



AIR EMISSIONS VERIFICATION REPORT

THERMAL DESTRUCTION OF PHARMACEUTICAL & ILLICIT DRUG WASTE

DA 86-04-01 MOD-12 and LEC 10397 of 1995 MOD-10

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		Prepared By:	C. McClung
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1. INTRODUCTION

In NSW, medical wastes (including pharmaceutical wastes) and illicit drug (exhibit) wastes must be disposed of via thermal treatment (autoclaving or incineration), and limited options currently exist for their responsible and sustainable destruction. Pharmaceutical wastes may consist of expired, superseded, unwanted / unused, off-specification medications and their associated packaging (including cardboard cartons, drums, plastic and glass bottles, blister packs and plastic wrap), as well as precursors and residues associated with their manufacture. Exhibit wastes typically include cannabis (leaf, stem and roots) and powdered or pill-formed narcotics confiscated by the NSW Police, as well as their associated cardboard, paper and plastic packaging and evidence satchels. Given the limited disposal options available, compounding waste generation rates, and technical challenges associated with responsible waste treatment (variable waste stream; stringent air emissions control requirements, storage and handling), medical wastes are often transported interstate for destruction. This situation is unsustainable.

In response to the continual decline in Weston Aluminium Pty Limited's (Weston Aluminium) traditional markets serviced (aluminium and steelmaking sectors), the resultant surplus thermal treatment capacity, and superior emissions control performance, Weston Aluminium sought to explore other diversification opportunities and investigate the viability of pharmaceutical and exhibit waste processing (thermal destruction) utilizing existing plant infrastructure, equipment and processes.

Research and development trial activities, undertaken in accordance with regulatory approvals and licence requirements during 2015 – 2017, established the following:

- Variability of waste consignment density, packaging type and moisture content;
- Verification of technology and infrastructure compatibility and performance on a relatively large-scale (storage and containment, treatment, and environmental control systems);
- Optimal furnace operating conditions, including identifying suitable batch composition, batch/residence time, burner protocol and required operating temperature for the processing of pharmaceutical and illicit drug wastes;
- Verification of the performance of the existing pollution control systems and compliance with regulatory limit criteria;
- Verification of the performance of various feedstock formulations;
- Assessment and confirmation of process and procedural controls relating to occupational exposures and safety performance;
- Assessment of treatment product (residual ashes) quantities and, in conjunction with other inputs, formulation of the manufacture of a value-added product which serves as a direct substitute for conventional industrial raw material feedstock (brick, tile and cement); and
- Energy demand requirements.

Following the successes of these formal trial processing activities, confirmation of air emissions control and extensive consultation with the NSW Department of Planning, Industry and Environment (DPIE) and the NSW Environment Protection Authority (EPA), Weston Aluminium sought Regulatory Approvals for the ongoing, commercial-scale thermal processing of Pharmaceutical and Illicit Drug Waste processing in its existing Rotary Furnaces. Approvals were granted by the NSW DPIE and NSW EPA on 02 August 2019 and 16 August 2019 respectively, permitting the thermal destruction of up to 2,000t of pharmaceutical and 5t of illicit drug wastes per annum.

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As a further extension, Weston Aluminium also sought regulatory approval for the construction and operation of an independent Medical and Other Waste Thermal Processing Facility (SSD 7396) at its Kurri Kurri premises. This brownfield development was constructed in 2019-20, and is currently being commissioned.

2. SCOPE OF WORKS

This Air Emissions Verification Report has been prepared in accordance with requirements of Development Consent (DA 86-04-01 MOD-12 and LEC 10397 of 1995 MOD-10), and describes the following in relation to the first 12-months (16 August 2019 – 15 August 2020) of waste processing:

- Furnace processing conditions, including input quantity and characteristics, operating profile and duration of thermal treatment;
- An assessment of Stack 1 air emissions monitoring against EPL limit criteria;
- Approaches taken to resolve any non-compliances, including timeframe for implementation; and
- A tracking summary of the implementation and monitoring of mitigation measures as listed under *Hazards and Risk, Table 15 Summary of Management Measures* of the Environmental Assessment (AECOM, July 2017).

