Weston Aluminium Pty Ltd
06-Sep-2016

Spent Potlining Processing

Air Quality Impact Assessment

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Air Quality Impact Assessment

Client: Weston Aluminium Pty Ltd

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Acronyms

Term	Description
Airshed	Part of the atmosphere that shares a common flow of air and to similar influences.
BRF	Battery recycling facility
BOM	Bureau of Meteorology
CN	Cyanide
Cumulative assessment	The cumulative assessment was undertaken by summing the project contributions with the ambient pollutant concentrations where relevant.
EPA	Environment Protection Authority
H_2SO_4	Sulphuric acid mist
HCl	Hydrogen chloride
HF	Hydrogen fluoride
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen, including nitric oxide (NO) and NO_2
OEH	Office of Environment and Heritage
Particulate matter	Very small solid particles or liquid droplets, which may become suspended in air.
PM_{10}	Particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less.
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter of 2.5 micrometres or less.
Receivers	Discrete receivers are identified by the EPA as anywhere someone works or resides or may work or reside
TSP	Total suspended particulates; a type of particulate matter.
WA	Weston Aluminium

Executive Summary

Weston Aluminium (WA) proposes to diversify its service provision to the aluminium smelting industry beyond the reprocessing of aluminium drosses, Second Cut Spent Pot Liner and other aluminium-bearing by-products to secure sustainable business growth and improve waste recycling options for the aluminium industry. The proposed Project, which is the subject of this report, is to treat and process all SPL waste arisings from the primary aluminium sector on a commercial scale. This would be an extension to WA's existing approvals relating to the commercial-scale processing of Second Cut SPL, and would in effect allow WA to process First and Second Cut SPL either separately or in any mixed ratio. The Project does not propose to increase the currently approval limit of 40,000 tonnes per year (dross and SPL combined) of material that can be processed through the WA operation. The proposed process is identical to that of Second Cut SPL treatment currently undertaken on site and would utilise the same facilities, plant and equipment.

The Purpose of this Air Quality Impact Assessment (AQIA) report is to document the methodologies used to calculate the Project's potential emissions and the predicted impacts of the Project on local sensitive receptors. This report aims to address the Environment Assessment Requirements (EARs) provided by the NSW Department of Planning and Environment and the NSW Environment Protection Authority for the Project, and has been prepared in accordance with required regulatory guidelines, primarily the *NSW Approved Methods for Modelling and Assessment OF Air Pollutants in NSW* (DEC 2005).

WA are also currently investigating the options for a thermal treatment facility to process other wastes at their Kurri Kurri site. The proposal is currently in the development phase and is the subject of a separate Development Application process. In an effort to consider the potential influence a thermal treatment facility may have on the site's emissions during an extension of existing SPL processing as proposed, estimates of the thermal treatment emissions from Stack 5 have been included in the assessment.

Dispersion modelling was undertaken for the AQIA using the CALPUFF model. One modelling scenario was assessed to take into account the processing emissions from Stack 1 associated with the processing of either Second Cut SPL, First Cut SPL or Mixed SPL, whichever is higher for each pollutant) and the proposed mixed use of Stack 5 (processing the reverb furnace or the proposed thermal treatment facility, whichever is the higher for each pollutant). Measures were taken to include a high degree of conservativism into the assessment to cover the range of potential operations from the site.

Additional modelling was undertaken to estimate the air quality impacts associated with the proposed Kurri Kurri Battery Recycling Facility (BRF) (not currently operating but proposed for a neighbouring site by others), and these results were added to the predicted incremental impacts associated with WA. Background air quality was also examined from the nearest OEH monitoring station to assess the cumulative impacts associated with the Project.

The WA SPL air dispersion modelling predicts that all assessed pollutants would meet their respective EPA criterion for all averaging periods both incrementally (WA alone) and cumulatively (WA+BRF+background). The assessed PM_{10} and $PM_{2.5}$ cumulative values predicted that there would be no additional exceedances of the EPA criteria beyond those already attributable to the background monitored data. The contribution of the WA operations to particulate levels, and most assessed pollutants, was minor.

Furthermore, the presented impact estimates are considered conservative as they assume the WA site is operating continuously for the entire year, and they also apply the higher value when a stack has potential mixed use (Stack 1 First Cut, Second Cut and Mixed SPL and Stack 5 proposed Thermal facility and current reverb furnace).

In conclusion, the results of the assessment predict that there would be no adverse air quality impacts from the commercial-scale processing of SPL at local receptors.

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1.0 Introduction

1.1 Project Overview

This Air Quality Impact Assessment (AQIA) has been prepared for inclusion in an Environmental Assessment for Weston Aluminium Pty Ltd (WA) to accompany an application under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to modify existing Development Consent DA 86-04-01 and LEC 10397 of 1995 (as modified) to allow for the commercial processing of Spent Potlining (SPL) at the Kurri Kurri facility (The Project).

Spent Potlining (SPL) is a by-product of primary aluminium production, generated from the periodic de-lining of electrolytic cells. First Cut SPL (originating from the carbon cathode) and Second Cut SPL (refractory lining) contain varying proportions of aluminium, carbon, cyanide, fluorides, sodium and other trace contaminants, and its management and disposal continues to represent a major issue faced by the industry on a worldwide scale.

Conventionally, primary aluminium smelters segregate the cathodic lining (1st Cut SPL) from the refractory lining (2nd Cut SPL) to assist with the fostering of end-use markets for the treated products. Prior to the mid-1990s, however, such segregation did not occur (or was otherwise limited), and legacy stockpiles of Mixed SPL have remained in storage on smelter sites without a viable treatment and reuse solution. WA has developed processing technologies for all SPL arisings, and has fostered end-use markets for derived products.

WA proposes to diversify its service provision to the aluminium smelting industry beyond the reprocessing of aluminium drosses, Second Cut SPL and other aluminium-bearing by-products to secure future sustainability and growth. The Project, which is the subject of this application, is to treat and process all SPL waste arisings from the primary aluminium sector on a commercial scale. This would be an extension to WA's existing approvals relating to the commercial-scale processing of Second Cut SPL, and would in effect allow WA to process First and Second Cut SPL either separately or in any mixed ratio.

The current development consent authorises WA to process up to 40,000 tonnes of aluminium dross and Second Cut SPL combined and process up to 35,000 tonnes of scrap aluminium metal per year on site. The Project does not proposed to amend the approval tonnage limit.

Since 2005, WA representatives have undertaken extensive research, both domestically and overseas, investigating available technologies for the treatment of SPL from primary aluminium smelters. Trial activities were undertaken in relation to processing of First Cut, Second Cut and Mixed phase SPL (varying ratios of combined First and Second Cut SPL). In 2012, WA was approved to process Second Cut SPL at a commercial-scale, and following additional trials since 2012, has demonstrated that it can suitably process mixed and First Cut SPL in its existing plant. WA's objective is to offer a sustainable solution to domestic smelters, enabling the cost-effective treatment of both First and Second Cut SPL and, in conjunction with other treated industrial by-products, formulate the manufacture of a value added substitute for manufacturing sector raw material inputs.

The Project involves the use of existing technologies located at our Kurri Kurri premises, including the following processes:

- The transportation of material from primary aluminium smelters to WA's Kurri Kurri facility by a licensed Dangerous Goods Contractor (segregated First Cut SPL, Second Cut SPL, or unsegregated Mixed SPL);
- The storage of material within existing enclosed buildings and dedicated storage bays;
- The processing and treatment of material within existing crushing circuits and rotary furnaces, capable of attaining the required temperatures to thermally oxidise contaminants and affect required mineralogical transformations;
- The continued use of existing emission controls systems, including extraction hoods, wet-dry lime scrubber, filter baghouse complexes, and real-time continuous fluoride and particulate monitoring systems; and
- The storage, handling and dispatch of finished product to Customers under existing quality control procedures.

WA are also currently investigating the options for a thermal treatment facility to process other wastes at their Kurri Kurri site. The proposal is currently in the development phase and is the subject of a separate Development Application process. In an effort to consider the potential influence a thermal treatment facility may have on the site's emissions during an extension of existing SPL processing as proposed, estimates of the waste thermal treatment emissions from Stack 5 have been included in the assessment. The focus of the current assessment is the emissions from Stack 1 associated with the commercial-scale processing of SPL, and as such any estimation of impacts from the proposed thermal treatment facility are provided for cumulative assessment reasons only and are not part of the current SPL Development Application process. A brief description of the thermal treatment facility is provided in **Appendix A**.

1.2 Proposed Operations

WA proposes to diversify its service provision to the aluminium smelting industry beyond the reprocessing of Second Cut SPL, aluminium dross and other aluminium-bearing wastes to also include the treatment and processing of all SPL arising's on a commercial scale. SPL is classified as a dangerous good and hazardous material and contains varying proportions of aluminium, carbon, cyanide, fluorides, sodium and other trace contaminants, such that its management and disposal represent a major issue to the aluminium smelting industry.

SPL will be received either pre-crushed or uncrushed from various domestic aluminium smelters, and stored on the premises in accordance with existing protocols as per the Australian Dangerous Goods Code.

WA would process and treat SPL waste inputs in the same manner that it currently does for Second Cut SPL. In summary, the key elements of the process are described as:

- Primary crushing (where necessary);
- Controlled blending with other propriety additives, as required;
- Fine milling;
- Thermal treatment; and
- Crushing and mixing (as required) and subsequent distribution to end markets.

The proposed process is identical to that of Second Cut SPL treatment currently undertaken on site, and utilising the same facilities, plant and equipment. First and Second Cut SPL may also be processed in a combination ratio of First to Second Cut SPL, depending upon waste source and end-user requirements.

The objective of SPL processing is to thermally oxidise the cyanide within the SPL and modify the mineralogical composition so that the material is declassified (from a Class 4.3 dangerous good),is able to be transported as a non-hazardous goods product, and to achieve end-user product specifications. Trials conducted by WA (refer to **Section 1.3**) demonstrate that the proposed process dramatically reduces cyanide concentrations to a level at or below the analytical limit of reporting (1 mg/kg). Additionally, emissions monitoring data obtained during the trials confirmed that all emission concentrations were below the existing regulatory compliance limits throughout the process. Consequently, no change to WA's existing Environmental Protection Licence (EPL) limits or discharge points will be required for the project. Cyanide monitoring is already undertaken by WA in order to manage its potential discharge as a result of Second Cut SPL processing. This monitoring would continue to be in place for the processing of all SPL inputs.

All occupational hygiene, safety and monitoring requirements for the treatment of SPL at the facility have already been successfully determined and implemented during both trials operations, and the commercial processing of Second Cut SPL.

1.3 SPL Trial Processing

1.3.1 2011 Trial Report

This report was prepared in accordance with requirements defined in the sites Development Consent (DA 86-04-01 Mod 4) and Environment Protection Licence (EPL No. 6423), and describes processing methodology, monitoring findings and verification of emission control performance assessed during the SPL processing Trial, as conducted on 14 August 2010. The Trial blends were designed to 1) mimic the batch formulations trialled earlier in New Zealand (i.e. blend of SPL, cullet, iron and lime), and 2) to facilitate as a Control (i.e. SPL only feed).

The principal objective of the SPL Processing Trial was to assess emissions and demonstrate the suitability of existing pollution control and monitoring systems at WA's Kurri Kurri facility, thereby verifying that air emissions generated during SPL processing activities could be controlled and maintained to the satisfaction of regulatory requirements. This objective is considered to have been successfully achieved. All air emission concentrations were well below regulatory compliance limits. It was concluded that the existing pollution control system is suitable for future processing of SPL.

1.3.2 2016 Trial Report

Pursuant to the conditions of consent under DA 86-04-01 Modification No. 8, and following their approval to process Second Cut SPL, WA has gained approval to undertake trial processing of up to 3,000 tonnes of Mixed SPL. A copy of the Monitoring and Verification Report for this recently-completed trial is attached at **Appendix B** and the key findings are summarised below:

- All regulatory requirements defined for the Trial, including approvals, material tracking, quantity and duration constraints, notification and reporting commitments, and environmental compliance obligations were adhered to throughout the Trial period;
- Batches of mixed SPL where delivered in variable ratios of First Cut SPL to Second Cut SPL. Batch profiles ranged from 5:95 through to 95:5 (First Cut SPL: Second Cut SPL; by visual assessment);
- Existing material storage, handling and treatment protocols, conventionally employed for the processing of 2nd Cut SPL and aluminium dross, were suitable for Mixed SPL storage and handling;
- Cyanide was thermally-destroyed at process temperatures achieved. The thermal treatment performance is confirmed by the 98% reduction in cyanide load, and negligible (exceptionally low) cyanide residuals;
- For each Trial batch, the furnace was operated at elevated temperatures to investigate the resultant emission control profile (including potential for fluoride evolution), and to monitor physical changes to feedstock blends. These operating conditions facilitated the required mineral transformations in the product (proprietary), and did not result in excessive or uncontrollable air emissions during the processing phase;
- Independent NATA certified emission testing identified low pollutant discharge concentrations, and confirmed the reliable performance of the existing lime-scrubber and fabric filter baghouse pollutant control systems for the processing of SPL wastes. Emissions data are of generally of the same order of magnitude, or lower, than that reported for previous Trials and conventional processing of 2nd Cut SPL and aluminium dross;
- The elevated carbon monoxide emissions were reported for the 1 April 2016 Trial processing event is attributed to the processing of high-Carbon content SPL feedstock. Whilst the measured emission concentration remains below the regulatory compliance limit for Stack 1, WA proposes to explore variable fuel: combustion air ratios for future processing of these higher-Carbon inputs. This may also improve the efficiencies of the oxidative treatment process;
- Real-time, continuous emission monitoring data confirm that gaseous fluoride and total particulate emission concentrations satisfied the regulatory compliance limits throughout each Trial interval, and similarly, notification to Regulators in the event of elevated emission concentrations was not required. These data further confirm the suitability of existing pollution control systems for future processing of SPL;
- As expected, cyanide loads were reduced through treatment. The particle size distribution, fluoride content and composition profile of products (proprietary information withheld) is of great interest to prospective Customers, and enables the substitution of virgin raw materials in various industrial processes (proprietary information withheld);
- Product materials were not intended for disposal. Rather, such materials were dispatched for Customer evaluation. WA has received positive feedback from its Customer base regarding the efficacy of use and proposed future market opportunities for the product; and
- Research and development activities have successfully demonstrated the compatibility of facility infrastructure, processes and control measures available for the effective treatment of Mixed fraction SPL with broad variance in First Cut: Second Cut SPL composition ratios. Trials have confirmed environmental performance, and have verified sustainable market interest.

As a result of the successful trials, WA is seeking a Development Consent Modification from the DP&E, for the ongoing processing of all SPL material at the Kurri Kurri facility – i.e. with no distinction between First Cut, Second Cut or Mixed fraction SPL. The trial data included mixed SPL ratios of both 9:95 and 95:5 for First Cut to Second cut. For the purposes of this AQIA, the range is considered appropriate to represent emissions of First Cut SPL as well as the various ratios in-between the cuts.

1.4 Purpose of the Report

1.4.1 Environmental Assessment Requirements

In preparing this AQIA, the Environmental Assessment Requirements (EARs) issued for the Project (DA 86_04_01 MOD 10 and DA 10397 of 1995 MOD 8) on 15 June 2016 have been addressed as required by Clause 75F of the EP&A Act. The key matters raised for consideration with respect to the AQIA, including those raised by the EPA, are outlined as follows.

Planning and Environment

- *Description of the modification – including a clear definition of SPL and a description of where it will be sourced.*
- *Need and justification for the modification.*
- *Other Approvals – Identification of any proposed variations to WA's existing EPL and Environmentally Hazardous Chemicals Act (1985) Licence.*
- *Identification of environmental impacts of the modification – Including a more detailed assessment of the following:*
    - *Air Quality.*
    - *Traffic and Transport – including details of any revised traffic movements.*
    - *Hazard and risk – including an updated Preliminary Hazard Analysis in accordance with the Hazardous Industry Advisory Paper No. 6 – Guidelines for Hazard Analysis and Multi-level Risk Assessment.*
- *Identification of conditions to be modified.*

NSW EPA

In preparing the EIS for the proposed modification, Weston aluminium Pty Ltd should identify whether any variation(s) are required to the current Environment Protection Licence (6423) and/or the existing Environmentally Hazardous Chemicals Act (1985) Licence, in order to permit activities under any approved modification to allow processing of mixed SPL waste. If modifications are sought the potential environmental impacts should be thoroughly analysed and justified. This includes justification to modifications to any/all pollutant load limits specified in the licence.

1.4.2 Air Quality Impact Assessment Objectives

The Purpose of this report is to document the AQIA process and potential impacts for the Project in regards to air quality. This report aims to address the EARs described in **Section 1.4.1** for the Project and has been prepared in accordance with the following guidelines:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005); and
- *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into Approved Methods for Modelling (sic) and Assessments of Air Pollutants in NSW, Australia* (TRC 2011).

The AQIA includes air dispersion modelling using the Lagrangian puff model CALPUFF to assess the air quality impacts from the Project. In summary the scope of this report includes:

- Description of the proposed modification;
- Description of the existing environment including local meteorology, climatic conditions, terrain, land use and sensitive receptors; and
- Preparation of an AQIA including:
    - Identification of relevant ambient air quality criteria;
    - Description of methodology used to develop emissions inventory;
    - Description of modelling methodology; and
    - Assessment of potential air quality impacts and identification of regulatory compliance.

2.0 Project Context

2.1 Legislation, Policy, Criteria and/or Guidelines

2.1.1 Pollutants of Concern and Ambient Air Quality Criteria

Potentially major contributing air pollutants from the existing Second Cut and proposed Mixed SPL processing operations are summarised in **Table 1**, together with corresponding NSW EPA impact assessment criteria as detailed in the *NSW Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005). All pollutants are measured at the 100th percentile unless otherwise stated. Those measured at the 99.9th percentile must be assessed at or beyond the site boundary; all others are to be assessed at the maximum sensitive receptor.

In general, these criteria relate to the total burden of air pollutants in the air and not just the air pollutants from Project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess impacts where appropriate. A discussion of background levels in the study area is provided in **Section 3.3**.

Table 1 NSW EPA Air Quality Impact Assessment Criteria

Pollutant		Averaging Period	Criteria (µg/m^3)	Reference
Total Suspended Particulates	TSP	Annual	90	NSW EPA
Particulates with a diameter of 10 micrometres	PM_{10}	24 Hour	50	NSW EPA
		Annual	30	NSW EPA
Particulates with a diameter of 2.5 micrometres	$PM_{2.5}$	24 Hour	8	NEPM
		Annual	25	NEPM
Sulfur Dioxide	SO_2	1 Hour	570	NSW EPA
		24 Hour	228	NSW EPA
		Annual	60	NSW EPA
Sulfuric Acid Mist	H_2SO_4	1 Hour (99.9th Percentile)	18	NSW EPA
Nitrogen Dioxide	NO_2	1 Hour	246	NSW EPA
		Annual	62	NSW EPA
Hydrogen Chloride	HCl	1 Hour (99.9th Percentile)	140	NSW EPA
Hydrogen Fluoride (General land use)	HF	90 days	0.5	NSW EPA
		30 days	0.84	NSW EPA
		7 days	1.7	NSW EPA
		24 hours	2.9	NSW EPA
Cyanide	CN	1 Hour (99.9th Percentile)	0.5	NSW EPA

2.1.2 Environment Protection Licence Stack Concentration Limits

Under the *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act), WA holds an EPL (No. 6423) administered by the NSW EPA. Section 3, Condition 3.3 of the EPL details the stack concentration limits for the existing plant for EPL Point 1, Point 2, Point 3, Point 4, Point 13, Point 14 and Point 15.

No changes are proposed to EPL stack concentration limits as part of this Project, inclusive of Stack 1 (EPL Point 1) which is proposed to vent SPL process emissions. EPL stack limits for the pollutants of concern for all points are presented in **Table 2**.

Table 2 Existing EPL Point Concentration Limits for All Stacks

EPL Point ID	WA Site ID	TSP (mg/m^3)	NOx (g/m^3)	H_2SO_4 and SO_3 (mg/m^3)	Gaseous Fluoride (mg/m^3)	HCl (mg/m^3)	Cyanide (mg/m^3)
Point 1	Stack 1 Rotary furnace	25	2.5	100	2	400	0.5
Point 2	Stack 2 Materials Storage	35	No Limit	No Limit	No Limit	No Limit	No Limit
Point 3	Stack 3 2nd MRM-Cooler	50	No Limit	No Limit	No Limit	No Limit	No Limit
Point 4	Stack 4 MRM-Cooler	24	No Limit	No Limit	No Limit	No Limit	No Limit
Point 13	Stack 5 Reverberatory furnace	10	0.1	100	No Limit	10	No Limit
Point 14	Stack 6 Gas combustion of Reverberatory furnace	10	No Limit	No Limit	No Limit	No Limit	No Limit
Point 15	Stack 7 Pre-processing plant and briquetting plant	15	No Limit	No Limit	No Limit	No Limit	No Limit

2.2 Study Area

The WA facility is located on Lot 796, Mitchell Avenue, within the Kurri Kurri industrial area of NSW. Residential receivers are located approximately 600 metres to the south (Kurri Kurri) and southwest (Weston) of the site. Dispersion modelling undertaken for the AQIA covered an area of 13km by 13km square area centred on the WA facility. **Figure 1** shows the location of the study area.

2.3 Review of Surrounding Developments

A review of Cessnock City Council and Department of Planning and Environment (DP&E) databases was conducted on 4 March 2016. No nearby developments of significance to this assessment were listed on Cessnock City Councils website. Three projects were listed on the DP&E Major Project website may have a cumulative influence on air quality within the regional air shed.

2.3.1 Kurri Kurri Battery Recycling Facility

Pymore Recyclers International Pty Ltd (Pymore) lodged a Request for SEARs for the proposed development of a battery recycling facility with the DP&E in February 2016. The facility would be located at 129 Mitchell Avenue, Kurri Kurri, and would occupy approximately 3.4ha of the lot on which WA is sited.

The proposed facility would recycle approximately 60,000 tpa of used-lead-acid batteries (ULABs) using a CX Integrated System which uses a combination of hydrometallurgical and pyro metallurgical process for the recovery of lead and associated by-products. ULAB recycling at the facility would be comprised of four main processes: crushing screening and separation; desulphurisation; crystallisation; and lead smelting (EMM 2016). As a result, the main pollutants of concern from the facility would be particulates, SO_2, NO_x and lead.

Cumulative impacts of the proposed facility have been assessed in this report and are addressed in **Section 5.0**. Details of the sites emissions and provided in **Appendix A**.

