

Total Speciated VOCs	Results	
Lower Bound Sampling time	0920-1050	
	Concentration mg/m³	Mass Rate g/min
Total	<0.06	<0.1

VOC's C5-C20	Results	
Sampling time	0920-1050	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.06	<0.1

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

NATA

Date	24/04/2020	Client	Nyrstar Hobart
Report	R009155	Stack ID	Foreshore A
Licence No.	7043-5	Location	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	State	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Isokinetic Results		Results	
	Sampling time	1230-1410	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<1	<3
PM10	(PSA)	<0.7	<1
PM2.5	(PSA)	<0.2	<0.3
Sulfur dioxide		7.6	13
Sulfur trioxide		0.25	0.43
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		99	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1227	
Final flow measurement time (hhmm)		1413	
Temperature, °C		19	
Velocity at sampling plane, m/s		17	
Volumetric flow rate, actual, m³/min		1900	
Volumetric flow rate (wet STP), m³/min		1700	
Volumetric flow rate (dry STP), m³/min		1700	
Mass flow rate (wet basis), kg/hour		130000	
Velocity difference, %		2	

Isokinetic Results		Results	
	Sampling time	0845-1025	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.054	0.089
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		99	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0833	
Final flow measurement time (hhmm)		1030	
Temperature, °C		19	
Velocity at sampling plane, m/s		16	
Volumetric flow rate, actual, m³/min		1800	
Volumetric flow rate (wet STP), m³/min		1700	
Volumetric flow rate (dry STP), m³/min		1600	
Mass flow rate (wet basis), kg/hour		130000	
Velocity difference, %		7	

Ektimo

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		*200415*

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)

Isokinetic Results	Results	
Sampling time	1045-1225	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.003	<0.006
Arsenic	<0.002	<0.003
Beryllium	<0.0004	<0.0007
Cadmium	0.0024	0.0042
Chromium	<0.0007	<0.001
Cobalt	<0.0005	<0.0008
Copper	0.0076	0.013
Lead	0.032	0.054
Manganese	0.014	0.023
Mercury	0.00077	0.0013
Nickel	<0.001	<0.002
Phosphorus	0.029	0.049
Selenium	<0.003	<0.006
Zinc	0.48	0.82
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1030	
Final flow measurement time (hhmm)	1227	
Temperature, °C	19	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1700	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	<1	

NATA

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1420 - 1600	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	15000	27000000
2-Methylnaphthalene	1500	2700000
Acenaphthylene	<10	<20000
Acenaphthene	8000	14000000
Fluorene	420	730000
Phenanthrene	200	340000
Anthracene	39	67000
Fluoranthene	59	100000
Pyrene	28	48000
Benz(a)anthracene	<10	<20000
Chrysene	<10	<20000
Benzo(b)fluoranthene	<10	<20000
Benzo(k)fluoranthene	<10	<20000
Benzo(e)pyrene	<10	<20000
Benzo(a)pyrene	<10	<20000
Perylene	<10	<20000
Indeno(1,2,3-cd)pyrene	<10	<20000
Dibenz(ah)anthracene	<10	<20000
Benzo(ghi)perylene	<10	<20000
Total 16 PAHs	24000	42000000
Total 19 PAHs	26000	45000000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	11	19000
Upper Bound	22	39000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	98
Velocity difference, %	<1
Gas Flow Parameters	
Flow measurement time (hhmm)	1413
Flow measurement time (hhmm)	1608
Temperature, °C	19
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000

2.2 Foreshore B

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas Flow Parameters		
Temperature, °C	21	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1800	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	140000	

Gas Analyser Results	Average	
Sampling time	1054 - 1153	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrous oxide	<1	<2
Nitrogen oxides (as NO_2)	56	97
Carbon monoxide	<2	<4
	Concentration % v/v	
Carbon dioxide	0.6	
Oxygen	10.3	

Total Speciated VOCs	Results	
Lower Bound — Sampling time	1100-1130	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.3

VOC's C5-C20	Results	
Sampling time	1100-1130	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.3

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	24/04/2020	Client	Nyrstar Hobart
Report	R009155	Stack ID	Foreshore B
Licence No.	7043-5	Location	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	State	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream. 200415		

Isokinetic Results		Results	
	Sampling time	1420-1600	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		1.3	2.3
PM10	(PSA)	0.59	1
PM2.5	(PSA)	0.13	0.24
Sulfur dioxide		38	68
Sulfur trioxide		0.17	0.3
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		99	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1414	
Final flow measurement time (hhmm)		1604	
Temperature, °C		22	
Velocity at sampling plane, m/s		18	
Volumetric flow rate, actual, m³/min		1900	
Volumetric flow rate (wet STP), m³/min		1800	
Volumetric flow rate (dry STP), m³/min		1800	
Mass flow rate (wet basis), kg/hour		140000	
Velocity difference, %		<1	

Isokinetic Results		Results	
	Sampling time	1045-1225	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		<0.01	<0.02
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		102	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1035	
Final flow measurement time (hhmm)		1228	
Temperature, °C		21	
Velocity at sampling plane, m/s		17	
Volumetric flow rate, actual, m³/min		1900	
Volumetric flow rate (wet STP), m³/min		1800	
Volumetric flow rate (dry STP), m³/min		1700	
Mass flow rate (wet basis), kg/hour		130000	
Velocity difference, %		1	

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.7	
Gas molecular weight, g/g mole	28.4 (wet)	28.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.27 (dry)

Isokinetic Results	Results	
Sampling time	0845-1025	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.003	<0.005
Arsenic	<0.001	<0.003
Beryllium	<0.0004	<0.0006
Cadmium	0.0028	0.0049
Chromium	<0.0007	<0.001
Cobalt	<0.0004	<0.0008
Copper	0.01	0.018
Lead	0.039	0.067
Manganese	0.013	0.022
Mercury	0.0011	0.0019
Nickel	<0.001	<0.002
Phosphorus	0.02	0.035
Selenium	<0.003	<0.006
Zinc	0.67	1.2
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	104	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0835	
Final flow measurement time (hhmm)	1035	
Temperature, °C	21	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1700	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	2	

Ektimo

Date	24/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Unit 5 producing 61,000 m3/hr & Unit 6 producing 82,000 m3/hr of gas through the acid stream.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1230 - 1410	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2200	3900000
2-Methylnaphthalene	87	150000
Acenaphthylene	<10	<20000
Acenaphthene	180	320000
Fluorene	<10	<20000
Phenanthrene	93	160000
Anthracene	22	38000
Fluoranthene	75	130000
Pyrene	32	56000
Benz(a)anthracene	<10	<20000
Chrysene	<10	<20000
Benzo(b)fluoranthene	<10	<20000
Benzo(k)fluoranthene	<10	<20000
Benzo(e)pyrene	<10	<20000
Benzo(a)pyrene	<10	<20000
Perylene	<10	<20000
Indeno(1,2,3-cd)pyrene	<10	<20000
Dibenz(ah)anthracene	<10	<20000
Benzo(ghi)perylene	<10	<20000
Total 16 PAHs	2600	4600000
Total 19 PAHs	2700	4800000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	11	20000
Upper Bound	23	40000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	97
Velocity difference, %	1
Gas Flow Parameters	
Flow measurement time (hhmm)	1228
Flow measurement time (hhmm)	1414
Temperature, °C	21
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1800
Mass flow rate (wet basis), kg/hour	140000

NATA

2.3 Paragoethite Dryer

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	10.4 m3/hr of dirt and 2.71 m3/hr of bypass flow into the drum.		200415

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas temperature of the sampling plane is below the dew point

Stack Parameters		
Moisture content, %v/v	34	
Gas molecular weight, g/g mole	25.5 (wet)	29.3 (dry)
Gas density at STP, kg/m³	1.14 (wet)	1.31 (dry)
Gas Flow Parameters		
Temperature, °C	76	
Velocity at sampling plane, m/s	9.7	
Volumetric flow rate, actual, m³/min	410	
Volumetric flow rate (wet STP), m³/min	320	
Volumetric flow rate (dry STP), m³/min	210	
Mass flow rate (wet basis), kg/hour	22000	

Gas Analyser Results	Average	
Sampling time	0858 - 0957	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	63	14
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.4
	Concentration % v/v	
Carbon dioxide	3.5	
Oxygen	14.4	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1011-1041	
	Concentration mg/m³	Mass Rate g/min
Total	<0.1	<0.03

VOC's C5-C20	Results	
Sampling time	1011-1041	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.1	<0.03

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	10.4 m3/hr of dirt and 2.71 m3/hr of bypass flow into the drum.		200415

Isokinetic Results		Results	
	Sampling time	1011-1111	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		55	12
PM10	(PSA)	34	7.2
PM2.5	(PSA)	9.1	1.9
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		98	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0950	
Final flow measurement time (hhmm)		1106	
Temperature, °C		76	
Velocity at sampling plane, m/s		9.6	
Volumetric flow rate, actual, m³/min		410	
Volumetric flow rate (wet STP), m³/min		320	
Volumetric flow rate (dry STP), m³/min		210	
Mass flow rate (wet basis), kg/hour		22000	
Velocity difference, %		<1	

Isokinetic Results		Results	
	Sampling time	0845-0945	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		10	2.2
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		108	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0830	
Final flow measurement time (hhmm)		0950	
Temperature, °C		75	
Velocity at sampling plane, m/s		9.8	
Volumetric flow rate, actual, m³/min		420	
Volumetric flow rate (wet STP), m³/min		330	
Volumetric flow rate (dry STP), m³/min		220	
Mass flow rate (wet basis), kg/hour		22000	
Velocity difference, %		-3	

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	10.4 m3/hr of dirt and 2.71 m3/hr of bypass flow into the drum.		200415

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	29	
Gas molecular weight, g/g mole	25.9 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.16 (wet)	1.30 (dry)

Isokinetic Results	Results	
Sampling time	0845-0945	
	Concentration mg/m³	Mass Rate g/min
Antimony	**0.032**	**0.0073**
Arsenic	0.23	0.053
Beryllium	<0.0009	<0.0002
Cadmium	**0.056**	**0.013**
Chromium	0.02	0.0046
Cobalt	0.0019	0.00044
Copper	0.59	0.14
Lead	**6.4**	**1.5**
Manganese	0.52	0.12
Mercury	**<0.001**	**<0.0003**
Nickel	0.0085	0.0019
Phosphorus	0.13	0.029
Selenium	<0.006	<0.001
Zinc	7.6	1.7
Total of Sb, As, Cd, Pb, Hg	**≤6.8**	**≤1.5**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	106	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0830	
Final flow measurement time (hhmm)	0950	
Temperature, °C	75	
Velocity at sampling plane, m/s	9.7	
Volumetric flow rate, actual, m³/min	410	
Volumetric flow rate (wet STP), m³/min	320	
Volumetric flow rate (dry STP), m³/min	230	
Mass flow rate (wet basis), kg/hour	22000	
Velocity difference, %	-3	

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	10.4 m3/hr of dirt and 2.71 m3/hr of bypass flow into the drum.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1011 - 1111	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2200	490000
2-Methylnaphthalene	<20	<5000
Acenaphthylene	<20	<5000
Acenaphthene	640	140000
Fluorene	320	71000
Phenanthrene	1300	290000
Anthracene	1200	270000
Fluoranthene	1100	240000
Pyrene	430	98000
Benz(a)anthracene	290	66000
Chrysene	840	190000
Benzo(b)fluoranthene	140	32000
Benzo(k)fluoranthene	29	6600
Benzo(e)pyrene	<20	<5000
Benzo(a)pyrene	<20	<5000
Perylene	<20	<5000
Indeno(1,2,3-cd)pyrene	<20	<5000
Dibenz(ah)anthracene	<20	<5000
Benzo(ghi)perylene	<20	<5000
Total 16 PAHs	8500	1900000
Total 19 PAHs	8500	1900000
BaP-TEQ		
Lower Bound	55	12000
Middle Bound	71	16000
Upper Bound	87	20000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	96
Velocity difference, %	<1
Gas Flow Parameters	
Flow measurement time (hhmm)	0950
Flow measurement time (hhmm)	1106
Temperature, °C	76
Velocity at sampling plane, m/s	9.6
Volumetric flow rate, actual, m³/min	410
Volumetric flow rate (wet STP), m³/min	320
Volumetric flow rate (dry STP), m³/min	220
Mass flow rate (wet basis), kg/hour	22000

2.4 Cadmium Smelter Plant Scrubber Stack

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		200415

Sampling Plane Details	
Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.5	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	25	
Velocity at sampling plane, m/s	13	
Volumetric flow rate, actual, m³/min	140	
Volumetric flow rate (wet STP), m³/min	130	
Volumetric flow rate (dry STP), m³/min	120	
Mass flow rate (wet basis), kg/hour	9700	

Gas Analyser Results	Average	
Sampling time	1121 - 1220	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	4.7	0.58
Sulfur dioxide	<5	<0.6
Carbon monoxide	<2	<0.2
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.7	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1125-1155	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.02

VOC's C5-C20	Results	
Sampling time	1125-1155	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		200415

Isokinetic Results		Results	
	Sampling time	1400-1501	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.2
PM10	(PSA)	<0.7	<0.08
PM2.5	(PSA)	<0.2	<0.02
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		105	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1349	
Final flow measurement time (hhmm)		1505	
Temperature, °C		25	
Velocity at sampling plane, m/s		13	
Volumetric flow rate, actual, m³/min		140	
Volumetric flow rate (wet STP), m³/min		130	
Volumetric flow rate (dry STP), m³/min		120	
Mass flow rate (wet basis), kg/hour		9700	
Velocity difference, %		1	

Isokinetic Results		Results	
	Sampling time	1245-1347	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.049	0.0061
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		102	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1213	
Final flow measurement time (hhmm)		1349	
Temperature, °C		25	
Velocity at sampling plane, m/s		13	
Volumetric flow rate, actual, m³/min		140	
Volumetric flow rate (wet STP), m³/min		130	
Volumetric flow rate (dry STP), m³/min		120	
Mass flow rate (wet basis), kg/hour		9800	
Velocity difference, %		-3	

Ektimo

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Sampling Plane Details	
Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.7	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1245-1347	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.0008**
Arsenic	**<0.003**	**<0.0004**
Beryllium	<0.0008	<0.0001
Cadmium	**0.093**	**0.012**
Chromium	0.0027	0.00033
Cobalt	<0.001	<0.0001
Copper	0.0078	0.00097
Lead	**0.32**	**0.039**
Manganese	0.045	0.0055
Mercury	**<0.001**	**<0.0001**
Nickel	<0.002	<0.0002
Phosphorus	0.084	0.01
Selenium	<0.007	<0.0008
Zinc	0.25	0.031
Total of Sb, As, Cd, Pb, Hg	**≤0.42**	**≤0.052**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	106	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1213	
Final flow measurement time (hhmm)	1349	
Temperature, °C	25	
Velocity at sampling plane, m/s	13	
Volumetric flow rate, actual, m³/min	140	
Volumetric flow rate (wet STP), m³/min	130	
Volumetric flow rate (dry STP), m³/min	120	
Mass flow rate (wet basis), kg/hour	9800	
Velocity difference, %	-3	

NATA

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1400 - 1501	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2100	260000
2-Methylnaphthalene	350	43000
Acenaphthylene	<20	<3000
Acenaphthene	77	9400
Fluorene	410	51000
Phenanthrene	630	77000
Anthracene	38000	4600000
Fluoranthene	190	23000
Pyrene	83	10000
Benz(a)anthracene	<20	<3000
Chrysene	<20	<3000
Benzo(b)fluoranthene	<20	<3000
Benzo(k)fluoranthene	<20	<3000
Benzo(e)pyrene	<20	<3000
Benzo(a)pyrene	<20	<3000
Perylene	<20	<3000
Indeno(1,2,3-cd)pyrene	<20	<3000
Dibenz(ah)anthracene	<20	<3000
Benzo(ghi)perylene	<20	<3000
Total 16 PAHs	41000	5100000
Total 19 PAHs	42000	5100000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	21	2600
Upper Bound	43	5200

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	106
Velocity difference, %	1
Gas Flow Parameters	
Flow measurement time (hhmm)	1349
Flow measurement time (hhmm)	1505
Temperature, °C	25
Velocity at sampling plane, m/s	13
Volumetric flow rate, actual, m³/min	140
Volumetric flow rate (wet STP), m³/min	130
Volumetric flow rate (dry STP), m³/min	120
Mass flow rate (wet basis), kg/hour	9700

2.5 Copper Sulphate Crystalliser Plant Vent Stack

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Production rate - 6.5 tonnes/day, Dryer Outlet Temperature - 52 deg C, Feed rate into Dryer - 55%		200415

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	9.4	
Gas molecular weight, g/g mole	28.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	45	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	200	
Volumetric flow rate (wet STP), m³/min	170	
Volumetric flow rate (dry STP), m³/min	150	
Mass flow rate (wet basis), kg/hour	13000	

Gas Analyser Results	Average	
Sampling time	0836 - 0935	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.5
Sulfur dioxide	<5	<0.7
Carbon monoxide	<2	<0.3
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.7	

Total Speciated VOCs	Results	
Lower Bound — Sampling time	0850-0922	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.02

VOC's C5-C20	Results	
Sampling time	0850-0922	
	Concentration mg/m³	Mass Rate g/min
Detection limit[(1)]	<0.2	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Ektimo

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Production rate - 6.5 tonnes/day, Dryer Outlet Temperature - 52 deg C, Feed rate into Dryer - 55%		200415

Isokinetic Results		Results	
	Sampling time	0945-1045	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.4
PM10	(PSA)	<1	<0.2
PM2.5	(PSA)	<0.4	<0.06
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		103	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0932	
Final flow measurement time (hhmm)		1048	
Temperature, °C		45	
Velocity at sampling plane, m/s		17	
Volumetric flow rate, actual, m³/min		200	
Volumetric flow rate (wet STP), m³/min		170	
Volumetric flow rate (dry STP), m³/min		150	
Mass flow rate (wet basis), kg/hour		12000	
Velocity difference, %		<1	

Isokinetic Results		Results	
	Sampling time	0830-0930	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.33	0.05
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		107	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0825	
Final flow measurement time (hhmm)		0932	
Temperature, °C		45	
Velocity at sampling plane, m/s		17	
Volumetric flow rate, actual, m³/min		200	
Volumetric flow rate (wet STP), m³/min		170	
Volumetric flow rate (dry STP), m³/min		150	
Mass flow rate (wet basis), kg/hour		13000	
Velocity difference, %		-2	

Ektimo

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Production rate - 6.5 tonnes/day, Dryer Outlet Temperature - 52 deg C, Feed rate into Dryer - 55%		200415

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	9.4	
Gas molecular weight, g/g mole	27.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	0830-0930	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.001**
Arsenic	**<0.004**	**<0.0006**
Beryllium	<0.0009	<0.0001
Cadmium	**0.032**	**0.0049**
Chromium	0.051	0.0078
Cobalt	0.002	0.0003
Copper	0.092	0.014
Lead	**0.022**	**0.0033**
Manganese	0.11	0.016
Mercury	**0.047**	**0.0071**
Nickel	0.058	0.0089
Phosphorus	0.1	0.016
Selenium	<0.007	<0.001
Zinc	0.61	0.094
Total of Sb, As, Cd, Pb, Hg	**0.11**	**0.017**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0825	
Final flow measurement time (hhmm)	0932	
Temperature, °C	45	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	200	
Volumetric flow rate (wet STP), m³/min	170	
Volumetric flow rate (dry STP), m³/min	150	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	-2	

NATA

Ektimo

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Production rate - 6.5 tonnes/day, Dryer Outlet Temperature - 52 deg C, Feed rate into Dryer - 55%		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0945 - 1045	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2300	350000
2-Methylnaphthalene	180	28000
Acenaphthylene	<20	<4000
Acenaphthene	<20	<4000
Fluorene	<20	<4000
Phenanthrene	1500	220000
Anthracene	43	6400
Fluoranthene	1200	180000
Pyrene	450	68000
Benz(a)anthracene	100	15000
Chrysene	130	20000
Benzo(b)fluoranthene	<20	<4000
Benzo(k)fluoranthene	<20	<4000
Benzo(e)pyrene	<20	<4000
Benzo(a)pyrene	<20	<4000
Perylene	<20	<4000
Indeno(1,2,3-cd)pyrene	<20	<4000
Dibenz(ah)anthracene	<20	<4000
Benzo(ghi)perylene	<20	<4000
Total 16 PAHs	5700	860000
Total 19 PAHs	5900	890000
BaP-TEQ		
Lower Bound	12	1700
Middle Bound	32	4900
Upper Bound	53	8000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	102
Velocity difference, %	<1
Gas Flow Parameters	
Flow measurement time (hhmm)	0932
Flow measurement time (hhmm)	1048
Temperature, °C	45
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	200
Volumetric flow rate (wet STP), m³/min	170
Volumetric flow rate (dry STP), m³/min	150
Mass flow rate (wet basis), kg/hour	12000

NATA

Ektimo

2.6 Casting Ventilation 1 – V1

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	26	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/min	290	
Volumetric flow rate (wet STP), m³/min	260	
Volumetric flow rate (dry STP), m³/min	260	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average	
Sampling time	0951 - 1117	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.9
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.5
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound Sampling time	0950-1023	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.04

VOC's C5-C20	Results	
Sampling time	0950-1023	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.04

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

NATA

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Isokinetic Results		Results	
	Sampling time	0940-1040	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.7
PM10	(PSA)	<1	<0.3
PM2.5	(PSA)	<0.3	<0.08
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		99	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0915	
Final flow measurement time (hhmm)		1048	
Temperature, °C		26	
Velocity at sampling plane, m/s		15	
Volumetric flow rate, actual, m³/min		280	
Volumetric flow rate (wet STP), m³/min		250	
Volumetric flow rate (dry STP), m³/min		250	
Mass flow rate (wet basis), kg/hour		20000	
Velocity difference, %		<1	

Isokinetic Results		Results	
	Sampling time	1305-1405	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		<0.03	<0.008
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		99	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1303	
Final flow measurement time (hhmm)		1407	
Temperature, °C		26	
Velocity at sampling plane, m/s		15	
Volumetric flow rate, actual, m³/min		290	
Volumetric flow rate (wet STP), m³/min		270	
Volumetric flow rate (dry STP), m³/min		260	
Mass flow rate (wet basis), kg/hour		21000	
Velocity difference, %		-2	

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		*200415*

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1215-1315	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.006**	**<0.002**
Arsenic	**<0.003**	**<0.0007**
Beryllium	<0.0007	<0.0002
Cadmium	**0.00067**	**0.00018**
Chromium	0.0015	0.00041
Cobalt	<0.0009	<0.0002
Copper	0.037	0.0099
Lead	**0.03**	**0.0081**
Manganese	0.024	0.0062
Mercury	**<0.0006**	**<0.0001**
Nickel	0.0067	0.0018
Phosphorus	0.077	0.02
Selenium	<0.006	<0.002
Zinc	0.79	0.21
Total of Sb, As, Cd, Pb, Hg	**≤0.04**	**≤0.011**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1155	
Final flow measurement time (hhmm)	1303	
Temperature, °C	27	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	300	
Volumetric flow rate (wet STP), m³/min	270	
Volumetric flow rate (dry STP), m³/min	270	
Mass flow rate (wet basis), kg/hour	21000	
Velocity difference, %	<1	

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1050 - 1150	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1800	460000
2-Methylnaphthalene	120	32000
Acenaphthylene	<20	<6000
Acenaphthene	110	29000
Fluorene	<20	<6000
Phenanthrene	890	230000
Anthracene	39	10000
Fluoranthene	1000	260000
Pyrene	600	160000
Benz(a)anthracene	33	8600
Chrysene	72	19000
Benzo(b)fluoranthene	79	20000
Benzo(k)fluoranthene	39	10000
Benzo(e)pyrene	<20	<6000
Benzo(a)pyrene	22	5700
Perylene	22	5700
Indeno(1,2,3-cd)pyrene	22	5700
Dibenz(ah)anthracene	22	5700
Benzo(ghi)perylene	<20	<6000
Total 16 PAHs	4700	1200000
Total 19 PAHs	4900	1300000
BaP-TEQ		
Lower Bound	49	13000
Middle Bound	49	13000
Upper Bound	49	13000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	100
Velocity difference, %	6
Gas Flow Parameters	
Flow measurement time (hhmm)	1048
Flow measurement time (hhmm)	1155
Temperature, °C	26
Velocity at sampling plane, m/s	15
Volumetric flow rate, actual, m³/min	290
Volumetric flow rate (wet STP), m³/min	260
Volumetric flow rate (dry STP), m³/min	260
Mass flow rate (wet basis), kg/hour	20000

Ektimo

2.7 Casting Ventilation 2 – V2

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	53	
Velocity at sampling plane, m/s	21	
Volumetric flow rate, actual, m³/min	350	
Volumetric flow rate (wet STP), m³/min	290	
Volumetric flow rate (dry STP), m³/min	290	
Mass flow rate (wet basis), kg/hour	23000	

