BACK RIVER PROJECT
Incineration Management Plan

October 2017

BACK RIVER PROJECT
INCINERATION MANAGEMENT PLAN

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Revision Log

Version	Date	Section	Page	Revision
1	October 2017	All	All	Supporting Document for Type A Water Licence Application, submitted to Nunavut Water Board for review and approval

Acronyms

CCME	Canadian Council of Ministers of the Environment
EC	Environment Canada
GHG	Greenhouse Gas
GN	Government of Nunavut
IMP or Plan	Incineration Management Plan
MAD	Main Application Document
MLA	Marine Laydown Area
Project	Back River Project
Sabina	Sabina Gold & Silver Corp.
QA	Quality Assurance
QC	Quality Control
WIR	Winter Ice Road

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold & Silver Corp. (Sabina) within the West Kitikmeot region of southwestern Nunavut. It is situated approximately 400 kilometres (km) southwest of Cambridge Bay, 95 km southeast of the southern end of Bathurst Inlet (Kingaok), and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4).

The Project is comprised of two main areas with interconnecting winter ice roads (WIR) (Main Application Document [MAD] Appendix A, base Figure 2): Goose Property (MAD Appendix A, base Figure 3) and the Marine Laydown Area (MLA) (MAD Appendix A, base Figure 4) situated along the western shore of southern Bathurst Inlet. The majority of annual resupply will be completed using the MLA, and an approximately 160 km long WIR will interconnect these sites. Refer to the MAD Appendix A, base Figures 1 to 5 for general site layout and locations. A detailed project description is provided in the MAD.

The Incineration Management Plan (IMP or Plan) outlines the approach for managing waste appropriate for incineration. This plan includes provisions for the MLA in southern Bathurst Inlet and the Goose Property. The IMP and other management plans are intended to support the Type A Water Licence Application for the Project.

The Plan was prepared following the requirements of the Supplementary Information Guidelines (SIG) for Mining and Milling MM3 and Water Works M1, issued by Nunavut Water Board (NWB 2010 a, b) and the Environmental Impact Statement Guidelines issued by the Nunavut Impact Review Board to Sabina (NIRB 2013) and in conformance with current Federal and Territorial statutory requirements

This plan is a living document to be updated upon changes in related regulatory requirements, management reviews, changes to facility operation or maintenance, and environmental monitoring results, best practice updates or other Project specific protocols once construction starts through to Project closure activities. Any updates will be filed with the Annual Report submitted under the Type A Water Licence.

The information presented herein is current as of September 2017. An update will be initiated prior to the start of construction. The Plan will be reviewed as needed for changes in operation and technology and as directed by the NWB in the Type A Water Licence or other regulatory authorization where appropriate. Completion of the updated Plan will be documented through signatures of the personnel responsible for reviewing, updating, and approving the Plan.

A record will document all significant changes that have been incorporated in the IMP subsequent to the latest review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Sabina will maintain a distribution list providing contact details for all parties to receive the Plan including key personnel, contractors, organizations, and external agencies.

2. Scope and Objectives

The IMP is one of the documents that forms part of Sabina's overall Waste Management Program for the Project. This plan has been written to meet requirements of a Type A Water Licence and applies to all Sabina projects in the Kitikmeot region.

This plan is divided into the following components:

- Applicable Legislation and Guidelines (Section 3);
- Planning and Implementation (Section 4);
- Roles and Responsibilities (Section 5);
- Operational and Maintenance (Section 6);
- Environmental Protection Measures (Section 7);
- Monitoring (Section 8);
- Record Keeping (Section 9);
- Environmental Reporting (Section 10);
- Adaptive Management (Section 11); and
- Reclamation (Section 12).

Incineration is an essential part of waste management at the Back River site. The incineration of acceptable solid waste from the accommodation complex, kitchen, lunch rooms, shops, warehouses, and offices will divert waste from the on-site landfill. Sewage sludge from the planned sewage treatment plant at the Goose Property will also be incinerated. Incineration has the advantage of eliminating waste that could potentially attract wildlife to the landfill, thereby reducing possible interactions between humans and wildlife.

Waste products will be safely managed from the time they are produced to their final disposal. Reduce, reuse, and recycle initiatives, as well as a waste segregation program will be implemented at the Project to minimize the quantity of waste incinerated or directed to the landfill. Waste that is deemed unsuitable for incineration, including hazardous materials, will be handled appropriately as per the Landfill and Waste Management Plan (Supporting Document [SD]-10) and Hazardous Materials Management Plan (SD-13).

By using state of the art incinerator technologies and developing a deliberate and conscientious waste management program, Sabina can ensure that each incinerator achieves full compliance with air quality requirements for the protection of the environment and human health.

The objectives of incineration management through all phases of the Project are to:

1. Characterize the quantity and composition of the waste products to be generated at the Back River site, and effectively separate wastes acceptable for incineration from waste that is not;
2. Select appropriate batch waste incinerators based on the characteristics and quantity of waste;

3. Locate incinerators at appropriate sites and set back an appropriate distance from other infrastructure;
4. Operate incinerators to achieve optimal combustion and avoid the formation of dioxins, furans, and mercury in the combustion process;
5. Implement incinerator operational practices and to document frequency and incinerator operating parameters, including the safe handling and disposal of incinerator residues; and
6. Demonstrate compliance with applicable Federal and Territorial regulations for environmental protection.

2.1 RELATED DOCUMENTS

Documents within the Application for the Type A Water Licence, which support this plan include the following:

- Environmental Management and Protection Plan (SD-20);
- Landfill and Waste Management Plan (SD-10);
- Risk Management and Emergency Response Plan (SD-15);
- Hazardous Materials Management Plan (SD-13); and
- Fuel Management Plan (SD-16).

3. Applicable Legislation and Guidelines

Federal and Territorial legislation that is applicable to solid waste incineration management in Nunavut is presented in Table 3-1.

Provincial and/or territorial regulations that pertain to emissions from incinerators are not available for Nunavut or the Northwest Territories. Therefore, performance limits for Project incinerators will be in accordance with the emission guidelines set out by the Canadian Council of Ministers of the Environment (CCME): Canada-Wide Standard for Dioxins and Furans (CCME 2001), and Canada-Wide Standards for Mercury Emissions (CCME 2000).

Ash produced from the incineration process will be disposed of in accordance with the Nunavut Environmental Guideline for Industrial Waste Discharges (GN 2011b).

Table 3-1. Applicable Legislation to the Incineration Management Plan

Acts	Regulations	Guidelines
Federal		
Canadian Environmental Protection Act (CEPA 1999 c.33)	Schedule 1: List of Toxic Substances Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2002-301)	Environment Canada (EC) Technical Document for Batch Waste Incineration (EC 2010) Canada-Wide Standards for Dioxins and Furans (CCME 2001) Canada-Wide Standards for Mercury (CCME 2000)
Hazardous Products Act	Controlled Products Regulations	Workplace Hazardous Materials Information System (WHMIS 2015)
Territorial – Nunavut		
Nunavut Environmental Protection Act		Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities (GN 2011b) Environmental Guidelines for the Burning and Incineration of Solid Waste (GN 2012a) Environmental Guidelines for Ambient Air Quality (GN 2011a) Environmental Guideline for Mercury-Containing Products and Waste Mercury (GN 2010) Environmental Guideline for Used Oil and Waste Fuel (GN 2012b)
Nunavut Public Health Act		

4. Planning and Implementation

The IMP considers existing (baseline) conditions, assessed potential impacts of the Project, developed conceptual mitigation strategies, and developed specific mitigation measures to execute these strategies. Conceptual strategies and plans will continue to be elaborated and executed throughout all phases of the Project.