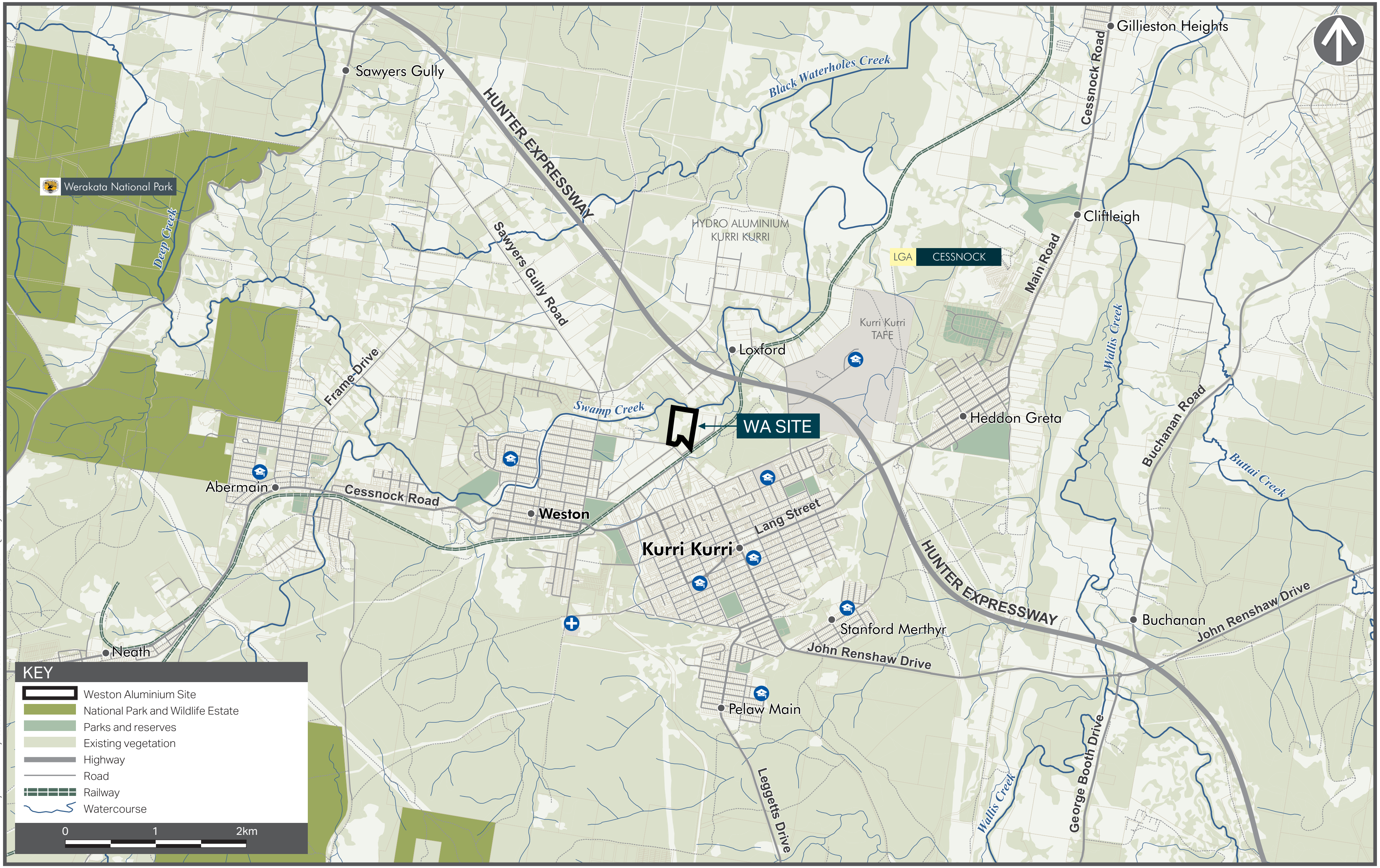
2.3.2 Hydro Aluminium

At the Hydro Aluminium plant at Kurri Kurri, metal production ceased in 2012 and the plant was permanently closed in 2014. This closure would have resulted in a reduction in ambient air quality concentrations of some pollutants within the local air shed. SEARs have currently been issued by DP&E for the proposed demolition and remediation of the site including demolition of buildings and structures, soil and ground water remediation and design and construction of a waste management facility. The demolition and construction works would potentially result in temporary air quality impacts to the local area, principally in relation to particulate concentrations. There are no planned dates or details regarding these works currently available.

2.3.3 Hunter Resource Recovery Centre and Energy from Waste (EFW) plant

Omega Energy is proposing to construct and operate the Hunter Resource Recovery Centre and Energy from Waste (EFW) plant to be located adjacently west of WA's facility within the broader Hunter Industrial Ecology Park. A Preliminary Environmental Assessment (PEA) was undertaken for the facility and SEARs issued by DP&E. The proposed facility would receive residue waste from existing contractors and landfills for thermal conversion and generation of gas and/or electricity. Construction and operation of the proposed EFW plant would result in potential air quality impacts within the local area. Primary emissions from the EFW facility are likely to be particulates, HCl, HF, CO, SO_2, NO_x, heavy metals, VOCs and dioxins and furans.

In 2015, the proposed development fell prone to setbacks with thermal waste treatment technologies currently under review. Omega Energy is expected to lodge a new development application with the DP&E in 2016 (Sustainable Materials Media 2015). At the time of writing, no new development application has been lodged.



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LOCAL CONTEXT
Environmental Impact Statement
Weston Aluminium Recycling Facility

FIGURE 1

3.0 Existing Environment

3.1 Dispersion Meteorology

3.1.1 Wind Speed and Direction

Meteorology in the area surrounding the WA facility is affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography at the small scale, while factors such as synoptic scale winds affect wind speed and direction on the larger scale. Wind speed and direction are important variables in assessing potential air quality impacts, as they dictate the direction and distance at which air pollutant plumes may travel. The CALMET meteorological model has been used to generate meteorological data for the WA Facility for the year 2014. Prognostic meteorological data for the site and surrounding area were generated using TAPM for surface and upper air conditions for a grid roughly centred on the WA facility. This methodology is further detailed in **Section 4.3.1**.

A wind speed frequency distribution table for the 2014 CALMET data is presented in **Table 3**, while annual and seasonal wind roses are presented in **Figure 2.** It can be seen from these data that on an annual basis the dominant wind direction is from the south west, occurring for 12 percent of the time, with winds also frequenting from the east and west northwest. The annual average wind speed was found to be 2.35 metres per second (m/s) - a light to moderate wind speed. Calms (<0.5m/s) were found to occur for just over two percent of the year.

Seasonally, the highest average wind speed during 2014 was observed during the winter months (2.55 m/s) and the lowest average wind speed occurring in autumn (1.91 m/s). The occurrence of easterly winds is frequent from spring through to autumn, while south westerlies are common from autumn through to spring. During the winter months there is also a predominance of west north-westerly winds. A comparison of the CALMET 2014 meteorological data with data collected from the Hydro Aluminium meteorological station for the period January to September 2014 (the available data from Hydro Aluminium) is presented in **Appendix C.**

Table 3 Wind Speed Frequency Distribution of CALMET 2014 data (%)

Wind Direction	Wind Speed Class (m/s)						
	0.5-2.1	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	≥11.1	Total
N	3.58	0.39	0.14	0.00	0.00	0.00	4.11
NNE	1.96	0.34	0.14	0.00	0.00	0.00	2.44
NE	2.35	0.92	0.65	0.00	0.00	0.00	3.91
ENE	3.71	2.03	1.45	0.10	0.00	0.00	7.29
E	5.19	3.64	1.45	0.05	0.00	0.00	10.33
ESE	3.47	3.07	1.00	0.02	0.00	0.00	7.55
SE	2.90	2.69	1.42	0.15	0.00	0.00	7.15
SSE	2.94	2.29	1.12	0.08	0.00	0.00	6.43
S	1.36	1.74	1.25	0.05	0.00	0.00	4.40
SSW	3.11	1.29	0.60	0.10	0.00	0.00	5.11
SW	8.85	2.16	0.78	0.14	0.00	0.00	11.93
WSW	2.11	1.85	0.85	0.17	0.02	0.00	5.00
W	1.60	1.50	0.78	0.40	0.05	0.00	4.33
WNW	1.82	3.85	2.42	0.84	0.07	0.00	8.99
NW	2.85	1.66	1.75	0.48	0.00	0.00	6.74
NNW	1.39	0.45	0.26	0.02	0.00	0.00	2.12
Sub-Total	49.18	29.86	16.05	2.60	0.14	0.00	97.83
Annual (Jan to Dec, 2014). Total periods = 8,736; Valid periods = 8,735; Calm wind periods = 189; Calm winds: 2.16 %							

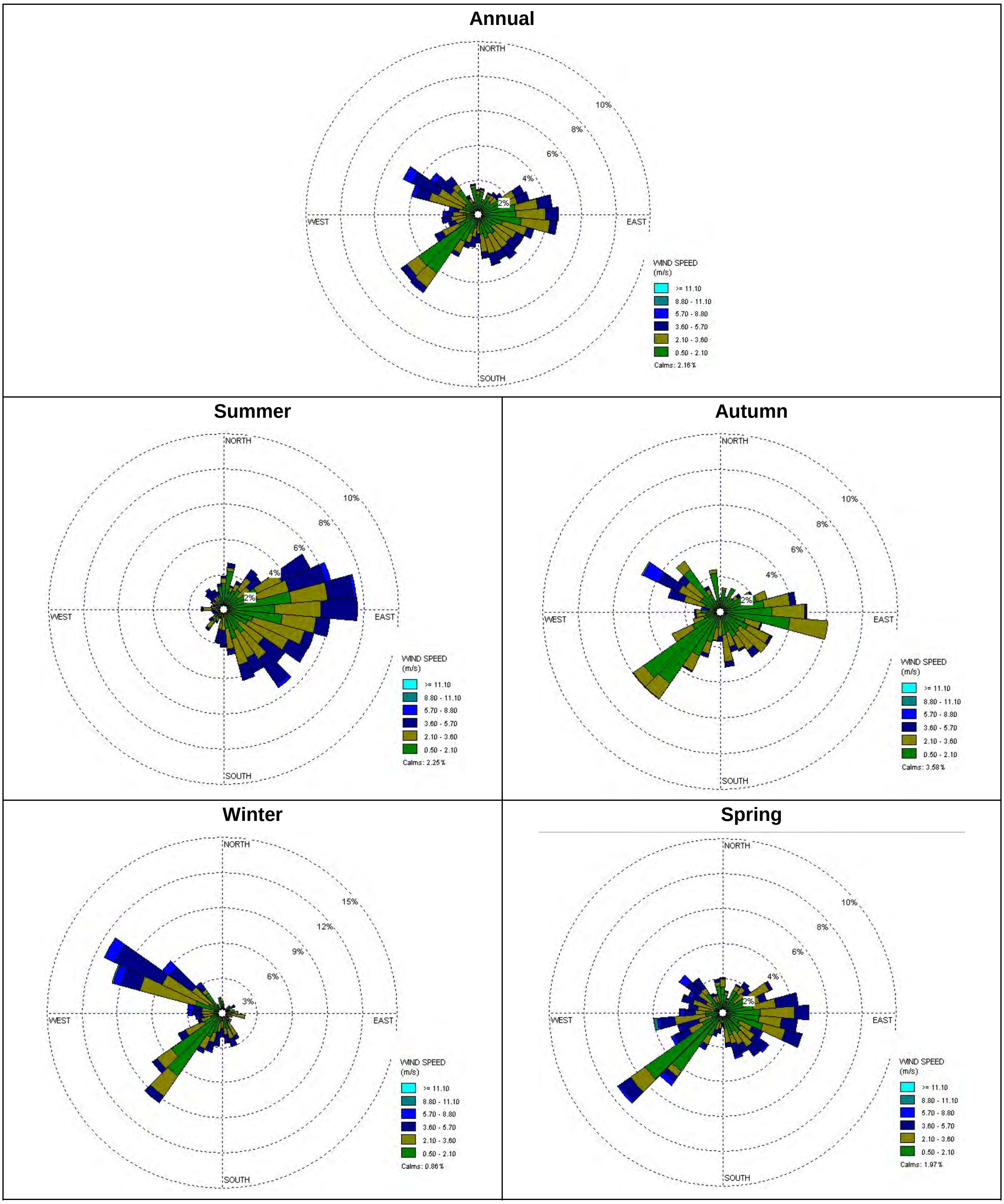


Figure 2 Annual and Seasonal Wind Roses at WA, Kurri Kurri. Generated by CALMET 2014

3.1.2 Atmospheric Stability

In dispersion modelling, atmospheric stability describes the rate at which a plume will disperse, typically represented by six classes; A to F (that is, unstable through to very stable conditions). For the WA site, stability class was calculated by CALMET for each hour in the 2014 calendar year. **Table 4** shows the frequency of occurrence of the stability categories expected in the area.

Table 4 Frequency of Occurrence of Stability Categories at Kurri Kurri (2014)

Stability Class	Frequency of Occurrence (%)
A	3
B	16
C	19
D	13
E	5
F	44
Total	100

The most common stability class was determined to be F class. This suggests that the dispersion conditions are such that air emissions will disperse slowly for a significant proportion of the time.

3.2 Local Climate

The Bureau of Meteorology (BoM) meteorological station located at Cessnock Airport (Station Number 061260), approximately 12.5 km west of the site, records climate data for a range of meteorological parameters including temperature, humidity, rainfall, wind speed and wind direction. A summary of the long-term data recorded at this station between 1968 and 2016 is shown in **Table 5**. The data provides an indication of the regional climate of the area.

Table 5 Climate Summary, BOM Monitoring Station at Cessnock, 1967 to 2015 (BoM 2015)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	30.0	29.0	27.3	24.1	20.6	17.8	17.3	19.4	22.5	25.3	26.8	28.8	24.1
Mean minimum temperature (°C)	16.8	16.8	14.6	10.5	7.5	5.7	4.0	4.5	7.0	9.7	13.1	14.9	10.4
Mean rainfall (mm)	82	100	70	58	43	57	29	35	44	51	76	81	742
Decile 5 (median) rainfall (mm)	59	106	55	45	43	36	19	24	32	43	63	74	748
Mean number of days of rain ≥ 1 mm	6	8	7	6	5	5	4	4	6	6	8	7	73
Mean 9am temperature (°C)	23.2	22.2	20.2	17.8	14.1	11.0	10.1	12.2	16.2	19.1	20.2	22.2	17.4
Mean 9am relative humidity (%)	68	76	80	76	79	80	76	69	63	60	65	65	71
Mean 9am wind speed (km/h)	11.5	10.2	8.7	10.1	10.4	11.5	11.5	13.0	14.0	13.7	12.7	11.8	11.6
Mean 3pm temperature (°C)	28.7	27.3	25.7	23.0	19.6	16.8	16.4	18.6	21.2	23.4	25.0	27.3	22.8
Mean 3pm relative humidity (%)	46	53	53	52	54	55	49	42	42	44	47	46	49
Mean 3pm wind speed (km/h)	18.5	17.3	15.7	14.6	14.2	15.1	15.3	17.3	19.1	18.7	18.6	18.3	16.9

As shown in **Table 5**, the study area experiences a warm to moderate climate. The warmest temperatures occur during the summer months, with the highest average maximum temperature (30.0^{o}C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 4.0^{o}C.

The annual average rainfall for the area is 743 millimetres (mm) over 73 days a year. February is the wettest month, with an average rainfall of 100 mm, while August is driest month with an average rainfall of just 29mm. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon.

Daytime wind speeds were found to be moderate, with higher wind speeds occurring in the afternoon compared to the morning. The annual average 9am wind speed recorded is 11.6 kilometres per hour (km/h) and the annual average 3pm wind speed was16.9 km/h. Seasonally, wind speeds are higher during the warmer months with the highest average wind speed occurring in September at 19.1 km/h.

3.3 Existing Air Quality

The EPA operates a number of air quality monitoring stations in the Lower Hunter. The closest monitoring station to the WA site is located at Beresfield (17km east of the site). This station records hourly PM_{10} and $PM_{2.5}$ concentrations using a Tapered Element Oscillating Microbalance (TEOM), NO_2 and SO_2. Ambient air quality monitoring data for 2015 at Beresfield is presented in **Table 6** as sourced from the Office of Environment and Heritage (OEH) website[1]. All other pollutants assessed in the AQIA are not measured and as such no background data is available for use in the cumulative assessment. Notable nearby emission sources, however, have been included in the assessment.

The maximum PM_{10} 24-hour concentration measured at Beresfield in 2015 (the most recent year for which data are available) was 64.9µg/m^3 which is above the EPA 24 hour maximum criterion of 50µg/m^3 (DEC 2005). There was one additional exceedance of the 24 hour EPA criterion recorded at 57.5µg/m^3. The third highest record for the reporting year was below the criterion at 43.3µg/m^3. When background levels exceed a criteria the NSW EPA (DEC 2005) allows for the identification of 'additional exceedances', that is, you remove those above the criterion, then add your project contribution and calculate if there are any further exceedances. As stated, the highest background value that meets the criterion is 43.3µg/m^3 and as such this value has been applied as the PM_{10} 24-hour background in the assessment in order to identify potential additional exceedances.

The annual average PM_{10} concentration recorded at 18.7µg/m^3 for 2015 is under the EPA annual average criterion of 30µg/m^3 (DEC 2005).

Similarly to PM_{10}, the maximum $PM_{2.5}$ 24-hour concentration measured at Beresfield in 2015 recorded at 25.9µg/m^3 was also found to be above the NEPM standard of 25µg/m^3. There were no additional exceedances of the EPA criterion, with the second highest 24 hour concentration recorded for 2015 at 20.2µg/m^3. As applied for PM_{10}, the highest value that does not exceed the criterion has been applied as the $PM_{2.5}$ 24-hour background in the assessment in order to identify potential additional exceedances, being 20.2µg/m^3.

The $PM_{2.5}$ annual average recorded for 2015 was found to be slightly below the NEPM annual average criterion of 8µg/m^3 with a concentration of 7.4 µg/m^3 recorded for the reporting year.

In 2015, the maximum 1 hour NO_2 concentration was 100.5µg/m^3, approximately 40 percent of the EPA criterion. The annual average NO_2 concentration was also well below the criterion recorded at 18.5µg/m^3. Similarly, recorded background concentrations for SO_2 for all averaging periods were well below the relevant criteria.

Ground level concentrations for CO are not recorded at the Beresfield EPA monitoring station, however 8-hour averages for CO are recorded at the EPA monitoring station in the more populated area of Newcastle located approximately 31km southeast of the site. The maximum 8-hour average for CO recorded at Newcastle for 2015 was found to be 1,900µg/m^3 which is just under one fifth of the EPA criterion of 10,000µg/m^3.

No measurements of local TSP ambient air quality concentrations were available. In the absence of existing annual TSP concentration data, the annual PM_{10} concentration can be assumed to be 40% of the annual TSP concentration. This is a conservative approach as reported by the NSW Minerals Council (2000) for the measurement of PM_{10} in TSP in the Hunter Valley and is considered to be applicable in Kurri Kurri. This equates to an annual average TSP concentration of 46.7µg/m^3, which is below the NSW EPA criterion of 90 µg/m$^{\mathbf{3}}$.

[1] http://www.environment.nsw.gov.au/AQMS/search.htm accessed May 2016

OEH does not currently undertake ambient air quality monitoring for air toxics (such as HCl, H_2SO_4 and CN). Previous ambient air quality monitoring for air toxics undertaken between 1996 and 2001 indicated low levels of pollutants within the Greater Metropolitan Region (GMR) and as such background concentrations of air toxics are not considered to be a primary issue of concern.

Table 6 Ambient Air Monitoring in Beresfield, NSW for 2015 (OEH website, accessed May 2016)

Pollutant	Averaging Period	Concentration (µg/m³)	EPA Criteria (µg/m³)
PM_{10}	24 Hour Maximum	**64.9**	50
	Highest 24 hour that meets criterion	43.3**	
	Annual Average	18.7	30
$PM_{2.5}$	24 Hour Maximum	**25.9**	25*
	Highest 24 hour that meets criterion	20.2**	
	Annual Average	7.4	8*
NO_2	1 Hour Maximum	100.5	246
	Annual Average	18.5	62
SO_2	1 Hour Maximum	234.5	570
	24 Hour Maximum	22.9	228
	Annual Average	2.9	60

* NEPM Standard
** Used in the AQIA as background in order to identify additional exceedances as per DEC 2005.

Table 7 presents ambient hydrogen fluoride ground level concentrations in the vicinity of the study area recorded between the cessation of smelter operation in October 2012 and 2014. Since the shutdown of Hydro Aluminium, the highest HF concentrations have been recorded at McLeod Road. The McLeod Road station is located in proximity to the WA site, and Hydro Aluminium staff have indicated that the concentrations recorded at this station were influenced by WA's emissions. As such, if ambient data from this station were used in the cumulative HF concentration calculations, the contribution from WA would likely be substantially overestimated. To avoid that overconservative situation, the ambient data used to calculate the total cumulative HF concentrations at receptors were the highest measured HF concentrations at any monitoring station other than McLeod Road, and as such the McLeod Road data was removed from the table.