Gas Analyser Results	Average	
Sampling time	1142 - 1241	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<1
Sulfur dioxide	8.3	2.4
Carbon monoxide	7.9	2.3
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1100-1132	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.05

VOC's C5-C20	Results	
Sampling time	1100-1132	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.05

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

NATA

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Isokinetic Results		Results	
	Sampling time	1100-1200	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.6
PM10	(PSA)	<1	<0.3
PM2.5	(PSA)	<0.3	<0.08
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		103	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1055	
Final flow measurement time (hhmm)		1202	
Temperature, °C		52	
Velocity at sampling plane, m/s		21	
Volumetric flow rate, actual, m³/min		360	
Volumetric flow rate (wet STP), m³/min		300	
Volumetric flow rate (dry STP), m³/min		290	
Mass flow rate (wet basis), kg/hour		23000	
Velocity difference, %		-3	

Isokinetic Results		Results	
	Sampling time	1310-1410	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.28	0.081
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		108	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1308	
Final flow measurement time (hhmm)		1413	
Temperature, °C		53	
Velocity at sampling plane, m/s		21	
Volumetric flow rate, actual, m³/min		350	
Volumetric flow rate (wet STP), m³/min		290	
Volumetric flow rate (dry STP), m³/min		290	
Mass flow rate (wet basis), kg/hour		22000	
Velocity difference, %		<1	

Ektimo

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	0.95	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	0945-1045	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.005**	**<0.001**
Arsenic	**<0.002**	**<0.0006**
Beryllium	<0.0006	<0.0002
Cadmium	**<0.0008**	**<0.0002**
Chromium	0.0008	0.00024
Cobalt	<0.0007	<0.0002
Copper	0.014	0.0041
Lead	**0.018**	**0.0055**
Manganese	0.015	0.0046
Mercury	**<0.0005**	**<0.0001**
Nickel	0.0019	0.00056
Phosphorus	0.099	0.03
Selenium	<0.005	<0.001
Zinc	1.1	0.34
Total of Sb, As, Cd, Pb, Hg	**≤0.027**	**≤0.008**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	97	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0920	
Final flow measurement time (hhmm)	1055	
Temperature, °C	52	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/min	360	
Volumetric flow rate (wet STP), m³/min	300	
Volumetric flow rate (dry STP), m³/min	300	
Mass flow rate (wet basis), kg/hour	23000	
Velocity difference, %	<1	

NATA

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1206 - 1306	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	7100	2100000
2-Methylnaphthalene	1000	310000
Acenaphthylene	56	17000
Acenaphthene	90	27000
Fluorene	210	61000
Phenanthrene	1300	390000
Anthracene	43	13000
Fluoranthene	1000	310000
Pyrene	590	170000
Benz(a)anthracene	30	8900
Chrysene	94	28000
Benzo(b)fluoranthene	<20	<6000
Benzo(k)fluoranthene	<20	<6000
Benzo(e)pyrene	<20	<6000
Benzo(a)pyrene	36	11000
Perylene	<20	<6000
Indeno(1,2,3-cd)pyrene	<20	<6000
Dibenz(ah)anthracene	<20	<6000
Benzo(ghi)perylene	<20	<6000
Total 16 PAHs	11000	3100000
Total 19 PAHs	12000	3400000
BaP-TEQ		
Lower Bound	40	12000
Middle Bound	46	14000
Upper Bound	53	16000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	98
Velocity difference, %	4
Gas Flow Parameters	
Flow measurement time (hhmm)	1202
Flow measurement time (hhmm)	1308
Temperature, °C	53
Velocity at sampling plane, m/s	21
Volumetric flow rate, actual, m³/min	360
Volumetric flow rate (wet STP), m³/min	300
Volumetric flow rate (dry STP), m³/min	300
Mass flow rate (wet basis), kg/hour	23000

2.8 Roaster Baghouse

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Roaster 6 - 54 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		200415

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas velocity at some or all sampling points is less than 3 m/s

Stack Parameters		
Moisture content, %v/v	1.7	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters	
Temperature, °C	30
Velocity at sampling plane, m/s	2.5
Volumetric flow rate, actual, m³/min	18
Volumetric flow rate (wet STP), m³/min	16
Volumetric flow rate (dry STP), m³/min	16
Mass flow rate (wet basis), kg/hour	1200

Gas Analyser Results	Average	
Sampling time	1411 - 1510	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.05
Carbon monoxide	<2	<0.03
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1600-1630	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.003

VOC's C5-C20	Results	
Sampling time	1600-1630	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.003

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane. Residuals as Toluene

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Roaster 6 - 54 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		200415

Isokinetic Results		Results	
	Sampling time	1535-1639	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.04
PM10	(PSA)	<1	<0.02
PM2.5	(PSA)	<0.3	<0.005
Sulfur dioxide		2.5	0.038
Sulfur trioxide		0.15	0.0022
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		97	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1506	
Final flow measurement time (hhmm)		1644	
Temperature, °C		30	
Velocity at sampling plane, m/s		2.4	
Volumetric flow rate, actual, m³/min		17	
Volumetric flow rate (wet STP), m³/min		15	
Volumetric flow rate (dry STP), m³/min		15	
Mass flow rate (wet basis), kg/hour		1200	
Velocity difference, %		-4	

Isokinetic Results		Results	
	Sampling time	1400-1504	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.098	0.0016
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		95	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1355	
Final flow measurement time (hhmm)		1506	
Temperature, °C		30	
Velocity at sampling plane, m/s		2.7	
Volumetric flow rate, actual, m³/min		19	
Volumetric flow rate (wet STP), m³/min		17	
Volumetric flow rate (dry STP), m³/min		16	
Mass flow rate (wet basis), kg/hour		1300	
Velocity difference, %		-8	

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Roaster 6 - 54 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		200415

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas velocity at some or all sampling points is less than 3 m/s

Stack Parameters		
Moisture content, %v/v	1.7	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1400-1504	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.005**	**<0.00009**
Arsenic	**<0.004**	**<0.00006**
Beryllium	<0.0006	<0.00001
Cadmium	**0.0082**	**0.00013**
Chromium	0.0012	0.00002
Cobalt	<0.0008	<0.00001
Copper	0.014	0.00023
Lead	**0.16**	**0.0026**
Manganese	0.071	0.0012
Mercury	**0.18**	**0.003**
Nickel	<0.002	<0.00003
Phosphorus	0.035	0.00057
Selenium	<0.005	<0.00009
Zinc	1.2	0.02
Total of Sb, As, Cd, Pb, Hg	**0.35**	**0.0058**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	109	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1355	
Final flow measurement time (hhmm)	1506	
Temperature, °C	30	
Velocity at sampling plane, m/s	2.7	
Volumetric flow rate, actual, m³/min	19	
Volumetric flow rate (wet STP), m³/min	17	
Volumetric flow rate (dry STP), m³/min	16	
Mass flow rate (wet basis), kg/hour	1300	
Velocity difference, %	-8	

Date	25/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Roaster 6 - 54 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1535 - 1639	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1900	28000
2-Methylnaphthalene	68	1000
Acenaphthylene	<20	<300
Acenaphthene	26	390
Fluorene	<20	<300
Phenanthrene	290	4300
Anthracene	32	480
Fluoranthene	140	2100
Pyrene	43	640
Benz(a)anthracene	<20	<300
Chrysene	<20	<300
Benzo(b)fluoranthene	<20	<300
Benzo(k)fluoranthene	<20	<300
Benzo(e)pyrene	<20	<300
Benzo(a)pyrene	<20	<300
Perylene	<20	<300
Indeno(1,2,3-cd)pyrene	<20	<300
Dibenz(ah)anthracene	<20	<300
Benzo(ghi)perylene	<20	<300
Total 16 PAHs	2400	36000
Total 19 PAHs	2500	37000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	18	270
Upper Bound	36	540

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	94
Velocity difference, %	-4
Gas Flow Parameters	
Flow measurement time (hhmm)	1506
Flow measurement time (hhmm)	1644
Temperature, °C	30
Velocity at sampling plane, m/s	2.4
Volumetric flow rate, actual, m³/min	17
Volumetric flow rate (wet STP), m³/min	15
Volumetric flow rate (dry STP), m³/min	15
Mass flow rate (wet basis), kg/hour	1200

2.9 Anode Casting

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	22	
Velocity at sampling plane, m/s	9	
Volumetric flow rate, actual, m³/min	86	
Volumetric flow rate (wet STP), m³/min	79	
Volumetric flow rate (dry STP), m³/min	77	
Mass flow rate (wet basis), kg/hour	6100	

Gas Analyser Results	Average	
Sampling time	0810 - 0909	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.3
Sulfur dioxide	<5	<0.3
Carbon monoxide	<2	<0.2
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound Sampling time	0811-0841	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.01

VOC's C5-C20	Results	
Sampling time	0811-0841	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Isokinetic Results		Results	
	Sampling time	0800-0900	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		12	0.9
PM10	(PSA)	5.6	0.43
PM2.5	(PSA)	1.5	0.11
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		100	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0745	
Final flow measurement time (hhmm)		0905	
Temperature, °C		22	
Velocity at sampling plane, m/s		8.9	
Volumetric flow rate, actual, m³/min		85	
Volumetric flow rate (wet STP), m³/min		78	
Volumetric flow rate (dry STP), m³/min		76	
Mass flow rate (wet basis), kg/hour		6000	
Velocity difference, %		-2	

Isokinetic Results		Results	
	Sampling time	0910-1010	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.11	0.0085
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		102	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		0905	
Final flow measurement time (hhmm)		1012	
Temperature, °C		22	
Velocity at sampling plane, m/s		9	
Volumetric flow rate, actual, m³/min		86	
Volumetric flow rate (wet STP), m³/min		80	
Volumetric flow rate (dry STP), m³/min		78	
Mass flow rate (wet basis), kg/hour		6100	
Velocity difference, %		5	

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:

The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	0800-0900	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.006**	**<0.0004**
Arsenic	**<0.002**	**<0.0002**
Beryllium	<0.0007	<0.00005
Cadmium	**0.005**	**0.00038**
Chromium	0.0018	0.00014
Cobalt	<0.0008	<0.00006
Copper	0.012	0.0009
Lead	**0.39**	**0.03**
Manganese	0.076	0.0058
Mercury	**0.0013**	**0.0001**
Nickel	<0.002	<0.0002
Phosphorus	0.084	0.0065
Selenium	<0.006	<0.0004
Zinc	0.35	0.026
Total of Sb, As, Cd, Pb, Hg	**≤0.4**	**≤0.031**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	97	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	0745	
Final flow measurement time (hhmm)	0905	
Temperature, °C	22	
Velocity at sampling plane, m/s	8.9	
Volumetric flow rate, actual, m³/min	85	
Volumetric flow rate (wet STP), m³/min	78	
Volumetric flow rate (dry STP), m³/min	76	
Mass flow rate (wet basis), kg/hour	6000	
Velocity difference, %	-2	

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0910 - 1010	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2500	190000
2-Methylnaphthalene	260	20000
Acenaphthylene	260	20000
Acenaphthene	82	6300
Fluorene	540	42000
Phenanthrene	1700	140000
Anthracene	59	4600
Fluoranthene	290	23000
Pyrene	150	12000
Benz(a)anthracene	<20	<2000
Chrysene	56	4300
Benzo(b)fluoranthene	<20	<2000
Benzo(k)fluoranthene	<20	<2000
Benzo(e)pyrene	<20	<2000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	<20	<2000
Dibenz(ah)anthracene	<20	<2000
Benzo(ghi)perylene	<20	<2000
Total 16 PAHs	5700	440000
Total 19 PAHs	6000	460000
BaP-TEQ		
Lower Bound	0.56	43
Middle Bound	20	1600
Upper Bound	40	3100

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	98
Velocity difference, %	5
Gas Flow Parameters	
Flow measurement time (hhmm)	0905
Flow measurement time (hhmm)	1012
Temperature, °C	22
Velocity at sampling plane, m/s	9
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	80
Volumetric flow rate (dry STP), m³/min	78
Mass flow rate (wet basis), kg/hour	6100

2.10 Zinc Plant 1 Baghouse – ZP1

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	78	
Velocity at sampling plane, m/s	8.1	
Volumetric flow rate, actual, m³/min	95	
Volumetric flow rate (wet STP), m³/min	74	
Volumetric flow rate (dry STP), m³/min	72	
Mass flow rate (wet basis), kg/hour	5700	

Gas Analyser Results	Average	
Sampling time	1246 - 1345	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Sulfur dioxide	<5	<0.3
Carbon monoxide	<2	<0.1
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1240-1310	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.01

VOC's C5-C20	Results	
Sampling time	1240-1310	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Isokinetic Results		Results	
	Sampling time	1230-1332	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		32	2.3
PM10	(PSA)	19	1.4
PM2.5	(PSA)	5.9	0.43
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		100	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1225	
Final flow measurement time (hhmm)		1334	
Temperature, °C		78	
Velocity at sampling plane, m/s		8.1	
Volumetric flow rate, actual, m³/min		95	
Volumetric flow rate (wet STP), m³/min		74	
Volumetric flow rate (dry STP), m³/min		72	
Mass flow rate (wet basis), kg/hour		5700	
Velocity difference, %		<1	

Isokinetic Results		Results	
	Sampling time	1400-1502	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		<0.04	<0.003
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		100	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1334	
Final flow measurement time (hhmm)		1505	
Temperature, °C		78	
Velocity at sampling plane, m/s		8.1	
Volumetric flow rate, actual, m³/min		95	
Volumetric flow rate (wet STP), m³/min		74	
Volumetric flow rate (dry STP), m³/min		72	
Mass flow rate (wet basis), kg/hour		5700	
Velocity difference, %		<1	

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1230-1332	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.0005**
Arsenic	**<0.003**	**<0.0002**
Beryllium	<0.0008	<0.00006
Cadmium	**0.018**	**0.0013**
Chromium	<0.001	<0.0001
Cobalt	0.0011	0.000079
Copper	0.034	0.0025
Lead	**0.41**	**0.029**
Manganese	0.033	0.0024
Mercury	**0.0026**	**0.00019**
Nickel	<0.003	<0.0002
Phosphorus	0.096	0.007
Selenium	<0.007	<0.0005
Zinc	32	2.3
Total of Sb, As, Cd, Pb, Hg	**≤0.44**	**≤0.032**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	104	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1225	
Final flow measurement time (hhmm)	1334	
Temperature, °C	78	
Velocity at sampling plane, m/s	8.1	
Volumetric flow rate, actual, m³/min	95	
Volumetric flow rate (wet STP), m³/min	74	
Volumetric flow rate (dry STP), m³/min	72	
Mass flow rate (wet basis), kg/hour	5700	
Velocity difference, %	<1	

Date	22/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1400 - 1502	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2200	160000
2-Methylnaphthalene	200	14000
Acenaphthylene	<30	<2000
Acenaphthene	200	14000
Fluorene	160	11000
Phenanthrene	410	30000
Anthracene	41	3000
Fluoranthene	220	16000
Pyrene	94	6800
Benz(a)anthracene	<30	<2000
Chrysene	<30	<2000
Benzo(b)fluoranthene	<30	<2000
Benzo(k)fluoranthene	<30	<2000
Benzo(e)pyrene	<30	<2000
Benzo(a)pyrene	42	3100
Perylene	<30	<2000
Indeno(1,2,3-cd)pyrene	<30	<2000
Dibenz(ah)anthracene	<30	<2000
Benzo(ghi)perylene	<30	<2000
Total 16 PAHs	3400	250000
Total 19 PAHs	3600	260000
BaP-TEQ		
Lower Bound	42	3100
Middle Bound	53	3800
Upper Bound	64	4600

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	103
Velocity difference, %	<1
Gas Flow Parameters	
Flow measurement time (hhmm)	1334
Flow measurement time (hhmm)	1505
Temperature, °C	78
Velocity at sampling plane, m/s	8.1
Volumetric flow rate, actual, m³/min	95
Volumetric flow rate (wet STP), m³/min	74
Volumetric flow rate (dry STP), m³/min	72
Mass flow rate (wet basis), kg/hour	5700

2.11 Zinc Plant 3 Baghouse – ZP3

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.7	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas Flow Parameters		
Temperature, °C	70	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/min	59	
Volumetric flow rate (wet STP), m³/min	47	
Volumetric flow rate (dry STP), m³/min	46	
Mass flow rate (wet basis), kg/hour	3600	

Gas Analyser Results	Average	
Sampling time	1142 - 1241	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Sulfur dioxide	8.3	0.38
Carbon monoxide	7.9	0.36
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Total Speciated VOCs	Results	
Lower Bound — Sampling time	1500-1532	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.008

VOC's C5-C20	Results	
Sampling time	1500-1532	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.008

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene. Decane. 3-Carene. D-Limonene. Undecane. Dodecane. Tridecane. Tetradecane

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Isokinetic Results		Results	
	Sampling time	1331-1435	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		24	1.1
PM10	(PSA)	14	0.63
PM2.5	(PSA)	3.9	0.18
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		97	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1325	
Final flow measurement time (hhmm)		1438	
Temperature, °C		70	
Velocity at sampling plane, m/s		15	
Volumetric flow rate, actual, m³/min		59	
Volumetric flow rate (wet STP), m³/min		47	
Volumetric flow rate (dry STP), m³/min		46	
Mass flow rate (wet basis), kg/hour		3600	
Velocity difference, %		2	

Isokinetic Results		Results	
	Sampling time	1331-1435	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		<0.04	<0.002
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		96	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1325	
Final flow measurement time (hhmm)		1438	
Temperature, °C		70	
Velocity at sampling plane, m/s		15	
Volumetric flow rate, actual, m³/min		59	
Volumetric flow rate (wet STP), m³/min		47	
Volumetric flow rate (dry STP), m³/min		46	
Mass flow rate (wet basis), kg/hour		3600	
Velocity difference, %		<1	

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1450-1554	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.0003**
Arsenic	**<0.003**	**<0.0001**
Beryllium	<0.0008	<0.00004
Cadmium	**<0.001**	**<0.00005**
Chromium	<0.001	<0.00006
Cobalt	<0.0009	<0.00004
Copper	0.0099	0.00046
Lead	**0.41**	**0.019**
Manganese	0.019	0.00089
Mercury	**<0.0006**	**<0.00003**
Nickel	<0.002	<0.0001
Phosphorus	0.063	0.003
Selenium	<0.007	<0.0003
Zinc	39	1.8
Total of Sb, Cd, Cd, Pb, Hg	**≤0.42**	**≤0.02**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	99	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1438	
Final flow measurement time (hhmm)	1600	
Temperature, °C	70	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	60	
Volumetric flow rate (wet STP), m³/min	48	
Volumetric flow rate (dry STP), m³/min	47	
Mass flow rate (wet basis), kg/hour	3700	
Velocity difference, %	2	

Date	21/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	Casting area in normal operation.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1450 - 1554	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1700	82000
2-Methylnaphthalene	69	3200
Acenaphthylene	<20	<1000
Acenaphthene	100	4900
Fluorene	<20	<1000
Phenanthrene	580	27000
Anthracene	<20	<1000
Fluoranthene	500	23000
Pyrene	200	9300
Benz(a)anthracene	<20	<1000
Chrysene	51	2400
Benzo(b)fluoranthene	<20	<1000
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<1000
Perylene	<20	<1000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	3200	150000
Total 19 PAHs	3200	150000
BaP-TEQ		
Lower Bound	0.51	24
Middle Bound	21	1000
Upper Bound	42	2000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	98
Velocity difference, %	3
Gas Flow Parameters	
Flow measurement time (hhmm)	1438
Flow measurement time (hhmm)	1600
Temperature, °C	70
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	60
Volumetric flow rate (wet STP), m³/min	48
Volumetric flow rate (dry STP), m³/min	47
Mass flow rate (wet basis), kg/hour	3700

2.12 MZR Furnace Baghouse

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		200415

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.30 (dry)
Gas Flow Parameters		
Temperature, °C	66	
Velocity at sampling plane, m/s	5.4	
Volumetric flow rate, actual, m³/min	81	
Volumetric flow rate (wet STP), m³/min	65	
Volumetric flow rate (dry STP), m³/min	64	
Mass flow rate (wet basis), kg/hour	5000	

Gas Analyser Results	Average	
Sampling time	1540 - 1639	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	5.9	0.38
Sulfur dioxide	<5	<0.3
Carbon monoxide	3	0.19
	Concentration % v/v	
Carbon dioxide	0.8	
Oxygen	19.6	

Total Speciated VOCs	Results	
Lower Bound Sampling time	1542-1617	
	Concentration mg/m³	Mass Rate g/min
Total	<0.2	<0.01

VOC's C5-C20	Results	
Sampling time	1542-1617	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.2	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		200415

Isokinetic Results		Results	
	Sampling time	1530-1630	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.2
PM10	(PSA)	<1	<0.07
PM2.5	(PSA)	<0.2	<0.02
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		101	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1528	
Final flow measurement time (hhmm)		1632	
Temperature, °C		66	
Velocity at sampling plane, m/s		5.5	
Volumetric flow rate, actual, m³/min		82	
Volumetric flow rate (wet STP), m³/min		66	
Volumetric flow rate (dry STP), m³/min		65	
Mass flow rate (wet basis), kg/hour		5100	
Velocity difference, %		-6	

Isokinetic Results		Results	
	Sampling time	1635-1735	
		Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)		0.72	0.046
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		109	
Gas Flow Parameters			
Initial flow measurement time (hhmm)		1632	
Final flow measurement time (hhmm)		1737	
Temperature, °C		66	
Velocity at sampling plane, m/s		5.4	
Volumetric flow rate, actual, m³/min		80	
Volumetric flow rate (wet STP), m³/min		65	
Volumetric flow rate (dry STP), m³/min		63	
Mass flow rate (wet basis), kg/hour		5000	
Velocity difference, %		1	

Ektimo

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		*200415*

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Isokinetic Results	Results	
Sampling time	1530-1630	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.006**	**<0.0004**
Arsenic	**<0.003**	**<0.0002**
Beryllium	<0.0007	<0.00004
Cadmium	**0.002**	**0.00013**
Chromium	0.0019	0.00012
Cobalt	<0.0008	<0.00005
Copper	0.0028	0.00018
Lead	**0.019**	**0.0012**
Manganese	0.0063	0.00041
Mercury	**<0.0008**	**<0.00005**
Nickel	<0.002	<0.0001
Phosphorus	0.038	0.0025
Selenium	<0.006	<0.0004
Zinc	0.19	0.013
Total of Sb, As, Cd, Pb, Hg	**≤0.03**	**≤0.002**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	104	
Gas Flow Parameters		
Initial flow measurement time (hhmm)	1528	
Final flow measurement time (hhmm)	1632	
Temperature, °C	66	
Velocity at sampling plane, m/s	5.5	
Volumetric flow rate, actual, m³/min	82	
Volumetric flow rate (wet STP), m³/min	66	
Volumetric flow rate (dry STP), m³/min	65	
Mass flow rate (wet basis), kg/hour	5100	
Velocity difference, %	-6	

NATA

Date	23/04/2020	**Client**	Nyrstar Hobart
Report	R009155	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	Glenn Trenear & Nick Heatley	**State**	TAS
Process Conditions	MZR Furnace in operation.		200415

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1635 - 1735	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	1300	82000
2-Methylnaphthalene	620	39000
Acenaphthylene	<20	<1000
Acenaphthene	350	22000
Fluorene	<20	<1000
Phenanthrene	410	26000
Anthracene	520	33000
Fluoranthene	440	28000
Pyrene	97	6100
Benz(a)anthracene	<20	<1000
Chrysene	<20	<1000
Benzo(b)fluoranthene	<20	<1000
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<1000
Perylene	<20	<1000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	3100	200000
Total 19 PAHs	3700	240000
BaP-TEQ		
Lower Bound	0	0
Middle Bound	15	920
Upper Bound	29	1800

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	98
Velocity difference, %	1
Gas Flow Parameters	
Flow measurement time (hhmm)	1632
Flow measurement time (hhmm)	1737
Temperature, °C	66
Velocity at sampling plane, m/s	5.4
Volumetric flow rate, actual, m³/min	80
Volumetric flow rate (wet STP), m³/min	65
Volumetric flow rate (dry STP), m³/min	63
Mass flow rate (wet basis), kg/hour	5000

3 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Nitrous oxide	Teledyne T320 Analyser	NA	not specified	NA	NA
Sulfur dioxide	USEPA 6C	USEPA 6C	12%	✓	✓
Speciated volatile organic compounds (VOC's)	Ektimo 344	Ektimo 344	19%	✓	✓†
Total particulate matter	AS 4323.2	AS 4323.2††	5%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓‡
Particulate matter (PM_{10} and $PM_{2.5}$) by particle size analysis	AS 4323.2	HRL In-house	-	-	×**
Polycyclic aromatic hydrocarbons (PAH's)	USEPA SW-846 0010	NGCMS 11.27	21%	✓	✓¶
Sulfuric acid mist and/or sulfur oxides	USEPA 8	Ektimo 235	16%	✓	✓†
Total fluoride	USEPA 13B	ALS Method QWI-EN/EA144C & Ektimo 235	17%	✓	✓#,†