Significance criteria have been developed that assist in identifying priority aspects, establish management criteria, and activity-specific mitigation measures. For social issues and effects, a key factor for determining significance is ongoing feedback from public consultation. These efforts will be used to communicate progress, and involve the public where necessary, on environmental performance.

Monitoring will be the principal mechanism to provide feedback to continually gauge the effectiveness of environmental performance. Operational control is facilitated through the contractor job-specific Standard Operating Procedures, work instructions, on-the-job instruction, tailgate meetings where required, contract requirements, and service agreements. The effectiveness of physical operational control will be reviewed according to preventative maintenance and review procedures and schedules.

The Project will select and operate incinerators based on Environment Canada's Technical Document for Batch Waste Incineration (EC 2010). The Goose Property incinerator will be comparable to the Eco Waste Solutions incinerator model ECO 2TN 1PV presented in Appendix A. The MLA incinerator will be comparable to the Eco Waste Solutions incinerator model ECO CA-100 also presented in Appendix A. The incinerator technical specifications of both models are provided in Appendix B. In addition, a list of acceptable and unacceptable waste streams suitable for processing in Eco Waste Solutions technology is provided in Appendix C.

4.1 INCINERATOR SELECTION

Typical modern, controlled-air, batch, dual chamber incinerators are designed using the principles of pyrolysis (starved-air burning condition) in the primary chamber and complete oxidation (high temperature, excess oxygen, and sufficient combustion time) in the secondary chamber. The incineration system will be a two-stage process. In the first stage, waste will be converted to gas in the primary chamber at approximately 650 to 850 degrees Celsius (°C). This process will be self-fueling until the volume is reduced by 90%. Gasses from the primary chamber will enter the secondary chamber of oxygen-rich and turbulent conditions, which is typically at a higher temperature of approximately 1000°C. Combustion will be complete after a retention time of about two seconds. The temperature of combustion gases exiting the stack is anticipated to exceed 700°C and to flash cool in the ambient air, thereby leaving little opportunity for the de novo synthesis of dioxins/furans. Heat capture will not be used on the exhaust gases.

Critical process parameters, such as temperature, air flow, and burner output will be computer-controlled to maintain optimal combustion conditions.

4.2 INCINERATOR LOCATIONS

The incinerator at the Goose Property will be housed inside a separate building east of the Process Plant and accommodations building (MAD Appendix A, base Figure 5). The incinerator at the MLA will be housed inside a separate building southeast of the accommodations building (MAD Appendix A, base Figure 4).

Both buildings will have sufficient floor space and capacity to receive and sort all waste material generated in one location.

4.3 ALTERNATIVES

The recovery of waste heat is a recovery method applicable to waste disposal: heat recovery systems can be installed on incinerators and methane can be burned from large mixed solid waste landfills. Fitting the incinerator with heat recovery is costly and is more applicable to large, continuous operation incinerators operated in larger population centres; it is not appropriate for a small batch operated incinerator.

Not all solid non-hazardous waste can be incinerated; therefore, incineration represents an option for disposing only a portion of the solid waste stream. However, it is technically feasible and economically viable. Properly operated, modern incinerators meet air quality guidelines and incineration of food wastes reduces the attraction of wildlife to the project sites. For these reasons, the use of incinerators at remote northern mines has become the standard.

5. Roles and Responsibilities

The General Manager is ultimately responsible for the success of this plan and approves all relevant policies and documents, auditing, action planning, and the verification process.

The Environmental Superintendent is responsible for the implementation of this plan including overall management including adaptive management, internal reporting, and compliance monitoring.

Other relevant personnel designated by the General Manager or Environmental Superintendent which may be responsible for incineration management will be require to complete and maintain compliance with appropriate training requirements as defined in this plan, Sabina's Standard Operating Procedures, current Best Management Practices, and applicable Health and Safety Laws and Regulations.

5.1 TRAINING

Incinerator operators will complete a training program prior to commencement of operation. This training will include recommendations presented in Environment Canada's Technical Document for Batch Waste Incineration (2010) and developed in conjunction with the training manual provided by the incinerator supplier.

At a minimum, the training program will educate operators in the following areas:

- hazard recognition and safety protocols;
- identification of waste types and understanding of how waste composition affects operation;
- incinerator start-up and operating procedures, including identification of adjustments to increase operating efficiency;
- incinerator clean-out and maintenance procedures; and
- record keeping and reporting requirements.

Initial operator training will be provided by a qualified technician appointed by the incinerator vendor during commissioning.

The incineration process will be automated and requires minimal attendance during operation. A computerized incinerator will typically require one operator to interact with the equipment for approximately 1 to 1.5 hours per day, largely for ash removal, loading, and start-up. Each incinerator will be designed, installed, and operated so that the operators are not exposed to high temperatures during loading or ash removal in accordance with the complete cool down after each burn cycle.

6. Operation and Maintenance

This section provides general guidance and standard operating procedures for the operation of the incinerator. The incinerator operator is to refer to the operational manual provided by the manufacturer for specific instructions and optimal operating conditions. The incinerators to be installed will be typical modern, controlled-air, batch, dual chamber incinerators that are designed using the principles of pyrolysis (starved-air burning condition) in a primary chamber followed by complete oxidation (high temperature, excess oxygen, and sufficient combustion time) in a secondary chamber. A full set of incinerator operating procedures will be developed in consultation with the supplier/manufacturer prior to use. The Standard Operating Procedures shall include the following general procedures:

- Waste sorting on the basis of origin and heating value. Food waste and waste that has been in contact with food will have priority for incineration.
- Waste mixing to ensure a calorific value within incinerator specifications and to achieve good combustion inside the primary chamber.
- The operator will observe the start of the burn cycle for at least 15 minutes to ensure incinerators are operating correctly, and the primary and secondary chambers operate in the temperature ranges specified by the manufacturer.
- Sizable front doors will be utilized for easy access to manually load-feed waste with a front-end loader.
- Incinerator doors will only be opened after the burn cycle is complete and the unit is fully cooled.

Ash disposal procedures are provided in Section 6.2.1.

Operation of the incinerators will be conducted in accordance with Environment Canada's Technical Document for Batch Waste Incineration (EC 2010). Additional acts, regulations, and guidelines applicable to the operation of the incinerators are listed in Section 3.

Key operational control procedures that will help maintain good operation of the incinerator are provided in the following sections.