Table 7 Maximum Ambient Fluoride Concentrations; October 2012 – 2014 (Hydro Aluminium)

Site	7 days (μg/m³)	30 days (μg/m³)	90 days (μg/m³)
Yawarra	0.20	0.16	0.11
Heddon Greta	0.16	0.12	0.11
Lot 103	0.16	0.11	0.08
Wangara	0.13	0.09	0.07
Bish Bridge	0.13	0.10	0.07
Kurri Kurri	0.13	0.10	0.08
Wandin Valley	0.13	0.09	0.06
Janannie	0.14	0.10	0.08
Allandale	0.14	0.08	0.06
Hope Estate	0.13	0.09	0.07
McWilliams	0.09	0.07	0.05
Wyndham Estate	0.12	0.09	0.07
Maximum	**0.20**	**0.16**	**0.11**
General land use criteria	***1.7***	***0.84***	***0.5***

3.4 Terrain and Land Use

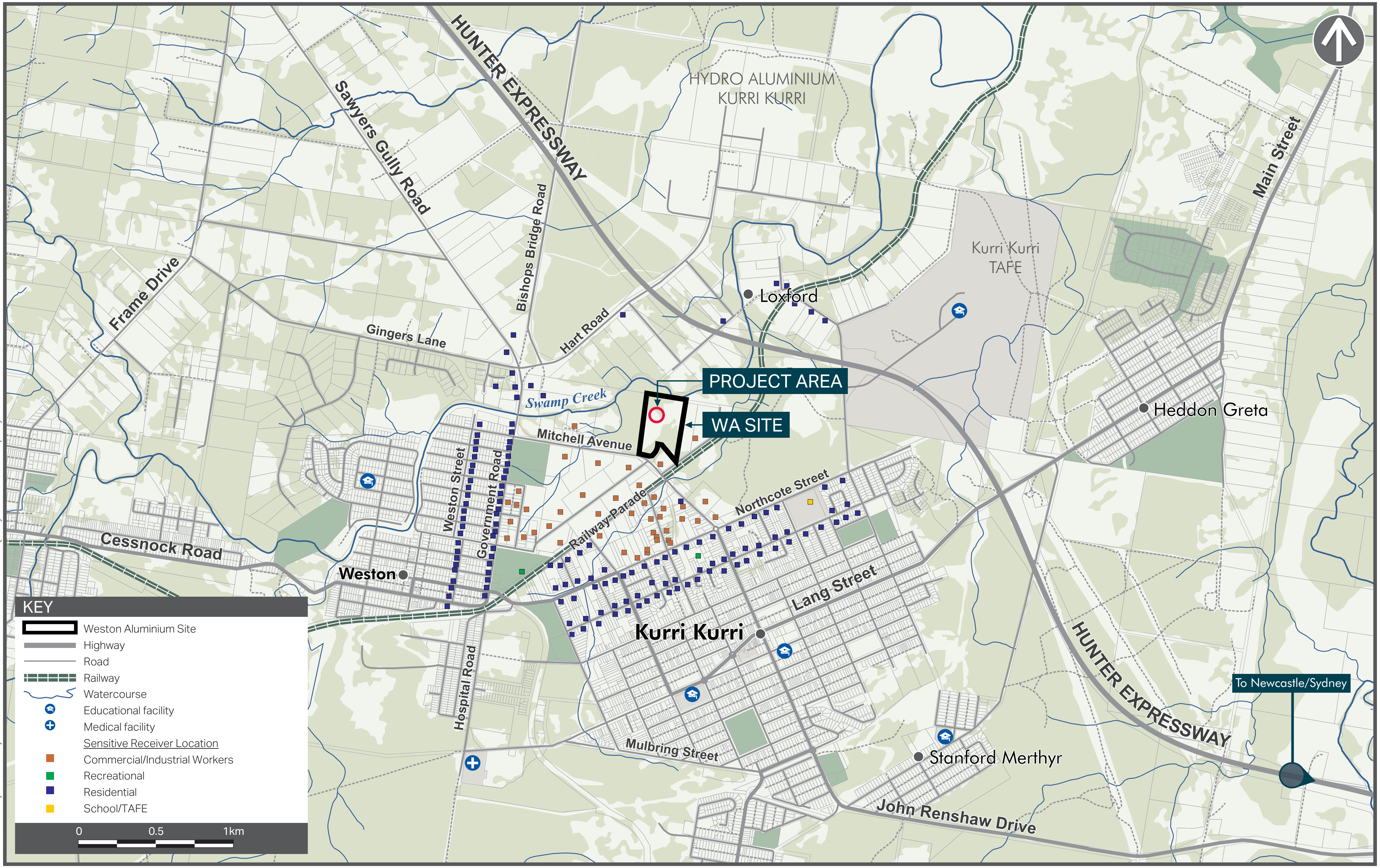
3.4.1 Terrain

Terrain data were captured from NASA's Shuttle Radar Topography Mission (SRTM), which produces terrain information for the entire globe. For Australia, terrain data are available at approximately 90 m resolution (3-arc seconds).

The site lies approximately 17m above MSL and the immediate terrain surrounding the area is relatively flat. In the wider context, the study area lies approximately 30km to the northwest of the East Australian coastline and terrain height within the study area range from between 0 and 520 metres with higher elevations to the southwest.

3.4.2 Land Use and Sensitive Receptors

The WA facility is located within the Kurri Kurri industrial area of NSW. Land use surrounding the WA facility is largely comprised of small to medium industrial premises (predominantly to the south of the site) and native vegetation. Residences are located approximately 600 metres to the southeast (Kurri Kurri) and southwest (Weston) of the site. A total of 184 sensitive receptors were included in the dispersion modelling and their location is shown in **Figure 3**. A description and coordinates for all sensitive receptors are tabulated in **Appendix D**.



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LOCATION OF AIR QUALITY SENSITIVE RECEIVERS
Environmental Impact Statement
Weston Aluminium Recycling Facility

FIGURE 3

4.0 Impact Assessment Methodology

4.1 Modelling Scenario

A modelling scenario was undertaken for this assessment to represent typical WA operations during the processing of SPL. A summary of the emissions from each stack is as follows, with more detail provided in **Section 4.5**:

- Stack 1, which would service the plant processing the SPL, has been modelled using the higher of either the proposed SPL emissions or the current Second cut SPL emissions;
- Stacks 2, 3, 4, 6 and 7 were modelled using average source emission data from the previous three years stack testing data; and
- Stack 5, which is proposed to ventilate either the current reverb furnace or a proposed thermal waste processing facility, has been modelled at the higher emissions of the two stated processes.

4.2 Dispersion Models

This assessment made use of TAPM, the CALMET meteorological processor and the CALPUFF dispersion model. A brief description of each model is provided in **Section 4.2.1** to **Section 4.2.3**. A summary of the data and parameters used for both the meteorological and air dispersion modelling is described in **Table 8**.

4.2.1 TAPM

The Air Pollution Model (TAPM) is a prognostic meteorological and air pollution model developed by CSIRO. The model can be used to predict threx10-dimensional meteorology, including terrain-induced circulations and is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world. TAPM was used in this assessment to generate a gridded three dimensional meteorological file for input into the CALMET model.

4.2.2 CALMET

CALMET is a meteorological model that develops hourly wind and temperature fields on a threx10-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. CALMET produces a meteorological file that is used within the CALPUFF model to predict the movement of air pollution.

TAPM prognostic threx10-dimensional meteorological data were used to simulate the threx10-dimensional complex meteorological patterns that exist within the modelling domain, accounting for the effects of local topography and changes in land surface characteristics. Gridded threx10-dimensional TAPM data were input into the CALMET model to generate the initial guess wind field[2] in CALMET and to generate the final threx10-dimensional wind fields for use in CALPUFF. The dispersion modelling was undertaken using one year of meteorological data (January 2014 – December 2014).

4.2.3 CALPUFF

CALPUFF is a non steady-state, threx10-dimensional Gaussian puff model developed for the US Environmental Protection Agency (USEPA) for use in situations where basic Gaussian plume models are not effective. These situations include areas where stagnation conditions occur, which are characterised by calm or very low wind speeds with variable wind direction. The CALPUFF modelling system (and associated CALMET program) has the ability to model spatially varying winds and turbulence fields that are important in complex terrain, long range transport and near calm conditions. As such, CALPUFF was selected as the appropriate dispersion model for this assessment.

A summary of the data and parameters used for both the meteorological and air dispersion modelling is described in **Table 8**.

[2] CALMET uses a two step procedure in developing final wind fields. The "initial guess" wind field is developed based on a domain-average wind profile, and this domain-average profile of winds is adjusted for terrain effects and divergence minimisation to produce a 'Step 1' wind field. The second step in the processing of the wind field is the introduction of observational data into the terrain adjusted Step 1 field.

The CALPUFF suite of programs, including meteorological (CALMET), dispersion (CALPUFF) and post processing modules (CALPOST), is an advanced non-steady state modelling system designed for meteorological and air quality modelling. CALPUFF is approved for use in NSW by the EPA, particularly in applications involving complex terrain, non-steady-state conditions, in areas where coastal effects may occur, and/ or when there are high frequencies of stable or calm meteorological conditions. CALPUFF was selected for use in this assessment based on the modelling system's ability to model low wind speeds and calm hours by simulating stagnant puffs and puff transport caused by divergence or slope flow.

4.3 Model Input Parameters

A summary of the data and parameters used as inputs to TAPM, CALMET and CALPUFF is provided in **Table 8**.

Table 8 Summary of Model Input Parameters

Parameter	Input
TAPM	
TAPM Version	v4.04
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1km)
Number of grid points	40 x 40 x 30
Simulation period	2014
Terrain information	AUSLIG 9 second (horizontal resolution 9")
Centre of analysis	32°81 S, 151°46 E
Local data assimilation	None
Mode	Meteorology mode only
CALMET (v6.42)	
Meteorological grid domain	37.5 km x 37.5 km
Meteorological grid resolution	250 metre resolution (150 x 150 grid cells)
Reference grid coordinate of SW corner	338600 E, 6350552 S
Cell face heights in vertical grid	0, 20, 50, 100, 150, 300, 600, 1000, 1500 and 3000 m
Simulation length	1 year (2014)
Surface meteorological stations	N/A
Upper air meteorological station	Three-dimensional gridded prognostic data from TAPM (M3d) were used as the initial guess wind-field for CALMET.
Terrain data	Terrain elevations were extracted from the NASA Shuttle Radar Topography Mission data set (SRTM 90 metre, 3-arc sec).
CALPUFF (v7.02)	
Modelling domain	**Computation grid**: 23 km x 23 km **Sampling Grid**: 13 km x 13 km *MGA SW Coordinates (km)*: 347.100 E, 6357.800 S **Nested Grid:** 1.5 km x 1.5 km *MGA SW Coordinates (km)*: 356.500 E, 6268.550 S
Modelling grid resolution	Sampling grid resolution of 250m. Nesting grid resolution of 50m.
Number of sensitive receptors	184 Discrete receptors and 12 boundary receptors
Dispersion algorithm	Turbulence computed from micrometeorology
Meteorological modelling period	1 January 2014 – 31 December 2014

4.3.1 Meteorology

Meteorology in the area surrounding WA is affected by several factors, such as terrain and land use. Wind speed and direction are largely affected by topography at a small scale, while factors such as synoptic scale winds and complex valley drainage flows that develop during night hours, affect wind speed and direction on the larger scale.

The CALMET meteorological model uses actual or prognostic meteorological observations to generate three - dimensional wind fields on an hourly time step at a grid of points covering the area under investigation. Topographical features and land use factors are then used to further refine the wind fields, which are subsequently used in the CALPUFF dispersion model.

Meteorological data for the period January – December 2014 were used in this assessment. Prognostic meteorological data were generated using TAPM for surface and upper air conditions for a grid roughly centred on the WA facility. The TAPM output (processed using CALTAPM) was then used as input into the CALMET meteorological module to compute the wind fields used by CALPUFF. Analyses of the meteorological data used in the modelling are provided in **Appendix C**.

4.3.2 Terrain

Digital terrain data used to generate the upper air prognostic meteorological data were obtained from the TAPM 9 second DEM database covering the meteorological domain. For the CALMET model, the geophysical processor was used to convert land use and terrain data from WebGIS (SRTM3 for terrain at approximately a 90 metre resolution) and GLCC Australia Pacific (approximate 1 kilometre resolution).

4.3.3 Building Wake Effects

The dispersion of pollutants around WA is likely to be affected by aerodynamic wakes generated by winds having to flow around the production and storage buildings. Building wakes generally decrease the distance downwind at which the plume comes into contact with the ground. This may result in higher ground level pollutant concentrations closer to the emission source. The Building Profile Input Program (BPIP) was used to assess building wake effects from the plant and ALDEX buildings on site.

4.4 Stack Parameters

Stack parameters for each of the seven modelled point sources are presented in **Table 9**. For existing stacks 1, 2, 3, 4, 6 and 7, physical parameters have been derived from stack testing reports obtained between 2013 and 2015 at the WA Facility (AECOM 2013, AECOM 2014 and AECOM 2015a). Stack 5 parameters have been based on existing stack data and design parameters provided by Advanced Combustion Engineering Pty Ltd. Stack parameters for the BRF are provided in **Appendix A**.

Table 9 Stack Parameters for WA

Stack ID	Diameter (m)	Flow Rate (Nm^3/s)	Velocity (m/s)	Temp (K)	Height AGL (m)	MGA 56 Coordinates (m)	
						X	Y
Stack 1	1.65	24.4	26.0	349.3	15	357265	6369322
Stack 2	1.265	13.7	22.9	302.4	15	357310	6369262
Stack 3	1.0	8.9	23.9	305.2	15	357310	6369272
Stack 4	1.395	22.7	31.8	312.4	15	357314	6369296
Stack 5	1.49	21.4	18.8	423.2	30	357347	6369347
Stack 6	0.58	1.9	21.9	557.6	18	357302	6369325
Stack 7	1.5	29.5	35.1	301.4	15	357325	6369226

4.5 Emissions Estimation

A conservative estimate of emission rates, as presented in **Table 11**, has been assumed whereby all plant operations, including operation of the SPL processing (Stack 1) and the reverb/thermal processing plant (Stack 5), would be operating continuously 24 hours a day seven days per week. The following methodology was used to estimate emission rates from each stack.

Site specific emissions testing data have been used for existing pollutant sources that would remain unchanged, being Stacks 2, 3, 4, 6 and 7. Three years of existing stack data has been used dating from 2013 to 2015, with the average emissions applied (AECOM 2013, AECOM 2014 and AECOM 2015a). Where $PM_{2.5}$ data was not available, it was conservatively assumed $PM_{2.5}$ had the same emission rates as PM_{10}.

The emission concentrations from Stack 1 during SPL processing have been obtained from two WA reports for trial operations as follows:

- WA, 2011, Monitoring and Verification Report – Spent Potlining Material Processing Trial (First and Seocnd Cut); and
- WA, 2016, Monitoring and Verification Report – SPL Processing Trial (Mixed).

The reports are detailed in **Section 1.3**. The reports summarise the stack emission concentrations for various trials. The 2011 report summarises the results from two trial batches, the first with a First Cut: Second Cut SPL ratio of 0.48:0.52 (together with iron oxide, cullet and lime) and the second 100% Second Cut SPL. The 2016 report reviews four compliance testing events, with an approximate First Cut: Second Cut SPL ratio ranging from 5:95 to 95:5. For the purposes of this AQIA, the range of the two reports is considered appropriate to represent emissions of First Cut SPL as well as the various ratios in-between. In order to estimate the ‘worst case’ emissions over the range of expected SPL mixes, the maximum values of both trial reports (six trial batches in total) were used for each pollutant in the emissions inventory. This is considered highly conservative as it is unlikely that the worst case SPL mix would be processed for the entire year. A comparison of data is provided in **Table 10**.

Further to the above use of the ‘worst case’ emissions inventory, the assessment has compared these values to the currently measured stack testing data for Stack 1 for the previous three years i.e. processing Second Cut SPL. The maximum of either the worst case SPL emission concentration previously discussed or the average current measured Second Cut SPL emission values have been used in the emission inventory to calculate the final emission rate. Again, this is highly conservative as it assumes that the maximum value from either the First Cut SPL, Second Cut SPL or Mixed SPL processing would be processed for the entire year. A comparison of data is provided in **Table 10**.

The methodology for the calculation of emission rates of the thermal treatment facility (Stack 5) and methodology and emission rates for the BRF are provided in **Appendix A**. The thermal treatment facility is the subject of a separate development application and has been included in this assessment in order to best estimate the cumulative future emissions from the site.

With respect to Stack 5, the source discharge can either reflect emissions from the current Reverb Furnace or from the proposed waste thermal treatment process individually i.e. one or the other, never at the same time. To estimate the potential emissions at any point in time from this source, the concentrations from the reverb stack monitoring data were compared against those calculated for the thermal treatment facility and the maximum of the two for each pollutant was used in the emissions inventory. This is highly conservative as it assumes that the maximum value from either the reverb stack or the thermal treatment facility would be processed for the entire year.

Table 10 Comparison of Pollutant Concentrations for Stack 1 and Stack 5 for WA

Pollutant (mg/m^3)	Stack 1 – SPL				Stack 5 – Reverb / Thermal		
	2011 SPL Trial	Second Cut SPL	2016 Mixed SPL Trial	Assessed Value	Reverb	Thermal	Assessed Value
TSP	8.90	4.18	0.76	8.90	3.33	0.39	3.33
PM_{10}	0.24	0.55	0.24	0.55	1.08	0.28	1.08
$PM_{2.5}$	0.24	0.55	0.24	0.55	1.08	0.039	1.08
SO_2	3.90	5.48	5.00	5.48	7.33	1.55	7.33
H_2SO_4	0.80	1.12	1.00	1.12	1.433	15.44	15.44
NO_x	4.00	11.33	3.00	11.33	4.67	25.39	25.39
HCl	0.95	1.15	7.50	7.50	1.32	1.85	1.85
HF	0.38	0.058	0.055	0.38	0.35	0.16	0.35
CN	0.031	0.14	0.33	0.33			

* Note that after visual inspection of the trial data, a potential outlier was identified in the fluoride data set. A review for statistical outliers using the Interquartile Range analysis method (IQR) was undertaken which confirmed that one of the values was outside the Upper Bound and was a recognised outlier. The value was therefore removed from the assessment calculations.

Table 11 Pollutant Emission Rates for WA

Pollutant (grams / second)	Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6	Stack 7
TSP	0.22	0.0054	0.0064	0.033	0.071	0.014	0.10
PM_{10}	0.013	0.0029	0.0037	0.015	0.023	0.0010	0.064
$PM_{2.5}$	0.013	0.0029	0.0037	0.015	0.023	0.0010	0.064
CO	2.88				0.37	0.0018	
SO_2	0.13				0.16	0.042	0.20
H_2SO_4	0.027				0.33	0.0025	0.039
NOx	0.28				0.54	0.10	0.072
HCl	0.18				0.040		
HF	0.0093	0.0066	0.0028	0.013	0.0074	0.0083	0.0062
CN	0.0081						

4.6 Limitations

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of different variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes based on our understanding of the processes involved and their interactions, available input data, and processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those wind speeds less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

While the models contain a large number of variables that can be modified to increase the accuracy of the predictions under any given circumstances, the constraints of model use in a commercial setting, as well as the lack of data against which to compare the results in most instances, typically precludes extensive testing of the impacts of modification of these variables. With this in mind, model developers typically specify a range of default values for model variables that are applicable under most modelling circumstances. These default values are recommended for use unless there is sufficient evidence to support their modification.

As a result, the findings of dispersion modelling provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time. As stated above, however, the model predictions are typically conservative, and tend to over predict maximum pollutant concentrations at receiver locations.

This assessment was undertaken with the data available at the time of the assessment. Should changes to the Project be made, further assessment may be required to determine if the findings of this assessment are still applicable.

AECOM take no responsibility for information provided to it from equipment suppliers. All information provided has been assumed to be accurate and fit for purpose.

The focus of the current assessment is the processing of emissions associated with the processing of SPL, and as such, any estimation of impacts from the proposed thermal treatment facility are provided for cumulative assessment reasons only and are not part of the current SPL Development Application process. Any modifications to the applied thermal treatment emission rates or other assumptions as part of the regulatory review of the thermal plants development application are outside the scope of this current AQIA.

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5.0 Impact Assessment

Results of the dispersion modelling are presented in **Table 12** as the maximum ground-level concentrations reported at either "at or beyond the boundary of the facility" (for H_2SO_4, HCl, CN) or at a sensitive receptor (all other pollutants). Maximum predicted concentrations from the WA facility have been added to the maximum predicted concentrations at each receptor location for the proposed Kurri Kurri BRF to determine the combined impact from all proposals. This has then been added to the existing background concentration to determine the cumulative impacts.

Table 12 Predicted Ground Level Concentrations

Pollutant	Averaging Period	Percentile	Ground Level Concentration (µg/m³)				Criteria (µg/m³)
			Maximum WA Incremental Contribution	Cumulative Assessment			
				WA + BRF[2]	Background	Cumulative	
TSP	Annual	100th	0.4	0.5	46.8	47.3	90
PM_{10}	24 Hour	100th	0.7	2.5	43.3[1]	45.8	50
	Annual	100th	0.09	0.2	18.7	18.9	30
$PM_{2.5}$	24 Hour	100th	0.7	2.5	20.2[1]	22.7	25
	Annual	100th	0.09	0.2	7.4	7.6	8
SO_2	1 Hour	100th	10	94	235	329	570
	24 Hour	100th	3	15	23	38	228
	Annual	100th	0.4	1	3	4	60
H_2SO_4	1 Hour	99.9th	4.3	4.3	-	4.3	18
NO_2	1 Hour	100th	15[3]	15	101	116	246
	Annual	100th	0.7[3]	0.7	18.5	19.2	62
HCl	1 Hour	99.9th	8	8	-	8	140
HF	90 days	100th	0.12	0.12	0.11	0.23	0.5
	30 days	100th	0.21	0.21	0.16	0.37	0.84
	7 days	100th	0.30	0.30	0.20	0.50	1.7
	24 hours	100th	0.61	0.61	-	0.61	2.9
CN	1 Hour	99.9th	0.36	0.36	-	0.36	0.5

1 Applied the highest background value that met the criterion in order to identify any additional exceedances. Refer to **Section 3.3** for full discussion of method.
2 The WA and BRF data could not be presented in separate columns as the maximum receptor may be different for each. Presenting the maximum for both in columns may lead to readers inadvertently adding the two and over predicting the actual cumulative value.
3 Conservatively assumed total conversion of NOx to NO_2.

A summary of the modelling results and the findings of a comparison with EPA criteria are as follows:

- The WA SPL air dispersion modelling predicts that all assessed pollutants would meet their respective EPA criterion for all average periods both incrementally (WA alone) and cumulatively (WA+BRF+background);
- The PM_{10} and $PM_{2.5}$ data predicts that there are no additional exceedances of the criteria, beyond those already identified in the background data, once the potential impacts from both the WA and BRF sites are cumulatively assessed with the background;
- The cumulative PM_{10} and $PM_{2.5}$ concentrations are due primarily due to existing background particulate concentrations, with the WA facility contributing approximately 1% and 3% of the cumulative 24 hour average value respectively; and

- The presented impact estimates are considered conservative as they assume the WA site is operating continuously for the entire year. The assessment has also applied the calculated emissions from Stack 1 as the higher of either the historical SPL Trial or commercial-scale Second SPL processing emission performance for each pollutant, and for Stack 5 the higher of the proposed thermal facility or current reverb operations for each pollutant, to be emitted at all times.

6.0 Conclusion

AECOM was commissioned by WA to prepare an air quality impact assessment of the proposed processing of all SPL arising's for inclusion into an environmental assessment as part of the Project (WA hold approval for the commercial processing of Second Cut SPL). The report provides an assessment of the potential ground level air quality impacts associated with the operation of the Project when processing SPL. In accordance with EPA guidelines (DEC 2005), a cumulative assessment was undertaken to include the potential impacts from the proposed BRF, proposed thermal treatment facility and ambient background monitoring data.

The air dispersion modelling predicts that all assessed pollutants would satisfy their respective EPA criterion for all average periods both incrementally (WA alone) and cumulatively (WA+BRF+background). The assessed PM_{10} and $PM_{2.5}$ cumulative values predicted that there would be no additional exceedances of the EPA criteria beyond those already attributable to the background monitored data. The contribution of the WA operations to particulate levels, and most assessed pollutants, was minor.

Furthermore, the presented impact estimates are considered conservative as they assume the WA site is operating continuously for the entire year, and they also apply the higher value when a stack has potential mixed use.

In conclusion, the results of the assessment predict that there would be no adverse air quality impacts from the processing of SPL to the local receptors.

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Appendix A

Thermal Processing and Battery Recycling Facility Details

Appendix A Thermal Processing and Battery Recycling Facility Details

Thermal Waste Processing Project

Overview

In response to the ongoing decline in traditional focus areas within the aluminium and steel sectors, and identified growth opportunities in other and emerging markets, WA proposes to further adapt and diversify its plant, equipment and processes to enable the thermal processing of other wastes. This project promotes development of the Kurri Kurri region, providing employment opportunities and contributes to the growth of industrial development in an environmentally sustainable manner.