3. VERIFICATION FINDINGS

3.1 Processing Conditions

Waste processing conditions are summarised as follows:

- A total of 5.1 tonnes of pharmaceutical wastes and 0.9 tonnes of NSW Police exhibit (illicit drug) wastes were received and processed during the first 12-months of operation;
- Pharmaceutical waste inputs (principally Ibuprofen and Calcium tablets) included expired / off-specification or surrendered product tablets in either plastic bottle preparations or conventional blister packs and cardboard cartons;
- Exhibit waste inputs were quite variable, including cannabis exhibits (seeds, foliage and stem material), loose powders (illicit drugs and suspected 'cutting agents') and preformed tablets. Unidentified pharmaceutical wastes were often associated with exhibit waste processing consignments;
- All packaging materials (cardboard cartons, plastic and paper/cardboard exhibit bags, shrink-wrapping, etc.) associated with pharmaceutical and illicit drug waste deliveries were also thermally destroyed, as per convention;
- Wastes were thermally co-processed with conventional aluminium dross inputs in existing 5 tonne natural gas-fired rotary furnaces;
- Pharmaceutical and/or exhibit wastes were typically charged at a rate of 0.5 – 2.5% (w/w) of the total charge mass – below the regulatory upper limit of 5% (w/w) (refer summary **Figure 1**);
- No liquids were present within input wastes;
- Furnace batch times were consistent with conventional dross processing batches (typically 1 – 2 hours; refer **Figure 2**); and

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- Temperature monitoring of furnace exhaust gases was performed during all processing operations. Flue exhaust temperatures achieved during destruction typically ranged from 900 - 1000 °C (also refer **Section 5**). A summary of furnace temperature profiling (Note: reflecting all phases of furnace cycling) for Rotary Furnaces 1 and 2 is illustrated in **Figures 3** and **4** respectively.

This process is consistent with conventional Aluminium Dross processing and that of 2015-17 Trial-based processing activities.

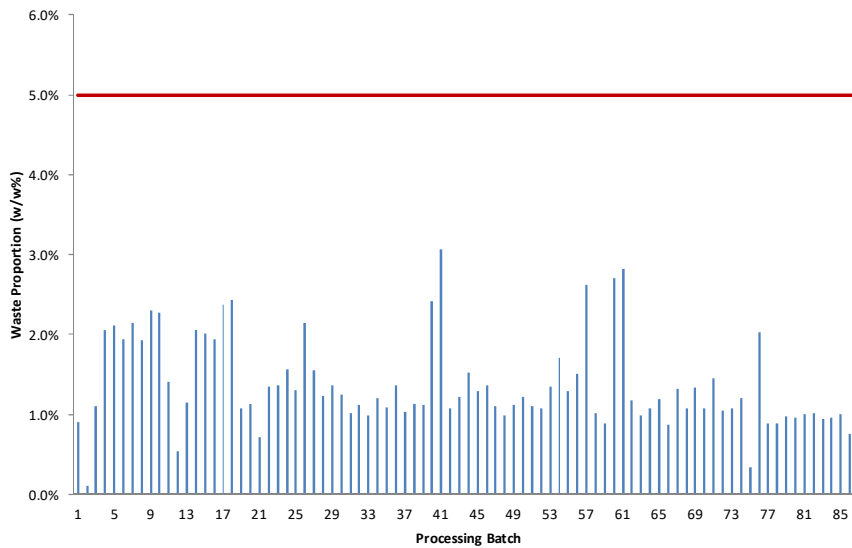


Figure 1: Proportion of waste quantities with conventional process inputs (first 12-months of processing)