6.1 WASTE STREAM MANAGEMENT

Only authorized waste may be incinerated. Table 6.1-1 provides a list of waste that is considered acceptable for incineration and examples of waste that is considered unacceptable. To facilitate the initial sorting of material, waste will be collected in transparent bags so that the contents are readily visible. Verification of correct sorting and mixing procedures will be ensured by periodic spot checks and Quality Assurance (QA)/Quality Control (QC) management by a trained staff member.

Table 6.1-1. Waste Classification for Incineration

Acceptable Wastes for Incineration	Unacceptable Wastes for Incineration
• organic matter including food; • food containers and packaging, including plastics that are contaminated by food; • untreated wood including lumber and plywood; • medical waste from the Health Care Station; • paper, cardboard; • painted wood except wood painted with lead or PCB-amended paint • hydrocarbon spill absorbents; • plastic and Styrofoam, except plastic containing chlorine; • dead animals; • used oils and waste fuel; • Pacto waste from the MLA; and • dewatered sewage sludge from the Goose Site Sewage Treatment Plant.	• chlorinated plastics; • inert materials, such as concrete, bricks, ceramics, ash; • machinery parts or large metal goods (i.e., appliances); • radioactive materials, such as smoke detectors; • potentially explosive materials, such as propane tanks, other pressurized vessels, unused or ineffective explosives; • hazardous materials such as organic chemicals (pesticides), other toxic substances (arsenic, cyanide); • electronics and/or batteries; • asbestos; • dry wall; vehicles and machinery; • fluorescent light bulbs; • whole tires; • paints and solvents; any materials containing mercury; and • any other wastes not considered ‘acceptable’.

6.1.1 Waste Volumes

The total volume of combustible solid waste generated at a given time during the Life of Mine will be dependent on the activities and number of personnel at that time. An inventory of the estimated annual quantities of combustible solid waste that will be generated during the various phases of the Project is presented in Table 6.1-2 and Table 6.1-3 for the MLA and Goose Property, respectively.

Table 6.1-2. Estimated Waste Quantities Generated at the Marine Laydown Area

Project Phase	Annual Waste Quantities (tonnes)	
	MLA Waste Incinerated	Ash
Construction (2 years)	20	6
Operations (10 years)	20	6
Closure - Active Closure Stage (2 years) (Note no Passive Closure)	5	2
Life of Mine Totals (tonnes)	250	76

Table 6.1-3. Estimated Waste Quantities Generated at the Goose Property

Project Phase	Annual Waste Quantities (tonnes)	
	Goose Property Waste Incinerated	Ash
Construction (3 years)	310	93
Operations (10 years)	235	71
Closure - Active Closure Stage (2 years)	125	38
Closure - Passive Closure Stage (6 years)	10	3
Life of Mine Totals (tonnes)	3,640	975

The estimated waste generation presented above is based on the following assumptions:

- kg/person/day (1 tonnes/year/person) total (incinerator and landfill) of solid non-hazardous waste (Environment Canada's 'State of the Environment InfoBase', Environmental Indicator Series 2003).
- Assumes that 50% of the waste is landfilled and 50% of the waste is incinerated.
- Assumes incineration reduces mass by 70%.
- The MLA is occupied only half of each year (annual quantities are halved).
- Life of Project totals are based on 3 years of Construction (Year -3 to Year -1), 10 years of Operations (Year 1 to Year 10), and a Closure Phase (divided into Active and Passive stages of 2 years and 6 years, respectively). Note the MLA will be only require a 2 year Active Closure stage; no Passive Closure will be necessary.
- Assume Active Closure waste is estimated at 5 times the volume per person.
- Quantities have been rounded upward.

6.2 INCINERATOR OPERATION

Each day, the Primary Chamber should be loaded to design capacity or at a minimum, to half capacity. If waste quantities are not sufficient to operate the machine daily, it can be used to store the waste until the required capacity is met. A front-end loader may be used to manually load feed waste.

Once loading is complete, the door should be sealed shut and the Secondary Chamber fired. The system is interlocked so that Primary Chamber waste is not allowed to combust until the Secondary Chamber is at operating temperature.

The system will complete the burn-cycle and cool-down phases automatically. Based on the waste quantity and description, the burn-cycle is expected to occur over 5 - 10 hours depending on system size, but could be longer depending on waste characteristics, to allow for thorough burn down. The cool-down phase that automatically follows is generally also 5 to 10 hours.

Upon completion of the cool-down phase, the operator will open the Primary Chamber door and clean out the ash. Incinerator doors should only be opened after the burn cycle is complete and the unit is completely cooled.

The complete system is automated from start to finish, however, after loading the waste, the operator is required to remain present to supervise the beginning of the process (start-up), generally the first hour of the burn. The operator should check that the primary and secondary chambers operate in the temperature ranges specified by the manufacturer. The entire process will be controlled by computer in the Main Control Panel. The Operator can see the status of all of critical components and parameters, such as temperature, air flow, and burner output in addition to any malfunction alarms.

The incinerator at the Goose Property Area will have an incineration capacity of approximately 250 kg/h. The incinerator at the MLA will have an incineration capacity of approximately 46 kg/h.

6.2.1 Ash Disposal

Incinerator ash should be handled and disposed of appropriately, following these steps:

- Ash will be removed from each incinerator before it is charged with the next load of waste to be incinerated.
- Ash will be placed in drums or bags before disposal. Incinerator ash will be packaged in drums or sacks and the whole container landfilled, minimizing wind-blown effects.
- The concentration of trace metals will be tested as per the Government of Nunavut's Environmental Guidelines for Industrial Waste Discharges (GN 2011b) for on-site disposal.
- Ash exceeding the above standard will be handled as per the Hazardous Materials Management Plan (SD-13).
- Ash generated at Goose Property and meeting the standard will be disposed in the on-site landfill. Ash generated at the MLA will be containerized and backhauled to either Goose Property or off-site for disposal.

6.2.2 Odour and Dust Control

Current state of the art incinerators are designed with a non-turbulent atmosphere in the primary burn chamber which reduces the formation of particulate matter. Additional dust or odour control is therefore not anticipated. Ash residues generated in the primary chamber will be manually removed and packaged in a drum or sack before being disposed of in the on-site landfill, thus eliminating wind-blown effects.

6.2.3 Used Oil and Waste Fuel

The incinerator will be capable of efficiently and safely burning oil and waste fuel. Sabina will manage used oil and waste fuel according to the Environmental Guideline for Used Oil and Waste Fuel (GN 2012b). The regulations stipulate the maximum level of contaminants in used oil that is allowed for incineration. Specifics of the used oil and waste fuel regulations are referenced in the Fuel Management Plan (SD-16).

6.3 CONTINGENCIES

In the event of an incinerator breakdown, the operator should consult the manufacturer provided operations manual to try and diagnose the cause. A local technician should be contacted for assistance. The operator should assess the likely downtime of the incinerator and alternative disposal methods should be implemented until the incinerator is repaired. Contingency or alternative waste storage procedures to be implemental until the incinerator is repaired, which are dependent on the length of incinerator down time may include:

- short-term shutdown of incinerator will be mitigated through temporary storage in sealed, wildlife-proof containers;

- long-term shutdown of incinerator will require backhauling for off-site disposal by a waste services provider; and
- food waste would be prioritized for storage in both instances with alternative disposal methods for other material considered.