200506

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported to Ektimo on
11 May 2020 in report number R009155-Halides_Halogens
19 May 2020 in report number R009155-SOx
21 May 2020 in report number R009155_SVOCs

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901.
Results were reported to Ektimo on 12 May 2020 in report number 242291

¶ Analysis performed by Australian Government National Measurement Institute, NATA accreditation number 198.
Results were reported to Ektimo on 1 & 2 June 2020 in report number # ORG20_030 & ORG20_029

** Analysis performed by HRL Technology using a Malvern Instruments Mastersizer laser particle size analyser.
NATA Accreditation does not cover the performance of this service.
Results were reported to Ektimo on 15 May 2020 in report number 200550

Analysis (solid fluoride only) performed by Australian Laboratory Services Pty Ltd, NATA accreditation number 825.
Results were reported to Ektimo on 19 May 2020 in report number EN2003236

4 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

5 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

6 APPENDIX 1: WEATHER OBSERVATIONS

Hobart April 2020

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	We	9.7	20	0	2.4	9.4	NW	26	5:00	12.9	76	1	N	7	1019.2	18.7	52	7	SSE	19	1018
2	Th	12.6	16.4	0	2.4	0.2	S	31	14:10	14.3	91	8	WNW	7	1015.6	15	96	8	SSW	20	1007.1
3	Fr	13.9	20.6	39.8	4.2	3.9	NW	39	4:20	15.5	72	7	NNW	11	1002.8	19.5	58	2	NE	15	1000.1
4	Sa	13.6	14.7	8.4	2	1	WSW	57	13:52	13.8	94	8	WNW	13	988.1	12.8	57	7	SW	37	988.2
5	Su	5.4	13.4	1.2	1.4	5.7	SW	56	12:47	7.4	72	7	NNW	11	995.5	12.7	40	4	WSW	11	997.4
6	Mo	7.2	16.2	0	2.2	9	WNW	41	14:25	12.9	53	7	WNW	20	1014.8	14.9	40	4	WNW	28	1016.7
7	Tu	5.5	17.7	0	1.8	7.6	SSW	41	21:46	11.2	65	2	NW	22	1022.3	17.1	49	4	WNW	11	1020.1
8	We	8.4	14.7	0	3	6.7	SE	31	14:16	12.3	65	7	SW	15	1028.1	14.1	52	1	SE	20	1028.5
9	Th	5.4	20.7	0	2.2	10.7	N	31	23:44	10.5	75	1	NNW	13	1029.3	20	40	1	NW	11	1023.9
10	Fr	10.4	21.4	0	2	3.2	NW	59	10:46	17.9	54	6	NNW	22	1009.5	19.8	44	7	NW	30	1002.2
11	Sa	10.1	13.4	3.2	3	2.3	SSW	46	11:50	12.3	71	7	SW	11	994.3	12.4	76	5	SSW	26	1001.4
12	Su	9	16.8	2.4	2.2	3.9	NW	46	9:50	12.1	61	7	WNW	24	1010.5	16.3	56	7	WSW	24	1009.9
13	Mo	5.1	15.6	0	1.6	3.7	ENE	17	19:30	11.6	77	7	Calm		1018.7	15.3	59	7	NE	7	1017.1
14	Tu	10.2	21.5	0	1.4	8.8	NW	33	10:28	14.1	70	3	NNW	15	1019.7	21.3	48	1	NNW	13	1016.9
15	We	13.4	17.1	0	2.4	0	NW	43	17:53	14.7	87	7	NE	4	1017.2	15.1	90	8	NNW	15	1012
16	Th	13.4	17	5.4	0	7.2	WNW	59	11:49	15.3	77	6	WSW	13	1000.8	14.9	38	1	W	35	1001.4
17	Fr	7.8	13.6	0.4	4.2	8.1	WNW	63	14:34	11.1	51	1	WNW	28	999.9	11.6	47	4	WNW	35	999.7
18	Sa	9.1	14.3	0	3.8	8.5	WSW	57	6:19	11.5	49	2	W	26	1008.3	13.4	41	5	WSW	20	1008.5
19	Su	4.5	13.2	0.2	1.8	1.4	NW	20	9:02	9.7	78	7	NW	13	1013.8	12.5	73	7	SSE	13	1012.4
20	Mo	9.3	17.2	0.8	0.8	4.8	NNW	67	13:14	12.1	79	8	NNE	11	1001.2	15.3	46	6	WNW	33	999.5
21	Tu	8.8	17.6	0.8	1.8	5.5	NW	41	12:50	11.3	66	2	NNW	13	1011.6	16	47	7	NW	17	1007.9
22	We	10.1	16.4	0	2.8	8.7	WNW	70	12:59	13.1	42	1	NW	31	1009.8	15.7	34	1	W	31	1011.1
23	Th	6.2	18.6	0	3.8	8.8	NNW	35	22:06	11.8	59	7	NW	13	1013.8	18.3	44	6	WNW	19	1008.4
24	Fr	10.4	18.2	0	3.4	7.1	WNW	70	16:03	15.5	40	1	WNW	20	1007.5	16.6	44	4	WNW	43	1005.5
25	Sa	11.7	18.7	0	3.8	1.6	NW	48	13:34	15.4	61	7	NW	9	1011.8	18.2	52	7	NW	26	1008.6
26	Su	12.6	16.6	0	2.6	8	WNW	61	10:51	15.2	39	1	W	35	1001.6	13.8	32	3	W	30	1006.2
27	Mo	9.4	19	0	3.8	5.9	WNW	63	1:52	15	52	6	NNW	20	1012.8	16.8	51	5	NW	26	1014.2
28	Tu	10.1	19.9	0	3.2	4.1	N	39	14:21	13.1	68	6	N	13	1015.2	17.8	47	7	N	24	1010.6
29	We	9	20.7	0	3.2	7.8	NNW	41	12:31	14.5	69	1	NW	15	1004.5	19.7	60	4	N	20	999.7
30	Th	11.1	14.9	10	2.6	3.8	NW	26	4:38	11.4	83	7	NNW	9	1002.8	14	61	7	ENE	9	998.6
	Statistics for April																				
Mean		9.4	17.2		2.5	5.6				13	66	4		15	1010	16	52	4		22	1008.4
Lowest		4.5	13.2	0	0	0				7.4	39	1	Calm		988.1	11.6	32	1	NE	7	988.2
Highest		13.9	21.5	39.8	4.2	10.7	WNW	70		17.9	94	8	W	35	1029.3	21.3	96	8	WNW	43	1028.5
Total				72.6	75.8	167.4															

7 APPENDIX 2: SITE PHOTOS


Anode Casting


Paragoethite Dryer


Casting Ventilation 2 - V2


Casting Ventilation 1 – V1


Zinc Plant 1 Baghouse – ZP1


Zinc Plant 3 Baghouse – ZP3


MZR Furnace


Cadmium Smelter


Copper Sulphate Stack


Roaster Baghouse


Foreshore A


Foreshore B

Address (Head Office)
7 Redland Drive
Mitcham VIC 3132

Postal Address
52 Cooper Road
Cockburn Central WA 6164

Office Locations
VIC NSW WA QLD

Freecall: 1300 364 005
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ABN 86 600 381 413

REPORT NUMBER R009609

Emission Testing Report

Round 2 – December 2020
Nyrstar Hobart, Lutana

Document Information

Template Version; 030620

Client Name:	Nyrstar Hobart
Report Number:	R009609
Date of Issue:	3 February 2021
Attention:	Kylie Veale
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Glenn Trenear
Senior Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 Background

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. This formed the second round of scheduled monitoring for 2020.

Testing was carried out in accordance with Tasmanian EPN notice 7043/5.

1.2 Project Objectives

The objectives of the project were to conduct a monitoring programme to quantify emissions from twelve (12) discharge points to determine compliance with Nyrstar Hobart 's Environmental Licence.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Foreshore A	10 December 2020	Total particulate matter Metals Sulfur dioxide, sulfur trioxide Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen
Foreshore B	10 December 2020	
Parageothite Dryer	10 December 2020	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Cadmium Smelter	9 December 2020	
Copper Sulphate Stack	18 December 2020	
Casting Ventilation 1 – V1	8 December 2020	
Casting Ventilation 2 – V2	8 December 2020	
Anode Casting	9 December 2020	
Zinc Plant 1 Baghouse – ZP1	9 December 2020	
Zinc Plant 3 Baghouse – ZP3	9 December 2020	
MZR Furnace Baghouse	8 December 2020	
Roaster Baghouse	8 December 2020	Total particulate matter Metals Sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

1.3 Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence limit and all analytes highlighted in red are outside the licence limit set by Tasmanian EPN 7043/5.

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 RESULTS

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	13
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.03
	Particulates	mg/m^3	100	<1
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	1.3
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.033
	Particulates	mg/m^3	100	<1
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	<3
V1 Furnace Stack				<2
V2 Furnace Stack				<2
Zinc Dust Plant Baghouse 1 Stack				<2
Zinc Dust Plant Bagouse 3 Stack				8.5
Cadmium Smelter Plant Scrubber Stack				1.7
Copper Sulphate Crystalliser Plant				<3
Roaster Baghouse				2.7
Paragoethite Dryer Baghouse				69
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	≤0.18
V1 Furnace Stack				≤0.02
V2 Furnace Stack				≤0.024
Zinc Dust Plant Baghouse 1 Stack				≤0.038
Zinc Dust Plant Baghouse 3 Stack				≤0.1
Cadmium Smelter Plant Scrubber Stack				≤0.026
Copper Sulphate Crystalliser Plant				≤0.087
Roaster Baghouse				≤0.54
Paragoethite Dryer Baghouse				5.4
Anode Casting Plant Exhaust	Metals - Hg	mg/m^3	1	0.00093
V1 Furnace Stack				<0.0006
V2 Furnace Stack				<0.0008
Zinc Dust Plant Baghouse 1 Stack				<0.0009
Zinc Dust Plant Baghouse 3 Stack				<0.0007
Cadmium Smelter Plant Scrubber Stack				<0.0005
Copper Sulphate Crystalliser Plant				<0.0007
Roaster Baghouse				0.0014
Paragoethite Dryer Baghouse				0.0021
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	0.001
V1 Furnace Stack				<0.0008
V2 Furnace Stack				0.0008
Zinc Dust Plant Baghouse 1 Stack				0.0011
Zinc Dust Plant Baghouse 3 Stack				<0.00059
Cadmium Smelter Plant Scrubber Stack				0.0036
Copper Sulphate Crystalliser Plant				0.028
Roaster Baghouse				0.028
Paragoethite Dryer Baghouse				0.028

(1) Total concentration of metals combined.

2.1 Foreshore A

Date	10/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Foreshore A
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 55,000 m3/hr & Unit 6 producing 98,000 m3/hr of gas through the acid stream.		201110

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1255 & 1450	
Temperature, °C	21	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	1800	
Volumetric flow rate (wet STP), m³/min	1600	
Volumetric flow rate (dry STP), m³/min	1600	
Mass flow rate (wet basis), kg/hour	120000	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1334 - 1433	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	30	47
Nitrous oxide	<1	<2
Carbon monoxide	<6	<10
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	10.2	

Isokinetic Results	Results	
Sampling time	1300-1442	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<1	<2
Sulfur dioxide	130	200
Sulfur trioxide	13	21
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	96	

Note: Nitrous Oxide as N_2O measurements are not NATA accredited.

Date	10/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Foreshore A
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 55,000 m3/hr & Unit 6 producing 98,000 m3/hr of gas through the acid stream. *201110*		

Stack Parameters		
Moisture content, %v/v	2.1	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1450 & 1647	
Temperature, °C	21	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1800	
Volumetric flow rate (wet STP), m³/min	1700	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	8	

Isokinetic Results	Results	
Sampling time	1500-1642	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.004	<0.006
Arsenic	<0.002	<0.003
Beryllium	<0.0004	<0.0007
Cadmium	0.0011	0.0018
Chromium	<0.0006	<0.0009
Cobalt	<0.0006	<0.0009
Copper	0.0022	0.0037
Lead	0.024	0.041
Manganese	0.0062	0.01
Mercury	0.00074	0.0012
Nickel	<0.001	<0.002
Phosphorus	<0.01	<0.02
Selenium	<0.004	<0.006
Zinc	0.16	0.26
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	100	
Velocity difference, %	8	

2.2 Foreshore B

Date	10/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Foreshore B
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 55,000 m3/hr & Unit 6 producing 98,000 m3/hr of gas through the acid stream. 201110		

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.1	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1445 & 1652	
Temperature, °C	21	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	1800	
Volumetric flow rate (wet STP), m³/min	1700	
Volumetric flow rate (dry STP), m³/min	1600	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	1	

Gas Analyser Results	Average	
Sampling time	1450 - 1549	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	33	53
Nitrous oxide	<1	<2
Carbon monoxide	<6	<10
	Concentration % v/v	
Carbon dioxide	0.4	
Oxygen	9.7	

Isokinetic Results	Results	
Sampling time	1500-1642	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<1	<2
Sulfur dioxide	120	200
Sulfur trioxide	1.3	2.1
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	

Note: Nitrous Oxide as N_2O measurements are not NATA accredited.

Ektimo

Date	10/12/2020	Client	Nyrstar Hobart
Report	R009609	Stack ID	Foreshore B
Licence No.	7032-5	Location	Hobart
Ektimo Staff	G Trenear & T Bakas	State	TAS
Process Conditions	Unit 5 producing 55,000 m3/hr & Unit 6 producing 98,000 m3/hr of gas through the acid stream.		201110

Stack Parameters		
Moisture content, %v/v	2.1	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1258 & 1445	
Temperature, °C	20	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	1800	
Volumetric flow rate (wet STP), m³/min	1600	
Volumetric flow rate (dry STP), m³/min	1600	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	2	

Isokinetic Results	Results	
Sampling time	1300-1442	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.004**	**<0.006**
Arsenic	**<0.002**	**<0.003**
Beryllium	<0.0005	<0.0008
Cadmium	**0.0012**	0.002
Chromium	<0.0006	<0.001
Cobalt	<0.0006	<0.001
Copper	0.00087	0.0014
Lead	**0.021**	**0.034**
Manganese	0.0061	0.0098
Mercury	**0.0011**	**0.0017**
Nickel	<0.001	<0.002
Phosphorus	<0.02	<0.02
Selenium	<0.004	<0.006
Zinc	0.18	0.3
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	97	

Ektimo

2.3 Parageothite Dryer

Date	10/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Parageothite Dryer
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	6.5 m3/hr of dirt and 2.03 m3/hr of bypass flow into the drum.		201110

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	35	
Gas molecular weight, g/g mole	25.4 (wet)	29.3 (dry)
Gas density at STP, kg/m³	1.13 (wet)	1.31 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1720 & 1840	
Temperature, °C	111	
Velocity at sampling plane, m/s	8	
Volumetric flow rate, actual, m³/min	340	
Volumetric flow rate (wet STP), m³/min	240	
Volumetric flow rate (dry STP), m³/min	160	
Mass flow rate (wet basis), kg/hour	16000	
Velocity difference, %	-3	

Gas Analyser Results	Average	
Sampling time	1728 - 1827	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	60	9.4
Carbon monoxide	<6	<1
	Concentration % v/v	
Carbon dioxide	4.3	
Oxygen	13.3	

NATA

Date	10/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Parageothite Dryer
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	6.5 m3/hr of dirt and 2.03 m3/hr of bypass flow into the drum.		*201110*

Isokinetic Results	Results	
Sampling time	1730-1832	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	69	11
Antimony	**0.02**	**0.0031**
Arsenic	**0.2**	**0.032**
Beryllium	<0.0006	<0.0001
Cadmium	**0.028**	**0.0044**
Chromium	0.0087	0.0014
Cobalt	0.00099	0.00016
Copper	0.52	0.083
Lead	**5.1**	**0.81**
Manganese	0.16	0.026
Mercury	**0.0021**	**0.00034**
Nickel	0.0064	0.001
Phosphorus	<0.02	<0.003
Selenium	<0.005	<0.0008
Zinc	4.2	0.66
Total Sb. As, Cd, Pb, Hg	**5.4**	**0.85**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	105	

2.4 Cadmium Smelter

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Cadmium Smelter
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		201110

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2.7	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1340 & 1455
Temperature, °C	25
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/min	150
Volumetric flow rate (wet STP), m³/min	140
Volumetric flow rate (dry STP), m³/min	130
Mass flow rate (wet basis), kg/hour	10000
Velocity difference, %	6

Gas Analyser Results	Average	
Sampling time	1348 - 1447	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.6
Carbon monoxide	<6	<0.8
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.7	

Ektimo

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Cadmium Smelter
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		*201110*

Isokinetic Results	Results	
Sampling time	1345-1446	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	1.7	0.22
Antimony	**<0.004**	**<0.0005**
Arsenic	**<0.002**	**<0.0002**
Beryllium	<0.0005	<0.00007
Cadmium	**0.0036**	**0.00047**
Chromium	0.0064	0.00085
Cobalt	0.0019	0.00025
Copper	0.0026	0.00034
Lead	**0.016**	**0.0022**
Manganese	0.018	0.0023
Mercury	**<0.0005**	**<0.00007**
Nickel	0.0069	0.00091
Phosphorus	<0.02	<0.002
Selenium	<0.004	<0.0005
Zinc	0.23	0.03
Total of Sb, As, Cd, Pb, Hg	**≤0.026**	**≤0.0035**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	94	

NATA

2.5 Copper Sulphate Stack

Date	18/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Copper Sulphate Stack
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Production rate - 12.5 tonnes/day, Dryer Outlet Temperature - 48 deg C, Feed rate into Dryer - 0% (The storage tanks were already full so the plant was in full production even though there was no feed into the dryer. The feed into the dryer was stopped due to a sulphuric acid leak upstream).		201110

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Stairs & fixed ladder 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	9.4	
Gas molecular weight, g/g mole	28.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0943 & 1100	
Temperature, °C	46	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	200	
Volumetric flow rate (wet STP), m³/min	170	
Volumetric flow rate (dry STP), m³/min	160	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	-1	

Gas Analyser Results	Average	
Sampling time	0956 - 1055	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<4	<0.7
Carbon monoxide	<6	<1
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.8	

Date	18/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Copper Sulphate Stack
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear	**State**	TAS
Process Conditions	Production rate - 12.5 tonnes/day, Dryer Outlet Temperature - 48 deg C, Feed rate into Dryer - 0% (The storage tanks were already full so the plant was in full production even though there was no feed into the dryer. The feed into the dryer was stopped due to a sulphuric acid leak upstream).		201110

Isokinetic Results	Results	
Sampling time	0955-1055	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<3	<0.5
Antimony	**<0.006**	**<0.0009**
Arsenic	**<0.003**	**<0.0005**
Beryllium	<0.0008	<0.0001
Cadmium	**0.028**	**0.0043**
Chromium	0.0043	0.00067
Cobalt	<0.001	<0.0002
Copper	0.04	0.0062
Lead	**0.05**	**0.0077**
Manganese	0.033	0.0051
Mercury	**<0.0007**	**<0.0001**
Nickel	0.019	0.003
Phosphorus	<0.03	<0.005
Selenium	<0.006	<0.0009
Zinc	0.25	0.039
Total of Sb, As, Cd, Pb, Hg	**≤0.087**	**≤0.014**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	109	

2.6 Casting Ventilation 1 – V1

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		201110

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1025 & 1134
Temperature, °C	29
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	310
Volumetric flow rate (wet STP), m³/min	280
Volumetric flow rate (dry STP), m³/min	270
Mass flow rate (wet basis), kg/hour	21000
Velocity difference, %	<1

Gas Analyser Results	Average	
Sampling time	1030 - 1129	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<4	<1
Carbon monoxide	<6	<2
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.9	

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		*201110*

Isokinetic Results	Results	
Sampling time	1030-1130	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.6
Antimony	**<0.006**	**<0.002**
Arsenic	**<0.003**	**<0.0007**
Beryllium	<0.0007	<0.0002
Cadmium	**<0.0008**	**<0.0002**
Chromium	<0.0009	<0.0002
Cobalt	<0.0009	<0.0002
Copper	0.0039	0.0011
Lead	**0.0099**	**0.0027**
Manganese	0.013	0.0037
Mercury	**<0.0006**	**<0.0002**
Nickel	<0.002	<0.0005
Phosphorus	<0.02	<0.005
Selenium	<0.006	<0.002
Zinc	0.51	0.14
Total Sb, As, Cd, Pb, Hg	**≤0.02**	**≤0.0054**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	

2.7 Casting Ventilation 2 – V2

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		201110

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1110 & 1219
Temperature, °C	49
Velocity at sampling plane, m/s	20
Volumetric flow rate, actual, m³/min	340
Volumetric flow rate (wet STP), m³/min	280
Volumetric flow rate (dry STP), m³/min	280
Mass flow rate (wet basis), kg/hour	22000
Velocity difference, %	-3

Gas Analyser Results	Average	
Sampling time	1132 - 1231	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	5.6	1.6
Carbon monoxide	29	8.1
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.9	

Ektimo

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		201110

Isokinetic Results	Results	
Sampling time	1115-1215	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.6
Antimony	**<0.005**	**<0.001**
Arsenic	**<0.002**	**<0.0006**
Beryllium	<0.0006	<0.0002
Cadmium	**0.0008**	**0.00022**
Chromium	0.052	0.015
Cobalt	0.013	0.0036
Copper	0.0072	0.002
Lead	**0.015**	**0.0042**
Manganese	0.03	0.0085
Mercury	**<0.0008**	**<0.0002**
Nickel	0.052	0.014
Phosphorus	<0.02	<0.007
Selenium	<0.005	<0.001
Zinc	0.23	0.065
Total Sb, As, Cd, Pb, Hg	**≤0.024**	**≤0.0068**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	93	

NATA

2.8 Anode Casting

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Anode Casting
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in full production during testing.		201110

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0835 & 0955
Temperature, °C	31
Velocity at sampling plane, m/s	9.6
Volumetric flow rate, actual, m³/min	92
Volumetric flow rate (wet STP), m³/min	82
Volumetric flow rate (dry STP), m³/min	81
Mass flow rate (wet basis), kg/hour	6300
Velocity difference, %	2

Gas Analyser Results	Average	
Sampling time	0854 - 0953	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<4	<0.3
Carbon monoxide	<6	<0.5
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.9	

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Anode Casting
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in full production during testing.		*201110*

Isokinetic Results	Results	
Sampling time	0852-0952	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<3	<0.3
Antimony	**<0.006**	**<0.0005**
Arsenic	**<0.003**	**<0.0002**
Beryllium	<0.0007	<0.00006
Cadmium	**0.001**	**0.000082**
Chromium	<0.001	<0.00008
Cobalt	<0.0009	<0.00008
Copper	0.0082	0.00066
Lead	**0.17**	**0.014**
Manganese	0.032	0.0026
Mercury	**0.00093**	**0.000075**
Nickel	0.0021	0.00017
Phosphorus	<0.02	<0.002
Selenium	<0.006	<0.0005
Zinc	0.44	0.035
Total of Sb, As, Cd, Pb, Hg	**≤0.18**	**≤0.015**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	93	

2.9 Zinc Plant 1 Baghouse – ZP 1

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		201110

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1027 & 1138
Temperature, °C	76
Velocity at sampling plane, m/s	8.4
Volumetric flow rate, actual, m³/min	99
Volumetric flow rate (wet STP), m³/min	77
Volumetric flow rate (dry STP), m³/min	77
Mass flow rate (wet basis), kg/hour	6000
Velocity difference, %	1

Gas Analyser Results	Average	
Sampling time	1030 - 1129	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.3
Carbon monoxide	<6	<0.5
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.9	

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		201110

Isokinetic Results	Results	
Sampling time	1030-1132	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.1
Antimony	**<0.005**	**<0.0004**
Arsenic	**<0.002**	**<0.0002**
Beryllium	<0.0006	<0.00005
Cadmium	**0.0011**	**0.000088**
Chromium	0.0018	0.00013
Cobalt	<0.0008	<0.00006
Copper	0.0028	0.00022
Lead	**0.029**	**0.0022**
Manganese	0.036	0.0027
Mercury	**<0.0009**	**<0.00007**
Nickel	0.0024	0.00019
Phosphorus	<0.02	<0.002
Selenium	<0.005	<0.0004
Zinc	0.46	0.035
Total Sb, As, Cd, Pb, Hg	**≤0.038**	**≤0.0029**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	94	