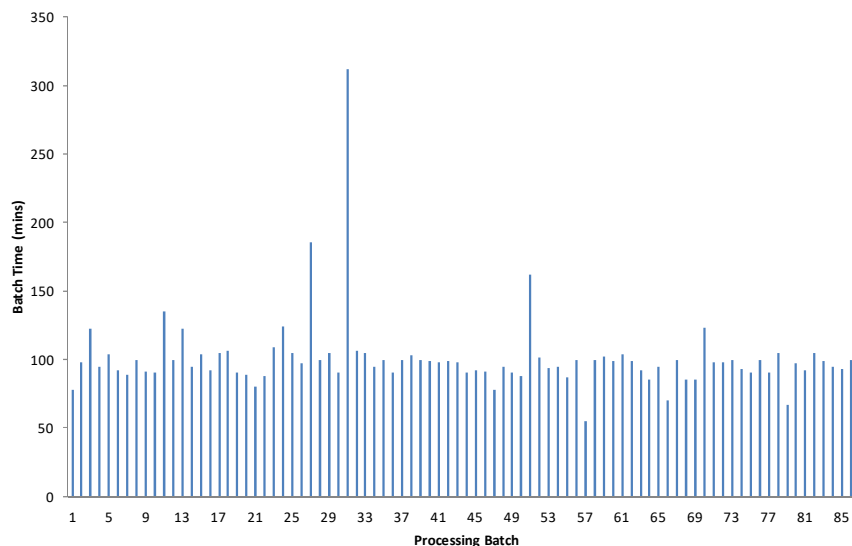


Figure 2: Thermal waste processing duration (first 12-months of processing)

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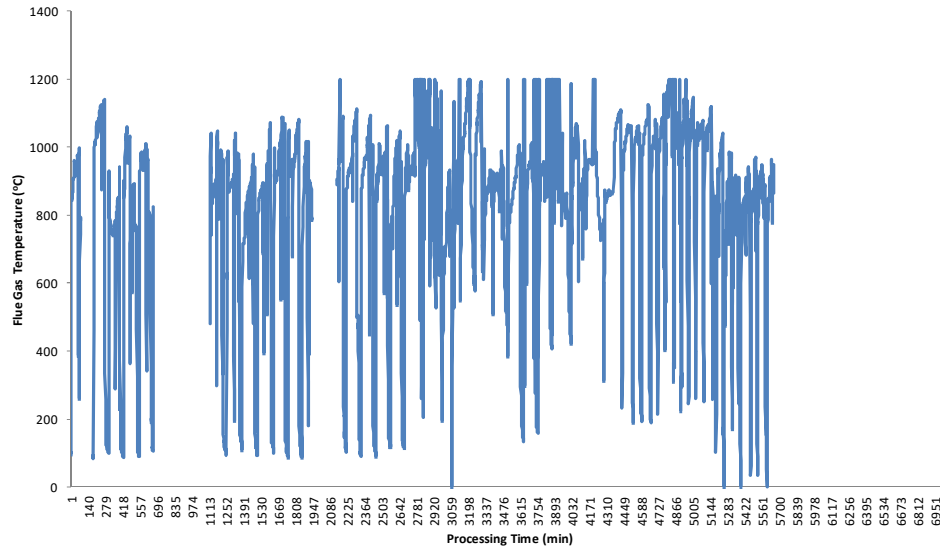


Figure 3: Rotary Furnace 1 exhaust gas temperature (consolidated for first 12-months of processing)

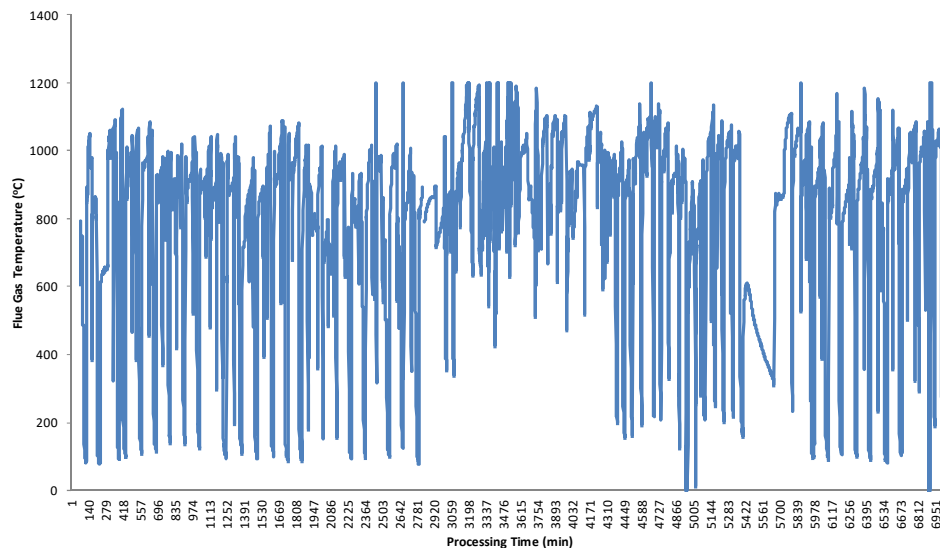


Figure 4: Rotary Furnace 2 exhaust gas temperature (consolidated for first 12-months of processing)

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3.2 Air Emissions Monitoring

Independent, NATA-certified emission monitoring was performed by AECOM on two events. Real-time, continuous monitoring of gaseous fluoride and particulate air emissions was also performed throughout all waste processing intervals to assess compliance with regulatory requirements. Monitoring findings are provided below.