Long-term storage due to the presence of putrescibles in the domestic is impractical due to the potential of attracting wildlife. In the event of long-term shutdown generation of organic wastes would be minimized as much a feasibly possible.

Spills associated with the incinerator or waste disposal steams will trigger the implementation of the Spill Contingency Plan (SD-17). Any accidents and malfunctions will trigger the implementation of the Risk Management and Emergency Response Plan (SD-15).

7. Environmental Protection Measures

Sabina has an ongoing commitment to implementing environmental protection measures in all aspects of its operations and is committed to reducing incinerator emissions through the use of technologically advanced, best available, and economically feasible procedures.

Sabina is committed to reducing waste volumes to be incinerated, while managing and minimizing dioxin, furan, and mercury emissions. In addition, Sabina will implement appropriate material handling procedures for the disposal of ash material generated by incineration.

A summary of the Canada-Wide Standards, as prepared by CCME, for dioxins, furans and mercury emission limits is presented in Table 7-1.

Table 7-1. Canada-Wide Standards for Waste Incineration Emissions

Waste Incineration Compound	Sector	Emission Limit (Max)
Dioxins and Furans[1]	Municipal Solid Waste[3] Sewage Sludge Incineration	80 picograms of International Toxic Equivalents (I-TEQ) per cubic metre (pg/m^3)
Mercury[2]	Municipal Solid Waste	20 micrograms per cubic metre ($\mu g/m^3$)
	Sewage Sludge Incineration	70 micrograms per cubic metre ($\mu g/m^3$)

[1] CCME 2001
[2] CCME 2000
[3] According to the Canada-Wide Standards (CWS) , "municipal solid waste" includes any waste that might be disposed of in a non-secure landfill site if not incinerated (i.e., non-hazardous wastes regardless of origin), but does not include "clean" wood waste.

The emission limits apply to waste incineration at new facilities across Canada. Compliance with these standards will be achieved through the use of state of the art technologies and a detailed and conscientious waste management program. The incinerator at the Project is expected to achieve full compliance immediately upon attaining normal full-scale operation.

Sabina will implement adaptive management strategies, if through dust fall monitoring program elevated metals, dioxins, furans are detected. Adaptive management strategies are provided in Section 11.

7.1 WASTE REDUCTION AND MITIGATION STRATEGIES

Waste reduction, reuse, and recycling initiatives as well as a waste segregation program will be developed at the Project as per the Landfill and Waste Management Plan (SD-10) to minimize the quantity of waste to be incinerated or directed to the landfill.

A waste audit will be completed after one year of operation of the incinerator to identify waste stream volumes that can be minimized prior to incineration. The waste audit will inform the development of waste segregation procedures and policies.

Sabina will develop a comprehensive list of acceptable and unacceptable waste for incineration based on the waste audit and at the time that all on-site waste materials have been identified. The identification of unacceptable waste for incineration will be based on the EC Technical Document for Batch Waste Incineration (EC 2010) and the regulations discussed in Section 3.

7.2 DIOXINS AND FURANS

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, commonly known as dioxins and furans, are toxic chemicals, which persist in the environment for long periods of time and are subject to bio-accumulation in plants and animals. Their presence in the environment results predominantly from human activity, most notably the large-scale incineration of municipal and medical wastes. The quantity of dioxins and furans in the incinerator emissions will vary depending on the type and volume of the waste stream. Sabina recognizes the importance of reducing the presence of dioxins and furans in emissions. Monitoring of dioxins and furans in the exhaust stream will be conducted and is described in more detail in Section 8.1.

7.3 MERCURY

Mercury is a naturally occurring substance, which can be transformed through biological processes to methyl mercury, a persistent substance which bio-accumulates in the food chain and is particularly toxic to humans and wildlife. The quantity of mercury in the incinerator emissions will vary depending on the type and volume of the waste stream. Sabina understands the importance of reducing the concentrations of mercury in emissions. Monitoring of mercury content in the exhaust stream will be conducted and is described in more detail in Section 8.1.

8. Monitoring

Sabina will implement a testing and monitoring program to ensure that criteria for applicable air quality standards and guidelines and ash disposal are being met. The monitoring program is outlined in the following sections.

8.1 INCINERATOR EMISSIONS TESTING

The incinerator stack design will incorporate sampling ports, with caps where necessary, at appropriate locations to allow for stack testing to be undertaken during incineration. Complete stack emissions testing for all incinerators will occur upon commission to ensure achievement of the Canada-wide Standards for Dioxins and Furans and the Canada-wide Standards for Mercury (CCME 2000, 2001). The frequency of recurring individual incinerator emissions testing at Sabina will be determined based on discussions with the appropriate regulatory authorities.

8.2 ASH TESTING

Provided the materials that go into the incinerator are controlled to exclude all hazardous materials, then the incinerator ash should be non-hazardous. Ash testing will be implemented as required to ensure that the incinerator ash is suitable for disposal in the landfill. The samples will be compared to the Environmental Guideline for Industrial Waste Discharges into *Municipal Solid Waste and Sewage Treatment Facilities* (GN 2011b) presented in Table 8.2-1.

Table 8.2-1. Guidelines for Solid Waste/Process Residuals (Ash) Suitable for Landfill

Parameter	Maximum concentration (mg/L)
Arsenic	2.5
Barium	100
Cadmium	0.5
Chromium	5
Lead	5
Mercury	0.1
Selenium	1
Silver	5
Zinc	500

If monitoring indicates the ash is above the guidelines and not suitable for landfilling, an investigation will be undertaken to identify the cause and eliminate the source of exceedance. Ash with elevated metals concentrations will be packaged in drums and sent to a licensed hazardous waste disposal facility. If monitoring indicates the ash meets the guidelines, it will be packaged in drums or sacks and the whole container landfilled, thereby eliminating any windblown effects.

8.3 QUALITY ASSURANCE/QUALITY CONTROL

Sabina will implement a series of QA and QC plans and programs at all levels of the incinerator operation and management. This includes emissions and ash testing procedures. QC procedures implemented as part of the IMP are variable and program-specific. QA/QC procedures will be implemented immediately and updated as necessary based on findings of the year-end reporting.

The following QA/QC procedures for incineration will be implemented:

- Incinerator operational data including temperature, differential pressure in the primary chamber, auxiliary burner operation, fan amperage will be recorded continuously, consistent with detailed written operating instructions from qualified personnel;
- Detailed training programs will be implemented to ensure that all staff working with the incinerator are competent and qualified for their respective task;
- Analysis of sampled emissions during monitoring will be completed by an accredited laboratory;
- Stack testing samples of emissions and ash samples will be collected and handled according to operating instructions prepared by qualified personnel; and
- Qualified personnel will calculate emission concentrations for monitored air quality parameters based on laboratory results and compare against the applicable guidelines.

9. Record Keeping

Maintenance and inspection procedures should be carried out in accordance with the manufacturer's specifications.

A maintenance log is required to be kept for regulatory review. The maintenance log will be used to record routine maintenance activities or operational changes, the date completed, personnel responsible, and observations during maintenance activities. The maintenance log will also note any problems encountered. Maintenance personnel should determine the cause of any failure to help avoid or reduce similar failures.