2.10 Zinc Plant 3 Baghouse – ZP 3

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		201110

Sampling Plane Details

Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1027 & 1259
Temperature, °C	80
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	65
Volumetric flow rate (wet STP), m³/min	50
Volumetric flow rate (dry STP), m³/min	49
Mass flow rate (wet basis), kg/hour	3900
Velocity difference, %	4

Gas Analyser Results	Average	
Sampling time	1150 - 1249	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<4	<0.2
Carbon monoxide	<6	<0.3
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.9	

Date	9/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		*201110*

Isokinetic Results	Results	
Sampling time	1150-1256	
	Concentration mg/m^3	Mass Rate g/min
Total particulate matter	8.5	0.42
Antimony	**<0.004**	**<0.0002**
Arsenic	**<0.002**	**<0.00008**
Beryllium	<0.0005	<0.00002
Cadmium	**0.00059**	**0.000029**
Chromium	0.00078	0.000038
Cobalt	<0.0006	<0.00003
Copper	0.00071	0.000035
Lead	**0.096**	**0.0047**
Manganese	0.011	0.00052
Mercury	**<0.0007**	**<0.00003**
Nickel	<0.001	<0.00005
Phosphorus	<0.02	<0.0009
Selenium	<0.004	<0.0002
Zinc	5.1	0.25
Total of Sb, As, Cd, Pb, Hg	**≤0.1**	**≤0.0051**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	92	

2.11 MZR Furnace Baghouse

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	MZR Furnace
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		201110

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1335 & 1446	
Temperature, °C	51	
Velocity at sampling plane, m/s	5.8	
Volumetric flow rate, actual, m³/min	87	
Volumetric flow rate (wet STP), m³/min	73	
Volumetric flow rate (dry STP), m³/min	72	
Mass flow rate (wet basis), kg/hour	5600	
Velocity difference, %	1	

Gas Analyser Results	Average	
Sampling time	1340 - 1439	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.3
Carbon monoxide	<6	<0.4
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.8	

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	MZR Furnace
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		*201110*

Isokinetic Results	Results	
Sampling time	1340-1441	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.2
Antimony	**<0.006**	**<0.0005**
Arsenic	**<0.003**	**<0.0002**
Beryllium	<0.0008	<0.00006
Cadmium	**<0.0008**	**<0.00006**
Chromium	<0.0009	<0.00007
Cobalt	<0.0009	<0.00007
Copper	0.0022	0.00016
Lead	**0.011**	**0.00076**
Manganese	0.024	0.0017
Mercury	**<0.0006**	**<0.00005**
Nickel	<0.002	<0.0001
Phosphorus	<0.02	<0.001
Selenium	<0.006	<0.0005
Zinc	0.37	0.027
Total of Sb, As, Cd, Pb, Hg	**≤0.021**	**≤0.0015**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	96	

2.12 Roaster Baghouse

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Roaster Baghouse
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 0 t/hr (shut down), Roaster 5 - 24 t/hr (Conveyor all in operation), fumes were on.		201110

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2.9	
Gas molecular weight, g/g mole	28.8 (wet)	29.1 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.30 (dry)

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1512 & 1631
Temperature, °C	29
Velocity at sampling plane, m/s	8.3
Volumetric flow rate, actual, m³/min	58
Volumetric flow rate (wet STP), m³/min	52
Volumetric flow rate (dry STP), m³/min	51
Mass flow rate (wet basis), kg/hour	4000
Velocity difference, %	3

Gas Analyser Results	Average	
Sampling time	1526 - 1625	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<4	<0.2
Sulfur dioxide	5900	300
Carbon monoxide	<6	<0.3
	Concentration % v/v	
Carbon dioxide	<0.4	
Oxygen	20.3	

Date	8/12/2020	**Client**	Nyrstar Hobart
Report	R009609	**Stack ID**	Roaster Baghouse
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 0 t/hr (shut down), Roaster 5 - 24 t/hr (Conveyor all in operation), fumes were on.		*201110*

Isokinetic Results	Results	
Sampling time	1519-1626	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	2.7	0.14
Antimony	**<0.004**	**<0.0002**
Arsenic	**0.0076**	**0.00039**
Beryllium	<0.0006	<0.00003
Cadmium	**0.028**	**0.0014**
Chromium	0.013	0.00065
Cobalt	0.0014	0.000071
Copper	0.015	0.00079
Lead	**0.49**	**0.025**
Manganese	0.019	0.00099
Mercury	**0.0014**	**0.000072**
Nickel	0.0075	0.00038
Phosphorus	<0.02	<0.001
Selenium	<0.004	<0.0002
Zinc	0.63	0.032
Total of Sb, As, Cd, Pb, Hg	**≤0.54**	**≤0.027**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	94	

3 PLANT OPERATING CONDITIONS

See Nyrstar Hobart records for complete process conditions.

4 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	ISO 10780	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Sulfur dioxide	USEPA 6C	USEPA 6C	12%	✓	✓
Total particulate matter	AS 4323.2	AS 4323.2††	3%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓‡
Sulfuric acid mist and/or sulfur oxides	USEPA 8	Ektimo 235	16%	✓	✓†
Nitrous oxide	Teledyne T320 Analyser	NA	not specified	×	×

201123

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.
Results were reported on 23 December 2020 in report number LV-000894.

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on
07 January 2021 in report number 258940.
13 January 2021 in report number 259036.

5 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

6 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

Ektimo

APPENDIX 1: WEATHER OBSERVATIONS

Hobart – December 2020

Date	Day	Temps		Rain	Evap	Max wind gust			9:00 AM						3:00 PM					
		Min	Max			Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Tu	16	26	0	6.8	NW	93	17:48	20.3	55	7	N	11	997.3	18.2	71	7	WNW	30	992.5
2	We	7.5	18.4	11	6.4	W	96	3:53	11.6	50	6	W	31	1009	17.3	33	3	S	20	1014
3	Th	9.8	20.5	0	7.6	NW	50	14:48	14.4	48	6	NW	28	1017	18.1	54	7	WNW	22	1015
4	Fr	12	19.8	0	4.4	W	63	9:36	14.6	57	7	NW	28	1007	18.3	35	4	S	11	1008
5	Sa	11	21.5	0	8	NNW	46	14:51	16.4	58	3	N	17	1004	21.4	31	8	NNW	17	993.7
6	Su	11	16.6	8	5.2	NW	70	12:20	12.1	52	4	WNW	48	985.5	14.5	50	4	N	20	987
7	Mo	7.9	17.6	1.4	4.6	WSW	56	16:30	10.5	75	7	NW	17	992.1	15.5	48	6	SSW	9	995.9
8	Tu	7	17.6	0	5	NW	61	14:20	12.2	55	7	N	15	1009	14.9	53	7	NNW	35	1007
9	We	12	23.2	0	5.2	NW	61	16:58	16.8	55	7	NNW	28	1011	20.8	42	3	NNW	24	1009
10	Th	8.1	17.6	0.2	8.8	SSW	48	10:56	11.6	50	5	SSW	19	1023	15.4	41	5	SSW	17	1025
11	Fr	8.6	19.4	0.2	5.4	ESE	46	12:39	13.1	56	7	ESE	7	1031	16.1	60	1	ESE	24	1031
12	Sa	11	20.6	0	5.6	SE	35	15:09	15	62	1	N	7	1034	19.1	61	1	ESE	22	1030
13	Su	12	29	0	7.2	NE	41	12:07	17.6	55	7	NNW	22	1027	28.4	18	7	NNE	24	1021
14	Mo	15	33.5	0	8	N	50	8:19	21	49	1	N	24	1016	30	33	1	E	19	1011
15	Tu	21	29.4	0	11	SE	41	10:35	27.3	34	2	N	17	1009	19	72	4	SE	24	1012
16	We	12	15.5	0	8.4	S	31	6:01	13.3	56	7	SE	20	1023	14.7	56	7	SE	20	1021
17	Th	11	16.2	4.8	4.8	SSW	20	11:26	11.8	94	8	E	6	1010	15.2	84	7	ENE	9	1005
18	Fr	12	20.3	6.4	2.2	SW	48	16:16	15	81	7	NNE	6	1005	17.4	64	6	NW	17	1006
19	Sa	11	16.8	0.6	3.2	SW	41	8:37	14.5	42	6	SW	20	1017	12.2	71	6	SE	17	1018
20	Su	10	17.2	0.8	3.2	NE	30	17:28	13	67	8	SSW	6	1020	16.2	56	7	NE	11	1018
21	Mo	9.4	19.4	0.2	3.8	ESE	35	13:31	16.6	57	1	NE	9	1015	17.5	59	7	SE	22	1011
22	Tu	14	18	0	4.6	SSW	30	8:49	15.8	79	8	SSW	19	1008	16.8	89	7	SE	9	1007
23	We	13	20.3	34	1.4	NW	50	12:54	16.9	54	2	NNW	19	1012	17.1	69	7	SSW	19	1011
24	Th	11	18.4	0.8	4.4	WSW	63	12:57	13.9	52	6	NNW	13	1014	15.8	47	3	SW	24	1013
25	Fr	8.9	17.6	0.4	3.8	SSW	39	11:22	14.6	42	3	SW	15	1022	16	47	2	ESE	20	1021
26	Sa	9.1	23.3	0	5.8	N	46	13:11	15.7	51	2	NNW	15	1021	22.2	32	3	N	24	1015
27	Su	14	26.4	0	7	N	80	14:15	19.4	46	6	N	19	1004	25.9	36	7	N	37	996.4
28	Mo	7.7	20.9	3	6.6	NNW	35	5:50	12.5	53	1	W	2	1010	20.2	31	7	WNW	17	1009
29	Tu	12	22.9	0	4	NNW	57	5:08	17.3	49	3	NW	28	1012	21.3	43	7	NW	24	1012
30	We	11	21.4	0	4.8	SSE	48	12:23	16.9	59	5	NNW	15	1019	17.9	61	5	SSE	28	1019
31	Th	11	15.9	0.4	6.6	SSE	33	12:09	12.6	81	8	SSW	20	1026	14.7	60	7	SSE	19	1028
Statistics for December 2020																				
	Mean	11	20.7		5.6				15.3	57	5		17	1013	18.3	51	5		20	1012
	Lowest	7	15.5	0	1.4				10.5	34	1	W	2	985.5	12.2	18	1	#	9	987
	Highest	21	33.5	34	11	W	96		27.3	94	8	WNW	48	1034	30	89	8	N	37	1031
	Total			72.2	174															

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Ektimo

REPORT NUMBER R010593

Emission Testing Report
Nyrstar Hobart , Lutana

www.ektimo.com.au

Document Information

Template Version; 240920

Client Name:	Nyrstar Hobart
Report Number:	R010593
Date of Issue:	1 April 2021
Attention:	Alex Lovibond
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Glenn Trenear
Senior Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 *Background*

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. Testing was carried out in accordance with Tasmanian EPN notice 7043/5.

1.2 *Project Objectives*

The objectives of the project were to conduct a monitoring programme to quantify emissions from one discharge point to determine compliance with Nyrstar Hobart 's Environmental Licence.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Parageothite Dryer	15 March 2021	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

1.3 *Licence Comparison*

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by Tasmanian EPN 7043/5.

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Paragoethite Dryer Baghouse	Particulates	mg/m^3	100	59
	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	4.5
	Metals - Hg	mg/m^3	1	0.00022
	Metals - Cd	mg/m^3	1	0.026

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 RESULTS

2.1 *Paragoethite Dryer*

Date	15/03/2021	**Client**	Nyrstar Hobart
Report	R010593	**Stack ID**	Parageothite Dryer
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	Nick Heatley, Tony Bakas	**State**	TAS
Process Conditions	~7.8 m3/hr of feed. No bypass. Baghouse 90 sec pulses.		210303

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	36	
Gas molecular weight, g/g mole	25.2 (wet)	29.3 (dry)
Gas density at STP, kg/m³	1.13 (wet)	1.31 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1330 & 1505	
Temperature, °C	87	
Velocity at sampling plane, m/s	9.8	
Volumetric flow rate, actual, m³/min	420	
Volumetric flow rate (wet STP), m³/min	320	
Volumetric flow rate (dry STP), m³/min	200	
Mass flow rate (wet basis), kg/hour	22000	

Gas Analyser Results	Average	
Sampling time	1355 - 1453	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	55	11
Carbon monoxide	<6	<1
	Concentration %v/v	
Carbon dioxide	3.7	
Oxygen	14.8	

Date	15/03/2021	**Client**	Nyrstar Hobart
Report	R010593	**Stack ID**	Parageothite Dryer
Licence No.	7032-5	**Location**	Hobart
Ektimo Staff	Nick Heatley, Tony Bakas	**State**	TAS
Process Conditions	~7.8 m3/hr of feed. No bypass. Baghouse 90 sec pulses.		210303

Isokinetic Results	Results	
Sampling time	1355-1500	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	59	12
Antimony	**0.025**	**0.0051**
Arsenic	**0.25**	**0.05**
Beryllium	<0.001	<0.0002
Cadmium	**0.026**	**0.0053**
Chromium	0.019	0.0039
Cobalt	0.0021	0.00042
Copper	0.45	0.092
Lead	**4.2**	**0.86**
Manganese	0.3	0.061
Mercury	**0.0022**	**0.00044**
Nickel	0.038	0.0077
Phosphorus	<0.07	<0.01
Selenium	<0.006	<0.001
Zinc	4.3	0.87
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	106	
Velocity difference, %	-4	

3 PLANT OPERATING CONDITIONS

See Nyrstar Hobart records for complete process conditions.

4 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Total particulate matter	AS 4323.2	AS 4323.2††	5%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓‡

200506

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 29 March 2021 in report number 265215.

5 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

6 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

Ektimo

7 APPENDIX 1: WEATHER OBSERVATIONS

Hobart – March 2021

		Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
Date	Day	Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8^{th}		km/h	hPa	°C	%	8^{th}		km/h	hPa
1	Mo	15.0	21.0	1.2	5.4		W	59	20:01	15.7	88	7	NW	7	1006.0	20.8	47	6	NW	22	1000.1
2	Tu	10.6	16.3	6.6	3.6		SSW	59	07:11	13.0	54	5	SW	33	1012.6	14.6	54	5	SSE	19	1014.0
3	We	8.1	19.1	0.6	1.8		NNW	57	19:49	12.3	61	6	NNW	17	1016.1	15.8	55	7	NW	20	1013.1
4	Th	12.1	22.3	0	4.6		SSW	69	15:14	19.1	57	3	SSW	15	1002.2	19.3	34	2	SW	30	1002.4
5	Fr	10.4	16.7	0	7.0		SW	69	23:14	12.1	58	7	S	28	1010.4	15.0	46	7	SSW	37	1012.0
6	Sa	11.2	18.5	0	5.0		ESE	43	14:35	12.7	61	7	SSW	13	1015.1	16.3	55	4	SE	26	1014.4
7	Su	9.8	19.1	0	3.6		SE	31	13:49	12.9	75	7	NW	9	1012.6	17.7	61	7	SE	24	1010.1
8	Mo	12.9	20.3	0	3.2		SE	31	16:30	15.9	77	7	NNW	9	1011.0	18.8	64	7	ESE	17	1008.4
9	Tu	13.2	21.0	0	4.0		NW	50	09:05	16.4	52	3	E	6	1010.3	18.0	49	7	SSW	26	1011.4
10	We	8.8	19.8	0	4.0		SW	30	23:39	14.3	57	1	N	6	1021.3	18.7	47	3	SE	17	1019.7
11	Th	11.7	21.2	0	5.4		SE	33	12:28	15.6	66	4	NNW	9	1019.7	20.6	58	7	SE	22	1018.7
12	Fr	13.4	29.1	0	4.4		N	54	16:19	16.4	78	1	NNW	22	1017.2	29.1	36	6	NNW	11	1011.6
13	Sa	16.4	22.3	0	6.2		NW	70	11:31	21.3	60	7	NW	11	1000.1	18.3	80	8	NW	24	1000.6
14	Su	7.7	20.3	0.8	4.6		NW	57	21:55	11.6	55	1	NW	20	1015.9	17.3	36	4	NW	24	1014.8
15	Mo	11.4	22.7	0	4.0		SSW	52	13:29	20.2	45	3	WNW	15	1015.2	19.8	45	5	SSW	28	1018.6
16	Tu	8.7	18.1	0	6.6		SW	24	23:05	11.4	69	7	NNW	11	1030.5	16.7	49	1	SE	19	1029.6
17	We	9.9	21.9	0	5.2		NNW	30	08:05	12.6	71	1	NNW	17	1031.2	20.9	49	1	SE	19	1028.3
18	Th	11.2	24.9	0	4.0		NNW	33	07:47	14.2	66	1	NNW	22	1031.1	23.1	39	5	NNE	19	1029.4
19	Fr	12.8	23.7	0	3.4		NNW	31	09:06	15.0	70	2	NNW	19	1034.8	22.0	52	1	ESE	19	1033.7
20	Sa	11.3	23.1	0	4.6		ESE	37	15:13	13.5	77	7	NNW	13	1036.4	21.7	45	1	E	17	1033.4
21	Su	13.5	24.6	0	4.8		ENE	39	15:35	17.0	58	6	NNW	17	1034.0	22.5	49	6	ENE	19	1030.9
22	Mo	13.9	25.7	0	3.2		ENE	37	14:59	17.2	70	1	N	13	1028.3	25.2	48	3	NE	19	1023.4
23	Tu	13.6	24.9	0	6.0		ENE	44	14:25	16.4	69	7	N	13	1018.3	24.5	45	2	NE	24	1013.7
24	We	16.1	17.0	4.6	3.4		SSW	57	21:15	16.5	91	8	E	22	1009.0	15.8	91	7	SE	17	1004.6
25	Th	15.1	19.6	38.6	1.8		NW	56	17:36	15.9	93	8	SSE	6	989.4	19.4	58	7	WSW	20	992.4
26	Fr	11.7	22.7	1.0	3.6		WNW	48	14:31	14.9	64	3	N	24	1007.7	22.3	36	5	NNW	22	1006.8
27	Sa	12.1	18.9	6.0	3.2		NW	43	15:27	13.0	88	7	NNW	20	1004.8	15.8	57	6	SE	9	1004.0
28	Su	11.1	19.5	0.2	2.6		NW	50	10:47	13.4	71	6	NNW	26	1010.2	18.2	53	7	NNW	20	1009.0
29	Mo	11.3	17.7	0	4.2		WSW	48	10:15	12.9	47	4	W	17	1019.4	16.8	42	7	SW	20	1021.4
30	Tu	9.6	21.8	0	2.8		NNW	41	14:40	11.6	65	7	SW	6	1023.5	21.2	48	1	N	20	1021.0
31	We	11.6		0	3.4					15.7	72	7	NNW	13	1023.8						
Statistics for the first 31 days of March 2021																					
	Mean	11.8	21.1		4.2					14.9	67	4		15	1016.7	19.5	50	4		21	1015.1
	Lowest	7.7	16.3	0	1.8					11.4	45	1	#	6	989.4	14.6	34	1	SE	9	992.4
	Highest	16.4	29.1	38.6	7.0		NW	70		21.3	93	8	SW	33	1036.4	29.1	91	8	SSW	37	1033.7
	Total			59.6	129.6																

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REPORT NUMBER R010591

Emission Testing Report

Round 1 – April 2021

Nyrstar Hobart , Lutana

Document Information

Template Version; 240920

Client Name:	Nyrstar Hobart
Report Number:	R010591
Date of Issue:	7 June 2021
Attention:	Kylie Veale
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

NATA Accredited Laboratory
No. 14601

Glenn Trenear
Senior Air Monitoring Consultant

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 EXECUTIVE SUMMARY

1.1 *Background*

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. Testing was carried out in accordance with Environmental Licence 7043/5.

1.2 *Project Objectives*

The objectives of the project were to conduct a monitoring programme to quantify emissions from 12 discharge points to determine compliance with Nyrstar Hobart 's Environmental Licence and meet NPI reporting requirements.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Foreshore A Foreshore B	22 April 2021	Total particulate matter Fine particulate matter (PM10 & PM2.5 via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAHs) Metals Sulfur dioxide, sulfur trioxide Total fluoride Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOCs)
Parageothite Dryer	23 April 2021	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAHs) Metals Total fluoride Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, sulfur dioxide Total & speciated volatile organic compounds (VOCs)
Cadmium Smelter Plant Scrubber Stack	21 April 2021	
Copper Sulphate Crystalliser Plant Vent Stack	26 April 2021	
Casting Ventilation 1 – V1 Casting Ventilation 2 – V2	19 April 2021	
Roaster Baghouse	20 April 2021	Total particulate matter Fine particulate matter (PM10 & PM2.5 via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAHs) Metals Sulfur dioxide, sulfur trioxide Total fluoride Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total & speciated volatile organic compounds (VOCs)
Anode Casting	21 April 2021	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAHs) Metals Total fluoride Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen, sulfur dioxide Total & speciated volatile organic compounds (VOCs)
Zinc Plant 1 Baghouse – ZP1	27 April 2021	
Zinc Plant 3 Baghouse – ZP3	21 April 2021	
MZR Furnace Baghouse	20 April 2021	

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP. Plant operating conditions have been noted in the report.

1.3 *Licence Comparison*

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by Tasmanian EPN 7043/5

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.33
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.055
	Particulates	mg/m^3	100	<1
	Sulphur dioxide (1)	g/m^3	7.2	0.023
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.33
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.058
	Particulates	mg/m^3	100	1.4
	Sulphur dioxide (1)	g/m^3	7.2	0.024
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	4.7
V1 Furnace Stack				3.4
V2 Furnace Stack				<2
Zinc Dust Plant Baghouse 1 Stack				<2
Zinc Dust Plant Bagouse 3 Stack				4.7
Cadmium Smelter Plant Scrubber Stack				<2
Copper Sulphate Crystalliser Plant				<3
Roaster Baghouse				50
Paragoethite Dryer Baghouse				16
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	≤0.2
V1 Furnace Stack				≤0.066
V2 Furnace Stack				≤0.059
Zinc Dust Plant Baghouse 1 Stack				≤0.073
Zinc Dust Plant Baghouse 3 Stack				≤1.1
Cadmium Smelter Plant Scrubber Stack				≤0.21
Copper Sulphate Crystalliser Plant				≤0.15
Roaster Baghouse				≤2.5
Paragoethite Dryer Baghouse				≤0.91
Anode Casting Plant Exhaust	Metals - Hg	mg/m^3	1	0.0012
V1 Furnace Stack				<0.0008
V2 Furnace Stack				<0.0009
Zinc Dust Plant Baghouse 1 Stack				<0.0007
Zinc Dust Plant Baghouse 3 Stack				0.0019
Cadmium Smelter Plant Scrubber Stack				<0.0007
Copper Sulphate Crystalliser Plant				0.015
Roaster Baghouse				0.012
Paragoethite Dryer Baghouse				<0.002
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	0.009
V1 Furnace Stack				0.0022
V2 Furnace Stack				0.0016
Zinc Dust Plant Baghouse 1 Stack				0.013
Zinc Dust Plant Baghouse 3 Stack				0.081
Cadmium Smelter Plant Scrubber Stack				0.0093
Copper Sulphate Crystalliser Plant				0.027
Roaster Baghouse				0.18
Paragoethite Dryer Baghouse				0.0096

(1) Total concentration of metals combined.