3.2.1 Stack Emission Monitoring

A summary of NATA-certified stack emission monitoring results is presented in **Table 1**. Regulatory compliance limits (applicable during the monitoring interval) are also tabulated for comparative assessment. A single non-compliance with emissions limits was determined during the first 12-months of operation (refer **Section 5**).

Table 1: Summary of independent stack emissions monitoring

Emission Parameter	Units	Air Emissions Monitoring Events		Regulatory Limits
		Event 1 (Nov / Dec 2019)	Event 2 (Jun / Aug 2020)	
Total Particulate	mg/m ³	11	12	25
Fine Particulate (PM ₁₀)	mg/m ³	3.1	3.3	NL
Chlorine	mg/m ³	<0.12	3.2	NL
Sulfuric Acid Mist	mg/m ³	<2.5	<1.6	100
Sulfur Dioxide	mg/m ³	<12	<8	NL
Hydrochloric Acid	mg/m ³	<1.2	0.098	400
Heavy Metals	mg/m ³	0.036	0.011	10
Cyanide	mg/m ³	0.74	<0.0085	0.5
Gaseous Fluoride	mg/m ³	0.06	0.023	2
Particulate Fluoride	mg/m ³	0.33	0.039	NL
Oxides of Nitrogen	mg/m ³	5	2	2500
Carbon Monoxide	ppm	10	2	100
Polycyclic Aromatic Hydrocarbons	mg/m ³	0.74	0.055	NL
Dioxins & Furans	ng/m ³	0.0023	0.00046	0.1
Volatile Organic Compounds	mg/m ³	3.1	0.1	NL
Carbon Dioxide	%	0.3	0.2	NL
NOTES: Emission concentrations expressed at dry gas, 273 K and 101.3 kPa conditions Exceedances of regulatory limit criteria are shown in bold type NL Not Listed				

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3.2.2 Real-time Gaseous Fluoride Emissions Monitoring

Continuous monitoring of gaseous fluoride emissions was performed during pharmaceutical and illicit drug waste processing intervals to assess compliance with the hourly average regulatory limit of 1.4 mg/m^3 . Monitoring data recorded during pharmaceutical and illicit drug processing events are illustrated in **Figure 5**. Full compliance with the limit criterion was observed during the first 12-months of operation.

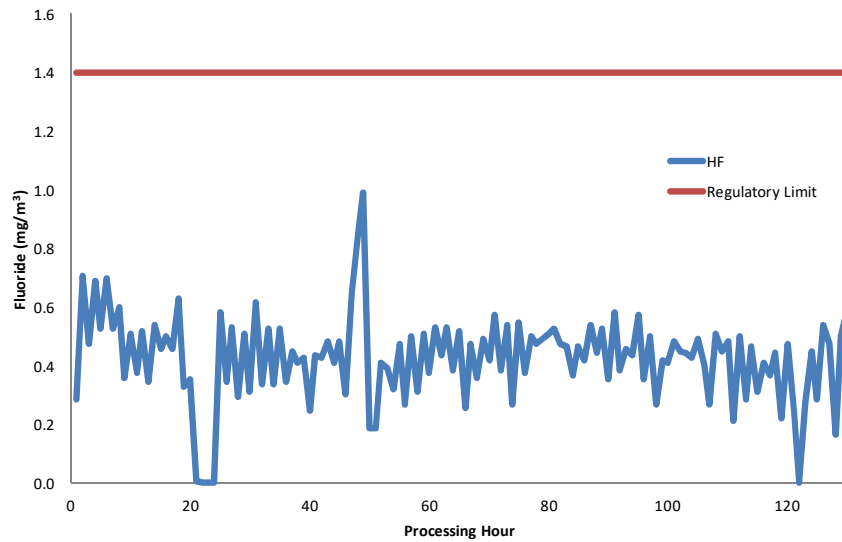


Figure 5: Real-time, continuous gaseous fluoride emissions monitoring data (consolidated for first 12-months of processing)

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3.2.3 Real-time Particulate Emissions Monitoring

Continuous monitoring of particulate emissions was performed during pharmaceutical and illicit drug waste processing intervals to assess compliance with the regulatory limit of 25 mg/m³. Monitoring data recorded during pharmaceutical and illicit drug processing events are illustrated in **Figure 6**. Full compliance with the limit criterion was observed during the first 12-months of operation.