The WA Site is ideally positioned in the Lower Hunter to cater for ever-increasing generation of wastes and the resulting increasing demand for regional specialist waste management solutions. Currently, such wastes must be transported significant distances, often interstate for disposal. WA has a strong demonstrated history of planning approval and environmental license compliance with stringent environmental requirements currently enforces through a comprehensive environmental management system.

Proposed thermal processing equipment would be incorporated into the existing WA Site footprint, using existing access and emission control systems. Proposed plant and equipment would be located within the northern end of the WA Site with the northern fence line to be extended further north to accommodate the new development (still remaining within WA property boundaries).

The thermal waste treatment plant is proposed to be established in an east-west orientation, with enclosed input storage facilities and a dedicated feeding system. The existing Baghouse 5 is to be utilised for emission capture and treatment of process emissions from the proposed plant and equipment before discharge to atmosphere via the existing Stack 5. This emission control system currently services Reverberatory Furnace process emissions, typically operated during 1 shift per day. A dry-lime scrubber system currently operates in conjunction with Baghouse 5 to treat acid gases and adsorb pollutants (e.g. PAHs and Dioxins/Furans). It is proposed that this scrubber system be upgraded to incorporate an activated carbon dosing system, with the activated carbon injected at the baghouse entry point.

Emission Rate Calculation Methodology

A conservative estimate of emission rates presented in **Table 11** has been assumed whereby all plant operations, including operation of the thermal processing plant, would be operating continuously 24 hours a day seven days per week. The following methodology was used to estimate emission rates from the Stack 5 during operation of the thermal processing plant:

- Largely derived from the *AP 42 Compilation of Air pollutant Emission Factors* (US EPA 1995) emission factors for thermal processing medical waste:
  - Where possible emission factors for rotary kiln waste thermal waste processors were used and where available, emission factors for pollutants where lime/carbon injection and fabric filters were also adopted; and
  - Particulate emissions for PM_{10} and $PM_{2.5}$ were calculated from TSP using particulate size distribution ratios for controlled air thermal waste processors.
- Calculated from AP-42 (US EPA 1995) emission factors using the maximum operating capacity for the thermal processing plant of 800kg/h;
- Most pollutants of concern were calculated from AP-42 emission factors. For pollutant not listed suitable publically available emission data were sought and applied for the heavy metals Co, Se, Sn and V:
  - While information gaps exist for heavy metals Co, Se, Sn and V under the normal operating scenario, these are covered by emission limit calculations as discussed below. Predicted impacts using the method below would be considered worst case impacts and predicted ground level concentrations during operation of the plant at maximum capacity are likely to be less than the proposed limit; and
- Stack concentrations for heavy metals included in the proposed Type 1 and Type 2 Substances EPL stack concentration limit of $1mg/m^3$, but not measured in the stack testing data, were calculated by dividing the

total stack concentration by the total number of heavy metals (13). These values were then used to calculate the relevant stack emission rate based on stack emission data (AECOM 2013, AECOM 2014 and AECOM 2015a). It should be noted that this methodology resulted in some particularly high emission rates when compared to emission rates from stack testing data. In the case of Beryllium this resulted in a gross over estimation of the ground level impacts, and as such the results of the heavy metals not measured in the stack testing are expected to be highly conservative.

Battery Recycling Facility

Overview

Pymore Recyclers International Pty Ltd (Pymore) lodged a Request for SEARs for the proposed development of a battery recycling facility with the DP&E in February 2016. The facility would be located at 129 Mitchell Avenue, Kurri Kurri, and would occupy approximately 3.4ha of the lot on which WA is sited.

The proposed facility would recycle approximately 60,000 tpa of used-lead-acid batteries (ULABs) using a CX Integrated System which uses a combination of hydrometallurgical and pyro metallurgical process for the recovery of lead and associated by-products. ULAB recycling at the facility would be comprised of four main processes: crushing screening and separation; desulphurisation; crystallisation; and lead smelting (EMM 2016). As a result, the main pollutants of concern from the facility would be particulates, SO_2, NO_x and lead.

Emission Rate Calculation Methodology

For the proposed Kurri Kurri BRF, stack temperatures, velocities and flowrates have been based on design parameters for the development and are shown in **Table 13**. Stack diameters for the proposed plant were calculated based on the flow rate, velocity and temperature data provided by Engitec Technologies.

Stack emission rates were based on maximum stack concentration design rates proposed for the plant and are shown in **Table 14**. Emission rates for PM_{10} and $PM_{2.5}$ were estimated conservatively, assuming PM_{10} and $PM_{2.5}$ were equal to the emission rate for TSP.

Table 13 Stack Parameters for Kurri Kurri Battery Recycling Facility

Stack ID	Description	Diameter (m)	Flow Rate (Nm^3/s)	Velocity (m/s)	Temp (K)	Height AGL (m)	MGA 56 Coordinates (m)	
							X	Y
Stack 1	RF-1 Common Stack	2.6	36.11	15.0	313.2	15	357462	6369262
Stack 2	RF-2 Common Stack	1.6	13.89	15.0	353.2	15	357467	6369295
Stack 3	Battery Breaker	0.9	4.44	15.0	298.2	15	357448	6369181
Stack 4	Steam Boiler	0.3	0.28	15.0	453.2	15	357446	6369212

Table 14 Pollutant Emission Rates for Kurri Kurri Battery Recycling Facility

Pollutant	Stack Concentration (mg/m^3)				Emission Rate (g/s)			
	Stack 1	Stack 2	Stack 3	Stack 4	Stack 1	Stack 2	Stack 3	Stack 4
TSP	5.0	5.0	5.0		0.1806	0.0694	0.0222	
PM_{10}	5.0	5.0	5.0		0.1806	0.0694	0.0222	
$PM_{2.5}$	5.0	5.0	5.0		0.1806	0.0694	0.0222	
SO_2		125.0				1.74		
NO_x		250.0		250.0		3.47		0.07
Pb	0.5	0.5	0.5		0.0181	0.0069	0.0022	

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Appendix B

Monitoring and Verification Reports – SPL Processing Trial

Appendix B Monitoring and Verification Reports – SPL Processing Trial

Monitoring and Verification Report, Spent Potlining Material Processing Trial, Rev 2, March 2011.

MONITORING AND VERIFICATION REPORT

SPENT POTLINING MATERIAL PROCESSING TRIAL

ALUMINIUM DROSS PROCESSING FACILITY KURRI KURRI, NSW

REVISION	**:**	**2**
COPY	**:**	**Original**
DATE	**:**	**04 March 2011**

DOCUMENT REVISION RECORD

Rev.	Date	Description	Prepared	Checked	Approved
Draft	23.22.2010	Draft preparation	C. McClung	-	-
0	29.10.2010	Document issue (Draft)	C. McClung	29.10.2010	T. Temelkovski
1	08.11.2010	Document Finalisation	C. McClung	08.11.2010	G. Simonian
2	04.03.2011	Document Update	C. McClung		

DISTRIBUTION LIST

Copy Number	Recipient	Location
Original	Environmental Management Representative	Kurri Kurri, NSW
2 of 4	NSW Department of Planning	Sydney, NSW
3 of 4	NSW Department of Environment, Climate Change & Water	Newcastle, NSW
4 of 4	Cessnock City Council	Cessnock, NSW

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1. INTRODUCTION

Since 2005, Weston Aluminium representatives have undertaken extensive research, both domestically and overseas, investigating available technologies for the treatment of SPL from primary aluminium smelters. Weston Aluminium's objective is to offer a sustainable solution to domestic smelters, enabling the cost-effective treatment of SPL and, in conjunction with other treated industrial by-products, formulate the manufacture of a value-added substitute for roadbase and other building and construction products. This particular project was conceived through our Membership in the NSW DECCW Sustainability Advantage Program and our central foundation and ongoing involvement with the NSW Industrial Ecology Network, represented by like-minded industry, academics and Government regulators, eager to encourage the recovery of industrial by-products as valuable resources, and thereby achieve the diversion of large material volumes from landfill.

SPL is a hazardous by-product of primary aluminium production, generated from the periodic de-lining of electrolytic cells. First Cut SPL (originating from the carbon cathode) and Second Cut SPL (refractory lining) contain varying proportions of aluminium, carbon, cyanide, fluorides, sodium and other trace contaminants, and its management and disposal represents a major issue faced by the industry on a worldwide scale. At present, the two primary smelters in NSW (Tomago Aluminium Company and Hydro Aluminium) have not yet attained an effective and sustainable solution for their SPL, and each continue to stockpile surplus SPL and/or export the waste to Europe for treatment. Such treatment is performed at significant expense, and relies on the transport of dangerous and hazardous materials over many jurisdictions and the vagaries of third party countries. This strategy is clearly not sustainable for the domestic industry.

Weston Aluminium proposes to diversify its service provision to the aluminium smelters beyond the reprocessing of aluminium drosses and other aluminium-bearing wastes, to include the treatment and processing of SPL at a local level.

As part of internal research and development programs, Weston Aluminium undertook a series of laboratory-scale SPL processing trials in New Zealand during early 2010 to investigate process design parameters and to assess emission control performance under such small-scale operating conditions. As an extension of these earlier trials, Weston Aluminium subsequently sought Development Modification Approval and a variation to our Environmental Protection Licence for a larger-scale Trial exercise at our Kurri Kurri premises (refer to correspondence by Weston Aluminium dated 26 May 2010). Regulatory approval was granted by the Department of Planning and the Department of Environment, Climate Change & Water, and the Trial subsequently conducted on 14 August 2010. Copies of our Development Consent and Environment Protection Licence are provided as **Attachments 1** and **2** respectively.

The objectives of the current Trial were to verify operations and to demonstrate emission control performance and compliance on the larger-scale.

This report has been prepared in accordance with requirements defined in our Development Consent (DA 86-04-01 Mod 4) and our Environment Protection Licence (EPL No. 6423), and describes processing methodology, monitoring findings and verification of emission control performance assessed during the SPL processing Trial, as conducted on 14 August 2010.

2. SCOPE OF WORKS

2.1 SPL Processing Trial

The scope of the SPL processing Trial conducted at Weston Aluminium on 14 August, as defined below, is consistent with proposal correspondence to Regulatory Authorities (26 May 2010) and incorporates regulatory approval requirements.

- Preparation of Risk Assessments and Safe Operating Procedures for the safe transport, handling, storage and processing of SPL;

- Sourcing and delivery of 1st and 2nd cut SPL from each of the two local smelters (Tomago Aluminium and Hydro Aluminium) by a licensed Dangerous Goods transport contractor (Note: SPL feedstock could not be obtained from the Hydro Aluminium smelter). Approximately 8 tonnes of SPL was provided by Tomago for the Trial;

- Storage of all SPL materials and treated products within under-cover and bunded areas to prevent the potential contamination of stormwater;

- NATA-certified laboratory analysis to characterise Trial feedstock materials;

- Provision of notification to regulatory bodies prior to, and upon conclusion, of Trial activities;

- Trial processing of the SPL at our Kurri Kurri facility, as follows:
  - Storage of Trial feedstock materials in existing, purpose-built and enclosed bays awaiting Trial use;
  - Preparation of feedstock blends, including an SPL-only feed, and a blend of SPL, cullet, iron oxide and lime;
  - Batch processing of the two discrete blends through an existing natural gas-fired rotary furnace in 2.5 – 3.5 tonne batches and at temperatures exceeding 650^{o}C. Note: SPL processing was performed independently of normal aluminium dross processing activities to thereby permit an assessment of emissions performance attributed to SPL processing only;
  - Maintenance and operation of the existing wet-dry fluoride scrubber and baghouse pollution control systems to control and monitor air emissions to within regulatory requirements. NATA-accredited emissions monitoring were performed concurrently with the Trial program to confirm air emissions performance; and
  - Recovery of the treated product and storage undercover awaiting laboratory assessment.

- Monitoring and recording of Trial operating conditions, including feedstock quantity and characteristics, processing intervals and furnace temperatures;

- NATA-certified laboratory analysis of the treated product to confirm cyanide destruction and contaminant immobilisation. The analytical suite included an assessment of total contaminant loads (including cyanide, fluoride, alkalis and heavy metals) and leachable contaminant loads (including cyanide, fluoride, alkalis and heavy metals) using the Toxicity Characterisation Leaching Procedure (TCLP);

- NATA-certified emission testing in conjunction with Trial furnace processing works to assess compliance with existing exhaust emission performance requirements for EPL Point 1 (Stack 1). This included an assessment of total and fine particulate, cyanide, oxides of sulfur, oxides of nitrogen, chlorine, hydrogen chloride, particulate and gaseous fluoride, polycyclic aromatic hydrocarbons, volatile organic hydrocarbons, hazardous substances (heavy metals), carbon monoxide, oxygen and flow characteristics (i.e. velocity, volumetric flowrate, temperature and gas density). Real-time, continuous assessment of gaseous fluoride and solid particulates was also performed using existing, on-site monitoring systems;

- Return of any unused SPL materials to the source Smelter; and

- Blending and performance testing of the glassy slag as an integrated aggregate substitute in a roadbase sample matrix (to occur at a later date).

2.2 Reporting

The scope of this monitoring and verification report is defined in Condition 54B of our Development Consent (DA 86-04-01 Mod 4) and Condition U2.2 of our Environment Protection Licence (EPL No. 6423), as reproduced below:

The Monitoring and Verification Report must:

- be submitted to DECCW, Cessnock City Council and the Director-General within 90 days of the completion of the Spent Potlining Material Processing Trial;

- detail the results of the monitoring required by Conditions of the Development Consent and the Environment Protection Licence;

- compare the results of the trial emissions assessment to the laboratory results described in the report dated 30 April 2010 prepared by K2 Environmental Limited *(prepared in relation to earlier NZ trials)*, and the limits in the EPL and DECCW's air quality impact assessment criteria specified in the "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (DEC 2005);

- describe any anomalies in the monitoring data, and any exceedances of the limits or assessment criteria;

- characterise the trial outputs and describe how these products are to be managed and disposed of;

- summarise the findings of the trial;

- recommend any actions that could be taken to minimise emissions during any future processing; and

- discuss the likely options for any future processing.

3. FINDINGS

3.1 Feedstock Blends

A summary of feedstock blends and raw material quantities employed in the Trial is presented in **Table 1**. Raw feedstock weight data may be referred to in **Attachment 3**.

Table 1: Trial Raw Material Feedstock Quantities and Blends

Trial Parameters	Trial No.	
	1	3
1st Cut SPL	0.46	-
2nd Cut SPL	0.50	2.00
Iron Oxide	0.69	-
Cullet	0.46	-
Lime	0.14	-
Total	**2.25 Mt**	**2.00 Mt**

3.2 Feedstock Analysis

Samples of feedstock materials (as received) were submitted to ALS NATA laboratories for characterisation analyses. A summary of these data is presented in **Table 2**. Analytical Laboratory Certificates may be referred to in **Attachment 4**.

The Trial blends were designed to 1) mimic the batch formulations trialled earlier in New Zealand (i.e. blend of SPL, cullet, iron and lime), and 2) to facilitate as a Control (i.e. SPL only feed). Analyses of inputs were undertaken by ALS NATA Laboratories to characterise the feed, and to assist with refining the blend formulations. The characteristics of SPL sourced for the Trial are considered to be representative of SPL generated at the Tomago Aluminium smelter. Other raw material additives contained suitable quantities of the essential components (i.e. iron oxide, silica and lime), and were considered suitable for the Trial. Should further work be undertaken with the iron-based additive (whilst unlikely), an alternative source may be investigated to limit and minimise heavy metal content.

Table 2: Analytical Laboratory Analysis Results – Raw Feedstock Materials

Analytical Parameter	Total Contaminant Concentrations (mg/kg, dry wt)					TCLP Leachable Contaminant Concentrations (mg/L)	
	1st Cut SPL	2nd Cut SPL	Iron Oxide	Cullet	Lime	1st Cut SPL	2nd Cut SPL
Aluminium	69,600	79,200	14,500	140	1,030	75.8	9.8
Antimony	6	<5	42	14	<5	<0.1	<0.1
Arsenic	8	8	15	<5	<5	<0.1	<0.1
Barium	410	390	60	<10	<10	2.0	0.6
Beryllium	9	7	1	<1	<1	0.08	<0.05
Cadmium	1	<1	13	<1	<1	<0.05	<0.05
Calcium	360	<10	70	180	3,920	63	21
Chromium	34	26	119	4	0.3	<0.1	<0.1
Cobalt	3	<2	6	<2	<2	<0.1	<0.1
Copper	127	18	168	22	5	0.6	<0.1
Cyanide	319	148	1	<1	<1	4.73	6.83
Fluoride	79,100	47,900	18,400	180	<40	98.0	134
Iron	39,600	14,700	413,000	410	760	20.2	11.3
Lead	42	18	532	109	<5	<0.1	<0.1
Manganese	590	141	7,050	14	78	1.9	<0.1
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.0010	<0.0010
Nickel	95	28	76	3	<2	0.7	0.1
Phosphorus	210	250	920	<50	120	0.45	0.55
Selenium	<5	<5	<5	3	<5	<0.05	<0.05
Sodium	13,700	68,900	1,880	490	100	2210	2390
Sulfur	1,500	800	700	400	500	40	29
Total Organic Carbon	8,000	<5,000	6,000	<5,000	<5,000	2250	2310
Thallium	<5	<5	8	<5	<5	<0.05	<0.05
Vanadium	104	48	457	<5	<5	0.3	0.3
Zinc	1,140	168	22,400	65	56	0.5	0.3

3.3 Thermal Operating Conditions

The temperature profile of furnace feedstock material, as a function of time during each Trial batch, is illustrated in **Figure 1**. Raw temperature monitoring data may be referred to in **Attachment 3**.

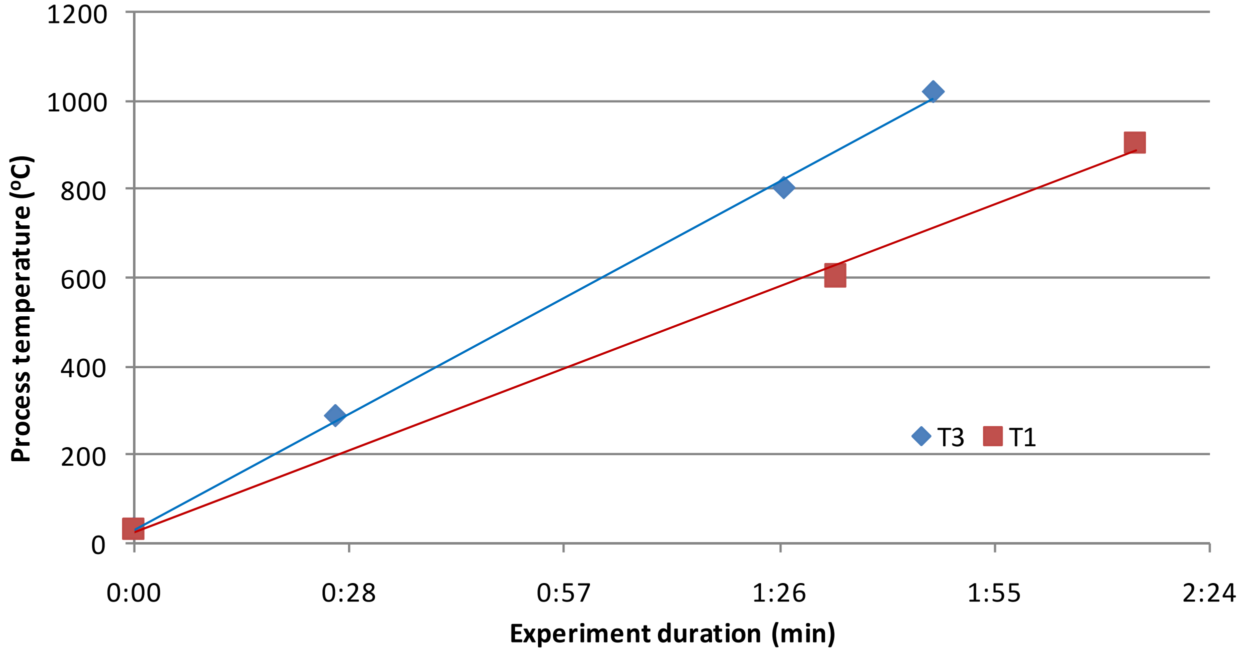

Figure 1: Temperature Profile of Furnace Feedstock Material

Processing of Trial blends was performed in a 5 tonne, refractory lined natural gas-fired rotary furnace. Processing was undertaken over extended periods and at elevated temperatures above 750^{o}C to thereby investigate worst-case exhaust generation (in particular, fluoride evolution), and hence determine air emission control performance (refer to **Section 3.4**).

3.4 Air Emission Monitoring

3.4.1 Real-time Gaseous Fluoride Emissions Monitoring

Continuous emissions monitoring of gaseous fluoride concentrations was performed throughout the Trial to assess compliance with the regulatory limit. Hourly average fluoride data are presented in **Figure 2** for comparison with the regulatory limit of 1.4 mg/m^3.

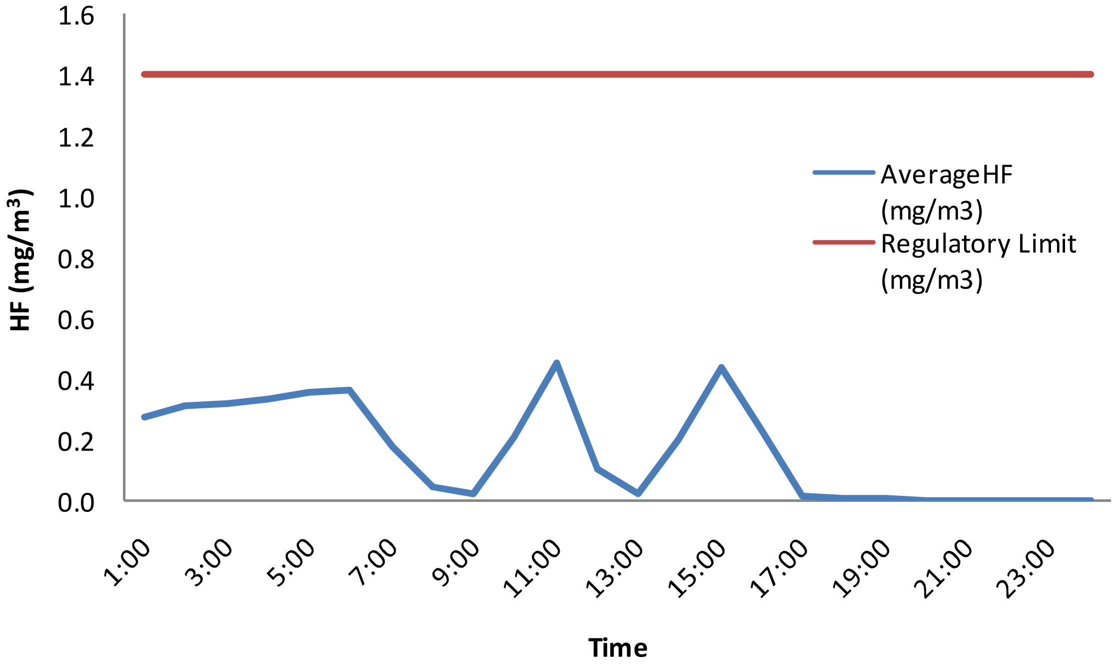

Figure 2: Real-time (Hourly Average) Gaseous Fluoride Emissions Monitoring Data

3.4.2 Real-time Particulate Emissions Monitoring

Continuous emissions monitoring of particulate concentrations was performed throughout the Trial to assess compliance with the regulatory limit of 25 mg/m^3. Monitoring data are presented in **Figure 3**.