Operational data will be collected by a data logger and stored continuously, even when the incinerator is not operating. The data will be used to monitor operating conditions to ensure that normal operating parameters are not exceeded. In the event that normal operating conditions are not met, the data will be used to identify causes of failure and to optimize the system.

Prior to incineration, the type of waste in each bag will be determined, weighed and the source noted. The total weight of each type of waste will be recorded before the burn cycle is started. After the cool-down period, the ash will be removed and weighed before it is sent for disposal. This information will be stored electronically with the operational data from the incinerator. This data will assist Sabina in determining incinerator waste generation rates at the facility, and in turn, provide data on the effectiveness of waste diversion, reduction and recycling programs.

Regulatory compliance reporting requirements will be defined in various regulatory authorization issued including the water licence.

10. Environmental Reporting

To demonstrate conformity with performance limits, an annual incineration management report will be prepared and submitted as part of annual reporting to authorizing agencies. The incinerator reporting will also be integrated into the annual air quality monitoring report which Sabina is committed to developing every year.

At the minimum, the following information will be included for incinerator reporting:

- the quantity and type of materials incinerated on-site during operations;
- results from the stack emissions and ash monitoring;
- record of ash disposal, including weight of ash disposed, location of disposal, and the transportation/load details;
- record of any use of auxiliary fuel, referenced to the Fuel Management Plan (SD-16) for fuel log, shipment and handling;
- summary of operational data that is recorded continuously throughout the year, this includes, but not limited to:
  - temperature;
  - carbon monoxide and oxygen levels;
  - auxiliary burner operating times; and
  - differential pressures;
- details of operating personnel and summary of their training.

The annual reporting will also identify any major changes to the operation and efficiency of the incinerator. Staff changes or amendments to training requirements will be noted.

10.1 NATIONAL POLLUTANT RELEASE INVENTORY

Under Section 46 of *Canadian Environmental Protection Act*, organizations that meet certain reporting thresholds are required annually to submit a National Pollutant Release Inventory report to Environment Canada. The report must quantify releases to air, water, land, and material recovery of over 300 listed substances that have been determined to have the potential to cause significant environmental impact (EC 2012). Whether or not reporting is necessary will depend on the results of the periodic stack testing and the quantity of annual emissions calculated using site-specific information on the Facilities operations over the previous calendar year.

10.2 GREENHOUSE GAS REPORTING

The Government of Canada requires Greenhouse Gas (GHG) Emissions Reporting, specifically targeting industrial GHG emitters in Canada, in order to satisfy Section 46(1) of the *Canadian Environmental Protection Act*. Facilities that emit 50 kilotonnes or more of carbon dioxide equivalent (CO2 eq) annually must submit a GHG emission report by June 1 of the following year. The GHG emissions to be reported to the Government of Canada consist of Scope 1 combustion and process related sources. Whether or not reporting is necessary will depend on the quantity of annual emissions calculated using site-specific information on the Facilities operations over the previous calendar year.

11. Adaptive Management

The IMP will be updated regularly to reflect the operating conditions at the Project during Construction, Operations, and Closure. The IMP will be reviewed annually by the Project management team and an updated version will be produced every two years of Operations. The IMP will be reviewed in conjunction with the preparation of the annual report to incorporate any lessons learned, major changes to the incinerator operation or maintenance, and environmental monitoring results.

The need for any corrective actions to on-site emission management or installation of additional control measures will be determined on a case-by-case basis. Indications of the need for corrective actions and additional control measures may include:

- monitoring data showing concentration greater than applicable standards (i.e., elevated metals, dioxins, and furans);
- monitoring data showing an increasing trend in contaminant concentrations; and
- issues raised by on-site staff, regulators, or local communities.

If through a dust fall monitoring program elevated metals, dioxins, furans are detected, an investigation will be undertaken to identify the cause and eliminate the source for the exceedance. Discussions will be initiated to resolve any issues as soon as possible after the issue has been identified.

All employees will be informed of relevant updates and the updated IMP will be stored appropriately on-site.

Sabina will retain all raw data records and annual reporting for at least two years in digital format. The updated IMP, raw data, and annual reporting will be made available by Sabina at all times for review by the Government of Nunavut, Nunavut Impact Review Board, and Environment and Climate Change Canada.

This Plan is part of a continually evolving process that relies not only on the efficacy of data collection and analytical results, but is also dependent on feedback from the communities, government, Aboriginal groups, and the public. Having an adaptive and flexible program allows for appropriate and necessary changes to the design of monitoring studies, and the mitigation and monitoring plans. Some changes may come about through the observation of unanticipated effects or inadequacies in the sampling methods to detect measurable effects. Other changes may result from ecological knowledge acquired through working with Aboriginal community members and discussions with elders, both in the field and through workshops.

Sabina is committed to considering and incorporating Traditional Knowledge into the Plan. The incorporation of Traditional Knowledge will occur throughout all stages of the Plan, including identification of mitigation measures, monitoring study design, data collection, and follow-up programs to obtain feedback.

12. Reclamation

In accordance with the Interim Closure and Reclamation Plan, all buildings, machinery, and equipment that is not salvageable will be disposed of in an on-site landfill after any hazardous material has been removed.

13. References

CCME (Canadian Council of Ministers of the Environment). 2000. Canada-Wide Standards for Mercury.

CCME. 2001a. Canada-Wide Standards for Dioxins and Furans.

EC (Environment Canada. 2003. State of the Environment InfoBase, Environmental Indicator Series 2003. Available online: http://www.ec.gc.ca.

EC. 2010. Technical Document for Batch Waste Incineration. Available online: http://www.ec.gc.ca/gddmw/default.asp?lang=En&n=F53EDE13-1

EC. 2012. National Pollutant Release Inventory (NPRI).

GN (Government of Nunavut). 2010. Environmental Guideline for Mercury-Containing Products and Waste Mercury. Government of Nunavut, Department of Environment, Environmental Protection Service. Available on-line: http://env.gov.nu.ca/sites/default/files/mercurycontaining_products_and_waste_mercury_2010.pdf

GN. 2011a. Environmental Guideline for Ambient Air Quality. Government of Nunavut, Department of Environment, Environmental Protection Service. Available online: http://env.gov.nu.ca/sites/default/files/guideline_-_ambient_air_quality_2011.pdf

GN. 2011b. Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities. Government of Nunavut, Department of Environment, Environmental Protection Service. Available online: http://env.gov.nu.ca/sites/default/files/industrial_waste_discharges_2011.pdf

GN. 2012a. Environmental Guideline for the Burning and Incineration of Solid Waste. Government of Nunavut, Department of Environment, Environmental Protection Service. Available online: http://env.gov.nu.ca/sites/default/files/guideline_-_burning_and_incineration_of_solid_waste_2012.pdf

GN. 2012b. Environmental Guideline for Used Oil and Waste Fuel. June 2012. Available online: http://www.gov.nu.ca/sites/default/files/guideline_-_used_oil_and_waste_fuel_final_2012-en.pdf

NIRB (Nunavut Impact Review Board). 2013. *Guidelines for the Preparation of an Environmental Impact Statement for Sabina Gold & Silver Corp.'s Back River Project*. NIRB File No. 12MN036).