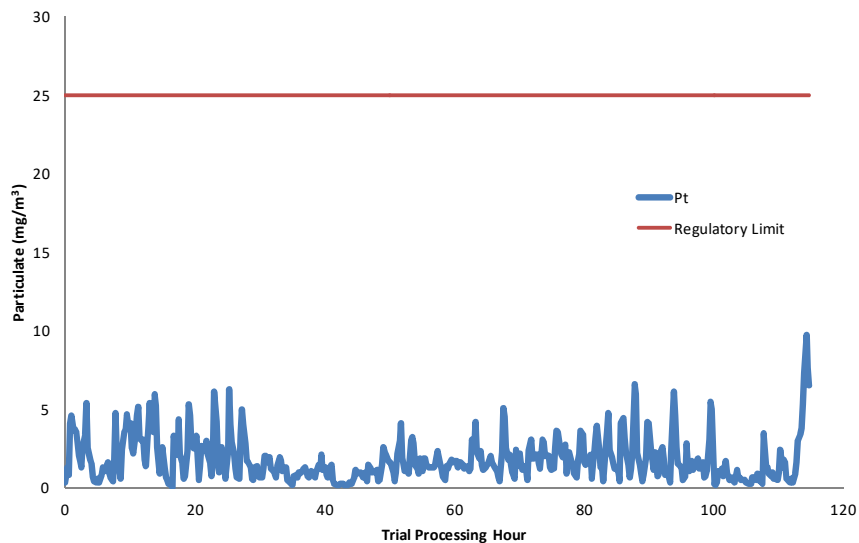


Figure 6: Real-time, continuous particulate emissions monitoring data (consolidated for first 12-months of processing)

4. MITIGATION MEASURES

A tracking summary of the implementation and monitoring of mitigation measures proposed for the ongoing, commercial-scale destruction of pharmaceutical and illicit drug wastes (as proposed in the original Environmental Assessment; AECOM, 2017) is provided in **Table 2**. This tracking summary has been prepared in accordance with Condition 54G of Development Consent.

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Table 2: Summary of monitoring and mitigation measure implementation tracking

Issue	Mitigation Measures	Status and Verification
Air Quality	- All existing air quality monitoring and management systems will continue to be operated for the duration of the Project; and - Monitoring of air emission parameters currently assessed for processing operations will continue to be undertaken in accordance with the existing emissions monitoring regimes.	- Implemented throughout the first 12-months of the Modification, and ongoing. - Monitoring of EPL Point 1 emissions performed in accordance with Consent Modification and Licence requirements. Monitoring ongoing per Licence.
Hazard and Risk	WA commits to the ongoing operation of existing and proposed site safeguards identified for the facility for the duration of operation of the Project: - Bag-houses – all bag-houses will be fitted with real-time, continuous particulate monitoring systems (existing); - Bag-houses – all bag-houses will be fitted with high differential pressure detection to activate bag pulsing and cleaning processes (existing); - Baghouse No.1 – Exhaust gases from the furnaces will be directed to Baghouse No.1 for treatment prior to release to atmosphere (existing); - The existing site Environmental Management System will be updated to incorporate the increased capacity with regards to pharmaceutical and illicit drug wastes. Change management procedures have been completed for the introduction of the processing trial, and prior to full scale commercial treatment the following documents will be updated: - Safety Management System; and - Environmental mitigation measures. - The Safety Management System Manual will be updated to include the operations and materials associated with the Project prior to the commencement of operation in accordance with the requirements of the NSW Work Health and Safety Regulation 2011; - The Emergency Response Plan will be updated to include specific responses to the hazard scenarios identified for this Project; - WA will continue to comply with the conditions of the EPL issued by the EPA under the POEO Act; - WA will update the SafeWork NSW Notification of Dangerous Goods for manifest quantities where the storage of DG materials is anticipated; - The transport of dangerous goods to and from site will be in accordance with the	- All baghouses continue to be fitted with real-time, continuous particulate monitoring systems. - All baghouses continue to be fitted with real-time dP detection to initiate and maintain filter cleaning processes. - Process exhaust gases continue to be directed to Baghouse 1 for treatment prior to atmospheric discharge. - EMS updated (Apr 2018) to reflect trial processing and modified site operations in relation to pharmaceutical and illicit drug waste destruction in rotary furnaces. SMS further updated (Sep and Oct 2019 and Feb 2020) to reflect MOD-12 and SSD 7396 site operations, inclusive of SOPs and mitigation measures. - As above, the SMS was updated to reflect MOD-12 and SSD 7396 operations in Sep and Oct 2019, and minor updates Feb 2020. Approved by DPIE May 2020. - ERP updated Apr 2019 to reflect both MOD-12 and SSD 7396 requirements. Approved by DPIE Nov 2019. - Single EPL non-compliance (refer Section 5). - DG Notification updated Apr 2020. Quantities received and stored prior to this date were below Manifest quantities. - All wastes transported in accordance with the ADG. No related wastes transported from site. - WA's SMS Manual updated to include the requirements of Australian Standards, where applicable, including the development of SOPs relating to the receipt, storage and destruction of pharmaceutical and illicit drug wastes. Note: no gaseous, liquid,