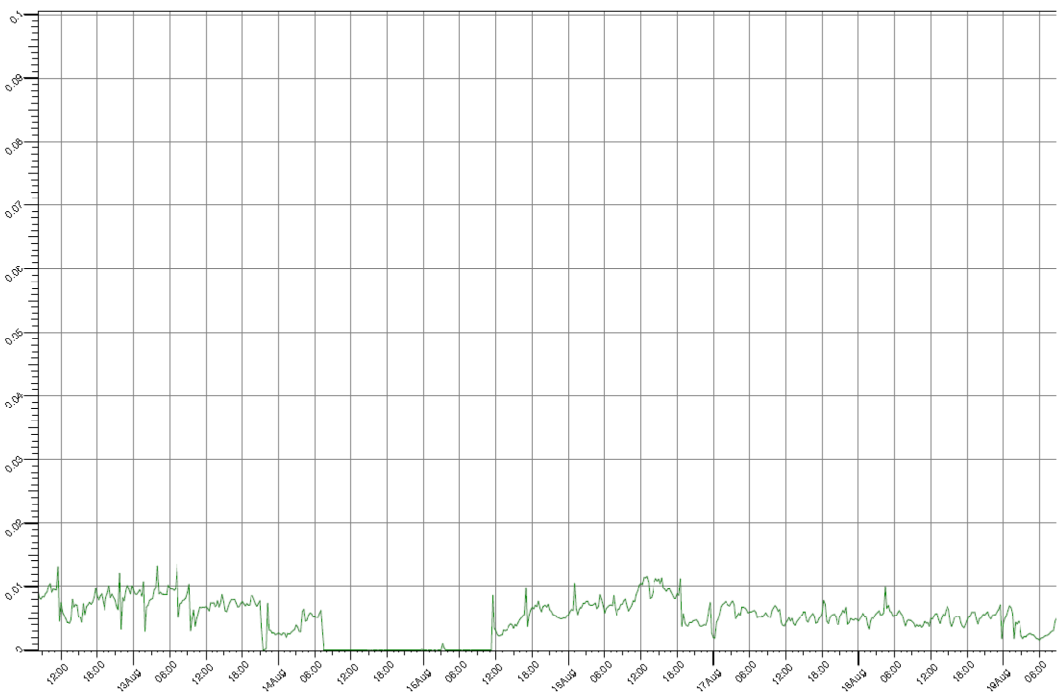

Figure 3: Real-time Particulate Emissions Monitoring Data

3.4.3 Stack Emission Monitoring

A summary of stack emission monitoring results is presented in **Table 3**. Regulatory compliance limits are also tabulated. A copy of the Air Emissions Monitoring Report may be referred to in **Attachment 5**.

Table 3: Summary of Compliance Stack Emission Testing Results

Emission Monitoring Parameter	Trial Emission Monitoring	Regulatory Compliance Limits	Emission Monitoring (NZ Trial)
Total Particulate Matter	8.9	25	<0.12
Fine Particulate Matter	0.24	NL	ND
Hydrogen Chloride	0.95	400	ND
Chlorine	0.42	NL	ND
Particulate Fluoride	0.027	NL	0.070
Gaseous Fluoride	0.38	2	0.072
Sulfuric Acid Mist	<1.6	100	ND
Sulfur Dioxide	<7.8	NL	ND
Total Hazardous Substances (metals)	0.017	10	ND
Total Polycyclic Aromatic Hydrocarbons	0.74	NL	ND
Volatile Organic Compounds	<0.17	NL	ND
Total Oxides of Nitrogen (as equiv. NO_2)	4	2500	ND
Carbon Monoxide	5	100	ND
Cyanide	<0.061	NL	0.068
Oxygen (%)	20.7	NL	3.1
Temperature (^oC)	52.4	NL	53
Velocity (m/s)	30	NL	5.6
Dry Gas Density (kg/m^3)	1.29	NL	1.31

Notes: All values are expressed in mg/m^3 (0^oC, 1 atm, dry gas) unless otherwise defined
NL – Not Listed
ND – Not Determined

All air pollutant emission concentrations monitored during the Trial were determined to be very low, and were well below Weston Aluminium's regulatory requirements. **No exceedances of air pollutant concentration limits occurred during the Trial.** This verifies that the air emission monitoring and control systems employed at Weston Aluminium were functioning correctly for the duration of the Trial, and perform more than adequately to maintain environmental compliance during the processing of SPL. Whilst such emission performance was expected, such verification was essential for progression to subsequent Trial and commercial activities relating to future SPL processing.

3.5 Treated Product Analysis

Samples of product materials were submitted to ALS NATA laboratories for characterisation analyses. A summary of these data is presented in **Table 4**. Analytical Laboratory Certificates may be referred to in **Attachment 4**.

Table 4: Analytical Laboratory Analysis Results – Product Materials

Analytical Parameter	Total Contaminant Concentrations (mg/kg, dry wt)		TCLP Leachable Contaminant Concentrations (mg/L)	
	T1	T3	T1	T3
Aluminium	58,400	117,000	37.2	537
Antimony	14	<5	<0.1	<0.1
Arsenic	9	8	<0.1	<0.1
Barium	260	500	0.7	3.3
Beryllium	4	8	<0.05	0.09
Cadmium	<1	<1	<0.05	<0.05
Calcium	10	<10	270	34
Chromium	66	52	<0.1	<0.1
Cobalt	4	3	<0.1	<0.1
Copper	96	58	<0.1	<0.1
Cyanide	6	4	<0.004	0.007
Fluoride	45,800	62,700	58.0	808.0
Iron	144,000	18,100	288	77.2
Lead	107	19	<0.1	<0.1
Manganese	1910	157	9.7	0.8
Mercury	<0.1	<0.1	<0.0010	<0.0010
Nickel	48	42	<0.1	<0.1
Phosphorus	320	300	0.10	0.38
Selenium	<5	<5	<0.05	<0.05
Sodium	2100	36,100	-	1740
Sulfur	600	900	<1	10
Total Organic Carbon	<5,000	<5,000	2,340	2230
Thallium	<5	<5	<0.05	<0.05
Vanadium	126	63	<0.1	0.1
Zinc	5,160	97	12.5	0.2

Notes: TCLP sodium could not be determined for the T1 product due to background matrix effects

4. DISCUSSION

- The principal objective of the SPL Processing Trial was to assess emissions and demonstrate the suitability of existing pollution control and monitoring systems at Weston Aluminium's Kurri Kurri facility, thereby verifying that air emissions generated during SPL processing activities could be controlled and maintained to the satisfaction of regulatory requirements. This objective is considered to have been successfully achieved;

- Trials were performed to investigate the emissions-control performance whilst thermally-treating SPL in conjunction with various feedstock additives. The treatment of an SPL-only feed was also investigated as a control. The final blends were determined based upon findings of earlier trials performed in NZ, and were also constrained by raw material availability;

- All SPL raw materials were appropriately stored within purpose-built building and bays throughout the Trial. These facilities are adequately bunded, and prevent the ingress of, and subsequent contact with, stormwater. This is consistent with the current storage, handling and management of aluminium dross on site, for which the same Dangerous Goods classification as SPL applies;

- Temperatures at which cyanide is known to be thermally-destroyed (>750^{o}C) were achieved. The thermal treatment performance is confirmed by the exceptionally low cyanide residuals. Treatment temperatures (over 1000^{o}C attained) and furnace residence times required for SPL treatment are expected to be somewhat less than that explored during the Trial;

- For each Trial batch, the furnace was operated at elevated temperatures to investigate the potential for fluoride evolution and its resultant emission control, and to monitor physical changes to feedstock blends, impacts upon emission control, and other operational issues (findings not reported);

- Emission testing undertaken in conjunction with Trial activities reveal exceptionally low pollutant discharge concentrations, and confirm the performance of the existing lime-scrubber and fabric filter baghouse pollutant control systems. All air emission concentrations were well below regulatory compliance limits. No further assessment of emission performance (including dispersion modelling) is considered warranted. It is considered that the existing pollution control system is suitable for future processing of SPL;

- Real-time, continuous emission monitoring data confirm that gaseous fluoride and particulate emission concentrations satisfied the regulatory compliance limits throughout the Trial interval. Hence, processing activities were not required to cease at any time during the Trial, nor were Regulatory Authorities required to be notified in relation to any exceedance;

- Stack emission data are generally in the same order as those determined by K2 Environmental Limited as part of the earlier NZ Trial exercise (Note: the exceptionally low total particulate concentration determined for the NZ trial is attributed to the relatively low gas volumes and excessively large fabric filter area available for emission control). Given the contrasting scale and technique of processing equipment, and the high sophistication of Weston Aluminium's air emission pollution control and monitoring systems compared with that employed during the laboratory-scale trials in NZ, direct comparison of the present Trial results to that reported by K2 Environmental is considered to be of limited value. Nevertheless, it is noted that in each case, that the concentrations of pollutant air emissions were very low and satisfied regulatory requirements. The stack emission data is generally the same as a function of the following:

- Thermal treatment of the feedstock mass exceeded 750^{o}C required for thermal destruction of cyanide. Hence, cyanide was negligible or not detectible in the exhaust streams; and
- Each emission control system is designed for fluoride control (via lime scrubbing) and for particulate matter removal (via fabric filter baghouse) prior to atmospheric discharge. Hence, fluoride emissions were adequately controlled on the scales applied, and similarly, particulate matter emissions (and emissions of those contaminants that may have been particulate-bound) were suitably controlled;

- As expected, cyanide loads and leachability within product slags were dramatically reduced through treatment, and were determined to be negligible within the residual slags. Treatment products exhibit similar heavy metal leachability rates relative to that determined for SPL feedstock materials, whilst fluoride leachability was elevated within the SPL-only (control) treatment product (see further discussion below). Assessment of contaminant loads and leachability rates in accordance with the DECCW's 2009 publication, *Waste Classification Guidelines, Part 1: Classifying Wastes*, revealed that the product slags retain a Hazardous Waste classification due to total fluoride loads and leachability behaviour (control only). Remaining parameters satisfy the General Waste criteria. Further work is to be performed to improve the fixation of fluoride and demonstrate inherent immobilisation;

- Fluoride leachability remains elevated for each Batch product, and depending upon treated product end use application, further work may be required to improve fluoride fixation/immobilisation. Due to the affinity of calcium for fluoride, and the resultant inert and highly insoluble CaF_2 formation, it is proposed that the incorporation of lime as a feedstock additive would be explored during future trial processing. Note: fluoride fixation was significantly greater for the Batch 1 treated product (with only 6% lime addition) compared with that of the Control (no lime addition). Specifically, future Trials may seek to investigate end product fluoride immobilisation principally as a function of lime addition rates;

- No further anomalies in the monitoring data are evident;

- Residual product quantities will be maintained on site for future processing and investigation; and

- Whilst the Trial successfully confirmed the compliant performance of air emissions control, insufficient data is available to determine ideal treatment conditions for product versatility and reuse. Future work may include the trialing and assessment of alternative raw material feedstock materials and blends under various operational conditions and will also focus on the performance and suitability of treatment product slag end uses, including use as roadbase component. Further consultation with regulatory authorities will occur at this time.

ATTACHMENT 1

ATTACHMENT 2

ATTACHMENT 3

ATTACHMENT 4

ATTACHMENT 5

Monitoring and Verification Report, Spent Potlining Material Processing Trial, Rev 0,May 2016.

MONITORING AND VERIFICATION REPORT

MIXED SPENT POTLINING PROCESSING TRIAL

ALUMINIUM DROSS PROCESSING FACILITY
KURRI KURRI, NSW

REVISION	**:**	**0**
COPY	**:**	**Original**
DATE	**:**	**20 May 2016**

DOCUMENT REVISION RECORD

Rev.	Date	Description	Prepared	Checked	Approved
Draft	17.05.2016	Draft preparation	C. McClung	I. Burns	I. Burns
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2 of 4	NSW Department of Planning & Environment	Sydney, NSW
3 of 4	NSW Environment Protection Authority	Newcastle, NSW
4 of 4	Cessnock City Council	Cessnock, NSW

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1. INTRODUCTION

Since 2005, Weston Aluminium representatives have undertaken extensive research, both domestically and overseas, investigating available technologies for the treatment of spent potlining (SPL) from primary aluminium smelters. Weston Aluminium's objective is to offer a sustainable solution to domestic smelters, enabling the cost-effective treatment of SPL and, in conjunction with other treated industrial by-products, formulate the manufacture of a value-added substitute for manufacturing sector raw material inputs. This particular project was conceived through our Membership in the NSW Office of Environment & Heritage (OEH) Sustainability Advantage Program and our central foundation and ongoing involvement with the Australasian Industrial Ecology Network, represented by like-minded industry, academics and Government regulators, eager to encourage the recovery of industrial by-products as valuable resources, and thereby achieve the diversion of large material volumes from landfill.

SPL is a hazardous by-product of primary aluminium production, generated from the periodic de-lining of electrolytic cells. First Cut SPL (originating from the carbon cathode) and Second Cut SPL (refractory lining) contain varying proportions of aluminium, carbon, cyanide, fluorides, sodium and other trace contaminants, and its management and disposal represents a major issue faced by the industry on a worldwide scale. At present, significant stockpiles of SPL exist within NSW and interstate, with limited technologies and reuse options developed for the sustainable processing of these materials. Domestic smelters continue to stockpile surplus SPL and/or export the waste to Europe for subsequent treatment. Such treatment is performed at significant expense, and relies on the transport of dangerous and hazardous materials over many jurisdictions and the vagaries of third party countries. This strategy is clearly not sustainable for the domestic industry.

Accordingly, the Australian Government Department of the Environment is at present facilitating a national program designed to confirm and quantify SPL stockpiles, profile the capacity, efficacy and cost associated with the limited treatment options, and better understand available domestic and international product reuse opportunities. The objective of the *'Spent Pot Lining (SPL) project (feasibility of an agreement for clearing stockpiles)'* program is to develop coordinated strategies between government and industry for the concerted reduction in national SPL stockpiles.

Since 2005, Weston Aluminium has undertaken a number of systematic Trials designed to investigate the feasibility of SPL treatment at our Kurri Kurri premises, and explore the viability and sustainability of end-use market opportunities. These Trials are outlined as follows:

- **NZ Trials -** As part of internal research and development programs, Weston Aluminium undertook a series of laboratory-scale SPL processing trials in New Zealand during early 2010 to investigate process design parameters and to assess emission control performance under such small-scale operating conditions;
- **40Mt Trial -** As an extension of these earlier trials, Weston Aluminium subsequently sought Development Modification Approval and a variation to our Environmental Protection Licence for a Trial exercise at our Kurri Kurri premises. The objectives of this Trial were to verify the suitability of plant and equipment for the processing of 1st and 2nd Cut SPL, and to demonstrate compliance with existing regulatory requirements. The Trial was conducted on 14 August 2010;
- **Laboratory Trials -** A process optimisation study was conducted using a laboratory scale rotary infra-red rotary furnace located at the University of Newcastle Newbolds laboratories during February 2011. The objective of this Trial was to confirm treatment temperature and residence time required to achieve cyanide destruction within SPL. Data obtained from this study was used to refine process conditions required to meet SPL processing objectives in future trials; and

- **200Mt Trial –** As an extension of these earlier Trials, Weston Aluminium sought Development Modification Approval and a variation to our Environmental Protection Licence for a larger-scale (200Mt) Trial exercise. The objectives of this larger Trial were to treat sufficient quantities of Second Cut SPL to enable prospective Customers the opportunity to evaluate the suitability of the material as an input within their processes, and to capture process, occupational hygiene and environmental compliance data to support approvals for commercial scale operation.

The successes of the above trials have enabled Weston Aluminium to diversify its service provision to the aluminium sector (beyond the reprocessing of aluminium drosses and other aluminium-bearing wastes), having since received regulatory approval in 2012 for the treatment and processing of up to 40,000 tonnes per annum of Second Cut SPL.

Since this 2012 Approval, Weston Aluminium have also worked closely with its Customers to understand the nature and quantities of 'Mixed' SPL legacy stores requiring treatment – those stockpiles containing a mixture of both 1st and 2nd Cut SPL (generated before the now-conventional practice of lining segregation). Accordingly, Weston Aluminium has sought regulatory approval for a limited processing Trial and investigation (up to 3,000 tonnes over a 12 month interval) to demonstrate process compatibility and regulatory compliance of the Kurri Kurri facility, and to confirm market acceptance of the resultant products. Findings of this Trial are reported herein.

This report has been prepared in accordance with requirements defined in Weston Aluminium's Development Consent (DA 86-04-01 Mod 8 and DA 10397 of 1995 Mod 6; refer Consolidated Consent in **Attachment 1**) and our Environment Protection Licence (EPL No. 6423; **Attachment 2**), and describes processing methodology, monitoring findings and verification of plant, equipment, processes and emission control performance assessed during the 3000Mt Mixed SPL processing Trial.

2. SCOPE OF WORKS

2.1 Mixed SPL Processing Trial

The scope of the Mixed SPL processing Trial conducted at Weston Aluminium during 2015 and 2016, as defined below, is consistent with proposal correspondence to Regulatory Authorities, and incorporated the following regulatory approval requirements:

- Confirmation of Risk Assessments and Safe Operating Procedures for the safe transport, handling, storage and processing of Mixed SPL, and conduct Toolbox Talks with site personnel;
- Sourcing and delivery of Mixed SPL from Tomago Aluminium by a licensed Dangerous Goods transport Contractor;
- Storage of all inputs and treated products within under-cover and bunded areas to prevent the potential contamination of air and stormwater;
- Provision of notification to regulatory bodies prior to, and upon conclusion, of Trial activities;
- Trial processing of the Mixed SPL at our Kurri Kurri facility, as follows:
    - Storage of Trial feedstock materials in existing, purpose-built and enclosed bays awaiting Trial use;
    - Batch processing through existing natural gas-fired rotary furnaces in up to 4 tonne batches. Note: Mixed SPL processing was performed independently of normal aluminium dross processing activities to thereby permit an assessment of emissions performance attributed to Mixed SPL processing only;

  - Maintenance and operation of the existing wet-dry fluoride scrubber and baghouse pollution control systems to control and monitor air emissions to within regulatory requirements; and
  - Packaging of the treated product and storage before dispatch to Customers.
- Monitoring and recording of Trial operating conditions, including feedstock quantity and characteristics, processing intervals and furnace temperatures;
- NATA-certified laboratory analysis of the treated product to confirm detoxification and composition;
- NATA-accredited emissions monitoring assessments of total and fine particulate, cyanide, chlorine, hydrogen chloride, particulate and gaseous fluoride, polycyclic aromatic hydrocarbons, volatile organic hydrocarbons, heavy metals, oxides of nitrogen and sulfur, carbon monoxide, oxygen and gas flow characteristics (i.e. velocity, volumetric flowrate, temperature and gas density) in conjunction with Trial furnace processing works to assess compliance with existing exhaust emission performance requirements for EPL Point 1 (Stack 1);
- Capture of real-time, continuous assessment of gaseous fluoride and solid particulates data using existing, on-site control and monitoring systems; and
- Dispatch of treated product to prospective Customers for evaluation.

2.2 Reporting

The scope of this Monitoring and Verification Report is defined in Condition 54 of our Development Consent and Condition U1 of our Environment Protection Licence, as reproduced below:

The Monitoring and Verification Report must:

- be submitted to the EPA, Cessnock City Council and the Director-General within 90 days of the completion of the Trial;
- detail the results of the monitoring required by conditions of the Development Consent and the Environment Protection Licence, including that of air emissions testing and Mixed SPL treatment;
- compare the results of the trial to the limits in the EPL and EPA's air quality impact assessment criteria;
- describe any anomalies in the monitoring data, and any exceedances of the limits or assessment criteria;
- characterise the trial outputs and describe how these products are to be managed and disposed of;
- summarise the findings of the trial;
- recommend any actions that could be taken to minimise emissions during any future processing;
- discuss the likely options for any future processing; and
- Within 90 days of Trial completion, submit an air quality monitoring report to the EPA detailing the results of air emissions testing conducted during the Mixed SPL Trial (Note: included within the scope of this Report).

3. TRIAL FINDINGS

3.1 SPL Handling

Raw Mixed SPL materials were received and handled in accordance with existing chain of custody protocols. SPL handling protocols adopted are defined as follows:

- Transport of raw, untreated Mixed SPL from Tomago Aluminium to Weston Aluminium's Kurri Kurri facility by a licensed Dangerous Goods transport contractor. Deliveries were documented in accordance with the NSW EPA's waste tracking protocols (total tonnage processed: 352 tonnes);
- Storage of SPL receivals within a single, dedicated storage bay within the Plant Building to mitigate contact with stormwater. As per Second Cut SPL and aluminium dross storage, this storage bay was ventilated (serviced by baghouse dust collector) to prevent the potential escape of any airborne particulates;
- Baghouse residues collected throughout the trial were returned to the process as feedstock; and
- Transfer of Mixed SPL within the Plant Building via forklift truck to rotary furnaces in discrete 3 – 4 tonne batches for treatment and processing.

3.2 Treatment Process Conditions

SPL processing conditions are summarised as follows:

- Trials of Mixed Cut SPL processing were performed in discrete 3-4 tonne batches;
- Furnaces were natural gas-fired;
- Temperatures achieved for furnace feedstock ranged between 545^{o}C and 590^{o}C (refer summary **Table 1**);
- Furnace residence times ranged between 0:50 and 1.03 hours per batch (including delays) (refer summary **Table 1**); and
- Treated residues were collected within bins, cooled by rotary cooler, crushed and stored within bulka bags within the Plant Building for ultimate dispatch to Customers.

This process is consistent with conventional 2nd Cut SPL processing.

Table 1: Summary of Furnace Feedstock Treatment Temperature and Process Residence Times

Rotary Furnace 1			Rotary Furnace 2		
Charge Number	**Temperature (^{o}C)**	**Residence Time (min)**	**Charge Number**	**Temperature (^{o}C)**	**Residence Time (min)**
18239	590	48	25823	575	48
18240	560	60	25824	590	62
18426	580	40	26036	565	40
18427	570	30	26037	560	30
18428	550	30	26038	550	30
18429	545	30	26039	550	30
18607	570	50	26224	585	50
18608	585	50	25225	580	50
18665	575	50	26279	575	50

3.3 Air Emission Monitoring

Independent NATA certified emission testing was performed during four consecutive quarterly monitoring events in accordance with regulatory requirements. Real-time, continuous monitoring of fluoride and particulate air emissions was also performed throughout the Trial to assess compliance with regulatory requirements. Monitoring findings are shown below.