NWB (Nunavut Water Board). 2010a. Mining and Milling Supplemental Information Guideline (SIG) for Mine Development (MM3). February 2010.

NWB. 2010b. Miscellaneous Supplemental Information Guideline (SIG) for General Water Works (including crossings, flood control, diversions, and flow alterations) (M1). February 2010.

WHMIS (Workplace Hazardous Materials Information System). 2015. Available at: http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/ghs-sgh/index-eng.php

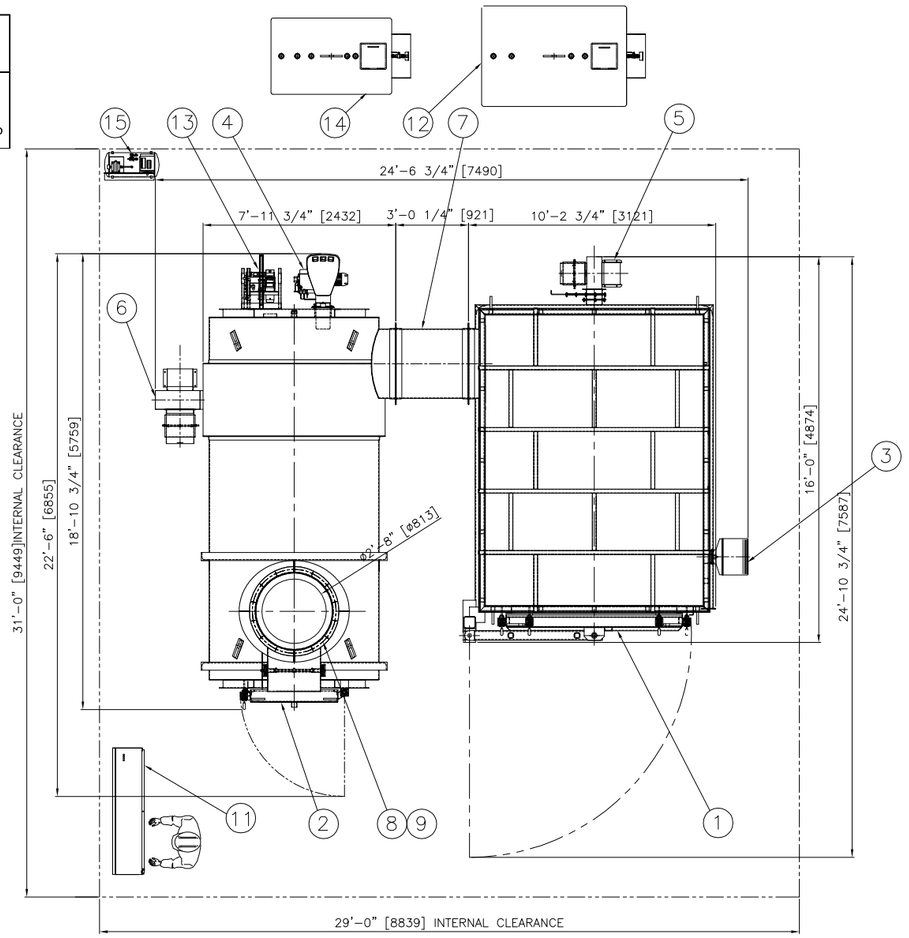
Appendix A. Incinerator Model Drawings

Goose Property Typical Incinerator - Eco Waste Solutions incinerator model ECO 2TN 1PV

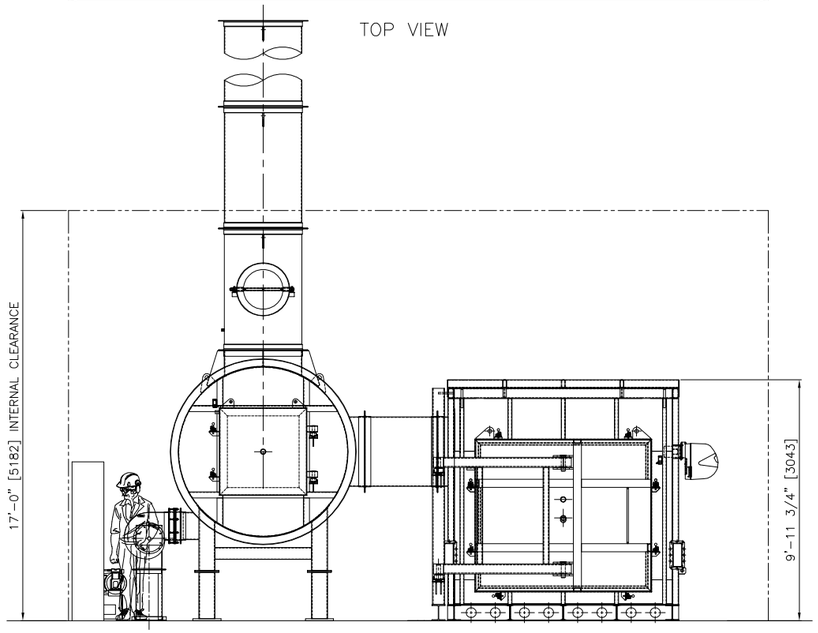
Marine Laydown Area Typical Incinerator - Eco Waste Solutions incinerator model ECO CA-100

Equipment Design Assumptions

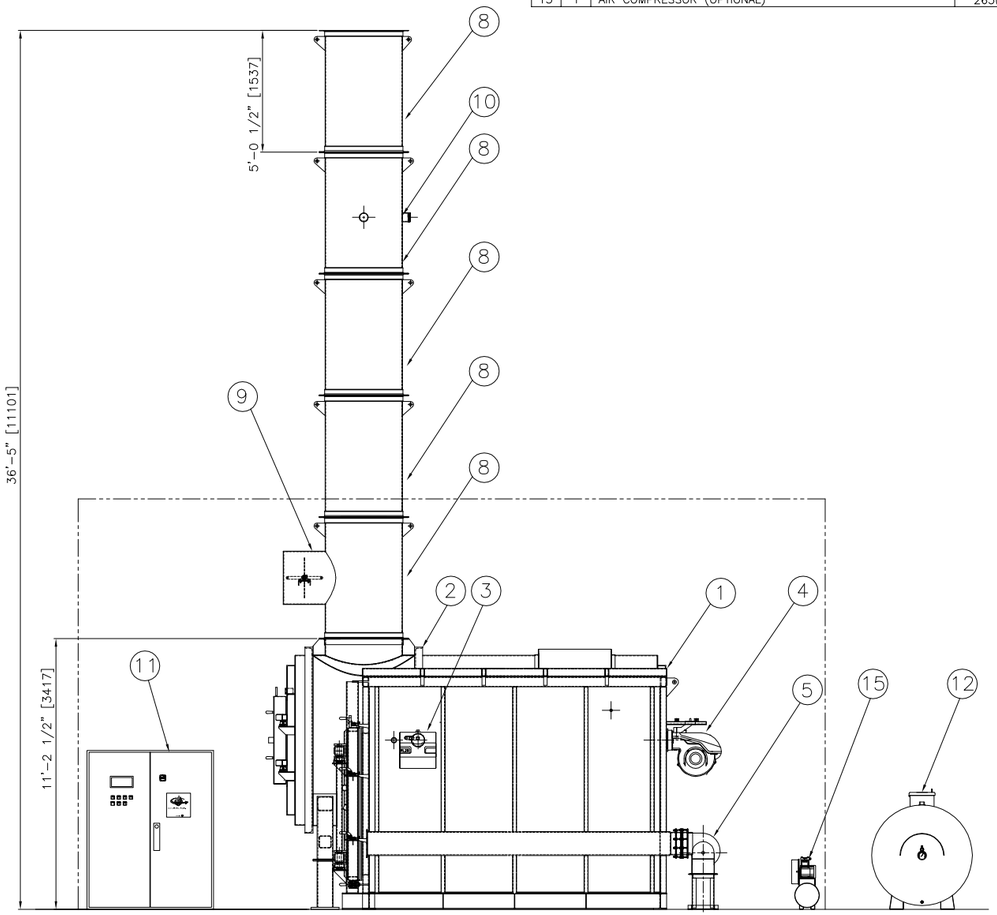
Waste Type	Waste Processing Capacity	Total Moisture Content	Average Density	Average Heat Value
Mixed Non-Hazardous Waste	2000 kg/batch 4410 lb/batch	Up to 30%	160 kg/m^3 10 lbs/ft^3	15 MJ/kg 6500 BTU/lb