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2 RESULTS

2.1 *Foreshore A*

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.5 (wet)	28.7 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1427 & 1615	
Temperature, °C	18	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1800	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	1019 - 1118	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	55	96
Carbon monoxide	<2	<3
	Concentration %v/v	
Carbon dioxide	0.8	
Oxygen	10.8	
Sampling time	1019 - 1118	
	Concentration mg/m³	Mass Rate g/min
Nitrous oxide		
Nitrous oxide	<1	<2

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream. 210329		

Isokinetic Results		Results	
	Sampling time	1430-1612	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<1	<2
PM10	(PSA)	<0.6	<1
PM2.5	(PSA)	<0.2	<0.3
Sulfur dioxide		23	39
Sulfur trioxide		0.33	0.56
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		100	

Total Speciated VOCs		Results	
	Sampling time	1100-1120	
		Concentration mg/m³	Mass Rate g/min
Total		<0.3	<0.5

VOC's C5-C20		Results	
	Sampling time	1100-1120	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.5
Residuals as Toluene		<0.3	<0.5

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stre		210329

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0857 & 1044
Temperature, °C	17
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000
Velocity difference, %	-4

Isokinetic Results	Results	
Sampling time	0900-1042	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.051	0.088

Isokinetic Sampling Parameters

Sampling time, min	100
Isokinetic rate, %	100
Velocity difference, %	-4

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream. 210329		

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.17	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1230 & 1427
Temperature, °C	18
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000
Velocity difference, %	-1

Isokinetic Results	Results	
Sampling time	1240-1422	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.003**	**<0.006**
Arsenic	**0.002**	**0.0034**
Beryllium	<0.0004	<0.0007
Cadmium	**0.0042**	**0.0072**
Chromium	0.0047	0.0081
Cobalt	<0.0008	<0.001
Copper	0.0039	0.0066
Lead	**0.078**	**0.13**
Manganese	0.051	0.088
Mercury	**0.00051**	**0.00088**
Nickel	0.011	0.019
Phosphorus	<0.01	<0.02
Selenium	<0.003	<0.006
Zinc	0.86	1.5
Total of Sb, As, Cd, Pb, Hg	**≤0.088**	**≤0.15**
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream. 210329		

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1042 & 1230
Temperature, °C	18
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1700
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000
Velocity difference, %	3

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore A
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1045 - 1227	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2700**	4600000
2-Methylnaphthalene	<10	<20000
Acenaphthylene	<10	<20000
Acenaphthene	<10	<20000
Fluorene	<10	<20000
Phenanthrene	49	85000
Anthracene	15	25000
Fluoranthene	200	340000
Pyrene	120	200000
Benz(a)anthracene	18	31000
Chrysene	51	87000
Benzo(b)fluoranthene	<10	<20000
Benzo(k)fluoranthene	<10	<20000
Benzo(e)pyrene	<10	<20000
Benzo(a)pyrene	<10	<20000
Perylene	<10	<20000
Indeno(1,2,3-cd)pyrene	<10	<20000
Dibenz(ah)anthracene	<10	<20000
Benzo(ghi)perylene	<10	<20000
Total 16 PAHs	3100	5400000
Total 19 PAHs	3100	5400000
BaP-TEQ		
Lower Bound	2.3	4000
Middle Bound	13	23000
Upper Bound	24	41000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	99

Ektimo

2.2 *Foreshore B*

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream		210329

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.5 (wet)	28.7 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1231 & 1426	
Temperature, °C	18	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1800	
Volumetric flow rate (dry STP), m³/min	1700	
Mass flow rate (wet basis), kg/hour	130000	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1158 - 1257	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	58	100
Carbon monoxide	<2	<3
	Concentration %v/v	
Carbon dioxide	0.9	
Oxygen	10.7	
Sampling time	1158 - 1257	
	Concentration mg/m³	Mass Rate g/min
Nitrous oxide		
Nitrous oxide	<1	<2

ilac-MRA NATA

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Isokinetic Results		Results	
	Sampling time	1240-1422	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		1.4	2.4
PM10	(PSA)	0.65	1.1
PM2.5	(PSA)	0.16	0.27
Sulfur dioxide		24	42
Sulfur trioxide		0.33	0.57
Isokinetic Sampling Parameters			
Sampling time, min		100	
Isokinetic rate, %		100	

Total Speciated VOCs		Results	
	Sampling time	1436-1500	
		Concentration mg/m³	Mass Rate g/min
Total		<0.2	<0.4

VOC's C5-C20		Results	
	Sampling time	1436-1500	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.2	<0.4
Residuals as Toluene		<0.2	<0.4

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1044 & 1231	
Temperature, °C	18	
Velocity at sampling plane, m/s	18	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1800	
Volumetric flow rate (dry STP), m³/min	1800	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	-4	

Isokinetic Results	Results	
Sampling time	1045-1227	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.02	<0.04
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The highest to lowest gas velocity ratio exceeds 1.6:1
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.8	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0855 & 1044
Temperature, °C	17
Velocity at sampling plane, m/s	18
Volumetric flow rate, actual, m³/min	2000
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1800
Mass flow rate (wet basis), kg/hour	140000
Velocity difference, %	-1

Isokinetic Results	Results	
Sampling time	0900-1042	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.003**	**<0.006**
Arsenic	**0.0015**	**0.0028**
Beryllium	<0.0004	<0.0007
Cadmium	**0.0036**	**0.0065**
Chromium	0.00094	0.0017
Cobalt	<0.0007	<0.001
Copper	0.0021	0.0037
Lead	**0.071**	**0.13**
Manganese	0.038	0.069
Mercury	**0.0016**	**0.0029**
Nickel	0.0033	0.0059
Phosphorus	<0.01	<0.02
Selenium	<0.003	<0.006
Zinc	0.92	1.7
Total of Sb, As, Cd, Pb, Hg	**≤0.081**	**≤0.15**
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.9	
Gas molecular weight, g/g mole	28.4 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.18	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1426 & 1616
Temperature, °C	18
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1700
Mass flow rate (wet basis), kg/hour	130000
Velocity difference, %	<1

Date	22/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Foreshore B
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Unit 5 producing 64000 m3/hr & Unit 6 producing 100000 m3/hr of gas through the acid stream.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1430 - 1612	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	2500**	4200000
2-Methylnaphthalene	42	72000
Acenaphthylene	<10	<20000
Acenaphthene	<10	<20000
Fluorene	<10	<20000
Phenanthrene	130	230000
Anthracene	<10	<20000
Fluoranthene	130	230000
Pyrene	82	140000
Benz(a)anthracene	20	34000
Chrysene	38	66000
Benzo(b)fluoranthene	20	34000
Benzo(k)fluoranthene	<10	<20000
Benzo(e)pyrene	<10	<20000
Benzo(a)pyrene	41	70000
Perylene	<10	<20000
Indeno(1,2,3-cd)pyrene	63	110000
Dibenz(ah)anthracene	<10	<20000
Benzo(ghi)perylene	<10	<20000
Total 16 PAHs	3000	5100000
Total 19 PAHs	3000	5200000
BaP-TEQ		
Lower Bound	52	89000
Middle Bound	55	94000
Upper Bound	58	99000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	100
Isokinetic rate, %	99

2.3 *Paragoethite Dryer*

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		210329

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	24	
Gas molecular weight, g/g mole	26.6 (wet)	29.4 (dry)
Gas density at STP, kg/m³	1.19 (wet)	1.31 (dry)
Gas density at discharge conditions, kg/m³	0.92	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1015 & 1125	
Temperature, °C	78	
Velocity at sampling plane, m/s	9.9	
Volumetric flow rate, actual, m³/min	420	
Volumetric flow rate (wet STP), m³/min	330	
Volumetric flow rate (dry STP), m³/min	250	
Mass flow rate (wet basis), kg/hour	23000	
Velocity difference, %	-3	

Gas Analyser Results	Average	
Sampling time	1048 - 1147	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	52	13
Sulfur dioxide	<5	<1
Carbon monoxide	<2	<0.5
	Concentration % v/v	
Carbon dioxide	4.2	
Oxygen	14.6	

Ektimo

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		210329

Isokinetic Results		Results	
	Sampling time	1020-1122	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		16	3.8
PM10	(PSA)	8.2	2
PM2.5	(PSA)	2.4	0.6
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		95	
Velocity difference, %		-3	

Total Speciated VOCs		Results	
	Sampling time	1030-1050	
		Concentration mg/m³	Mass Rate g/min
Total		2.2	0.53

VOC's C5-C20		Results	
	Sampling time	1030-1050	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.07
Residuals as Toluene		2.2	0.53

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		210329

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	24	
Gas molecular weight, g/g mole	26.5 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.18 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.92	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	0905 & 1015
Temperature, °C	76
Velocity at sampling plane, m/s	9.9
Volumetric flow rate, actual, m³/min	420
Volumetric flow rate (wet STP), m³/min	330
Volumetric flow rate (dry STP), m³/min	250
Mass flow rate (wet basis), kg/hour	23000
Velocity difference, %	4

Isokinetic Results	Results	
Sampling time	0910-1012	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.31	0.076
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	97	

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		*210329*

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	24	
Gas molecular weight, g/g mole	26.5 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.18 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.92	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	0905 & 1015
Temperature, °C	76
Velocity at sampling plane, m/s	9.9
Volumetric flow rate, actual, m³/min	420
Volumetric flow rate (wet STP), m³/min	330
Volumetric flow rate (dry STP), m³/min	250
Mass flow rate (wet basis), kg/hour	23000
Velocity difference, %	4

Isokinetic Results	Results	
Sampling time	0910-1012	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.006**	**<0.001**
Arsenic	**0.026**	**0.0064**
Beryllium	<0.0009	<0.0002
Cadmium	**0.0096**	**0.0024**
Chromium	0.014	0.0034
Cobalt	0.0016	0.0004
Copper	0.045	0.011
Lead	**0.86**	**0.21**
Manganese	0.12	0.029
Mercury	**<0.002**	**<0.0004**
Nickel	0.045	0.011
Phosphorus	<0.05	<0.01
Selenium	<0.006	<0.001
Zinc	1.7	0.42
Total of Sb, As, Cd, Pb, Hg	**≤0.91**	**≤0.22**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		210329

Sampling Plane Details

Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	24	
Gas molecular weight, g/g mole	26.5 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.18 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.92	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1015 & 1125
Temperature, °C	78
Velocity at sampling plane, m/s	9.9
Volumetric flow rate, actual, m³/min	420
Volumetric flow rate (wet STP), m³/min	330
Volumetric flow rate (dry STP), m³/min	250
Mass flow rate (wet basis), kg/hour	23000
Velocity difference, %	-3

Ektimo

Date	23/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Paragoethite Dryer
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	8.3 m3/hr of dirt and 2.5 m3/hr of bypass flow into the drum.		*210329*

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1020 - 1122	
	Concentration ng/m^3	Mass Rate ng/min
Naphthalene	4800**	1200000
2-Methylnaphthalene	320	78000
Acenaphthylene	400	98000
Acenaphthene	100	25000
Fluorene	230	58000
Phenanthrene	3400	830000
Anthracene	210	53000
Fluoranthene	1400	350000
Pyrene	470	120000
Benz(a)anthracene	68	17000
Chrysene	210	53000
Benzo(b)fluoranthene	<20	<5000
Benzo(k)fluoranthene	<20	<5000
Benzo(e)pyrene	<20	<5000
Benzo(a)pyrene	<20	<5000
Perylene	<20	<5000
Indeno(1,2,3-cd)pyrene	<20	<5000
Dibenz(ah)anthracene	<20	<5000
Benzo(ghi)perylene	<20	<5000
Total 16 PAHs	11000	2800000
Total 19 PAHs	12000	2900000
BaP-TEQ		
Lower Bound	9	2200
Middle Bound	26	6500
Upper Bound	44	11000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	93

2.4 *Cadmium Smelter Plant Scrubber Stack*

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		210329

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equa
The sampling plane is too near to the upstream disturbance but is greater than or equal to

Stack Parameters

Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.19	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1210 & 1320
Temperature, °C	21
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	180
Volumetric flow rate (wet STP), m³/min	170
Volumetric flow rate (dry STP), m³/min	160
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	-1

Gas Analyser Results	Average	
Sampling time	1323 - 1422	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.6
Sulfur dioxide	<5	<0.8
Carbon monoxide	<2	<0.3
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		210329

Isokinetic Results		Results	
	Sampling time	1215-1316	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.3
PM10	(PSA)	<0.9	<0.2
PM2.5	(PSA)	<0.2	<0.03
Isokinetic Sampling Parameters			
Sampling time, min		60	
Velocity difference, %		-1	

Total Speciated VOCs		Results	
	Sampling time	1335-1355	
		Concentration mg/m³	Mass Rate g/min
Total		<0.6	<0.09

VOC's C5-C20		Results	
	Sampling time	1335-1355	
		Concentration mg/m³	Mass Rate g/min
Detection limit[(1)]		<0.6	<0.09
Residuals as Toluene		<0.6	<0.09

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2.1	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.19	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1320 & 1427
Temperature, °C	21
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	180
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	160
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	-4

Isokinetic Results	Results	
Sampling time	1323-1425	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.04	<0.007
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		210329

Sampling Plane Details	
Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or equa

The sampling plane is too near to the upstream disturbance but is greater than or equal t

Stack Parameters		
Moisture content, %v/v	2	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.19	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1210 & 1320
Temperature, °C	21
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	180
Volumetric flow rate (wet STP), m³/min	170
Volumetric flow rate (dry STP), m³/min	160
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	-1

Isokinetic Results	Results	
Sampling time	1215-1316	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.005**	**<0.0009**
Arsenic	**<0.004**	**<0.0006**
Beryllium	<0.0007	<0.0001
Cadmium	**0.0093**	**0.0015**
Chromium	0.0085	0.0014
Cobalt	<0.001	<0.0002
Copper	0.003	0.0005
Lead	0.19	0.031
Manganese	0.049	0.0081
Mercury	**<0.0007**	**<0.0001**
Nickel	0.028	0.0046
Phosphorus	<0.02	<0.004
Selenium	<0.005	<0.0009
Zinc	1.1	0.19
Total of Sb, As, Cd, Pb, Hg	**≤0.21**	**≤0.034**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2.1	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.19	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1320 & 1427
Temperature, °C	21
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	180
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	160
Mass flow rate (wet basis), kg/hour	13000
Velocity difference, %	-4

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Cadmium Smelter
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		*210329*

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1323 - 1425	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	90000**	14000000
2-Methylnaphthalene	240	39000
Acenaphthylene	<20**	<3000
Acenaphthene	<20	<3000
Fluorene	<20	<3000
Phenanthrene	6200	990000
Anthracene	6200	990000
Fluoranthene	350	57000
Pyrene	180	29000
Benz(a)anthracene	36	5800
Chrysene	92	15000
Benzo(b)fluoranthene	<20	<3000
Benzo(k)fluoranthene	<20	<3000
Benzo(e)pyrene	<20	<3000
Benzo(a)pyrene	<20	<3000
Perylene	<20	<3000
Indeno(1,2,3-cd)pyrene	<20	<3000
Dibenz(ah)anthracene	<20	<3000
Benzo(ghi)perylene	<20	<3000
Total 16 PAHs	100000	16000000
Total 19 PAHs	100000	17000000
BaP-TEQ		
Lower Bound	4.6	730
Middle Bound	22	3500
Upper Bound	39	6200

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	103

2.5 *Copper Sulphate Crystalliser Plant Vent Stack*

Date	26/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		210329

Sampling Plane Details

Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	8.5	
Gas molecular weight, g/g mole	28.1 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.09	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1440 & 1550
Temperature, °C	43
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	190
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	150
Mass flow rate (wet basis), kg/hour	12000
Velocity difference, %	-2

Gas Analyser Results	Average	
Sampling time	1425 - 1524	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<3	<0.5
Sulfur dioxide	<5	<0.7
Carbon monoxide	<2	<0.3
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.6	

Date	26/04/2021	Client	Nyrstar Hobart
Report	R010591	Stack ID	Copper Sulphate Stack
Licence No.	7043-5	Location	Hobart
Ektimo Staff	G Trenear & T Bakas	State	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		210329

Isokinetic Results		Results	
	Sampling time	1445-1547	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<3	<0.4
PM10	(PSA)	<1	<0.2
PM2.5	(PSA)	<0.3	<0.04
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		99	

Total Speciated VOCs		Results	
	Sampling time	1450-1510	
		Concentration mg/m³	Mass Rate g/min
Total		<0.3	<0.04

VOC's C5-C20		Results	
	Sampling time	1450-1510	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.04
Residuals as Toluene		<0.3	<0.04

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	26/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		*210329*

Sampling Plane Details

Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	8.1 (saturated)	
Gas molecular weight, g/g mole	28.1 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.09	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1252 & 1400
Temperature, °C	43
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	190
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	150
Mass flow rate (wet basis), kg/hour	12000

Isokinetic Results	Results	
Sampling time	1255-1357	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.048	0.0072
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	

Date	26/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		210329

Sampling Plane Details

Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	8.1 (saturated)	
Gas molecular weight, g/g mole	28.1 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.09	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1252 & 1400
Temperature, °C	43
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	190
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	150
Mass flow rate (wet basis), kg/hour	12000
Velocity difference, %	2

Isokinetic Results	Results	
Sampling time	1255-1357	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.001**
Arsenic	**<0.005**	**<0.0008**
Beryllium	<0.0009	<0.0001
Cadmium	**0.027**	**0.0041**
Chromium	0.003	0.00045
Cobalt	0.0016	0.00025
Copper	0.023	0.0035
Lead	0.097	**0.015**
Manganese	0.054	0.0082
Mercury	**0.015**	**0.0022**
Nickel	0.015	0.0022
Phosphorus	<0.03	<0.004
Selenium	<0.007	<0.001
Zinc	0.93	0.14
Total of Sb, As, Cd, Pb, Hg	**≤0.15**	**≤0.023**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	107	

Date	26/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		210329

Sampling Plane Details

Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	8.5	
Gas molecular weight, g/g mole	28.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.25 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.08	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1440 & 1550
Temperature, °C	43
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	190
Volumetric flow rate (wet STP), m³/min	160
Volumetric flow rate (dry STP), m³/min	150
Mass flow rate (wet basis), kg/hour	12000
Velocity difference, %	-2

Date	26/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Copper Sulphate Stack
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Production rate - 17 tonnes/day, Dryer Outlet Temperature - 46 deg C, Feed rate into Dryer - 40%		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1445 - 1547	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	4600	690000
2-Methylnaphthalene	620	93000
Acenaphthylene	<30	<4000
Acenaphthene	77	12000
Fluorene	<30	<4000
Phenanthrene	990	150000
Anthracene	300	44000
Fluoranthene	620	93000
Pyrene	600	91000
Benz(a)anthracene	42	6400
Chrysene	120	18000
Benzo(b)fluoranthene	<50	<8000
Benzo(k)fluoranthene	<30	<4000
Benzo(e)pyrene	<30	<4000
Benzo(a)pyrene	<30	<5000
Perylene	<30	<5000
Indeno(1,2,3-cd)pyrene	<30	<4000
Dibenz(ah)anthracene	<30	<4000
Benzo(ghi)perylene	130	19000
Total 16 PAHs	7500	1100000
Total 19 PAHs	8100	1200000
BaP-TEQ		
Lower Bound	5.5	820
Middle Bound	32	4800
Upper Bound	58	8700

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	99

Ektimo

2.6 *Casting Ventilation 1 – V1*

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1258 & 1403
Temperature, °C	35
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/min	270
Volumetric flow rate (wet STP), m³/min	240
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	<1

Gas Analyser Results	Average	
Sampling time	1543 - 1642	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.8
Sulfur dioxide	<5	<1
Carbon monoxide	2.6	0.6
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

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Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Isokinetic Results	Results	
Sampling time	1300-1400	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	3.4	0.79
PM10 (PSA)	1.8	0.42
PM2.5 (PSA)	0.5	0.12
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	

Total Speciated VOCs	Results	
Sampling time	1500-1535	
	Concentration mg/m³	Mass Rate g/min
Total	0.76	0.18

VOC's C5-C20	Results	
Sampling time	1500-1535	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.1	<0.03
Toluene	0.76	0.18
Residuals as Toluene	<0.1	<0.03

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1613 & 1717
Temperature, °C	35
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/min	270
Volumetric flow rate (wet STP), m³/min	230
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	1615-1715	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.03	<0.007
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	98	

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.4	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1508 & 1613
Temperature, °C	35
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/min	270
Volumetric flow rate (wet STP), m³/min	240
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	1510-1610	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.002**
Arsenic	**<0.003**	**<0.0008**
Beryllium	<0.0009	<0.0002
Cadmium	**0.0022**	**0.00051**
Chromium	0.0036	0.00084
Cobalt	<0.001	<0.0003
Copper	0.011	0.0026
Lead	0.057	0.013
Manganese	0.17	0.038
Mercury	**<0.0008**	**<0.0002**
Nickel	0.0048	0.0011
Phosphorus	<0.02	<0.006
Selenium	<0.007	<0.002
Zinc	0.64	0.15
Total of Sb, As, Cd, Pb, Hg	**≤0.07**	**≤0.016**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.3	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1403 & 1508
Temperature, °C	35
Velocity at sampling plane, m/s	14
Volumetric flow rate, actual, m³/min	270
Volumetric flow rate (wet STP), m³/min	240
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	1

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Polycyclic Aromatic Hydrocarbons (PAHs)	Results	
Sampling time	1405 - 1505	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	7600	1800000
2-Methylnaphthalene	650	150000
Acenaphthylene	<30	<6000
Acenaphthene	49	11000
Fluorene	230	53000
Phenanthrene	2000	470000
Anthracene	190	44000
Fluoranthene	1500	350000
Pyrene	590	140000
Benz(a)anthracene	220	50000
Chrysene	320	75000
Benzo(b)fluoranthene	<30	<6000
Benzo(k)fluoranthene	<30	<6000
Benzo(e)pyrene	<30	<6000
Benzo(a)pyrene	<30	<6000
Perylene	<30	<6000
Indeno(1,2,3-cd)pyrene	<30	<6000
Dibenz(ah)anthracene	<30	<6000
Benzo(ghi)perylene	<30	<6000
Total 16 PAHs	13000	3000000
Total 19 PAHs	13000	3100000
BaP-TEQ		
Lower Bound	25	5800
Middle Bound	48	11000
Upper Bound	71	16000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	99

2.7 Casting Ventilation 2 – V2

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details	
Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.6	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1402 & 1507	
Temperature, °C	55	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	280	
Volumetric flow rate (wet STP), m³/min	230	
Volumetric flow rate (dry STP), m³/min	230	
Mass flow rate (wet basis), kg/hour	18000	

Gas Analyser Results	Average	
Sampling time	1426 - 1525	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.8
Sulfur dioxide	6.6	1.5
Carbon monoxide	9.4	2.1
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20	

Ektimo

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Isokinetic Results		Results	
	Sampling time	1405-1505	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.5
PM10	(PSA)	<1	<0.3
PM2.5	(PSA)	<0.3	<0.08
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		100	
Velocity difference, %		1	

Total Speciated VOCs		Results	
	Sampling time	1330-1405	
		Concentration mg/m³	Mass Rate g/min
Total		0.68	0.15

VOC's C5-C20		Results	
	Sampling time	1330-1405	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.1	<0.03
Benzene		0.33	0.076
Pentane		0.18	0.041
Residuals as Toluene		0.17	0.038

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m +p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.3	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1612 & 1718
Temperature, °C	54
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	280
Volumetric flow rate (wet STP), m³/min	230
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	1615-1715	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.03	<0.007
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.4	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1256 & 1402
Temperature, °C	54
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	280
Volumetric flow rate (wet STP), m³/min	230
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	3

Isokinetic Results	Results	
Sampling time	1300-1400	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.001**
Arsenic	**<0.003**	**<0.0007**
Beryllium	<0.0008	<0.0002
Cadmium	**0.0016**	**0.00036**
Chromium	0.0047	0.0011
Cobalt	<0.001	<0.0002
Copper	0.0091	0.0021
Lead	0.047	0.011
Manganese	0.12	0.027
Mercury	**<0.0009**	**<0.0002**
Nickel	0.0046	0.001
Phosphorus	<0.02	<0.005
Selenium	<0.007	<0.002
Zinc	0.63	0.14
Total of Sb, As, Cd, Pb, Hg	**≤0.059**	**≤0.013**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Date	19/04/2021	Client	Nyrstar Hobart
Report	R010591	Stack ID	Casting Ventilation 2 - V2
Licence No.	7043-5	Location	Hobart
Ektimo Staff	G Trenear & T Bakas	State	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1507 & 1612
Temperature, °C	55
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m³/min	280
Volumetric flow rate (wet STP), m³/min	230
Volumetric flow rate (dry STP), m³/min	230
Mass flow rate (wet basis), kg/hour	18000
Velocity difference, %	-2

Date	19/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1510 - 1610	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	100000	24000000
2-Methylnaphthalene	9800	2200000
Acenaphthylene	8300	1900000
Acenaphthene	<20	<5000
Fluorene	3400	780000
Phenanthrene	8200	1900000
Anthracene	550	130000
Fluoranthene	2500	570000
Pyrene	1400	320000
Benz(a)anthracene	180	40000
Chrysene	430	100000
Benzo(b)fluoranthene	<20	<5000
Benzo(k)fluoranthene	<20	<5000
Benzo(e)pyrene	<20	<5000
Benzo(a)pyrene	<20	<5000
Perylene	<20	<5000
Indeno(1,2,3-cd)pyrene	<20	<5000
Dibenz(ah)anthracene	<20	<5000
Benzo(ghi)perylene	<20	<5000
Total 16 PAHs	130000	30000000
Total 19 PAHs	140000	32000000
BaP-TEQ		
Lower Bound	22	5000
Middle Bound	42	9600
Upper Bound	62	14000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	100

2.8 *Roaster Baghouse*

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		210329

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1337 & 1500	
Temperature, °C	36	
Velocity at sampling plane, m/s	7.1	
Volumetric flow rate, actual, m³/min	50	
Volumetric flow rate (wet STP), m³/min	44	
Volumetric flow rate (dry STP), m³/min	43	
Mass flow rate (wet basis), kg/hour	3300	
Velocity difference, %	3	

Gas Analyser Results	Average	
Sampling time	1335 - 1434	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	3.4	0.14
Carbon monoxide	9.9	0.42
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	19.6	