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Issue	Mitigation Measures	Status and Verification
	Australian Dangerous Goods Code of Practice / NZ 5433; - As a part of the update to the safety management system manual, WA's dangerous goods policy, plans and procedures will be updated to include the requirement to store and handle all dangerous goods in accordance with the relevant Australian Standard; - The following additional safeguards have been identified in protecting against the accumulation of flammable gases within the furnace in the event of a flameout; - During normal operation, the temperature of the furnaces would operate in the order of 900-1000°C; - In the event of burner failure, the furnace automatically undergoes a purge cycle as part of reset conditions (as per Australian Standard requirements), eliminating the potential for the accumulation of flammable gases; and - The operating temperatures would be well above the auto-ignition temperature of methane and also that of any hydrocarbon solvents that could be introduced in the waste stream that might be a potential source of flammable gases. Therefore it would not be possible for flammable gases to accumulate within the furnaces regardless of whether the burners were on or off. Many furnaces, once at operational temperatures, can operate for extended periods of time without the use of any auxiliary fuel burners utilising the energy release of the waste materials incinerated and residual hot ash to maintain the required combustion temperatures.	corrosive or Class 9 DG pharmaceutical or illicit drug wastes were received. - As illustrated in Figures 3 and 4, exhaust flue gas temperatures exiting the furnace were in the order of 900 – 1000 °C during furnace heat cycles. Temperatures within the furnace and charge mass are anticipated to exceed 1000 °C (also refer Section 5). - No flame failures occurred within the first 12-months of MOD-12 operations. - Pharmaceutical and/or illicit drug wastes were always charged to hot furnaces (i.e. at operating temperature) to maintain combustion efficiencies.
Traffic	- Transport of illicit drug wastes will be facilitated by NSW Police; - Transport of pharmaceutical wastes will be undertaken by licensed waste transport operators; and - Transport routes, material handling and quality control documentation protocols established and implemented for existing waste movements will be adopted for the transport and handling of these wastes.	- All illicit drug waste transport facilitated by NSW Police. - All pharmaceutical waste transported by licenced waste transport operators (all registered on NSW EPA OWT). - All transport movements performed per SMS. Waste tracking per NSW EPA Online Waste Tracking (OWT).
Soil and Water	- All raw material truck delivery loads will be covered by tarpaulin or in sealed bins to prevent spillages, as per current process material deliveries; - All operations will be performed within enclosed buildings to mitigate against external spills; - Should a spill occur, site personnel will recover materials in accordance with established spill response procedures. Spilt material will be returned to storage for processing (i.e. not disposed of); and - The water quality monitoring program will continue to be implemented.	- All deliveries either within tautliner or pantech trucks (pharmaceutical) or enclosed vehicles (illicit drug waste). - All operations were performed within buildings per SOPs. - No spills occurred during the first 12-months of MOD-12 operation. - Water quality monitoring program continued to be implemented.