3.3.1 Stack Emission Monitoring

A summary of NATA certified stack emission monitoring results is presented in **Table 2**. Regulatory compliance limits are also tabulated for comparative assessment.

Copies of Air Emissions Assessment Reports (excluding Appendices) are enclosed as **Attachment 3**.

Table 2: Summary of Compliance Stack Emission Testing Results

Emission Monitoring Parameter	04 Aug 2015	05 Nov 2015	29 Feb 2016	01 Apr 2015	Regulatory Compliance Limits
Total Particulate Matter	0.7	0.75	0.49	0.76	25
Fine Particulate Matter	0.16	<0.16	0.24	0.17	NL
Hydrogen Chloride	<2	<15	<1.1	<9.1	400
Chlorine	<2	<7.5	<1.1	<4.5	NL
Particulate Fluoride	0.009	0.28	0.098	0.027	NL
Gaseous Fluoride	0.012	0.47	0.03	0.055	2
Sulfuric acid mist (H_2SO_4 as SO_3)	<2	<2	<1.9	<1.5	100
Sulfur dioxide (SO_2 as SO_3)	<10	<9.9	<9.7	<7.6	NL
Total Hazardous Substances (metals)	0.012	0.084	0.084	0.022	10
Total Polycyclic Aromatic Hydrocarbons	0.012	0.044	0.032	0.23	NL
Volatile Organic Compounds	<0.35	<0.6	<0.37	1.47	NL
Total Oxides of Nitrogen (as equiv. NO_2)	3	4	2	3	2500
Carbon Monoxide	14	20	49	95	100
Cyanide	<0.012	0.038	<0.012	0.33	0.5
Oxygen (%)	20.4	20.4	20.5	20.3	NL
Temperature (stack conditions; ^oC)	66	53	77	62	NL
Velocity (stack conditions; m/s)	14	13	15	17	NL
Flowrate (m^3/s)	24	23	24	28	NL
Dry Gas Density (kg/m^3)	1.29	1.29	1.29	1.29	NL

Notes: All values are expressed in mg/m^3 (0^oC, 1 atm, dry gas) unless otherwise defined

NL – Not Listed

ND – Not Determined

3.3.2 Real-time Gaseous Fluoride Emissions Monitoring

Continuous monitoring of gaseous fluoride emissions was performed throughout the Trial to assess compliance with the hourly average regulatory limit of 1.4 mg/m^3. Monitoring data are illustrated in **Figure 1**. Instantaneous gaseous fluoride emissions also remained below the limit criterion of 2 mg/m^3 at all times (data not shown).

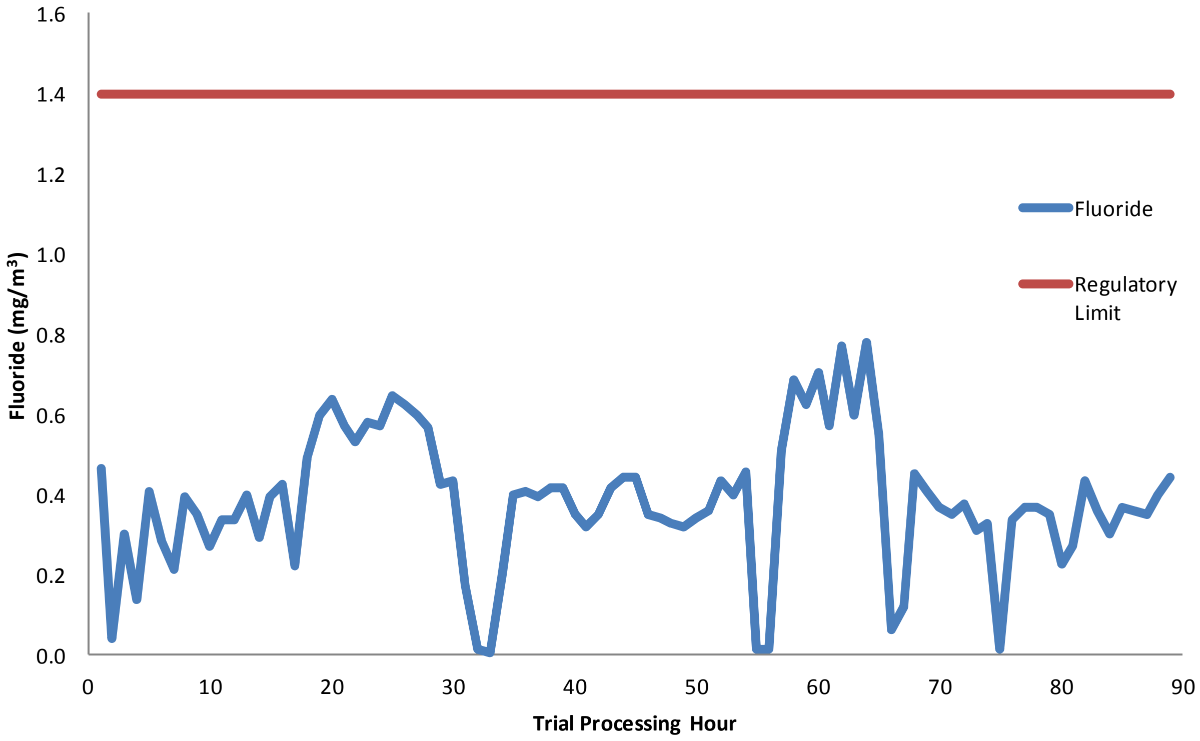


Figure 1: Real-time Gaseous Fluoride Emissions Monitoring Data

3.3.3 Real-time Particulate Emissions Monitoring

Continuous monitoring of particulate emission was performed throughout the Trial to assess compliance with the regulatory limit of 25 mg/m^3. Monitoring data are illustrated in **Figure 2**.

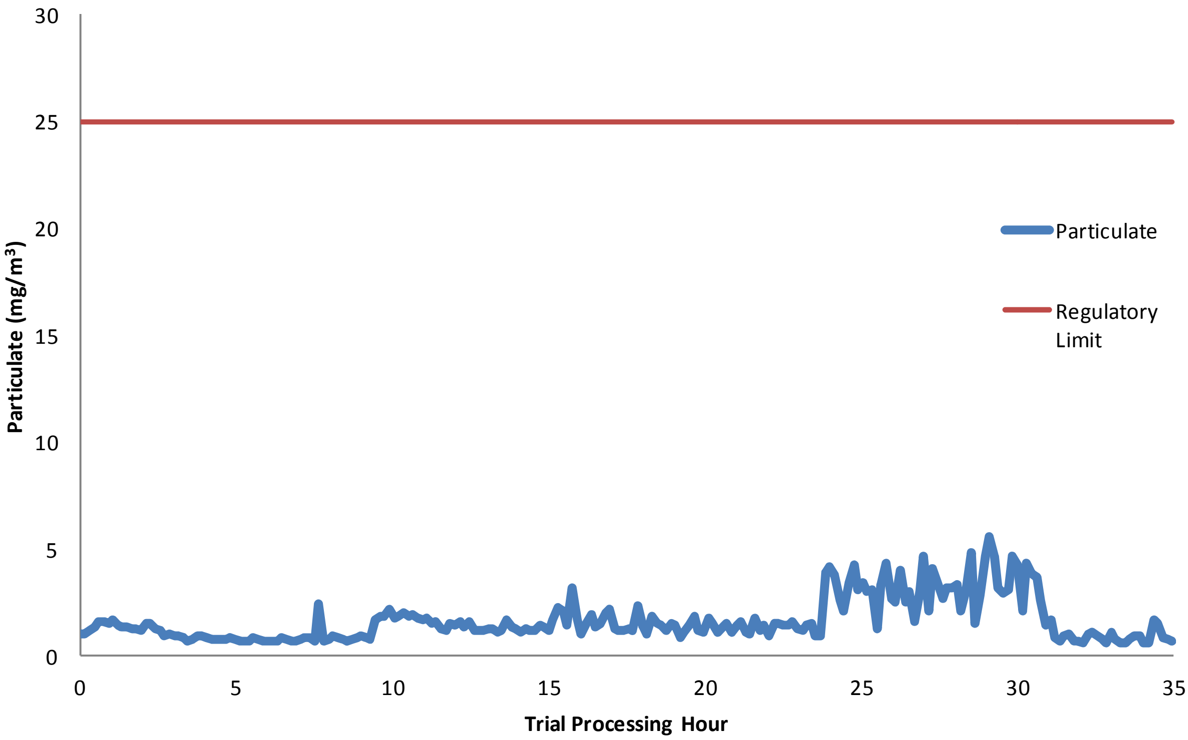


Figure 2: Real-time Particulate Emissions Monitoring Data

3.4 Treated Product Analysis

Samples of treated product materials were obtained during each Trial processing event, and submitted to ALS NATA laboratories for analysis. Composite samples were also obtained for trace component analysis. Analyses of raw (untreated) SPL samples were also performed for completeness.

A summary of these data is presented in **Table 3**. Analytical Laboratory Certificates are enclosed as **Attachment 4**.

Table 3: Summary of Analytical Laboratory Analysis Results

Analytical Parameter	Raw (Untreated) SPL		Treatment Product	
	Total Contaminant Concentrations (mg/kg, dry wt)	TCLP Leachable Contaminant Concentrations (mg/L)	Total Contaminant Concentrations (mg/kg, dry wt)	TCLP Leachable Contaminant Concentrations (mg/L)
Antimony	<5	<0.1	<5	<0.1
Arsenic	11	<0.1	11	<0.1
Barium	210	0.6	265	0.2
Beryllium	2	<0.05	3	<0.05
Cadmium	<1	<0.05	<1	<0.05
Chromium	54	<0.1	58	<0.1
Cobalt	24	<0.1	25	<0.1
Copper	460	0.3	523	0.4
Cyanide	4751	51	86	8
Fluoride	4.6%	545	4.9%	397
Lead	394	<0.1	399	<0.1
Manganese	228	<0.1	252	<0.1
Mercury	<0.1	<0.001	<0.1	<0.001
Molybdenum	4	<0.1	4	<0.1
Nickel	41	<0.1	54	0.1
Phosphorus	207	0.36	262	0.12
Selenium	<5	<0.05	<5	<0.05
Sulfur	0.21%	66	0.19%	63
Thallium	<5	<0.05	<5	<0.05
Vanadium	38	0.3	67	0.5
Zinc	3720	0.2	3855	0.2

4. DISCUSSION

- All regulatory requirements defined for the Trial, including approvals, material tracking, quantity and duration constraints, notification and reporting commitments, and environmental compliance obligations were adhered to throughout the Trial period;
- All deliveries were inspected upon arrival, and were found to be free of foreign contaminants. As expected, the ratio of 1st Cut SPL to 2nd Cut SPL was highly variable. Batch profiles ranged from 5:95 through to 95:5 (1st Cut SPL: 2nd Cut SPL; by visual assessment);
- Existing material storage, handling and treatment protocols, conventionally employed for the processing of 2nd Cut SPL and aluminium dross, were suitable for Mixed SPL storage and handling;
- Cyanide was thermally-destroyed at process temperatures achieved. The thermal treatment performance is confirmed by the 98% reduction in cyanide load, and negligible (exceptionally low) cyanide residuals;
- For each Trial batch, the furnace was operated at elevated temperatures to investigate the resultant emission control profile (including potential for fluoride evolution), and to monitor physical changes to feedstock blends. These operating conditions facilitated the required mineral transformations in the product (proprietary), and did not result in excessive or uncontrollable air emissions during the processing phase;
- Independent NATA certified emission testing undertaken in conjunction with Trial activities reveal exceptionally low pollutant discharge concentrations, and confirm reliable performance of the existing lime-scrubber and fabric filter baghouse pollutant control systems. All air emission concentrations were below regulatory compliance limits, and hence, notification to Regulators in the event of elevated emission concentrations was not required during the Trial. Emissions data are of generally of the same order of magnitude, or lower, than that reported for previous Trials and conventional processing of 2nd Cut SPL and aluminium dross. Accordingly, no further assessment of emission performance (including dispersion modelling) is considered warranted;
- The elevated carbon monoxide emissions were reported for the 1 April 2016 Trial processing event is attributed to the processing of high-Carbon content SPL feedstock. Whilst the measured emission concentration remains below the regulatory compliance limit for Stack 1, Weston Aluminium proposes to explore variable fuel : combustion air ratios for future processing of these high-Carbon inputs. This may also improve the efficiencies of the oxidative treatment process;
- Real-time, continuous emission monitoring data confirm that gaseous fluoride and total particulate emission concentrations satisfied the regulatory compliance limits throughout each Trial interval, and similarly, notification to Regulators in the event of elevated emission concentrations was not required. These data further confirm the suitability of existing pollution control systems for future processing of SPL;
- As expected, cyanide loads within charge matrix were reduced through treatment. The particle size distribution, fluoride content and composition profile of products (proprietary information withheld) is of great interest to prospective Customers, and enables the substitution of virgin raw materials in various industrial processes (proprietary information withheld);
- Product materials were not intended for disposal. Rather, such materials were dispatched for Customer evaluation. Weston Aluminium has received positive feedback from its Customer base regarding the efficacy and ongoing appetite for the product; and

- Research and development activities have successfully demonstrated the compatibility of facility infrastructure, processes and control measures available for the effective treatment of Mixed fraction SPL with broad variance in 1st Cut : 2nd Cut SPL composition ratios. Trials have confirmed environmental performance, and have verified sustainable market interest.

  Accordingly, Weston Aluminium is currently seeking a Development Consent Modification from the NSW Department of Planning & Environment, and an Environmental Protection Licence Variation from the Environment Protection Authority, for the ongoing processing of all SPL material at our Kurri Kurri facility – i.e. with no distinction between 1st Cut, 2nd Cut or Mixed fraction SPL. The scale of processing proposed will remain with the currently regulated 40,000 tonnes per annum.

  The proposal involves the use of existing technologies located at our Kurri Kurri premises, including the following processes:

  - The transportation of material from primary aluminium smelters to Weston Aluminium's Kurri Kurri facility by a licensed Dangerous Goods Contractor (segregated 1st Cut SPL, 2nd Cut SPL, or unsegregated Mixed SPL);
  - The storage of material within existing enclosed buildings and dedicated storage bays;
  - The processing and treatment of material within existing crushing circuits and rotary furnaces, capable of attaining the required temperatures to thermally oxidise contaminants and affect required mineralogical transformations;
  - The continued use of existing best-practice emission controls systems, including extraction hoods, wet-dry lime scrubber, filter baghouse complexes, and real-time continuous fluoride and particulate monitoring systems; and
  - The storage, handling and dispatch of finished product to Customers under existing quality control procedures.

ATTACHMENT 1

ATTACHMENT 2

ATTACHMENT 3

ATTACHMENT 4

Appendix C

Meteorology

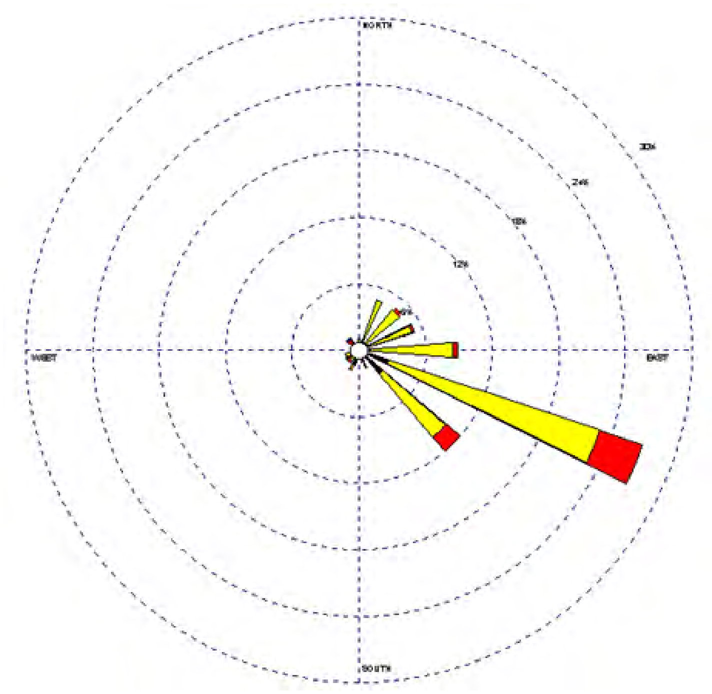
Appendix C Meteorology

Wind roses prepared from the CALMET data used in the modelling were compared to the wind roses from the Hydro Aluminium meteorological station for January – September 2014 (the available data from Hydro Aluminium). As shown in the following plots, there was good agreement between the data sets in terms of wind direction and wind speed. Wind patterns for the full year predominantly occurred within the north-easterly quadrant for both the Hydro Aluminium (measured) and Weston Aluminium (WA) (prognostic) data. The Hydro Aluminium data occurred more on the southerly side, while the WA data had a higher proportion of north-easterly winds

There was a large difference between the data sets in terms of the percentage of calm conditions, with the CALMET data predicting substantially lower calm periods. This is expected as the prognostic data were developed using TAPM, which typically predict fewer calm wind conditions than are measured at a given location. The percentage of calm conditions recorded at Hydro Aluminium are, however, much higher than would be expected for a site affected by valley drainage flow. Calm wind conditions typically produce poor dispersion conditions, resulting in greater pollutant concentrations close to the point of emission. As there are few receptors located close to the WA facility, the pollutant plumes are expected to be relatively dispersed and diluted before reaching most receptors.