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		210329

Isokinetic Results		Results	
	Sampling time	1352-1456	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		50	2.1
PM10	(PSA)	34	1.4
PM2.5	(PSA)	8	0.34
Sulfur dioxide		1900	79
Sulfur trioxide		1.1	0.047
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		101	

Total Speciated VOCs		Results	
	Sampling time	1432-1452	
		Concentration mg/m³	Mass Rate g/min
Total		<0.3	<0.01

VOC's C5-C20		Results	
	Sampling time	1432-1452	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.01
Residuals as Toluene		<0.3	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		210329

Sampling Plane Details

Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1220 & 1337
Temperature, °C	35
Velocity at sampling plane, m/s	6.8
Volumetric flow rate, actual, m³/min	48
Volumetric flow rate (wet STP), m³/min	42
Volumetric flow rate (dry STP), m³/min	41
Mass flow rate (wet basis), kg/hour	3200
Velocity difference, %	7

Isokinetic Results	Results	
Sampling time	1230-1335	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.26	0.01
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	100	

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		210329

Sampling Plane Details

Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1220 & 1337
Temperature, °C	35
Velocity at sampling plane, m/s	6.8
Volumetric flow rate, actual, m³/min	48
Volumetric flow rate (wet STP), m³/min	42
Volumetric flow rate (dry STP), m³/min	41
Mass flow rate (wet basis), kg/hour	3200
Velocity difference, %	7

Isokinetic Results	Results	
Sampling time	1230-1335	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.005**	**<0.0002**
Arsenic	**0.027**	**0.0011**
Beryllium	<0.0007	<0.00003
Cadmium	**0.18**	**0.0073**
Chromium	0.034	0.0014
Cobalt	0.0039	0.00016
Copper	0.13	0.0055
Lead	**2.3**	**0.092**
Manganese	0.12	0.0049
Mercury	**0.012**	**0.00048**
Nickel	0.1	0.0042
Phosphorus	<0.03	<0.001
Selenium	<0.005	<0.0002
Zinc	16	0.65
Total of Sb, As, Cd, Pb, Hg	**≤2.5**	**≤0.1**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	99	

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Roaster Baghouse
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on		*210329*

Sampling Plane Details

Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.12	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1337 & 1500
Temperature, °C	36
Velocity at sampling plane, m/s	7.1
Volumetric flow rate, actual, m³/min	50
Volumetric flow rate (wet STP), m³/min	44
Volumetric flow rate (dry STP), m³/min	43
Mass flow rate (wet basis), kg/hour	3300
Velocity difference, %	3

Date	20/04/2021	**Client**	Nyrstar Hobart	
Report	R010591	**Stack ID**	Roaster Baghouse	
Licence No.	7043-5	**Location**	Hobart	
Ektimo Staff	G Trenear & T Bakas	**State**	TAS	
Process Conditions	Roaster 6 - 52 t/hr, Roaster 5 - 18 t/hr (Conveyor all in operation), fumes were on			210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1350 - 1456	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	3000**	130000
2-Methylnaphthalene	78	3300
Acenaphthylene	<20	<700
Acenaphthene	<20	<700
Fluorene	<20	<700
Phenanthrene	330	14000
Anthracene	31	1300
Fluoranthene	370	16000
Pyrene	220	9300
Benz(a)anthracene	49	2100
Chrysene	100	4400
Benzo(b)fluoranthene	<20	<700
Benzo(k)fluoranthene	<20	<700
Benzo(e)pyrene	<20	<700
Benzo(a)pyrene	<20	<700
Perylene	<20	<700
Indeno(1,2,3-cd)pyrene	<20	<700
Dibenz(ah)anthracene	<20	<700
Benzo(ghi)perylene	<20	<700
Total 16 PAHs	4100	170000
Total 19 PAHs	4100	180000
BaP-TEQ		
Lower Bound	5.9	250
Middle Bound	21	880
Upper Bound	36	1500

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	101

2.9 *Anode Casting*

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.21	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0808 & 0920
Temperature, °C	17
Velocity at sampling plane, m/s	9
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	81
Volumetric flow rate (dry STP), m³/min	80
Mass flow rate (wet basis), kg/hour	6200
Velocity difference, %	6

Gas Analyser Results	Average	
Sampling time	1010 - 1109	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<3	<0.3
Sulfur dioxide	<5	<0.4
Carbon monoxide	<2	<0.2
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Isokinetic Results		Results	
	Sampling time	0815-0915	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		4.7	0.37
PM10	(PSA)	2.3	0.18
PM2.5	(PSA)	0.53	0.042
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		101	
Velocity difference, %		6	

Total Speciated VOCs		Results	
	Sampling time	0830-0850	
		Concentration mg/m³	Mass Rate g/min
Total		<0.3	<0.02

VOC's C5-C20		Results	
	Sampling time	0830-0850	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.02
Residuals as Toluene		<0.3	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.20	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0920 & 1105
Temperature, °C	18
Velocity at sampling plane, m/s	9.3
Volumetric flow rate, actual, m³/min	89
Volumetric flow rate (wet STP), m³/min	83
Volumetric flow rate (dry STP), m³/min	82
Mass flow rate (wet basis), kg/hour	6400
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	1000-1100	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as F)	<0.03	<0.003
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.21	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0808 & 0920
Temperature, °C	17
Velocity at sampling plane, m/s	9
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	81
Volumetric flow rate (dry STP), m³/min	80
Mass flow rate (wet basis), kg/hour	6200
Velocity difference, %	6

Isokinetic Results	Results	
Sampling time	0815-0915	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.006**	**<0.0004**
Arsenic	**<0.004**	**<0.0003**
Beryllium	<0.0007	<0.00006
Cadmium	**0.009**	**0.00072**
Chromium	0.0085	0.00068
Cobalt	<0.001	<0.0001
Copper	0.008	0.00063
Lead	0.18	0.014
Manganese	0.065	0.0051
Mercury	**0.0012**	**0.000092**
Nickel	0.027	0.0021
Phosphorus	<0.03	<0.002
Selenium	<0.006	<0.0004
Zinc	1.5	0.12
Total of Sb, As, Cd, Pb, Hg	**≤0.2**	**≤0.016**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

Ektimo

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Sampling Plane Details

Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments

The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.20	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0920 & 1105
Temperature, °C	18
Velocity at sampling plane, m/s	9.3
Volumetric flow rate, actual, m³/min	89
Volumetric flow rate (wet STP), m³/min	83
Volumetric flow rate (dry STP), m³/min	82
Mass flow rate (wet basis), kg/hour	6400
Velocity difference, %	<1

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Anode Casting
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Casting area in normal operation.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1000 - 1100	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	20000**	1600000
2-Methylnaphthalene	1100	89000
Acenaphthylene	390	32000
Acenaphthene	120	9700
Fluorene	530	43000
Phenanthrene	1400	110000
Anthracene	140	11000
Fluoranthene	610	50000
Pyrene	380	31000
Benz(a)anthracene	290	23000
Chrysene	460	38000
Benzo(b)fluoranthene	<20	<2000
Benzo(k)fluoranthene	<20	<2000
Benzo(e)pyrene	<20	<2000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	<20	<2000
Dibenz(ah)anthracene	<20	<2000
Benzo(ghi)perylene	<20	<2000
Total 16 PAHs	24000	2000000
Total 19 PAHs	25000	2100000
BaP-TEQ		
Lower Bound	33	2700
Middle Bound	50	4100
Upper Bound	67	5400

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	101

2.10 *Zinc Plant 1 Baghouse – ZP1*

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210329

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.04	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0825 & 0934	
Temperature, °C	68	
Velocity at sampling plane, m/s	7.4	
Volumetric flow rate, actual, m³/min	86	
Volumetric flow rate (wet STP), m³/min	70	
Volumetric flow rate (dry STP), m³/min	68	
Mass flow rate (wet basis), kg/hour	5400	
Velocity difference, %	-1	

Gas Analyser Results	Average	
Sampling time	0943 - 1042	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Sulfur dioxide	<5	<0.3
Carbon monoxide	<2	<0.1
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210329

Isokinetic Results		Results	
	Sampling time	0830-0932	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.1
PM10	(PSA)	<0.8	<0.05
PM2.5	(PSA)	<0.2	<0.01
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		98	

Total Speciated VOCs		Results	
	Sampling time	0940-1004	
		Concentration mg/m³	Mass Rate g/min
Total		<0.2	<0.02

VOC's C5-C20		Results	
	Sampling time	0940-1004	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.2	<0.02
Residuals as Toluene		<0.2	<0.02

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		*210329*

Sampling Plane Details

Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.03	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0934 & 1045
Temperature, °C	69
Velocity at sampling plane, m/s	7.3
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	69
Volumetric flow rate (dry STP), m³/min	67
Mass flow rate (wet basis), kg/hour	5300
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	0940-1042	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.03	<0.002
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210329

Sampling Plane Details

Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.04	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0825 & 0934
Temperature, °C	68
Velocity at sampling plane, m/s	7.4
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	70
Volumetric flow rate (dry STP), m³/min	68
Mass flow rate (wet basis), kg/hour	5400
Velocity difference, %	-1

Isokinetic Results	Results	
Sampling time	0830-0932	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.005**	**<0.0004**
Arsenic	**<0.003**	**<0.0002**
Beryllium	<0.0007	<0.00004
Cadmium	**0.013**	**0.0009**
Chromium	0.01	0.0007
Cobalt	0.0014	0.000093
Copper	0.0061	0.00042
Lead	**0.051**	**0.0035**
Manganese	0.059	0.004
Mercury	**<0.0007**	**<0.00005**
Nickel	0.052	0.0036
Phosphorus	<0.02	<0.001
Selenium	<0.005	<0.0004
Zinc	0.52	0.035
Total of Sb, As, Cd, Pb, Hg	**≤0.073**	**≤0.005**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210329

Sampling Plane Details

Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Comments

The discharge is assumed to be composed of dry air and moisture

Stack Parameters

Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.03	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0934 & 1045
Temperature, °C	69
Velocity at sampling plane, m/s	7.3
Volumetric flow rate, actual, m³/min	86
Volumetric flow rate (wet STP), m³/min	69
Volumetric flow rate (dry STP), m³/min	67
Mass flow rate (wet basis), kg/hour	5300
Velocity difference, %	<1

Date	27/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		*210329*

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0940 - 1042	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	12000**	790000
2-Methylnaphthalene	3600	240000
Acenaphthylene	1800	120000
Acenaphthene	250	17000
Fluorene	860	58000
Phenanthrene	6100	410000
Anthracene	6100	410000
Fluoranthene	640	43000
Pyrene	280	19000
Benz(a)anthracene	28	1900
Chrysene	85	5700
Benzo(b)fluoranthene	<20	<1000
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<2000
Perylene	<20	<2000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	28000	1900000
Total 19 PAHs	31000	2100000
BaP-TEQ		
Lower Bound	3.7	250
Middle Bound	23	1500
Upper Bound	42	2800

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	100

2.11 *Zinc Plant 3 Baghouse – ZP3*

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal t
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2

Stack Parameters		
Moisture content, %v/v	3.3	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.98	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1505 & 1613	
Temperature, °C	82	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/min	71	
Volumetric flow rate (wet STP), m³/min	54	
Volumetric flow rate (dry STP), m³/min	53	
Mass flow rate (wet basis), kg/hour	4200	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1626 - 1725	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Sulfur dioxide	<5	<0.2
Carbon monoxide	<2	<0.1
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	21/04/2021	Client	Nyrstar Hobart
Report	R010591	Stack ID	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	Location	Hobart
Ektimo Staff	G Trenear & T Bakas	State	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Isokinetic Results		Results	
	Sampling time	1506-1611	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		4.7	0.24
PM10	(PSA)	2.2	0.12
PM2.5	(PSA)	0.61	0.032
Isokinetic Sampling Parameters			
Sampling time, min		64	
Isokinetic rate, %		100	

Total Speciated VOCs		Results	
	Sampling time	1620-1640	
		Concentration mg/m³	Mass Rate g/min
Total		<0.3	<0.01

VOC's C5-C20		Results	
	Sampling time	1620-1640	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.3	<0.01
Residuals as Toluene		<0.3	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equ
The sampling plane is too near to the upstream disturbance but is greater than or equal t

Stack Parameters		
Moisture content, %v/v	3.3	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.98	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1613 & 1722	
Temperature, °C	81	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/min	71	
Volumetric flow rate (wet STP), m³/min	55	
Volumetric flow rate (dry STP), m³/min	53	
Mass flow rate (wet basis), kg/hour	4200	
Velocity difference, %	<1	

Isokinetic Results	Results	
Sampling time	1615-1720	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	<0.02	<0.001
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	99	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equ
The sampling plane is too near to the upstream disturbance but is greater than or equal

Stack Parameters		
Moisture content, %v/v	3.3	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.98	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1505 & 1613	
Temperature, °C	82	
Velocity at sampling plane, m/s	19	
Volumetric flow rate, actual, m³/min	71	
Volumetric flow rate (wet STP), m³/min	54	
Volumetric flow rate (dry STP), m³/min	53	
Mass flow rate (wet basis), kg/hour	4200	
Velocity difference, %	<1	

Isokinetic Results	Results	
Sampling time	1506-1611	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.007**	**<0.0004**
Arsenic	**0.017**	**0.00088**
Beryllium	<0.0007	<0.00004
Cadmium	**0.081**	**0.0043**
Chromium	0.012	0.00062
Cobalt	0.0031	0.00016
Copper	0.065	0.0034
Lead	**1**	**0.054**
Manganese	0.15	0.008
Mercury	**0.0019**	**0.000098**
Nickel	0.096	0.0051
Phosphorus	<0.02	<0.0009
Selenium	<0.006	<0.0003
Zinc	8.5	0.45
Total of Sb, As, Cd, Pb, Hg	**≤1.1**	**≤0.06**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	102	

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Sampling Plane Details

Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the downstream disturbance but is greater than or eq

The sampling plane is too near to the upstream disturbance but is greater than or equal

Stack Parameters

Moisture content, %v/v	3.3	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.98	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1613 & 1722
Temperature, °C	81
Velocity at sampling plane, m/s	19
Volumetric flow rate, actual, m³/min	71
Volumetric flow rate (wet STP), m³/min	55
Volumetric flow rate (dry STP), m³/min	53
Mass flow rate (wet basis), kg/hour	4200
Velocity difference, %	<1

Date	21/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1615 - 1720	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	3200	170000
2-Methylnaphthalene	110	5800
Acenaphthylene	<20	<1000
Acenaphthene	150	8100
Fluorene	<20	<1000
Phenanthrene	360	19000
Anthracene	310	16000
Fluoranthene	260	14000
Pyrene	150	8100
Benz(a)anthracene	<20	<1000
Chrysene	70	3700
Benzo(b)fluoranthene	<20	<1000
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<1000
Perylene	<20	<1000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	4500	240000
Total 19 PAHs	4600	240000
BaP-TEQ		
Lower Bound	0.7	37
Middle Bound	20	1100
Upper Bound	40	2100

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	64
Isokinetic rate, %	101

2.12 *MZR Furnace Baghouse*

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		210329

Sampling Plane Details

Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	2.6	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0833 & 0948
Temperature, °C	54
Velocity at sampling plane, m/s	5.3
Volumetric flow rate, actual, m³/min	80
Volumetric flow rate (wet STP), m³/min	66
Volumetric flow rate (dry STP), m³/min	64
Mass flow rate (wet basis), kg/hour	5100
Velocity difference, %	-1

Gas Analyser Results	Average	
Sampling time	0950 - 1049	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	4.7	0.3
Sulfur dioxide	<5	<0.3
Carbon monoxide	86	5.5
	Concentration % v/v	
Carbon dioxide	0.6	
Oxygen	18.8	

Ektimo

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		210329

Isokinetic Results		Results	
	Sampling time	0844-0945	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<2	<0.1
PM10	(PSA)	<0.8	<0.05
PM2.5	(PSA)	<0.2	<0.01
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		101	

Total Speciated VOCs		Results	
	Sampling time	0930-1000	
		Concentration mg/m³	Mass Rate g/min
Total		0.32	0.021

VOC's C5-C20		Results	
	Sampling time	0930-1000	
		Concentration mg/m³	Mass Rate g/min
Detection limit(1)		<0.2	<0.01
Benzene		0.32	0.021
Residuals as Toluene		<0.2	<0.01

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m +p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, 2-Methylhexane, Isopropyl acetate, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		*210329*

Sampling Plane Details

Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v		
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0948 & 1055
Temperature, °C	55
Velocity at sampling plane, m/s	5.3
Volumetric flow rate, actual, m³/min	79
Volumetric flow rate (wet STP), m³/min	65
Volumetric flow rate (dry STP), m³/min	64
Mass flow rate (wet basis), kg/hour	5000
Velocity difference, %	<1

Isokinetic Results	Results	
Sampling time	0950-1051	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.72	0.046
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		210329

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.6	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0833 & 0948	
Temperature, °C	54	
Velocity at sampling plane, m/s	5.3	
Volumetric flow rate, actual, m³/min	79	
Volumetric flow rate (wet STP), m³/min	66	
Volumetric flow rate (dry STP), m³/min	64	
Mass flow rate (wet basis), kg/hour	5100	
Velocity difference, %	-1	

Isokinetic Results	Results	
Sampling time	0844-0945	
	Concentration mg/m³	Mass Rate g/min
Antimony	**<0.004**	**<0.0003**
Arsenic	**<0.002**	**<0.0001**
Beryllium	<0.0005	<0.00003
Cadmium	**0.0015**	**0.000095**
Chromium	0.003	0.0002
Cobalt	<0.0007	<0.00004
Copper	0.0067	0.00043
Lead	**0.029**	**0.0018**
Manganese	0.1	0.0065
Mercury	**0.0011**	**0.000073**
Nickel	0.0076	0.00049
Phosphorus	0.033	0.0021
Selenium	<0.004	<0.0003
Zinc	1.1	0.07
Total of Sb, As, Cd, Pb, Hg	**≤0.038**	**≤0.0024**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	101	

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		210329

Sampling Plane Details

Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v		
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.06	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0948 & 1055
Temperature, °C	55
Velocity at sampling plane, m/s	5.3
Volumetric flow rate, actual, m³/min	79
Volumetric flow rate (wet STP), m³/min	65
Volumetric flow rate (dry STP), m³/min	64
Mass flow rate (wet basis), kg/hour	5000
Velocity difference, %	<1

Ektimo

Date	20/04/2021	**Client**	Nyrstar Hobart
Report	R010591	**Stack ID**	MZR Furnace
Licence No.	7043-5	**Location**	Hobart
Ektimo Staff	G Trenear & T Bakas	**State**	TAS
Process Conditions	MZR Furnace in operation.		210329

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 0950 - 1051	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	24000	1500000
2-Methylnaphthalene	220	14000
Acenaphthylene	230	15000
Acenaphthene	<20	<1000
Fluorene	<20	<1000
Phenanthrene	760	49000
Anthracene	<20	<1000
Fluoranthene	360	23000
Pyrene	170	11000
Benz(a)anthracene	39	2500
Chrysene	91	5800
Benzo(b)fluoranthene	<20	<1000
Benzo(k)fluoranthene	<20	<1000
Benzo(e)pyrene	<20	<1000
Benzo(a)pyrene	<20	<1000
Perylene	<20	<1000
Indeno(1,2,3-cd)pyrene	<20	<1000
Dibenz(ah)anthracene	<20	<1000
Benzo(ghi)perylene	<20	<1000
Total 16 PAHs	26000	1600000
Total 19 PAHs	26000	1700000
BaP-TEQ		
Lower Bound	4.8	310
Middle Bound	19	1200
Upper Bound	33	2100

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	60
Isokinetic rate, %	100

3 TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited Sampling	NATA Accredited Analysis
Sample plane criteria	AS 4323.1	NA	NA	✓	NA
Flow rate, temperature and velocity	NA	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA 4	USEPA 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA 3	not specified	NA	✓
Carbon dioxide and oxygen	NA	USEPA 3A	13%	NA	✓
Carbon monoxide	USEPA 10	USEPA 10	12%	✓	✓
Nitrogen oxides	USEPA 7E	USEPA 7E	12%	✓	✓
Nitrous oxide	Teledyne T320 Analyser	NA	not specified	NA	NA
Sulfur dioxide	USEPA 6C	USEPA 6C	12%	✓	✓
Speciated volatile organic compounds (VOC's)	Ektimo 344	Ektimo 344	19%	✓	✓†
Total particulate matter	AS 4323.2	AS 4323.2††	5%	✓	✓
Total (gaseous and particulate) metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA 29	Envirolab inhouse Metals-006, Metals-022, Metals-021	15%	✓	✓‡
Particulate matter (PM_{10} and $PM_{2.5}$) by particle size analysis	AS 4323.2	HRL In-house	-	-	×**
Polycyclic aromatic hydrocarbons (PAH's)	USEPA SW-846 0010	NGCMS 11.27	21%	✓	✓¶
Sulfuric acid mist and/or sulfur oxides	USEPA 8	Ektimo 235	16%	✓	✓†
Total fluoride	USEPA 13B	ALS Method QWI-EN/EA144C & Ektimo 235	17%	✓	✓#,†

200506

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported on
6 May 2021 in report number LV-001403.
10 May 2021 in report number LV-001419.
27 May 2021 in report number LV-001432.

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 7 May 2021 in report number 268037

¶ Analysis performed by Australian Government National Measurement Institute, NATA accreditation number 198. Results were reported to Ektimo on 24 May 2021 in report number ORG21_035A.

** Analysis performed by HRL Technology using a Malvern Instruments Mastersizer laser particle size analyser. NATA Accreditation does not cover the performance of this service. Results were reported to Ektimo on 28 May 2021 in report number 210621.

Analysis (solid fluoride only) performed by Australian Laboratory Services Pty Ltd, NATA accreditation number 825. Results were reported to Ektimo on 19 May 2021 in report number EN2103948.