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Issue	Mitigation Measures	Status and Verification
Greenhouse Gas	Practices currently in place at the plant to reduce GHG emissions, including the routine tuning and maintenance of furnace burners, will continue to be undertaken.	Existing practices (burner tuning and optimisation, maintenance, monitoring and reporting) implemented.
Noise	Truck movements will continue to be restricted to between the hours of 7am and 10am in accordance with Condition L5.1 of the EPL.	Deliveries restricted between 7am and 10pm Mon – Fri, and typically between 7am and 3pm. No complaints.
Waste Management	- Transport of pharmaceutical waste will be undertaken by licensed waste transport operators and the waste will be formally tracked in accordance with the NSW EPA's Online Waste Tracking protocol; - Transport of illicit drug wastes will be facilitated by NSW Police and relevant Chain of Custody procedures will apply; - WA standard operating procedures for material receipt and delivery record keeping will continue to apply for pharmaceutical and illicit drug wastes; - Prior to storage and/or processing, wastes will be inspected and details recorded on the relevant inspection sheet, including the date and time, the nature of the consignment, packaging type, mass / volume and the source; - Bulk bag wastes will be disposed of to an appropriately licensed facility in conjunction with routine site disposal protocols; and - No landfilling of the ash residues will occur.	- Waste movements performed by Licenced operators. Tracking of wastes performed in accordance with NSW EPA Online Waste Tracking protocols. - Illicit drug wastes performed by NSW Police. Chris McClung of WA maintained NSW Justice of the Peace status in support of chain of custody requirements. - Established SOPs (for receipt, inspection, storage handling, processing and ash management) implemented. Documentation maintained in relation to waste consignments. - No bulk bag wastes generated during the first 12-months of operation. - All ash generated from co-processing of pharmaceutical and illicit drug wastes were incorporated into existing dust value-add and reuse streams. No landfilling of ash residues occurred during the first 12-months of operation.
Social and Economic	- The site will be secure at all times and security will be maintained in accordance with defined protocols; - NSW Police will be responsible for the secure transport of illicit drug wastes to the facility, and will supervise the handling and complete destruction of these wastes immediately upon receipt. There will be no storage of illicit drugs on site. These processes will be thoroughly controlled and documented by NSW Police; and - In the event that pharmaceutical wastes requiring disposal do contain small quantities of precursors, WA will require formal prior notification from waste suppliers and will insist that such materials be segregated for either immediate processing upon receipt or secure onsite storage. Storage and processing of such wastes will be under the direct supervision of WA management and waste generator / agent representatives, as required.	- Site security protocols (per SMS) maintained at all times. - NSW Police facilitated the secure transport of drug waste to the facility, supervised their handling and destruction, and controlled all associated documentation. No storage of illicit drug wastes occurred during the first 12-months. - All illicit drug (exhibit) waste consignments received to site for burn events were destroyed. No storages occurred during the first 12-months. WA management and NSW Police representation present during each destruction event. No drug waste-related security issues experienced during the first 12-months of operation. No precursors of illicit drugs (e.g. pseudoephedrine) received in pharmaceutical waste consignments during the first 12-months.