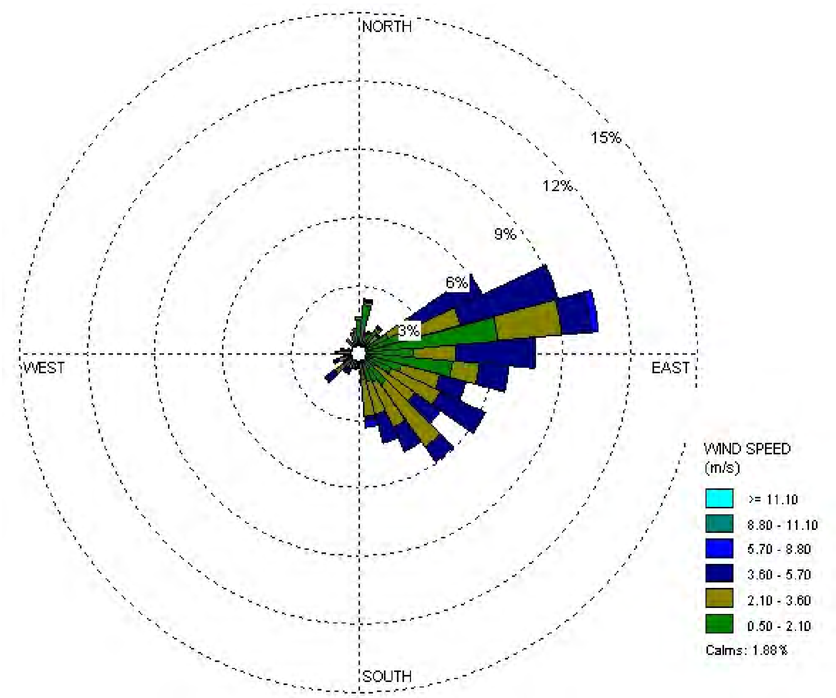
Wind Roses: Hydro Aluminium v CALMET

JANUARY 2014



Hydro Aluminium

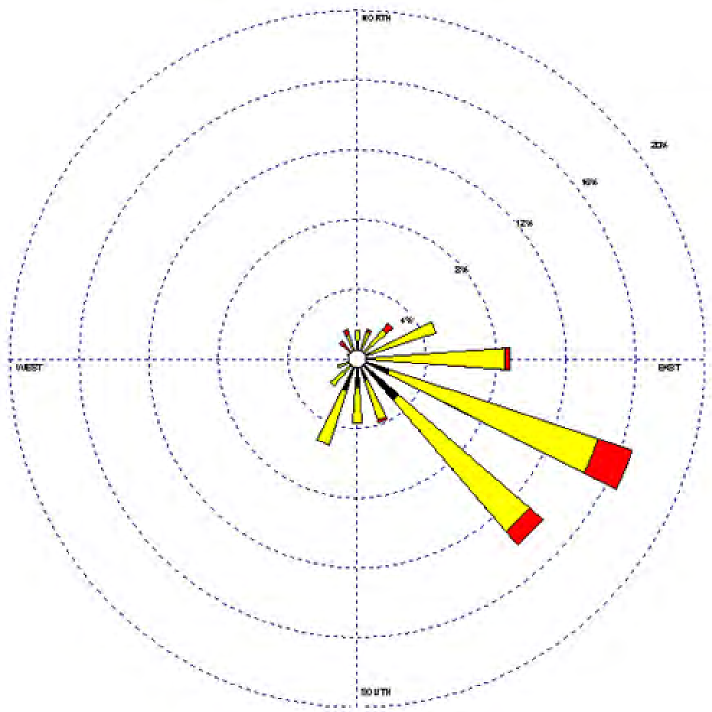
Calms: 26.21%



CALMET

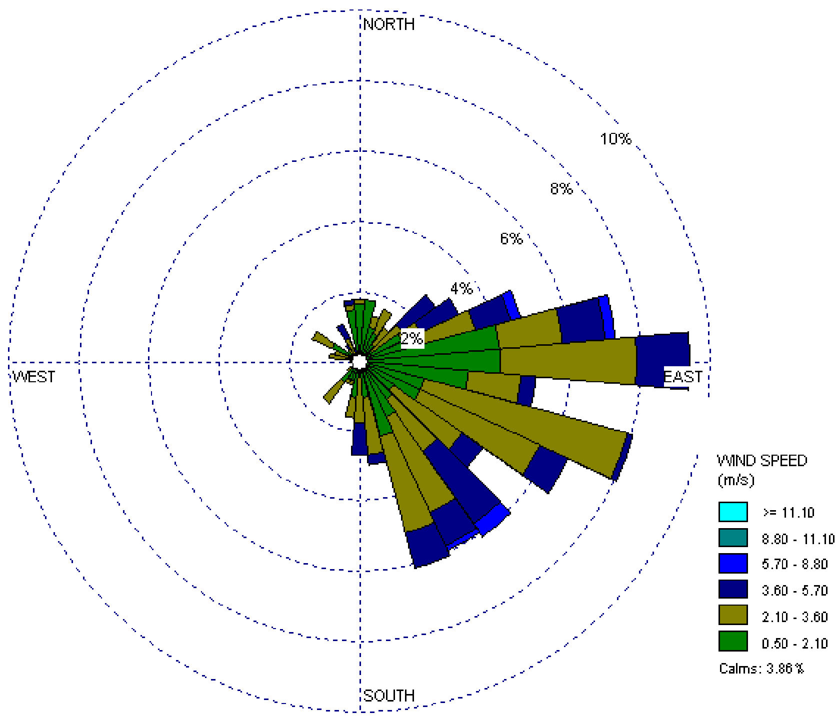
Calms: 1.88 %

FEBRUARY 2014



Hydro Aluminium

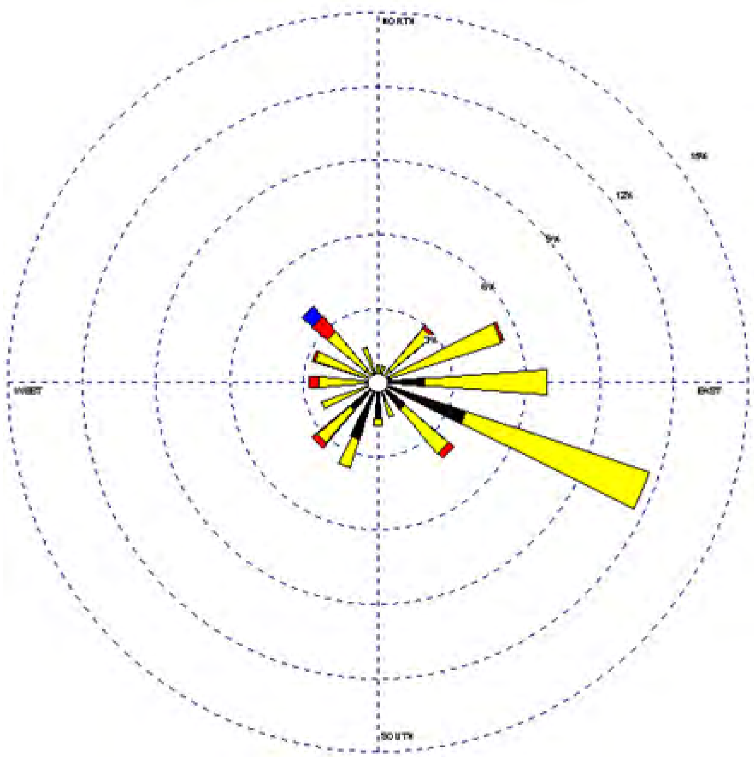
Calms: 29.61 %



CALMET

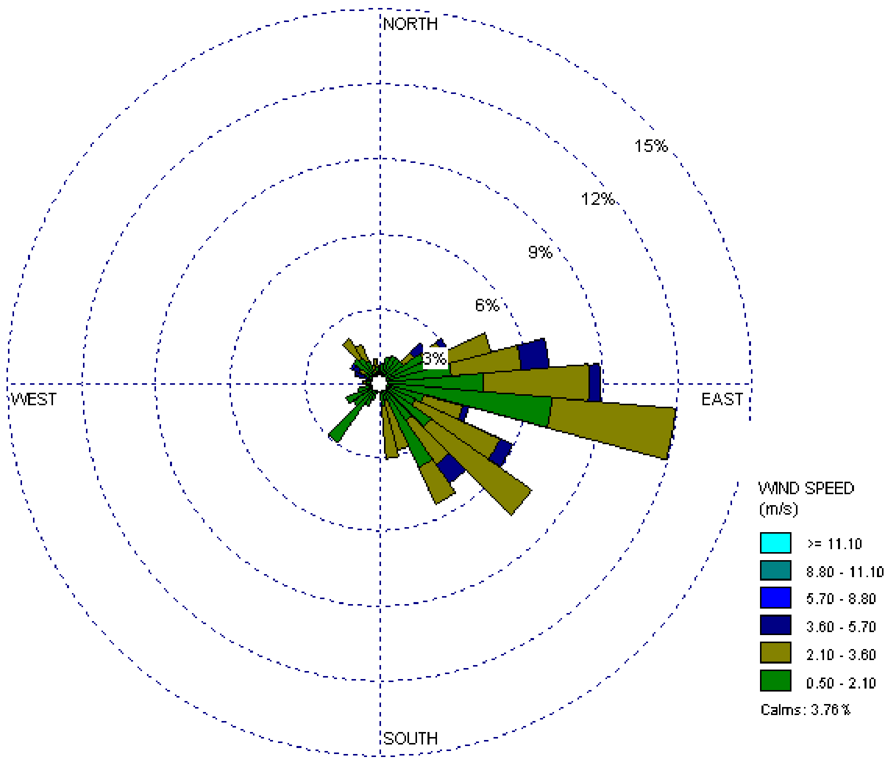
Calms: 3.86 %

MARCH 2014



Hydro Aluminium

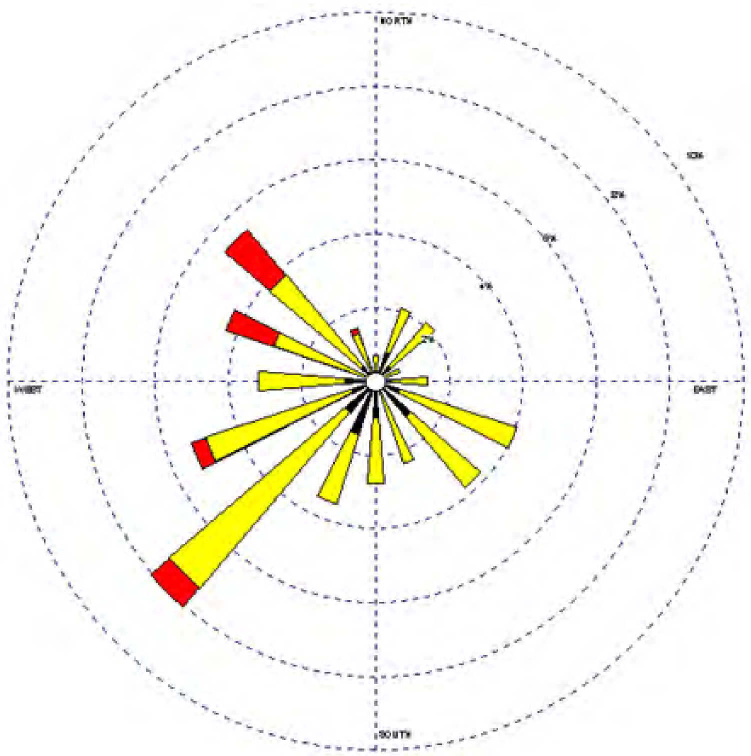
Calms: 43.95 %



CALMET

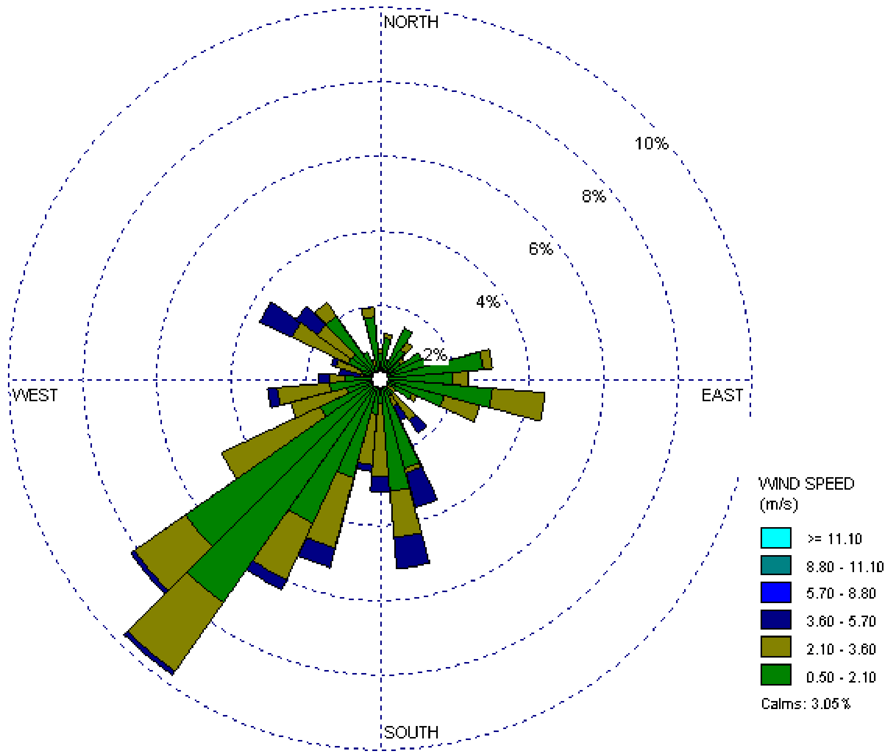
Calms: 3.76 %

APRIL 2014



Hydro Aluminium

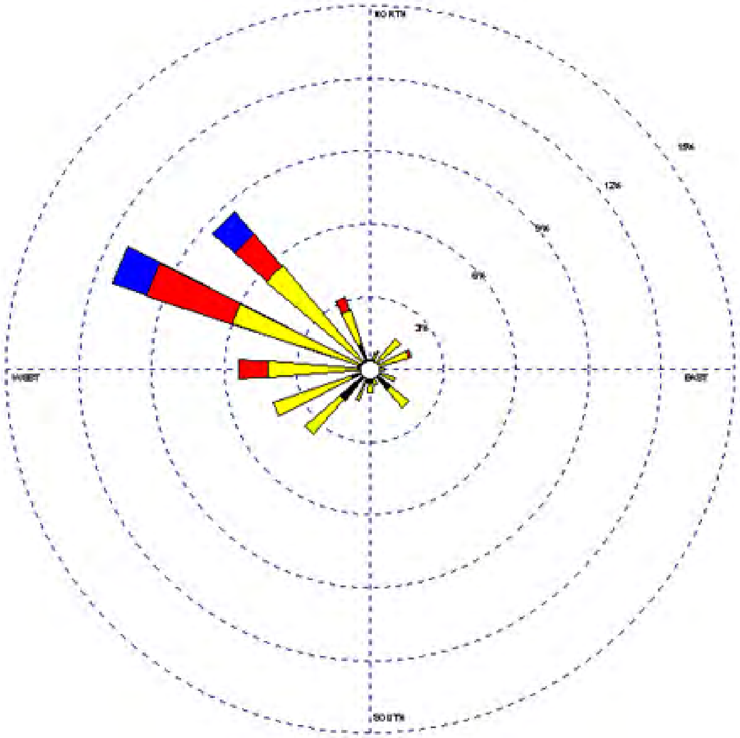
Calms: 48.89 %



CALMET

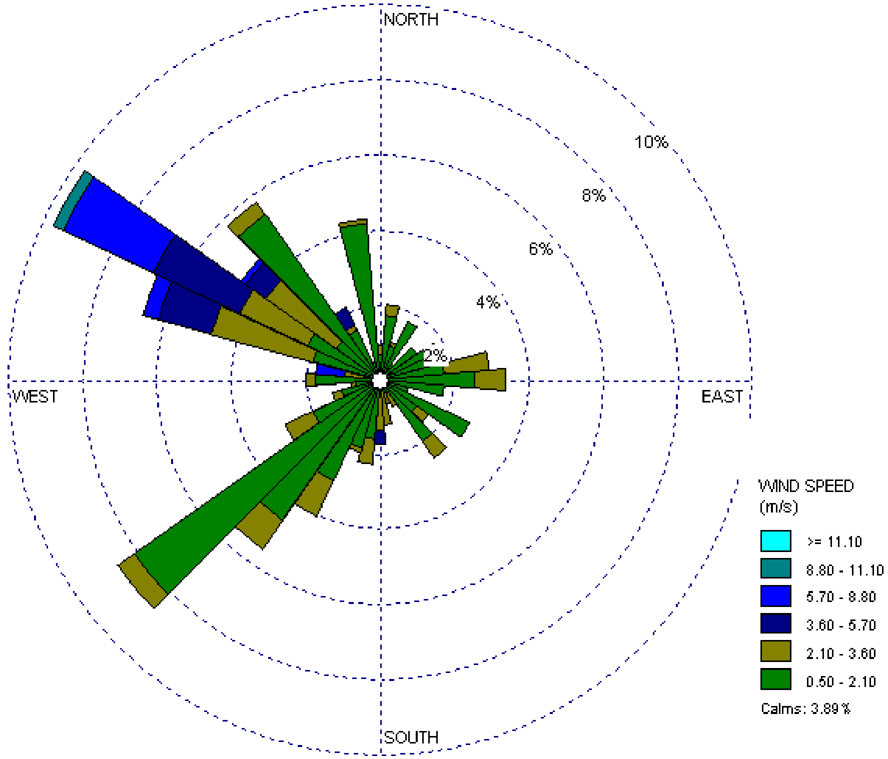
Calms: 3.05 %

MAY 2014



Hydro Aluminium

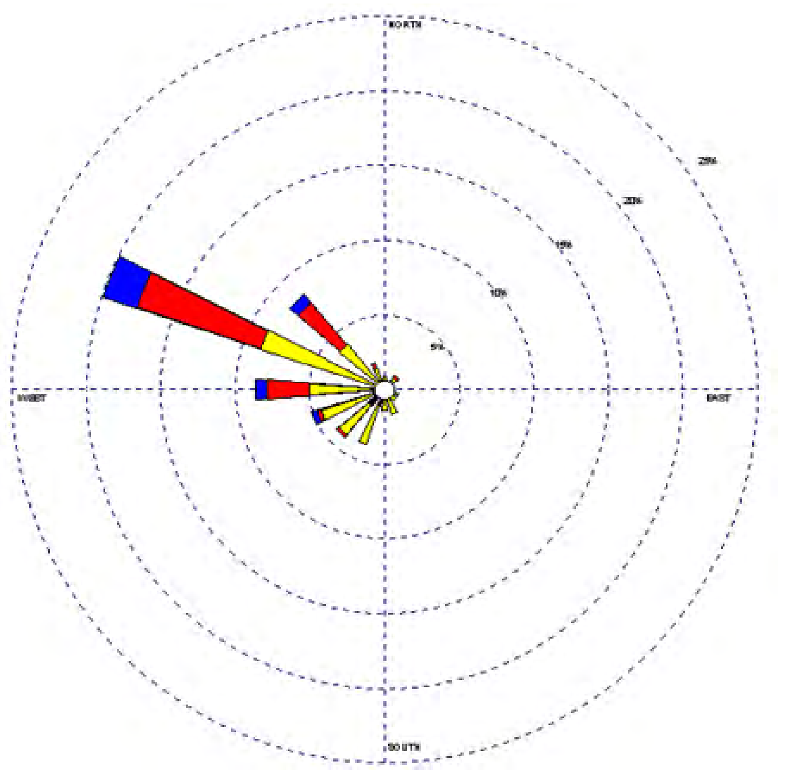
Calms: 52.59 %



CALMET

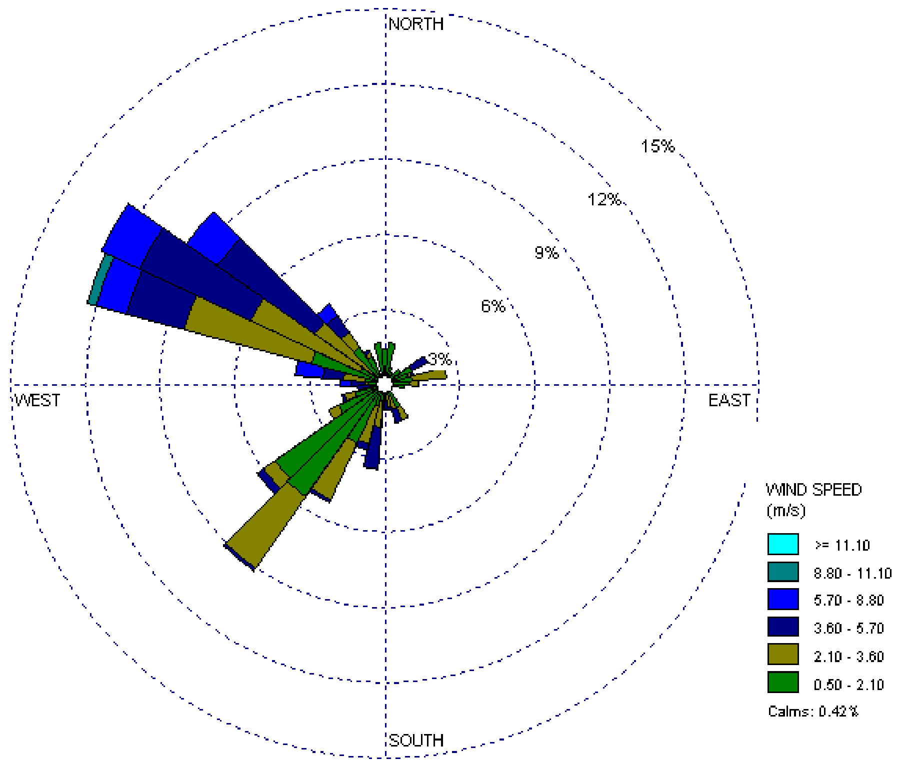
Calms: 3.89 %

JUNE 2014



Hydro Aluminium

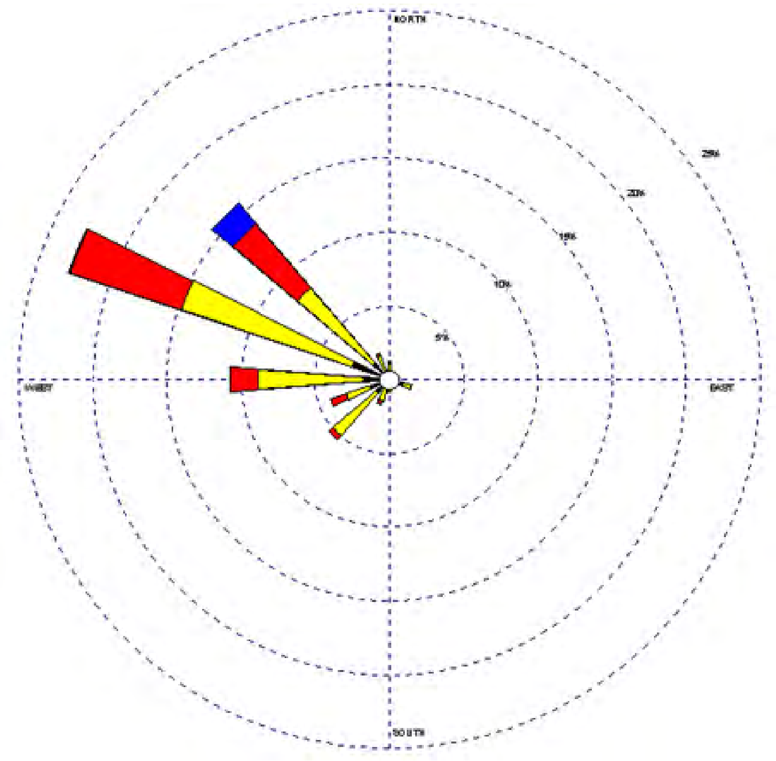
Calms: 39.44 %



CALMET

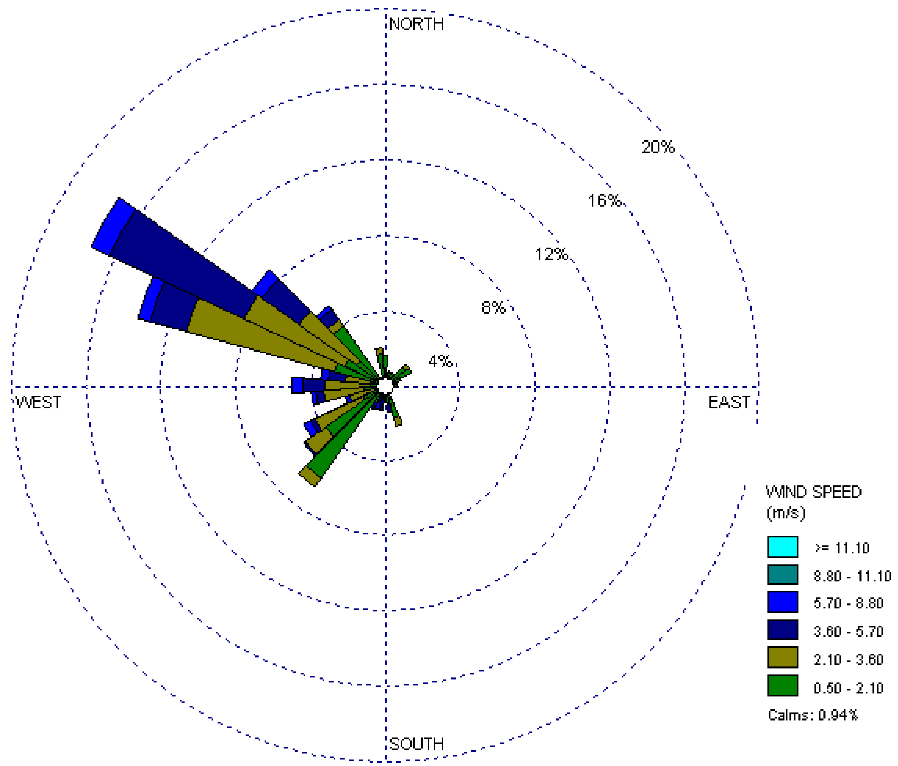
Calms: 0.42 %

JULY 2014



Hydro Aluminium

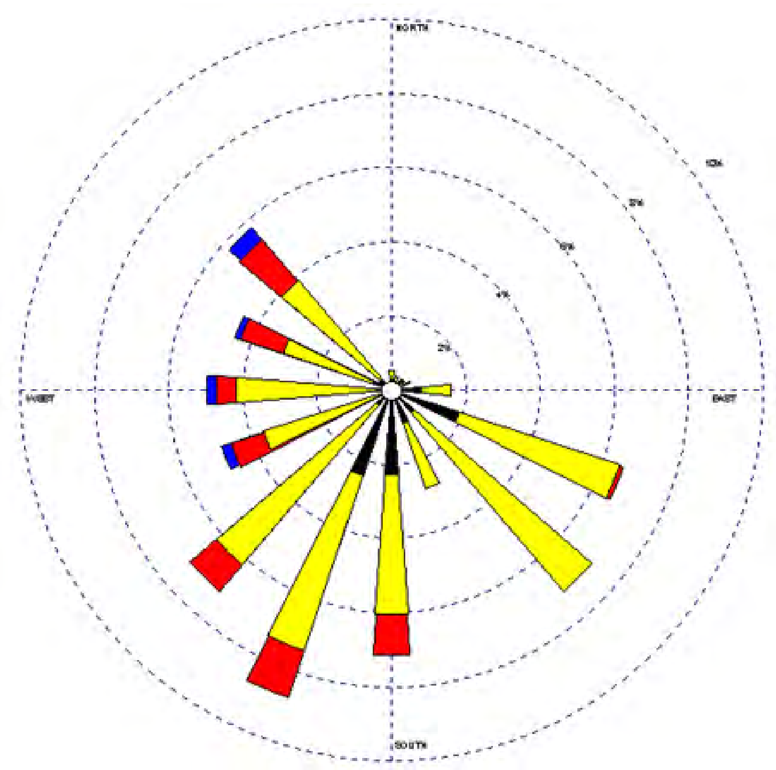
Calms: 32.12 %



CALMET

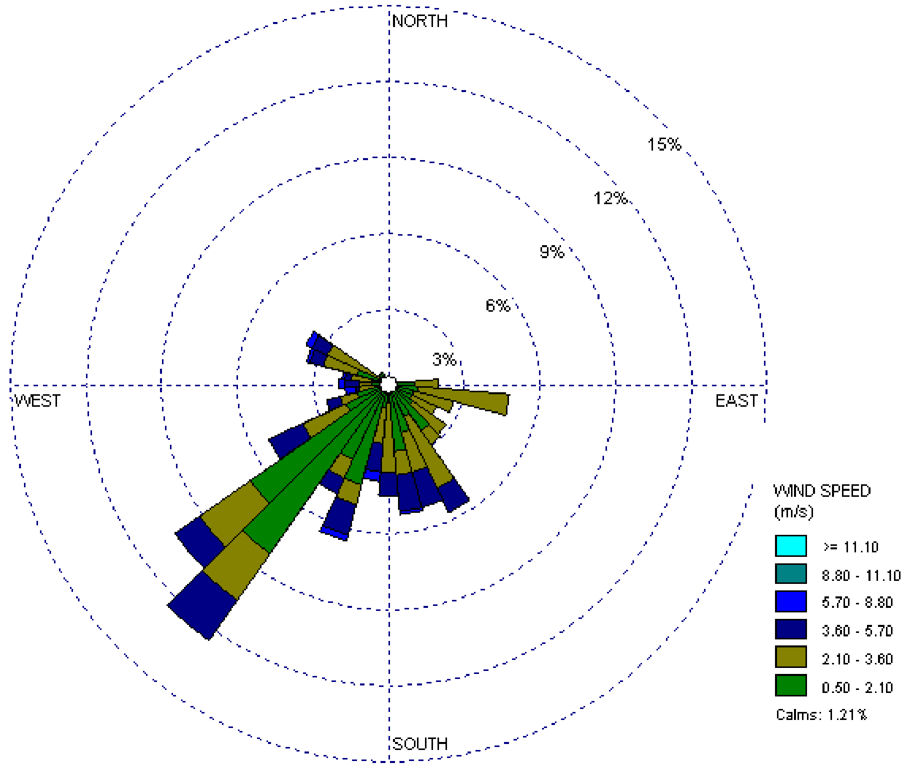
Calms: 0.94 %

AUGUST 2014



Hydro Aluminium

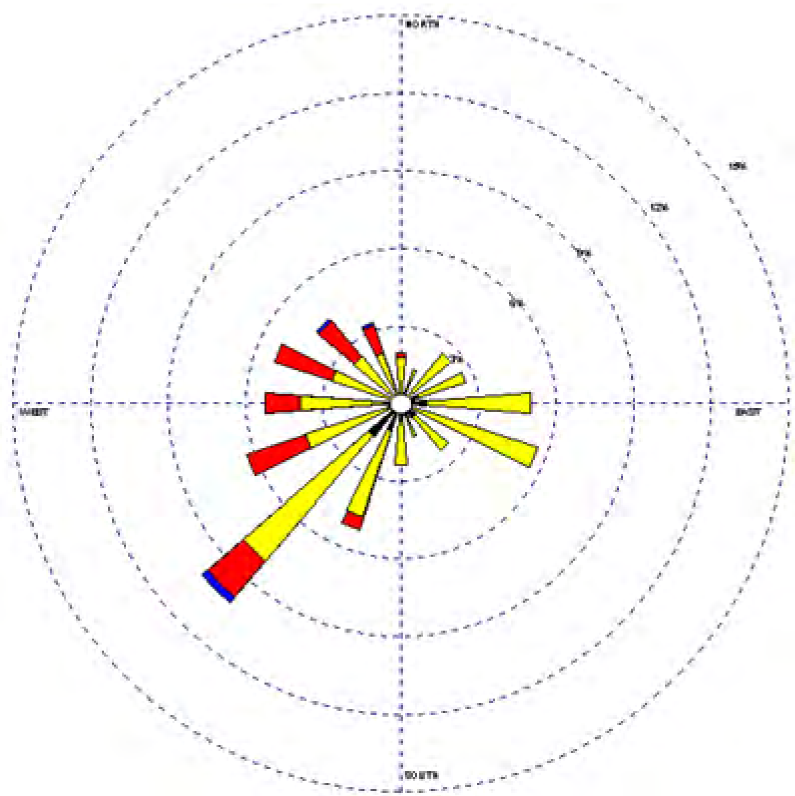
Calms: 36.83 %



CALMET

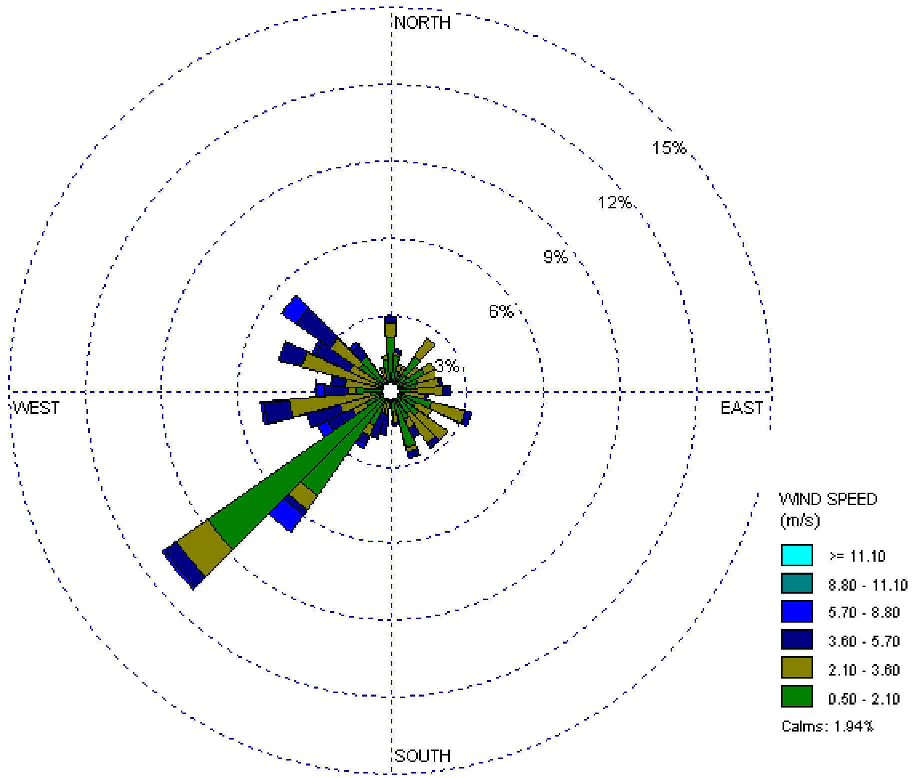
Calms: 1.21 %

SEPTEMBER 2014



Hydro Aluminium

Calms: 35.28 %

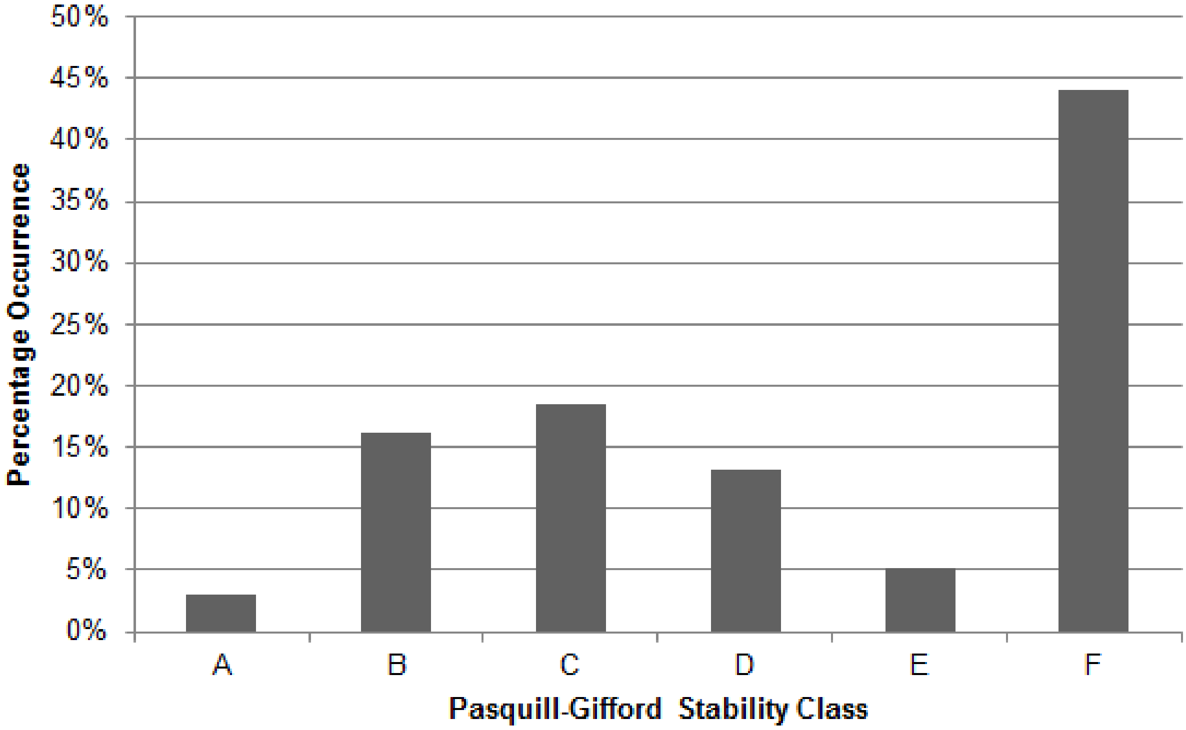


CALMET

Calms: 1.94 %

Atmospheric stability is a measure of atmospheric turbulence and the dispersive properties of the atmosphere. The Pasquill Gifford scheme specifies seven classes of atmospheric stability, which are designated A through G; most dispersion models, however, group Classes F & G together. Class A conditions are very unstable, while Class F conditions are stable, such as occur at night. Class D conditions are neutral.

The distribution of stability classes in the CALMET data is shown in the figure below. As shown, the greatest proportion of conditions were Class F, which represented 44 % of all the hours modelled. Class F stability conditions occur at night; as such, this result is not unexpected. Class C, B and D stability conditions occurred with a similar frequency,



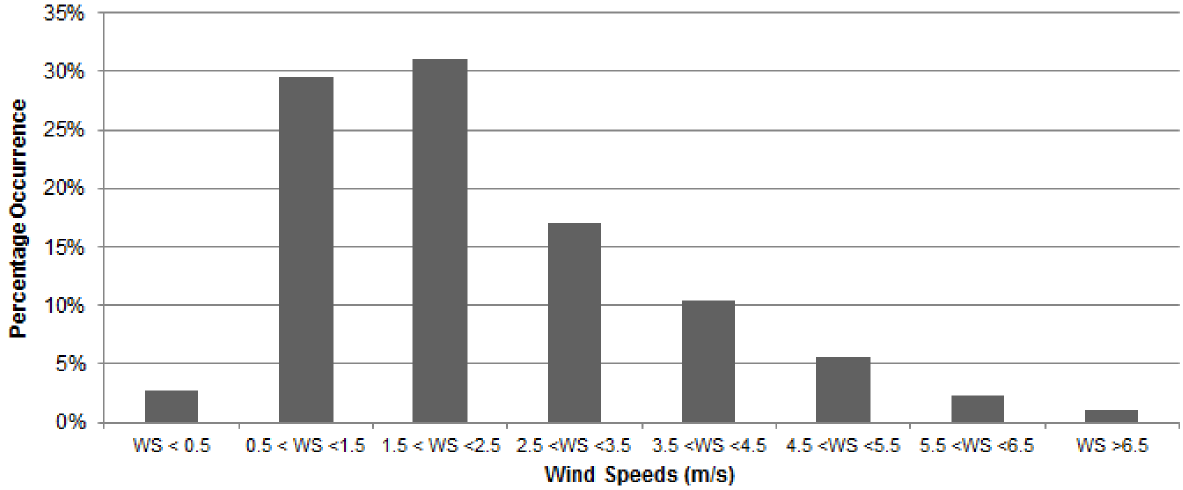
As shown below, the stability classes occurred at the expected times. Class E and F stability occurred only at night and during the early morning, while classes A, B and C occurred during the day; Class D stability (neutral conditions) occurred throughout the 24 hour period, but predominantly during daylight hours, with the highest occurrence in the late afternoon. This pattern is considered to be representative of the meteorological conditions in the area.

Stability Class by Hour of Day

Hour of Day	Stability Class					
	A	B	C	D	E	F
0	0	0	0	8	23	333
1	0	0	0	7	25	332
2	0	0	0	8	29	327
3	0	0	0	6	34	324
4	0	0	0	7	30	327
5	0	0	97	35	27	205
6	0	61	133	61	16	93
7	0	109	168	87	0	0
8	10	192	132	30	0	0
9	16	193	113	42	0	0
10	63	172	95	34	0	0
11	75	166	88	35	0	0
12	62	149	105	48	0	0
13	28	155	113	68	0	0
14	2	125	150	87	0	0
15	2	74	177	111	0	0
16	0	15	178	171	0	0
17	0	5	57	171	15	116
18	0	0	11	97	43	213
19	0	0	0	7	69	288
20	0	0	0	7	44	313
21	0	0	0	7	35	322
22	0	0	0	7	30	327
23	0	0	0	8	25	331

Stable conditions result in poorer dispersion and, subsequently, higher pollutant concentrations; as such, the high proportion of stable conditions (Class E and F combined) mean that the meteorological data used in the assessment are conservative.

The distribution of wind speeds was also reviewed. As shown below, the CALMET data contained mostly low wind speeds, with 64 % of the winds in the meteorological file being less than 2.5 m/s. Low wind speeds can also result in poorer dispersion.



As shown in the following table, the highest wind speeds occurred during Class C and D stability, which is expected as per DEC (2005a). Also as expected, Class A and Class F stability conditions were associated with low wind speeds.

Wind Speed (m/s)	Stability Class					
	A	B	C	D	E	F
0.5	27	33	32	0	0	147
1	48	168	109	0	0	648
1.5	32	239	142	0	0	1150
2	50	210	164	56	48	865
2.5	57	147	165	149	105	626
3	0	206	156	130	51	92
3.5	38	174	161	139	47	260
4	0	33	199	106	55	0
4.5	0	33	199	106	55	0
5	0	11	134	87	36	0
6	0	0	131	206	13	0
7	0	0	10	80	0	0
8	0	0	2	33	0	0
10	0	0	4	26	0	0
12	0	0	7	28	0	0
14	0	0	0	0	0	0

On the basis of the above analysis, the predicted meteorological conditions appear to provide a representative estimation for the local meteorology and, as such, were considered appropriate for use in this assessment.

Appendix D

Discrete Receptor Locations

Appendix D Discrete Receptor Locations

Table 15 Sensitive Receptors

ID	MGA 56 (m)		Land Use	ID	MGA 56 (m)		Land Use
	X	Y			Y	Y	
1	357580.2	6368434	Recreational	**93**	358169.6	6368525	Residential
2	356435.7	6368332	Recreational	**94**	358081.5	6368483	Residential
3	358173.5	6369639	Commercial/Industrial	**95**	357979.7	6368446	Residential
4	357561.1	6369198	Commercial/Industrial	**96**	357894.1	6368403	Residential
5	356414.7	6368854	Commercial/Industrial	**97**	357833.5	6368376	Residential
6	357334.2	6369029	Commercial/Industrial	**98**	357747.9	6368336	Residential
7	357197.1	6368893	Commercial/Industrial	**99**	357652.8	6368335	Residential
8	357044.7	6368809	Commercial/Industrial	**100**	357575.4	6368281	Residential
9	356931.2	6368706	Commercial/Industrial	**101**	357511.7	6368247	Residential
10	356684.2	6368519	Commercial/Industrial	**102**	357444.1	6368222	Residential
11	357128.4	6369008	Commercial/Industrial	**103**	357391.6	6368197	Residential
12	356830.4	6368829	Commercial/Industrial	**104**	357312.5	6368175	Residential
13	356685.2	6368720	Commercial/Industrial	**105**	357247.7	6368141	Residential
14	356612.7	6368628	Commercial/Industrial	**106**	357195.5	6368110	Residential
15	356515.6	6368586	Commercial/Industrial	**107**	357123.9	6368078	Residential