4 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

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5 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required.
OM	Other approved method
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
Vic EPA	Victorian Environment Protection Authority
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

6 APPENDIX 1: WEATHER OBSERVATIONS

Hobart – December 2021

Date	Day	Temps Min	Temps Max	Rain	Evap	Sun	Max wind gust Dir	Max wind gust Spd	Max wind gust Time	9 am Temp	9 am RH	9 am Cld	9 am Dir	9 am Spd	9 am MSLP	3 pm Temp	3 pm RH	3 pm Cld	3 pm Dir	3 pm Spd	3 pm MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Th	15.7	28.1	0	3.6		NNW	72	02:12	21.9	41	6	N	31	1016.6	27.0	25	6	NW	31	1015.6
2	Fr	13.5	24.0	0	4.6		NNW	44	22:37	14.6	71	7	N	7	1026.4	22.8	50	6	NNW	20	1021.8
3	Sa	14.6	32.3	0	3.0		WNW	74	20:34	22.8	33	0	N	20	1013.2	32.3	16	0	NW	22	1008.0
4	Su	14.1	20.9	0	11.0		NW	61	09:57	16.6	45	3	NNW	39	1012.8	19.4	35	2	NW	31	1011.9
5	Mo	11.1	22.1	0	5.0		NW	37	00:05	17.1	56	2	NNW	17	1019.7	21.3	41	1	NW	17	1019.6
6	Tu	8.7	18.8	0	4.0		S	24	17:09	14.0	69	1	NNW	13	1024.9	18.5	55	1	SE	15	1022.7
7	We	11.0	20.7	0	2.8		N	26	09:15	14.1	76	1	N	15	1020.4	19.9	59	1	ESE	15	1015.6
8	Th	14.0	23.7	0	3.0		NW	63	18:53	16.9	56	7	NNW	19	1006.4	23.3	30	7	NNW	11	999.8
9	Fr	10.9	14.8	1.8	3.4		SW	48	11:21	13.2	58	1	NW	11	1002.2	13.1	50	6	SW	9	1003.8
10	Sa	9.5	14.3	0	3.0		W	63	10:59	11.8	76	7	NNE	13	995.4	9.9	60	6	NNW	24	994.9
11	Su	5.6	11.9	6.6	4.8		SW	63	16:04	6.6	85	7	NNW	17	1004.1	11.1	70	6	SW	22	1008.0
12	Mo	6.6	14.9	8.4	0.4		SW	43	00:07	10.6	76	7	S	11	1020.0	13.1	65	7	S	11	1019.5
13	Tu	6.6	16.5	0.2	1.4		N	41	21:39	10.2	82	6	NNW	19	1016.6	15.7	59	7	NNW	17	1009.6
14	We	10.1	18.9	2.4	2.6		NW	96	11:16	15.5	61	3	NW	43	994.7	17.3	51	6	NW	28	996.3
15	Th	11.6	16.0	0.2	5.4		WSW	72	15:56	14.2	53	4	WNW	33	1001.4	12.2	50	6	WSW	44	1004.2
16	Fr	6.6	16.3	1.2	3.2		NE	48	12:31	11.2	60	1	NNW	22	1019.1	14.3	50	3	NW	24	1018.1
17	Sa	10.7	18.7	0	3.6		NNW	59	01:12	15.5	56	7	NNW	28	1016.2	16.5	61	7	NW	17	1015.4
18	Su	12.7	16.6	0	3.2		NW	57	04:32	14.2	63	7	NNW	28	1014.8	16.4	57	7	NNW	24	1012.0
19	Mo	12.8	19.5	0	3.4		NW	67	12:08	14.4	57	6	NNW	33	1008.2	19.0	39	6	NW	35	1004.4
20	Tu	10.0	10.2	0.8	4.6		WNW	65	01:59	10.0	72	8	SSW	13	1006.0	8.8	79	8	S	19	1008.7
21	We	2.0	14.5	1.6	2.0		NNW	46	10:16	6.6	74	1	NNW	19	1014.0	14.2	43	4	NW	22	1008.6
22	Th	6.6	15.8	0.2	3.2		WNW	65	15:54	12.5	55	6	N	20	1000.3	14.5	63	4	ESE	9	998.9
23	Fr	10.4	14.7	0	4.0		W	61	03:22	12.5	55	6	NNW	20	1007.6	13.4	59	7	NE	13	1008.9
24	Sa	10.4	17.5	0.4	4.0		WNW	54	12:04	12.3	75	3	N	19	1012.6	16.4	47	6	W	24	1013.8
25	Su	9.0	16.0	0	2.2		NNW	50	10:54	11.7	73	5	NW	20	1019.4	15.4	55	7	NNW	28	1016.6
26	Mo	11.5	20.0	0	3.6		NW	54	14:48	15.8	51	6	NE	11	1019.4	17.3	52	3	NW	28	1019.1
27	Tu	6.9	18.6	0	3.2		NNW	26	12:49	11.6	73	1	N	2	1026.1	17.4	54	1	NE	7	1023.9
28	We	7.8	18.7	0	2.2					10.3	80	6	NW	17	1023.3	18.3	50	7	N	7	1019.8
29	Th	10.3	20.8		2.6		NW	43	14:29	14.0	73	7	WSW	7	1020.4	20.2	50	5	NW	19	1019.8
30	Fr	11.3	20.3	0	1.0		N	37	12:04	12.2	87	8	NNW	19	1026.1	20.0	49	1	NNW	15	1023.5
Statistics for April 2021																					
	Mean	10.1	18.5		3.5					13.5	64	4		19	1013.6	17.3	50	4		20	1012.1
	Lowest	2.0	10.2	0	0.4					6.6	33	0	N	2	994.7	8.8	16	0	#	7	994.9
	Highest	15.7	32.3	8.4	11.0		NW	96		22.8	87	8	NW	43	1026.4	32.3	79	8	WSW	44	1023.9
	Total			23.8	104.0																

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REPORT NUMBER R011345

Emission Testing Report

Round 2 – October 2021

Nyrstar Hobart, Lutana

Document Information

Template Version; 230621

Client Name:	Nyrstar Hobart
Report Number:	R011345
Date of Issue:	3 December 2021
Attention:	Kylie Veale
Address:	Risdon Road Lutana TAS 7009
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Glenn Trenear **NATA Signatory**	NATA Accredited Laboratory No. 14601	**Benedict Guinery** **Senior Air Monitoring Consultant**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1. EXECUTIVE SUMMARY

1.1. Background

Ektimo was engaged by Nyrstar Hobart to perform emission testing at their Lutana plant. Testing was carried out in accordance with Environmental Licence 7043/5.

1.2. Project Objectives

The objectives of the project were to conduct a monitoring programme to quantify emissions from 15 discharge points to determine compliance with Nyrstar Hobart 's Environmental Licence and meet NPI reporting requirements.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
Foreshore A	17 October 2021	Total particulate matter Metals Nitrogen oxides, nitrous oxide, carbon monoxide, carbon dioxide, oxygen Sulfur dioxide, sulfur trioxide
Foreshore B		
Parageothite Dryer	12 October 2021	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Cadmium Smelter Plant Scrubber Stack		
Copper Sulphate Crystalliser Plant Vent Stack	13 October 2021	
Casting Ventilation 1 – V1	14 October 2021	
Casting Ventilation 2 – V2		
Roaster Baghouse	16 October 2021	Total particulate matter Metals Nitrogen oxides, carbon monoxide, sulfur dioxide carbon dioxide, oxygen
Anode Casting	15 October 2021	Total particulate matter Metals Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
Zinc Plant 1 Baghouse – ZP1		
Zinc Plant 3 Baghouse – ZP3	16 October 2021	
MZR Furnace Baghouse		
Package Boiler 1	13 October 2021	Total particulate matter Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Sulfur dioxide
Package Boiler 2		
Zinc Oxide Fume Debagging Station	14 October 2021	Total particulate matter Fine particulate matter (PM_{10} & $PM_{2.5}$ via particle sizing analysis) Polycyclic aromatic hydrocarbons (PAHs) Metals Sulfur dioxide, sulfur trioxide Total fluoride Nitrogen oxides, carbon monoxide, carbon dioxide, oxygen Total and speciated volatile organic compounds (VOCs)

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP. Plant operating conditions have been noted in the report.

1.3. Licence Comparison

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by Tasmanian EPN 7043/5

Emission Point / Monitoring Location	Parameter	Units	Licence limit	Detected values
Foreshore A (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.12
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.05
	Particulates	mg/m^3	100	<2
	Sulphur dioxide	g/m^3	7.2	0.0027
Foreshore B (Tail Gas Scrubber) Stack	Sulfuric acid and Sulfur trioxide (SO_3)	mg/m^3	100	0.12
	Oxides of nitrogen (as NO_2)	g/m^3	2	0.05
	Particulates	mg/m^3	100	1.5
	Sulphur dioxide	g/m^3	7.2	0.018
Anode Casting Plant Exhaust	Particulates	mg/m^3	100	120
V1 Furnace Stack				<2
V2 Furnace Stack				<2
Zinc Dust Plant Baghouse 1 Stack				4.4
Zinc Dust Plant Bagouse 3 Stack				26
Cadmium Smelter Plant Scrubber Stack				<2
Copper Sulphate Crystalliser Plant				4.8
Roaster Baghouse				37
Paragoethite Dryer Baghouse				6.9
Anode Casting Plant Exhaust	Metals - Pb, As, Sb, Cd, Hg (1)	mg/m^3	5	≤1.8271
V1 Furnace Stack				≤0.0526
V2 Furnace Stack				≤0.0297
Zinc Dust Plant Baghouse 1 Stack				≤0.1708
Zinc Dust Plant Baghouse 3 Stack				≤0.1815
Cadmium Smelter Plant Scrubber Stack				≤0.0461
Copper Sulphate Crystalliser Plant				≤0.1755
Roaster Baghouse				≤0.4544
Paragoethite Dryer Baghouse				≤0.0723
Anode Casting Plant Exhaust	Metals - Hg	mg/m^3	1	0.0011
V1 Furnace Stack				<0.0006
V2 Furnace Stack				<0.0005
Zinc Dust Plant Baghouse 1 Stack				<0.0008
Zinc Dust Plant Baghouse 3 Stack				<0.001
Cadmium Smelter Plant Scrubber Stack				<0.0005
Copper Sulphate Crystalliser Plant				0.014
Roaster Baghouse				0.018
Paragoethite Dryer Baghouse				<0.001
Anode Casting Plant Exhaust	Metals - Cd	mg/m^3	1	0.016
V1 Furnace Stack				0.004
V2 Furnace Stack				0.0022
Zinc Dust Plant Baghouse 1 Stack				0.019
Zinc Dust Plant Baghouse 3 Stack				0.0015
Cadmium Smelter Plant Scrubber Stack				0.0036
Copper Sulphate Crystalliser Plant				0.031
Roaster Baghouse				0.026
Paragoethite Dryer Baghouse				0.0033
Package Boiler 1	Sulfur dioxide	g/m^3	7.2	<0.005
	Oxides of nitrogen (as NO_2) (corrected to 7% O_2)	g/m^3	2	0.12
	Particulates (corrected to 7% O_2)	mg/m^3	100	<2
Package Boiler 2	Sulfur dioxide	g/m^3	7.2	<0.005
	Oxides of nitrogen (as NO_2) (corrected to 7% O_2)	g/m^3	2	0.13
	Particulates (corrected to 7% O_2)	mg/m^3	100	<2

(1) Total concentration of metals combined.

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

Refer to the Test Methods table for the measurement uncertainties.

2. RESULTS

2.1. *Foreshore A*

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore A
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		*210907*

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.8 (saturated)	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.20	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0826 & 1013	
Temperature, °C	16	
Velocity at sampling plane, m/s	18	
Volumetric flow rate, actual, m³/min	1900	
Volumetric flow rate (wet STP), m³/min	1800	
Volumetric flow rate (dry STP), m³/min	1800	
Mass flow rate (wet basis), kg/hour	140000	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	0912 - 1011	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	50	89
Carbon monoxide	<2	<4
	Concentration %v/v	
Carbon dioxide	0.6	
Oxygen	10.7	
Sampling time	-	
	Concentration mg/m³	Mass Rate g/min
Nitrous oxide		
Nitrous oxide	<0.004	<0.007

Note: Nitrous Oxide as N_20 measurements are not NATA accredited.

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore A
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Isokinetic Results	Results	
Sampling time	0830-1011	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	23	42
Sulfur trioxide	0.12	0.21
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	99	
Velocity difference, %	2	

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore A
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.7 (saturated)	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.20	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0826 & 1013
Temperature, °C	16
Velocity at sampling plane, m/s	18
Volumetric flow rate, actual, m³/min	1900
Volumetric flow rate (wet STP), m³/min	1800
Volumetric flow rate (dry STP), m³/min	1800
Mass flow rate (wet basis), kg/hour	140000
Velocity difference, %	2

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Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore A
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Isokinetic Results	Results	
Sampling time	0830-1011	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<3
Antimony	<0.003	<0.006
Arsenic	<0.002	<0.003
Beryllium	<0.0004	<0.0007
Cadmium	0.002	0.0035
Chromium	<0.0007	<0.001
Cobalt	<0.0005	<0.0008
Copper	0.0032	0.0058
Lead	0.027	0.048
Manganese	0.043	0.078
Mercury	0.00033	0.00059
Nickel	0.0013	0.0023
Phosphorus	0.02	0.035
Selenium	<0.003	<0.006
Zinc	0.25	0.45
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	100	
Velocity difference, %	2	
Gravimetric analysis date (total particulate)	27-10-2021	

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2.2. Foreshore B

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore B
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream. 210907		

Sampling Plane Details	
Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.8 (saturated)	
Gas molecular weight, g/g mole	28.5 (wet)	28.7 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.19	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1016 & 1206	
Temperature, °C	16	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m³/min	1700	
Volumetric flow rate (wet STP), m³/min	1600	
Volumetric flow rate (dry STP), m³/min	1600	
Mass flow rate (wet basis), kg/hour	120000	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	1042 - 1141	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	50	79
Carbon monoxide	<2	<3
	Concentration %v/v	
Carbon dioxide	0.6	
Oxygen	10.9	
Sampling time	-	
	Concentration mg/m³	Mass Rate g/min
Nitrous oxide		
Nitrous oxide	<0.004	<0.006

Note: Nitrous Oxide as N_20 measurements are not NATA accredited.

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore B
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Isokinetic Results	Results	
Sampling time	1023-1204	
	Concentration mg/m³	Mass Rate g/min
Sulfur dioxide	18	29
Sulfur trioxide	0.12	0.2
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	100	
Velocity difference, %	2	

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore B
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Sampling Plane Details

Sampling plane dimensions	1530 mm
Sampling plane area	1.84 m²
Sampling port size, number & depth	4" Flange (x2), 150 mm
Access & height of ports	Stairs 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Centrifugal fan 3 D
No. traverses & points sampled	2 20
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments

The number of points sampled is less than the requirement
The discharge is assumed to be composed of dry air and moisture

The sampling plane is deemed to be non-ideal due to the following reasons:

The highest to lowest gas velocity ratio exceeds 1.6:1
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	1.7 (saturated)	
Gas molecular weight, g/g mole	28.5 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	1.19	

Gas Flow Parameters

Flow measurement time(s) (hhmm)	1016 & 1206
Temperature, °C	16
Velocity at sampling plane, m/s	16
Volumetric flow rate, actual, m³/min	1700
Volumetric flow rate (wet STP), m³/min	1600
Volumetric flow rate (dry STP), m³/min	1600
Mass flow rate (wet basis), kg/hour	120000
Velocity difference, %	2

Date	17/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Foreshore B
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Unit 5 producing 45 m3/hr & Unit 6 producing 98 m3/hr of gas through the acid stream.		210907

Isokinetic Results	Results	
Sampling time	1023-1204	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	1.5	2.4
Antimony	<0.004	<0.006
Arsenic	<0.002	<0.003
Beryllium	<0.0004	<0.0007
Cadmium	0.0021	0.0033
Chromium	0.0019	0.003
Cobalt	<0.0006	<0.0009
Copper	0.0043	0.0067
Lead	0.033	0.053
Manganese	0.052	0.082
Mercury	0.00056	0.00088
Nickel	0.001	0.0016
Phosphorus	0.013	0.021
Selenium	<0.004	<0.006
Zinc	0.3	0.47
Isokinetic Sampling Parameters		
Sampling time, min	100	
Isokinetic rate, %	100	
Velocity difference, %	2	
Gravimetric analysis date (total particulate)	27-10-2021	

2.3. Parageothite Dryer

Date	12/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Parageothite Dryer
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	8.9 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum.		210907

Sampling Plane Details	
Sampling plane dimensions	950 mm
Sampling plane area	0.709 m²
Sampling port size, number & depth	4" Flange (x2), 50 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Centrifugal fan >6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	35	
Gas molecular weight, g/g mole	25.4 (wet)	29.3 (dry)
Gas density at STP, kg/m³	1.13 (wet)	1.31 (dry)
Gas density at discharge conditions, kg/m³	0.89	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1225 & 1335	
Temperature, °C	75	
Velocity at sampling plane, m/s	11	
Volumetric flow rate, actual, m³/min	450	
Volumetric flow rate (wet STP), m³/min	360	
Volumetric flow rate (dry STP), m³/min	230	
Mass flow rate (wet basis), kg/hour	24000	
Velocity difference, %	-1	

Gas Analyser Results	Average	
Sampling time	1232 - 1331	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	50	12
Carbon monoxide	<2	<0.6
	Concentration %v/v	
Carbon dioxide	3.4	
Oxygen	14.8	

Date	12/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Parageothite Dryer
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	8.9 m3/hr of dirt and 2.9 m3/hr of bypass flow into the drum.		210907

Isokinetic Results	Results	
Sampling time	1230-1331	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	6.9	1.6
Antimony	**<0.005**	**<0.001**
Arsenic	**<0.003**	**<0.0007**
Beryllium	<0.0008	<0.0002
Cadmium	**0.0033**	**0.00077**
Chromium	0.0039	0.0009
Cobalt	<0.001	<0.0003
Copper	0.0099	0.0023
Lead	**0.06**	**0.014**
Manganese	0.041	0.0097
Mercury	**<0.001**	**<0.0003**
Nickel	0.0059	0.0014
Phosphorus	0.065	0.015
Selenium	<0.005	<0.001
Zinc	0.28	0.066
Total of Sb, As, Cd, Pb, Hg	**≤0.072**	**≤0.017**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	-1	
Gravimetric analysis date (total particulate)	27-10-2021	

2.4. Cadmium Smelter Plant Scrubber Stack

Date	12/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Cadmium Smelter
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		210907

Sampling Plane Details	
Sampling plane dimensions	470 mm
Sampling plane area	0.173 m²
Sampling port size, number & depth	4" BSP (x2), 85 mm
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Change in diameter 2 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	0.5	
Gas molecular weight, g/g mole	29.0 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.23	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1607 & 1720	
Temperature, °C	16	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	180	
Volumetric flow rate (wet STP), m³/min	170	
Volumetric flow rate (dry STP), m³/min	170	
Mass flow rate (wet basis), kg/hour	13000	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	1610 - 1709	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.6
Carbon monoxide	<2	<0.4
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	12/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Cadmium Smelter
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Fume extraction while furnace in operation.		*210907*

Isokinetic Results	Results	
Sampling time	1615-1716	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.3
Antimony	**<0.005**	**<0.0009**
Arsenic	**<0.003**	**<0.0005**
Beryllium	<0.0006	<0.0001
Cadmium	**0.0036**	**0.00062**
Chromium	0.0009	0.00015
Cobalt	<0.0008	<0.0001
Copper	0.0052	0.00089
Lead	**0.034**	**0.0058**
Manganese	0.011	0.0019
Mercury	**<0.0005**	**<0.00009**
Nickel	0.0018	0.00031
Phosphorus	0.083	0.014
Selenium	<0.005	<0.0009
Zinc	0.13	0.022
Total of Sb, As, Cd, Pb, Hg	**≤0.047**	**≤0.0079**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	
Velocity difference, %	2	
Gravimetric analysis date (total particulate)	27-10-2021	

2.5. Copper Sulphate Crystalliser Plant Vent Stack

Date	13/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Copper Sulphate Stack
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Production rate - 16.5 tonnes/day, Dryer Outlet Temperature - 44 deg C, Feed rate into Dryer - 40%		210907

Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Truck mounted boom 35 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The gas temperature of the sampling plane is below the dew point
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	14 (saturated)	
Gas molecular weight, g/g mole	27.4 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.22 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.02	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0955 & 1103	
Temperature, °C	54	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	200	
Volumetric flow rate (wet STP), m³/min	160	
Volumetric flow rate (dry STP), m³/min	140	
Mass flow rate (wet basis), kg/hour	12000	
Velocity difference, %	-1	

Gas Analyser Results	Average	
Sampling time	1001 - 1100	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.5
Carbon monoxide	<2	<0.3
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.7	

Date	13/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Copper Sulphate Stack
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Production rate - 16.5 tonnes/day, Dryer Outlet Temperature - 44 deg C, Feed rate into Dryer - 40%		210907

Isokinetic Results	Results	
Sampling time	1000-1101	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	4.8	0.68
Antimony	**<0.007**	**<0.001**
Arsenic	**0.0035**	**0.00049**
Beryllium	<0.001	<0.0001
Cadmium	**0.031**	**0.0044**
Chromium	0.0015	0.00021
Cobalt	<0.002	<0.0003
Copper	0.038	0.0053
Lead	**0.12**	**0.017**
Manganese	0.056	0.0079
Mercury	**0.014**	**0.002**
Nickel	0.052	0.0073
Phosphorus	0.19	0.026
Selenium	<0.008	<0.001
Zinc	1.5	0.21
Total of Sb, AS, Cd, Pb, Hg	**≤0.18**	**≤0.025**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	-1	
Gravimetric analysis date (total particulate)	27-10-2021	

2.6. Casting Ventilation 1 – V1

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		210907

Sampling Plane Details	
Sampling plane dimensions	635 mm
Sampling plane area	0.317 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.3	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.16	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1525 & 1634	
Temperature, °C	27	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/min	410	
Volumetric flow rate (wet STP), m³/min	370	
Volumetric flow rate (dry STP), m³/min	360	
Mass flow rate (wet basis), kg/hour	29000	
Velocity difference, %	-4	

Gas Analyser Results	Average	
Sampling time	1533 - 1632	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<1
Carbon monoxide	<2	<0.7
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Casting Ventilation 1 - V1
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		*210907*

Isokinetic Results	Results	
Sampling time	1530-1631	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.6
Antimony	**<0.004**	**<0.002**
Arsenic	**<0.002**	**<0.0009**
Beryllium	<0.0005	<0.0002
Cadmium	**0.004**	**0.0015**
Chromium	0.0015	0.00053
Cobalt	<0.0007	<0.0002
Copper	0.0071	0.0026
Lead	**0.042**	**0.015**
Manganese	0.021	0.0077
Mercury	**<0.0006**	**<0.0002**
Nickel	0.0035	0.0013
Phosphorus	0.091	0.033
Selenium	<0.004	<0.002
Zinc	0.8	0.29
Total of Sb, As, Cd, Pb, Hg	**≤0.053**	**≤0.019**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	-4	
Gravimetric analysis date (total particulate)	27-10-2021	

2.7. Casting Ventilation 2 – V2

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		210907

Sampling Plane Details	
Sampling plane dimensions	595 mm
Sampling plane area	0.278 m²
Sampling port size, number & depth	4" Flange (x1), 245 mm
Access & height of ports	Stairs 2 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.3	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1641 & 1748	
Temperature, °C	38	
Velocity at sampling plane, m/s	22	
Volumetric flow rate, actual, m³/min	360	
Volumetric flow rate (wet STP), m³/min	320	
Volumetric flow rate (dry STP), m³/min	320	
Mass flow rate (wet basis), kg/hour	25000	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1651 - 1751	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<1
Carbon monoxide	<2	<0.6
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Casting Ventilation 2 - V2
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		210907

Isokinetic Results	Results	
Sampling time	1645-1745	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.5
Antimony	**<0.004**	**<0.001**
Arsenic	**<0.002**	**<0.0007**
Beryllium	<0.0005	<0.0002
Cadmium	**0.0022**	**0.00068**
Chromium	<0.001	<0.0003
Cobalt	<0.0006	<0.0002
Copper	0.0052	0.0017
Lead	**0.021**	**0.0066**
Manganese	0.022	0.007
Mercury	**<0.0005**	**<0.0002**
Nickel	0.0026	0.00083
Phosphorus	0.069	0.022
Selenium	<0.004	<0.001
Zinc	0.71	0.22
Total of Sb, As, Cd, Pb, Hg	**≤0.03**	**≤0.0095**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	<1	
Gravimetric analysis date (total particulate)	27-10-2021	

2.8. Roaster Baghouse

Date	16/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Roaster Baghouse
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Roaster 6 - 40 t/hr, Roaster 5 - 6 t/hr (Conveyor all in operation), fumes were off		210907

Sampling Plane Details	
Sampling plane dimensions	385 mm
Sampling plane area	0.116 m²
Sampling port size, number & depth	4" BSP (x2), 105 mm
Access & height of ports	Stairs 15 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 6 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	3.4	
Gas molecular weight, g/g mole	28.6 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.05	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1422 & 1532	
Temperature, °C	53	
Velocity at sampling plane, m/s	15	
Volumetric flow rate, actual, m³/min	110	
Volumetric flow rate (wet STP), m³/min	88	
Volumetric flow rate (dry STP), m³/min	85	
Mass flow rate (wet basis), kg/hour	6700	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	1423 - 1522	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	5.3	0.45
Sulfur dioxide	510	43
Carbon monoxide	<2	<0.2
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.8	

Date	16/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Roaster Baghouse
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Roaster 6 - 40 t/hr, Roaster 5 - 6 t/hr (Conveyor all in operation), fumes were off		210907

Isokinetic Results	Results	
Sampling time	1425-1530	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	37	3.2
Antimony	**<0.004**	**<0.0003**
Arsenic	**0.0064**	**0.00054**
Beryllium	<0.0005	<0.00004
Cadmium	**0.026**	**0.0022**
Chromium	0.002	0.00017
Cobalt	<0.0006	<0.00005
Copper	0.033	0.0028
Lead	**0.4**	**0.034**
Manganese	0.15	0.012
Mercury	**0.018**	**0.0015**
Nickel	0.0016	0.00014
Phosphorus	0.031	0.0026
Selenium	<0.004	<0.0003
Zinc	4.6	0.39
Total of Sb, As, Cd, Pb, Hg	**≤0.45**	**≤0.038**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	100	
Velocity difference, %	<1	
Gravimetric analysis date (total particulate)	27-10-2021	

2.9. Anode Casting

Date	15/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Anode Casting
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		210907

Sampling Plane Details	
Sampling plane dimensions	450 mm
Sampling plane area	0.159 m²
Sampling port size, number	4" Flange (x1)
Access & height of ports	Stairs & fixed ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Centrifugal fan 2 D
No. traverses & points sampled	1 6
Sample plane compliance to AS4323.1	Non-compliant

Comments
The number of traverses sampled is less than the requirement
The number of points sampled is less than the requirement

The sampling plane is deemed to be non-compliant due to the following reasons:
The stack or duct does not have the required number of access holes (ports)
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1.7	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.17	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0821 & 0935	
Temperature, °C	22	
Velocity at sampling plane, m/s	8.7	
Volumetric flow rate, actual, m³/min	83	
Volumetric flow rate (wet STP), m³/min	75	
Volumetric flow rate (dry STP), m³/min	74	
Mass flow rate (wet basis), kg/hour	5800	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	0832 - 0931	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Carbon monoxide	<2	<0.1
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	15/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Anode Casting
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Casting area in normal operation.		210907