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5. DISCUSSION

- A total of 5.1 tonnes of pharmaceutical wastes and 0.9 tonnes of NSW Police exhibit (illicit drug) wastes were received and processed during the first 12-months of MOD-12 operation. This is well below the anticipated input quantities and respective 2,000 and 5 tonnes approved for processing per annum. Relatively small processing quantities are attributed to the following:
 - Movement of domestic pharmaceutical product manufacturing operations offshore since MOD-12 approval. This has translated to a dramatic reduction in the generation and disposal of pharmaceutical wastes (waste pharmaceuticals, drugs and medicines, as well as wastes associated with the production and preparation of pharmaceutical products);
 - Competitors constraining pharmaceutical waste availabilities in the market through revised contractual arrangements in response to MOD-12 approval; and
 - Weston Aluminium electing to retain liquid-based pharmaceutical wastes in support of future Thermal Waste Treatment Plant commissioning activities (per SSD 7396 Approval) rather than processing such inputs in existing rotary furnaces as part of MOD-12 operations;
- All packaging material associated with pharmaceutical and illicit drug waste deliveries were thermally destroyed. This practice meets NSW requirements for the thermal destruction of pharmaceutical wastes, satisfies NSW Police chain of custody requirements, and meets internal work health and safety requirements designed to eliminate direct contact between furnace inputs and site personnel;
- As illustrated in **Figure 1**, pharmaceutical and/or exhibit wastes were typically charged at a rate of 0.5 – 2.5% (w/w) of the total charge mass; maximum charge quantity 140 kg (representing 3.1% of total batch weight). This satisfies Consent (Condition 5B) and Environment Protection Licence (Conditions L7.2 and L7.4) requirements relating to maximum quantities per processing batch (5% by mass and no more than 250kg per batch);
- No liquids were present within input wastes, and accordingly, requirements for EPA approvals and associated Environment Protection Licence provisions (Conditions L7.3, E2) were not triggered;
- Furnace batch times were consistent with conventional dross processing batches (typically 1 – 2 hours; refer **Figure 2**), although it is noted that waste inputs were rapidly destroyed – typically within 5 minutes of furnace addition; and
- Whilst furnace flue exhaust temperatures achieved typically ranged from 900 – 1,000 °C during the thermal-processing phase of each furnace cycle (refer **Figures 3 and 4**), it is considered that temperature monitoring of exhaust gases understates (and therefore does not adequately reflect the actual) temperature of the charge mass - typically >1000 °C. As an alternative, and following discussion with the NSW EPA, Weston Aluminium has elected to utilise a high-temperature Infrared Thermometer during future operations as a more practical and reliable method of charge temperature monitoring, which enables the direct measurement of charge mass temperatures during each batch. Batch temperatures will be documented on Rotary Furnace Operations Sheets;
- A single air emissions non-compliance occurred during the first 12-months of operation, whereby a cyanide emission concentration of 0.74 mg/m³ (exceeding the 0.5 mg/m³ limit) was reported for the 16 December 2019 monitoring event. Weston Aluminium reported the exceedance as part of the 2018-19 Annual Return, and subsequently received an Official Caution from the NSW EPA. As detailed in the Annual Return, and subsequently in response to the EPA's Show Cause Notice, the cause of the elevated cyanide concentration is not readily understood. Feedstock being processed

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at the time of the monitoring event - including aluminium dross and small quantities of pharmaceutical waste (ibuprofen) and illicit drugs (cannabis) - do not contain cyanide, nor are they considered precursors of cyanide formation. Furthermore, all plant and equipment (furnace, combustion and air emissions control systems) were operating normally at the time, and no operational or maintenance issues were experienced. This emissions finding is considered to be anomalous and a statistical outlier. Following consultation with the EPA, a Licence Variation has been sought to increase the cyanide emissions limit from 0.5 mg/m³ to 0.8 mg/m³. Quantitative air dispersion modelling assessments verify that maximum ground-level cyanide concentrations remain well-below the assessment criterion, and accordingly, this limit increase was approved by the EPA on 05 November 2020. Furthermore, the frequency of cyanide monitoring has been increased to ensure that emissions control performance, licence compliance and data variability is adequately demonstrated. Emissions monitoring performed since this event have confirmed licence compliance, and verify that plant and equipment operating conditions and maintenance regimes implemented are appropriate and effective;

- All remaining emissions monitoring undertaken in conjunction with MOD-12 operations reveals exceptionally low pollutant discharge concentrations, and confirms reliable performance of the thermal treatment process and lime-scrubber and fabric filter baghouse pollutant control systems. Emissions data are of generally of the same order, or lower, than that reported for conventional rotary furnace processing operations;
- Continuous monitoring of gaseous fluoride and solid particulate emissions was performed during processing intervals. Data confirm full compliance with regulatory approval requirements (refer **Figures 5 and 6**);
- Existing air emission scrubbing and filtration systems continue to be appropriate and effective during pharmaceutical and illicit drug waste processing operations; and
- All monitoring and risk mitigation measures relating to air quality control, hazard and risk, waste management, traffic, noise, greenhouse gas, soil and water and social and economic development modification aspects were implemented as proposed, and continue to appropriately serve ongoing pharmaceutical and illicit drug waste processing requirements.