TOP VIEW



FRONT ELEVATION



RIGHT ELEVATION

PROPRIETARY INFORMATION

PRELIMINARY DRAWING

BILL OF MATERIAL

ITM.	QTY.	DESCRIPTION	WEIGHT lbs(kg)
1	1	PRIMARY CHAMBER	26455(12000)
2	1	SECONDARY CHAMBER	14110(6400)
3	1	PRIMARY BURNER	88(40)
4	1	SECONDARY BURNER	200(90)
5	1	PRIMARY BLOWER ASSEMBLY	276(125)
6	1	SECONDARY BLOWER ASSEMBLY	400(200)
7	1	BREECH ASSEMBLY	1146(520)
8	5	STACK SECTIONS	1590(720) x5
9	1	BAROMETRIC DAMPER ASSEMBLY	200(90)
10	2	AIR EMISSIONS TEST PORTS	–
11	1	MAIN CONTROL PANEL	507(230)
12	1	DIESEL TANK (OPTIONAL)	1100(500)
13	1	WASTE OIL BURNER (OPTIONAL)	50(22)
14	1	WASTE OIL TANK (OPTIONAL)	510(231)
15	1	AIR COMPRESSOR (OPTIONAL)	265(120)

REV.	DATE	DESCRIPTION	BY	APPROVED

DRAWN: J.X.	DATE: APR-25-2014	ECO WASTE SOLUTIONS ECO BURN INC.	
CHECKED: –	DATE: –		
PROJECT NAME: –		CUSTOMER P.O. –	
PROJECT NUMBER: –		CUSTOMER EQUIPMENT. # –	
SCALE: NONE	TITLE: GENERAL ARRANGEMENT ECO 2TN1PV		P:1_OF_1
JOB NO. –			
THIRD ANGLE	DWG. NO. ECO 2TN1PV-00	REV. A	

Goose Property Typical Incinerator
ISSUE FOR PERMITTING

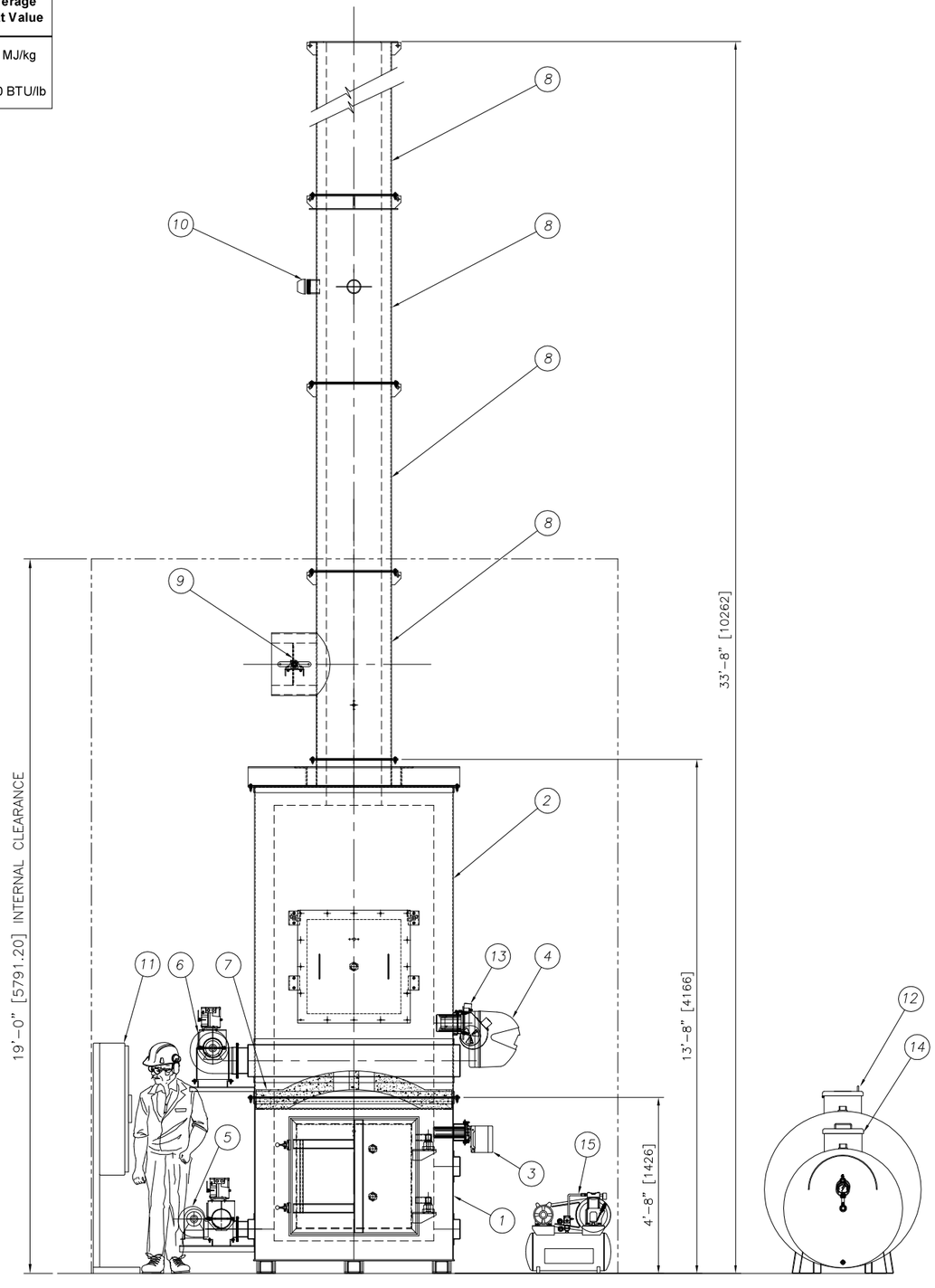
Equipment Design Assumptions

Waste Type	Waste Processing Capacity	Total Moisture Content	Average Density	Average Heat Value
Mixed Non-Hazardous Waste	200 kg/batch 441 lb/batch	Up to 30%	160 kg/m^3 10 lbs/ft^3	15 MJ/kg 6500 BTU/lb