Isokinetic Results	Results	
Sampling time	0830-0930	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	120	8.8
Antimony	**<0.006**	**<0.0004**
Arsenic	**<0.004**	**<0.0003**
Beryllium	<0.0007	<0.00005
Cadmium	**0.016**	**0.0012**
Chromium	0.019	0.0014
Cobalt	0.0058	0.00043
Copper	0.16	0.012
Lead	**1.8**	**0.13**
Manganese	11	0.84
Mercury	**0.0011**	**0.00008**
Nickel	0.19	0.014
Phosphorus	0.064	0.0047
Selenium	<0.008	<0.0006
Zinc	11	0.79
Total of Sb, AS, Cd, Pb, Hg	**≤1.8**	**≤0.13**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	<1	
Gravimetric analysis date (total particulate)	27-10-2021	

Ektimo

2.10. Zinc Plant 1 Baghouse – ZP1

Date	15/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210907

Sampling Plane Details	
Sampling plane dimensions	390 x 500 mm
Sampling plane area	0.195 m²
Sampling port size, number	1" Holes (x3)
Access & height of ports	Scissor lift 4 m
Duct orientation & shape	Vertical Rectangular
Downstream disturbance	Bend >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	3 6
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	2.4	
Gas molecular weight, g/g mole	28.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.10	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1529 & 1645	
Temperature, °C	43	
Velocity at sampling plane, m/s	7.6	
Volumetric flow rate, actual, m³/min	89	
Volumetric flow rate (wet STP), m³/min	76	
Volumetric flow rate (dry STP), m³/min	74	
Mass flow rate (wet basis), kg/hour	5900	
Velocity difference, %	-3	

Gas Analyser Results	Average	
Sampling time	1539 - 1638	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Carbon monoxide	<2	<0.1
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	15/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zinc Plant 1 Baghouse - ZP 1
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Normal production in Zinc Plant 1 area.		210907

Isokinetic Results	Results	
Sampling time	1540-1641	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	4.4	0.32
Antimony	**<0.007**	**<0.0005**
Arsenic	**<0.004**	**<0.0003**
Beryllium	<0.0009	<0.00007
Cadmium	**0.019**	**0.0014**
Chromium	<0.001	<0.0001
Cobalt	<0.001	<0.00008
Copper	0.0099	0.00074
Lead	**0.14**	**0.011**
Manganese	0.8	0.059
Mercury	**<0.0008**	**<0.00006**
Nickel	0.016	0.0012
Phosphorus	<0.02	<0.002
Selenium	<0.007	<0.0005
Zinc	0.73	0.054
Total of Sb, As, Cd, Pb, Hg	**≤0.17**	**≤0.013**
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	-3	
Gravimetric analysis date (total particulate)	27-10-2021	

2.11. Zinc Plant 3 Baghouse – ZP3

Date	16/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210907

Sampling Plane Details	
Sampling plane dimensions	285 mm
Sampling plane area	0.0638 m²
Sampling port size, number	2" Holes (x2)
Access & height of ports	Stairs 15 m
Duct orientation & shape	Horizontal Circular
Downstream disturbance	Bend 1 D
Upstream disturbance	Bend 4 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.00	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1103 & 1219	
Temperature, °C	72	
Velocity at sampling plane, m/s	17	
Volumetric flow rate, actual, m³/min	63	
Volumetric flow rate (wet STP), m³/min	49	
Volumetric flow rate (dry STP), m³/min	49	
Mass flow rate (wet basis), kg/hour	3800	
Velocity difference, %	2	

Gas Analyser Results	Average	
Sampling time	1108 - 1207	
Combustion Gases	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<3	<0.2
Carbon monoxide	<2	<0.1
	Concentration %v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

Date	16/10/2021	Client	Nyrstar Hobart
Report	R011345	Stack ID	Zinc Plant 3 Baghouse - ZP 3
Licence No.	7045-5	Location	Hobart
Ektimo Staff	B Guinery/M Faboade	State	TAS
Process Conditions	Normal production in Zinc Plant 3 area.		210907

Isokinetic Results	Results	
Sampling time	1110-1215	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	26	1.3
Antimony	**<0.006**	**<0.0003**
Arsenic	**<0.003**	**<0.0001**
Beryllium	<0.0008	<0.00004
Cadmium	**0.0015**	**0.000075**
Chromium	0.0019	0.000094
Cobalt	<0.0009	<0.00004
Copper	0.0049	0.00024
Lead	**0.17**	**0.0084**
Manganese	0.092	0.0045
Mercury	**<0.001**	**<0.00005**
Nickel	<0.003	<0.0001
Phosphorus	0.036	0.0017
Selenium	<0.006	<0.0003
Zinc	8.6	0.42
Total of Sb, As, Cd, Pb, Hg	**≤0.18**	**≤0.0089**
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	101	
Velocity difference, %	2	
Gravimetric analysis date (total particulate)	27-10-2021	

2.12. MZR Furnace Baghouse

Date	16/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	MZR Furnace
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	645 x 385 mm
Sampling plane area	0.248 m²
Sampling port size, number & depth	4" BSP (x2), 45 mm
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Horizontal Rectangular
Downstream disturbance	Exit 2 D
Upstream disturbance	Bend 3 D
No. traverses & points sampled	2 6
Sample plane compliance to AS4323.1	Compliant but non-ideal

The sampling plane is deemed to be non-ideal due to the following reasons:
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	2.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.13	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0826 & 0933	
Temperature, °C	33	
Velocity at sampling plane, m/s	5.5	
Volumetric flow rate, actual, m³/min	81	
Volumetric flow rate (wet STP), m³/min	72	
Volumetric flow rate (dry STP), m³/min	70	
Mass flow rate (wet basis), kg/hour	5500	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	0832 - 0931	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.2
Carbon monoxide	37	2.6
	Concentration %v/v	
Carbon dioxide	0.5	
Oxygen	20.2	

Date	16/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	MZR Furnace
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Isokinetic Results	Results	
Sampling time	0830-0931	
	Concentration mg/m³	Mass Rate g/min
Total particulate matter	<2	<0.1
Antimony	<0.006	<0.0004
Arsenic	<0.003	<0.0002
Beryllium	<0.0007	<0.00005
Cadmium	0.0075	0.00053
Chromium	0.0018	0.00012
Cobalt	<0.0008	<0.00006
Copper	0.0059	0.00041
Lead	0.1	0.0071
Manganese	0.3	0.021
Mercury	0.0082	0.00057
Nickel	0.0066	0.00046
Phosphorus	0.04	0.0028
Selenium	<0.006	<0.0004
Zinc	1.2	0.082
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	100	
Velocity difference, %	<1	
Gravimetric analysis date (total particulate)	27-10-2021	

2.13. Package Boiler 1

Date	13/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Package Boiler 1
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1016 mm
Sampling plane area	0.811 m²
Sampling port size, number & depth	4" Flange (x3), 300 mm
Access & height of ports	Crane
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Junction 6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	9	
Gas molecular weight, g/g mole	29.0 (wet)	30.1 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.95	
% Oxygen correction & Factor	7 %	0.94
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1654 & 1801	
Temperature, °C	100	
Velocity at sampling plane, m/s	6.8	
Volumetric flow rate, actual, m³/min	330	
Volumetric flow rate (wet STP), m³/min	240	
Volumetric flow rate (dry STP), m³/min	220	
Mass flow rate (wet basis), kg/hour	19000	
Velocity difference, %	<1	

Gas Analyser Results	Average		
Sampling time	1708 - 1807		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	130	120	28
Sulfur dioxide	<5	<4	<1
Carbon monoxide	<2	<2	<0.4
	Concentration %v/v		
Carbon dioxide	10.5		
Oxygen	6.2		

Isokinetic Results	Results		
Sampling time	1657-1757		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Total particulate matter	<2	<2	<0.4
Isokinetic Sampling Parameters			
Sampling time, min	60		
Isokinetic rate, %	100		
Velocity difference, %	<1		
Gravimetric analysis date (total particulate)	27-10-2021		

2.14. Package Boiler 2

Date	13/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Package Boiler 2
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	1016 mm
Sampling plane area	0.811 m²
Sampling port size, number & depth	4" Flange (x3), 300 mm
Access & height of ports	Crane
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 2 D
Upstream disturbance	Junction 6 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Ideal

Stack Parameters		
Moisture content, %v/v	9.3	
Gas molecular weight, g/g mole	28.9 (wet)	30.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.34 (dry)
Gas density at discharge conditions, kg/m³	0.95	
% Oxygen correction & Factor	7 %	0.97
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1441 & 1551	
Temperature, °C	97	
Velocity at sampling plane, m/s	7.4	
Volumetric flow rate, actual, m³/min	360	
Volumetric flow rate (wet STP), m³/min	270	
Volumetric flow rate (dry STP), m³/min	240	
Mass flow rate (wet basis), kg/hour	21000	
Velocity difference, %	<1	

Gas Analyser Results	Average		
Sampling time	1452 - 1551		
Combustion Gases	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	140	130	33
Sulfur dioxide	<5	<5	<1
Carbon monoxide	<2	<2	<0.5
	Concentration %v/v		
Carbon dioxide	10.2		
Oxygen	6.6		

Isokinetic Results	Results		
Sampling time	1445-1545		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Total particulate matter	<2	<2	<0.4
Isokinetic Sampling Parameters			
Sampling time, min	60		
Isokinetic rate, %	101		
Velocity difference, %	<1		
Gravimetric analysis date (total particulate)	27-10-2021		

Ektimo

2.15. Zinc Oxide Fume Debagging Station

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	250 mm
Sampling plane area	0.0491 m²
Sampling port size, number	3" Flange (x4)
Access & height of ports	Fixed ladder
Duct orientation & shape	Vertical Circular
Downstream disturbance	Cowl >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 4
Sample plane compliance to AS4323.1	Ideal

Comments
Batch stopped before afterflows could be taken

Stack Parameters		
Moisture content, %v/v	1.4	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.22	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1007	
Temperature, °C	14	
Velocity at sampling plane, m/s	9.2	
Volumetric flow rate, actual, m³/min	27	
Volumetric flow rate (wet STP), m³/min	26	
Volumetric flow rate (dry STP), m³/min	26	
Mass flow rate (wet basis), kg/hour	2000	
Velocity difference, %	<1	

Gas Analyser Results	Average	
Sampling time	0659 - 0724	
	Concentration mg/m³	Mass Rate g/min
Combustion Gases		
Nitrogen oxides (as NO_2)	<3	<0.08
Carbon monoxide	<2	<0.05
	Concentration % v/v	
Carbon dioxide	<0.3	
Oxygen	20.9	

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Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Isokinetic Results		Results	
Sampling time		1007-1022	
		Concentration mg/m³	Mass Rate g/min
Total particulate matter		<8	<0.2
PM10	(PSA)	<3	<0.08
PM2.5	(PSA)	<0.7	<0.02
Isokinetic Sampling Parameters			
Sampling time, min		16	
Isokinetic rate, %		100	
Velocity difference, %		<1	
Gravimetric analysis date (total particulate)		27-10-2021	

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.22	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1007	
Temperature, °C	14	
Velocity at sampling plane, m/s	9.3	
Volumetric flow rate, actual, m³/min	27	
Volumetric flow rate (wet STP), m³/min	26	
Volumetric flow rate (dry STP), m³/min	26	
Mass flow rate (wet basis), kg/hour	2000	
Velocity difference, %	<1	

Isokinetic Results	Results	
Sampling time	1007-1022	
	Concentration mg/m³	Mass Rate g/min
Antimony	<0.02	<0.0005
Arsenic	<0.01	<0.0004
Beryllium	<0.002	<0.00006
Cadmium	0.028	0.00073
Chromium	0.0037	0.000095
Cobalt	<0.003	<0.00008
Copper	0.055	0.0014
Lead	0.37	0.0094
Manganese	0.1	0.0026
Mercury	0.0021	0.000055
Nickel	0.0063	0.00016
Phosphorus	0.36	0.0092
Selenium	<0.02	<0.0005
Zinc	4.4	0.11
Isokinetic Sampling Parameters		
Sampling time, min	16	
Isokinetic rate, %	100	
Velocity difference, %	<1	

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	250 mm
Sampling plane area	0.0491 m²
Sampling port size, number	3" Flange (x4)
Access & height of ports	Fixed ladder
Duct orientation & shape	Vertical Circular
Downstream disturbance	Cowl >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 4
Sample plane compliance to AS4323.1	Ideal

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.22	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1156
Temperature, °C	14
Velocity at sampling plane, m/s	8.5
Volumetric flow rate, actual, m³/min	25
Volumetric flow rate (wet STP), m³/min	24
Volumetric flow rate (dry STP), m³/min	23
Mass flow rate (wet basis), kg/hour	1800

Total Speciated VOCs	Results	
Sampling time	1156-1225	
	Concentration mg/m³	Mass Rate g/min
Total	0.58	0.013

VOC's C5-C20	Results	
Sampling time	1156-1226	
	Concentration mg/m³	Mass Rate g/min
Detection limit(1)	<0.1	<0.003
Acetone	0.58	0.013

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Dichloromethane, Ethanol, Isopropanol, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m +p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Polycyclic Aromatic Hydrocarbons (PAHs) Sampling time	Results 1156 - 1226	
	Concentration ng/m³	Mass Rate ng/min
Naphthalene	99000**	2300000
2-Methylnaphthalene	750	17000
Acenaphthylene	<50**	<1000
Acenaphthene	<50	<1000
Fluorene	<50	<1000
Phenanthrene	410	9600
Anthracene	<50	<1000
Fluoranthene	360	8400
Pyrene	120	2800
Benz(a)anthracene	<50	<1000
Chrysene	96	2200
Benzo(b)fluoranthene	<50	<1000
Benzo(k)fluoranthene	<50	<1000
Benzo(e)pyrene	<50	<1000
Benzo(a)pyrene	<50	<1000
Perylene	<50	<1000
Indeno(1,2,3-cd)pyrene	<50	<1000
Dibenz(ah)anthracene	<50	<1000
Benzo(ghi)perylene	<50	<1000
Total 16 PAHs	100000	2300000
Total 19 PAHs	100000	2300000
BaP-TEQ		
Lower Bound	0.96	22
Middle Bound	44	1000
Upper Bound	88	2000

Abbreviations and definitions

BaP-TEQ	Benzo(a)pyrene toxic equivalents.
Lower Bound	Defines values reported below detection as equal to zero.
Middle Bound	Defines values reported below detection are equal to half the detection limit.
Upper Bound	Defines values reported below detection are equal to the detection limit.

TEQs are calculated by multiplying the quantified result for each toxic compound by its corresponding toxic equivalency factor.

** Indicates the surrogate recovery is outside the range of linearity.

Isokinetic Sampling Parameters	Results
PAHs	
Sampling time, min	28
Isokinetic rate, %	100
Velocity difference, %	<1

Date	14/10/2021	**Client**	Nyrstar Hobart
Report	R011345	**Stack ID**	Zink Oxide Fume Debagging Station
Licence No.	7045-5	**Location**	Hobart
Ektimo Staff	B Guinery/M Faboade	**State**	TAS
Process Conditions	Please refer to client records.		210907

Sampling Plane Details	
Sampling plane dimensions	250 mm
Sampling plane area	0.0491 m²
Sampling port size, number	3" Flange (x4)
Access & height of ports	Fixed ladder
Duct orientation & shape	Vertical Circular
Downstream disturbance	Cowl >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 4
Sample plane compliance to AS4323.1	Ideal

Comments
The discharge is assumed to be composed of dry air and moisture

Stack Parameters		
Moisture content, %v/v	1.5	
Gas molecular weight, g/g mole	28.8 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.22	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1156	
Temperature, °C	14	
Velocity at sampling plane, m/s	8.5	
Volumetric flow rate, actual, m³/min	25	
Volumetric flow rate (wet STP), m³/min	24	
Volumetric flow rate (dry STP), m³/min	23	
Mass flow rate (wet basis), kg/hour	1800	

Isokinetic Results	Results	
Sampling time	1156-1226	
	Concentration mg/m³	Mass Rate g/min
Total fluoride (as HF)	0.073	0.0017
Isokinetic Sampling Parameters		
Sampling time, min	28	
Isokinetic rate, %	100	
Velocity difference, %	<1	

3. PLANT OPERATING CONDITIONS

See Nyrstar Hobart records for complete process conditions.

4. TEST METHODS

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sampling points - Selection	AS 4323.1 (1995)	NA	NA	✓	NA
Flow rate, temperature and velocity	ISO 10780	ISO 10780	8%, 2%, 7%	NA	✓
Moisture	USEPA Method 4	USEPA Method 4	8%	✓	✓
Moisture (stacks <60°C)	Ektimo 050	Ektimo 050	not specified	✓	✓
Molecular weight	NA	USEPA Method 3	not specified	NA	✓
Carbon dioxide and oxygen	USEPA Method 3A	USEPA Method 3A	13%	✓	✓
Carbon monoxide	USEPA Method 10	USEPA Method 10	12%	✓	✓
Nitrogen oxides	USEPA Method 7E	USEPA Method 7E	12%	✓	✓
Nitrous oxide	NA	gas analyser	12%	NA	✗[h]
Sulfur dioxide	USEPA Method 6C	USEPA Method 6C	12%	✓	✓
Speciated volatile organic compounds (VOCs)	Ektimo 344	Ektimo 344	19%	✓	✓[†]
Total particulate matter	AS 4323.2	AS 4323.2	7%	✓	✓[††]
Particulate matter (PM_{10} and $PM_{2.5}$) by particle size analysis	AS 4323.2	HRL in-house method using Malvern Mastersizer 2000	-	-	✗[**]
Particulate metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Ni, P, Pb, Sb, Se, Tl, Zn)	USEPA Method 29	Envirolab in-house methods Metals-006, Metals-022, Metals-021	15%	✓	✓[‡]
Total fluoride	USEPA Method 13B	ALS in-house method EA144C & Ektimo 235	17%	✓	✓[#,†]
Polycyclic aromatic hydrocarbons (PAHs)	USEPA SW-846 0010	NMI in-house method NGCMS 11.27	21%	✓	✓[¶]
Sulfuric acid mist and/or sulfur oxides	USEPA Method 8	Ektimo 235	16%	✓	✓[†]

211109

* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported on:
26 October 2021 in report LV-002058.
5 November 2021 in report LV-002064.
8 November 2021 in report LV-002079.

†† Gravimetric analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 4 November 2021 in report 281392.

¶ Analysis performed by Australian Government National Measurement Institute, NATA accreditation number 198. Results were reported to Ektimo on 22 November 2021 in report #ORG21_081.

** Analysis performed by HRL Technology using a laser-diffraction particle size analyser. NATA accreditation does not cover the performance of this service. Results were reported to Ektimo on 8 November 2021 in report 211408.

\# Analysis (solid fluoride only) performed by Australian Laboratory Services Pty Ltd, NATA accreditation number 825. Results were reported to Ektimo on 4 November 2021 in report EN2109498.

h Nitrous oxide performed using the instrumental technique as per USEPA Method 7E.

5. QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

6. DEFINITIONS

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test method
TOC	The sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

Ektimo

7. APPENDIX 1: WEATHER OBSERVATIONS

Hobart – October 2021

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Fr	10.1	15.5	7.0	1.0		SSW	33	00:34	12.7	97	8	SSW	15	1013.6	14.8	91	6	ESE	9	1009.7
2	Sa	12.7	15.2	3.4	1.0		SSW	46	21:55	13.4	95	8	SSE	15	1008.9	14.5	84	8	S	20	1006.0
3	Su	11.4	17.8	7.4	0.6		SSE	43	07:49	12.0	96	8	S	28	1001.9	14.2	80	5	SSE	20	997.0
4	Mo	10.9	17.6	2.2	1.6		ESE	26	18:26	13.2	88	7	ENE	6	992.8	14.6	91	7	E	9	990.3
5	Tu	7.7	16.4	2.6	1.6		SW	31	16:28	11.2	71	6	S	6	995.8	15.4	58	7	ENE	9	997.9
6	We	8.6	18.8	0.2	3.0		NW	44	11:22	12.2	52	5	N	13	1008.3	17.6	43	6	NW	22	1005.8
7	Th	8.4	15.4	2.2	3.6		WSW	61	11:16	9.7	54	4	WNW	17	1001.3	13.6	41	2	WSW	24	1005.2
8	Fr	8.8	21.3	0	4.0		NW	52	14:09	13.1	74	1	WNW	24	1010.2	20.9	38	7	NW	28	1006.2
9	Sa	12.3	18.7	0	4.8		NNW	57	02:25	13.4	62	7	NNW	22	1006.9	16.1	61	7	NW	28	1004.2
10	Su	6.6	15.0	0.4	3.0		NW	54	00:02	10.8	55	2	NNW	17	1008.9	13.6	37	5	SW	28	1009.1
11	Mo	3.6	13.6	0	3.2		SSW	44	11:27	10.0	58	1	ENE	7	1018.4	11.0	58	6	S	15	1019.1
12	Tu	4.9	15.9	0	2.4		ESE	31	15:22	9.4	69	6	NNW	9	1022.6	13.4	57	2	ESE	20	1019.7
13	We	7.7	17.2	0	2.4		NE	44	14:19	11.6	56	7	N	15	1019.1	15.6	58	7	NE	30	1015.2
14	Th	10.4	14.3	0.6	3.4		NNE	28	14:08	12.3	81	7	SSE	7	1013.0	13.6	80	8	NNE	7	1009.8
15	Fr	12.0	15.1	10.0	1.6		SSW	48	22:58	12.8	99	8	SSE	17	999.0	14.4	93	7	ESE	17	994.4
16	Sa	10.0	16.2	12.8	1.4		SSW	72	05:13	10.7	77	8	S	24	999.6	14.9	56	6	SW	26	1000.3
17	Su	6.4	18.8	0	2.4		WSW	39	23:41	11.0	66	7	SSE	7	1008.8	17.6	42	7	NNW	20	1007.0
18	Mo	10.0	16.2	0	3.8		S	48	16:00	13.1	59	7	N	17	1008.8	11.1	80	7	SSE	26	1010.1
19	Tu	6.3	13.1	21.4	4.0		SSE	44	01:20	9.0	60	7	SSE	17	1027.0	12.1	45	7	SE	15	1027.5
20	We	4.5	15.1	0	2.4		NE	39	17:51	10.8	61	1	NNW	13	1027.9	14.5	56	5	ENE	20	1024.6
21	Th	9.4	23.9	0.2	2.8		NNW	52	11:59	15.0	60	6	N	20	1018.8	23.3	40	3	NNW	22	1014.8
22	Fr	14.7	22.1	0	5.8		N	39	12:08	17.8	68	7	NNE	17	1016.0	19.5	62	7	N	22	1013.1
23	Sa	10.6	13.2	7.6	3.4		SSW	41	22:39	10.8	97	8	ESE	19	1013.9	11.6	80	8	SSE	11	1013.0
24	Su	8.0	12.6	14.8	2.0		S	61	13:58	9.1	77	7	SSW	19	1019.0	9.9	67	7	S	39	1019.4
25	Mo	7.7	12.1	3.0	2.4		SSW	50	03:55	9.0	74	7	S	24	1021.6	10.0	84	7	S	24	1021.5
26	Tu	8.7	14.8	1.0	0.8		SW	31	23:24	10.6	59	7	SW	15	1023.1	14.0	52	1	ESE	13	1019.8
27	We	6.1	21.5	0	2.2		NNW	39	22:53	13.0	67	0	NW	15	1016.0	18.1	62	1	SE	26	1011.1
28	Th	12.8	19.4	0	6.0		NNW	43	01:25	18.8	49	1	S	6	1007.0	13.4	69	8	SE	24	1008.4
29	Fr	7.2	10.5	41.8	2.6		SSW	69	12:53	7.3	93	8	SSW	35	1000.2	7.4	88	8	S	33	996.9
30	Sa	5.2	15.9	21.8	5.8		SW	54	11:04	10.4	54	4	WSW	20	1012.8	14.2	42	5	SW	20	1013.7
31	Su	9.8	18.4	0	3.6		NNW	56	02:29	13.9	58	7	NNW	28	1017.6	16.5	49	7	WNW	24	1016.6
Statistics for October 2021																					
Mean		8.8	16.5		2.9					11.9	70	5		16	1011.6	14.6	62	5		21	1009.9
Lowest		3.6	10.5	0	0.6					7.3	49	0	#	6	992.8	7.4	37	1	NNE	7	990.3
Highest		14.7	23.9	41.8	6.0		SSW	72		18.8	99	8	SSW	35	1027.9	23.3	93	8	S	39	1027.5
Total				160.4	88.6																

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8. APPENDIX 1: SITE PHOTOS

Foreshore A

Foreshore B

Parageothite Dryer

Cadmium Smelter

Copper Sulphate Stack

Casting Ventilation 1 – V1

Casting Ventilation 2 – V2

Roaster Baghouse

Anode Casting

Zinc Plant 1 Baghouse – ZP1

Zinc Plant 3 Baghouse – ZP3

MZR Furnace Baghouse

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