16	356448.6	6368556	Commercial/Industrial	**108**	357041.7	6368056	Residential
17	356338.8	6368549	Commercial/Industrial	**109**	356934.4	6367994	Residential
18	356361.1	6368657	Commercial/Industrial	**110**	356834.4	6367961	Residential
19	356464.9	6368736	Commercial/Industrial	**111**	356761	6367924	Residential
20	356400.1	6368765	Commercial/Industrial	**112**	356971.5	6368343	Residential
21	356345.1	6368782	Commercial/Industrial	**113**	356884.3	6368289	Residential
22	356714.9	6369079	Commercial/Industrial	**114**	356796.8	6368271	Residential
23	356929	6369037	Commercial/Industrial	**115**	356717.5	6368248	Residential
24	356777.5	6369277	Commercial/Industrial	**116**	356654.5	6368226	Residential
25	356939.9	6368564	Commercial/Industrial	**117**	356620	6368373	Residential
26	357099.4	6368456	Commercial/Industrial	**118**	356684.5	6368371	Residential
27	357185.2	6368422	Commercial/Industrial	**119**	356732.7	6368410	Residential
28	357248.6	6368455	Commercial/Industrial	**120**	356810.9	6368454	Residential

ID	MGA 56 (m)		Land Use	ID	MGA 56 (m)		Land Use
	X	Y			Y	Y	
29	357147.4	6368711	Commercial/Industrial	**121**	356872.9	6368503	Residential
30	357230.2	6368777	Commercial/Industrial	**122**	357467	6368788	Residential
31	357272.7	6368674	Commercial/Industrial	**123**	357091	6370000	Residential
32	357289.3	6368585	Commercial/Industrial	**124**	357741.6	6369959	Residential
33	357309.6	6368558	Commercial/Industrial	**125**	358088.4	6370204	Residential
34	357312.6	6368537	Commercial/Industrial	**126**	358154.8	6370188	Residential
35	357249.7	6368475	Commercial/Industrial	**127**	358206.1	6370072	Residential
36	357292.9	6368816	Commercial/Industrial	**128**	358313.6	6370019	Residential
37	357354.8	6368741	Commercial/Industrial	**129**	358403.1	6369962	Residential
38	357330.7	6368688	Commercial/Industrial	**130**	356493.8	6369540	Residential
39	357374	6368597	Commercial/Industrial	**131**	356574.2	6369475	Residential
40	357387.2	6368535	Commercial/Industrial	**132**	356380.2	6369869	Residential
41	357398.5	6368518	Commercial/Industrial	**133**	356336.1	6369757	Residential
42	357480.4	6368755	Commercial/Industrial	**134**	356372.7	6369622	Residential
43	357475.6	6368674	Commercial/Industrial	**135**	356391.4	6369531	Residential
44	357576.9	6368661	Commercial/Industrial	**136**	356402.7	6369463	Residential
45	357626	6368787	Commercial/Industrial	**137**	356371.7	6369290	Residential
46	357691.9	6368686	Commercial/Industrial	**138**	356369.3	6369239	Residential
47	358307.6	6368785	School TAFE	**139**	356357.4	6369175	Residential
48	358516.9	6368924	Residential	**140**	356351.3	6369136	Residential
49	358401.8	6368881	Residential	**141**	356347	6369082	Residential
50	358090.6	6368748	Residential	**142**	356342	6369032	Residential
51	358020.6	6368715	Residential	**143**	356331.2	6368986	Residential
52	357944.8	6368690	Residential	**144**	356319	6368942	Residential
53	357860.1	6368641	Residential	**145**	356305.4	6368888	Residential
54	357776.9	6368612	Residential	**146**	356295.8	6368839	Residential
55	357674.9	6368559	Residential	**147**	356291.6	6368788	Residential
56	357587.4	6368523	Residential	**148**	356282.4	6368738	Residential
57	357503	6368490	Residential	**149**	356271.6	6368708	Residential
58	357428.2	6368460	Residential	**150**	356267.8	6368641	Residential

ID	MGA 56 (m)		Land Use	ID	MGA 56 (m)		Land Use
	X	Y			Y	Y	
59	357365.4	6368424	Residential	**151**	356261	6368591	Residential
60	357311.5	6368395	Residential	**152**	356248.3	6368564	Residential
61	357230.1	6368368	Residential	**153**	356249.2	6368483	Residential
62	357149	6368326	Residential	**154**	356238.1	6368431	Residential
63	357094.3	6368304	Residential	**155**	356225.6	6368382	Residential
64	357040.8	6368276	Residential	**156**	356218.1	6368326	Residential
65	356976.4	6368254	Residential	**157**	356213.3	6368278	Residential
66	356910.5	6368233	Residential	**158**	356206.3	6368229	Residential
67	356773.7	6368158	Residential	**159**	356194.2	6368176	Residential
68	356689.2	6368137	Residential	**160**	355951.2	6368107	Residential
69	356744.2	6367995	Residential	**161**	355961.9	6368172	Residential
70	356850.6	6368026	Residential	**162**	355977.3	6368227	Residential
71	356949.1	6368066	Residential	**163**	355989.9	6368271	Residential
72	357038.3	6368110	Residential	**164**	356000.1	6368343	Residential
73	357112.4	6368139	Residential	**165**	356007.8	6368378	Residential
74	357186.4	6368176	Residential	**166**	356012.9	6368420	Residential
75	357279.5	6368260	Residential	**167**	356018.1	6368464	Residential
76	357368.9	6368253	Residential	**168**	356021.9	6368519	Residential
77	357430.3	6368279	Residential	**169**	356036	6368580	Residential
78	357590.5	6368343	Residential	**170**	356050.3	6368626	Residential
79	357672.9	6368385	Residential	**171**	356054.8	6368677	Residential
80	357747.9	6368412	Residential	**172**	356060.1	6368725	Residential
81	357804.3	6368446	Residential	**173**	356073.6	6368773	Residential
82	357885.3	6368482	Residential	**174**	356084.2	6368828	Residential
83	357973.3	6368502	Residential	**175**	356089.2	6368879	Residential
84	358079.2	6368556	Residential	**176**	356101.8	6368923	Residential
85	358156.7	6368589	Residential	**177**	356107.9	6368984	Residential
86	358448.7	6368729	Residential	**178**	356116.1	6369022	Residential
87	358547.3	6368770	Residential	**179**	356128.3	6369078	Residential
88	358615.3	6368712	Residential	**180**	356134.3	6369126	Residential

ID	MGA 56 (m)		Land Use	ID	MGA 56 (m)		Land Use
	X	Y			Y	Y	
89	358537.9	6368684	Residential	**181**	356139.1	6369175	Residential
90	358477.5	6368652	Residential	**182**	356146.7	6369219	Residential
91	358377.5	6368620	Residential	**183**	356161.9	6369288	Residential
92	358277.6	6368577	Residential	**184**	356265.7	6369535	Residential

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