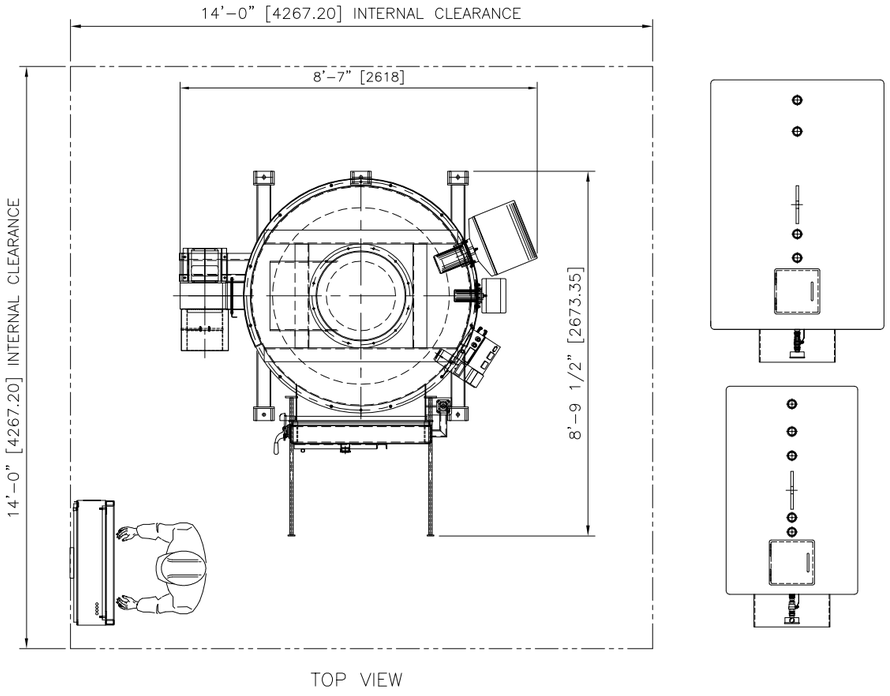
PROPRIETARY INFORMATION

PRELIMINARY DRAWING

BILL OF MATERIAL			
ITM.	QTY.	DESCRIPTION	WEIGHT lbs(kg)
1	1	PRIMARY CHAMBER ASSEMBLY	4100(1860)
2	1	SECONDARY CHAMBER ASSEMBLY	12680(5752)
3	1	PRIMARY BURNER	30(14)
4	1	SECONDARY BURNER	90(41)
5	1	PRIMARY BLOWER ASSEMBLY	40(18)
6	1	SECONDARY BLOWER ASSEMBLY	70(32)
7	1	PRIMARY CHAMBER DOME	950(431)
8	4	STACK SECTIONS	1020(463) x4
9	1	BAROMETRIC DAMPER ASSEMBLY	110(50)
10	2	AIR EMISSIONS TEST PORTS	–
11	1	MAIN CONTROL PANEL (STAND OPTIONAL)	300(136)
12	1	DIESEL TANK (OPTIONAL)	1100(500)
13	1	WASTE OIL BURNER (OPTIONAL)	50(22)
14	1	WASTE OIL TANK (OPTIONAL)	510(231)
15	1	AIR COMPRESSOR (OPTIONAL)	265(120)



FRONT ELEVATION



TOP VIEW

Marine Laydown Area Typical Incinerator
ISSUE FOR PERMITTING

REV.	DATE	DESCRIPTION	BY	APPROVED
–	–	–	–	–

DRAWN: J.X.	DATE: APR–25–2014	ECO WASTE SOLUTIONS ECO BURN INC.	
CHECKED: –	DATE: –		
PROJECT NAME:		CUSTOMER P.O. – –	
PROJECT NUMBER: – –		CUSTOMER EQUIPMENT. # –	
SCALE: –	TITLE: GENERAL ARRANGEMENT CA–100		P.1_OF_1
JOB NO. –			
THIRD ANGLE	DWG. NO. CA 100–00	REV. A	

Appendix B. Incinerator Model Technical Specifications

HATCH™

TECHNICAL - PROPOSAL EVALUATION SUMMARY

CLIENT: Sabina Gold and Silver Corp.
PROJECT: H347078
DESCRIPTION: Back River Feasibility Study

PM061
Incinerators
C. Harmsen
February 24, 2015

Vendor information				
Package supplier		**Eco Waste Solutions**	**Eco Waste Solutions**	**Eco Waste Solutions**
Location		**Burlington, ON. Canada**	**Burlington, ON. Canada**	**Burlington, ON. Canada**
Scope	Units			
Equipment Number		**3123-IN-XXXX**	**3323-IN-XXXX**	**7167-IN-XXXX**
Equipment Name		**Waste Incinerator**	**Waste Incinerator**	**Waste Incinerator**
Equipment Location		**Goose Lake**	**George Lake**	**MLA Port**
Model Number		ECO 2.5TN1P	CA 600	CA 100
Total Install Weight	kg	28,500	14,000	11,200
1 DESIGN DATA				
Waste classification (TYPES)		I, II, III & IV	I, II, III & IV	I, II, III & IV
Mixed waste charge classification: Break-down of each type of waste	%	TBD	TBD	TBD
Emissions:		All emission data below based on 11% O2 content	All emission data below based on 11% O2 content	All emission data below based on 11% O2 content
SO2	g/s	0.0516	0.021	0.0168
CO	g/s	0.0282	0.012	0.0092
Nox	g/s	0.0966	0.04	0.032
VOCs	g/s	0.0129	0.0053	0.0042
PART	g/s	0.0148 (Particulate Matter)	0.006 (Particulate Matter)	0.0048 (Particulate Matter)
PH10	g/s	n/a	n/a	n/a
Dioxins	pg I-TEQ/m^3	<80 (Dioxins/Furans)	<80 (Dioxins/Furans)	<80 (Dioxins/Furans)
Furans	pg I-TEQ/m^3	See Above	See Above	See Above
Mercury	µg/Rm^3	0.07	0.06	0.06
Flue Gas Temperature	°C	Ave.1000	Ave.1000	Ave.1000
Flue Gas Flow Rate	kg/s	1.28	0.523	0.414
Incineration capacity:	kg/batch	2500	340	182
Charge per cycle:	kg	2500	340	182
Burning rate:	kg/h	250 (10 hours burn time)	57 (6 hours burn time)	46 (4 hours burn time)
Off-time per cycle:	h	2 hrs (10 hour burn cycle then goes into automated cooldown cycle of 12 hours)	2 hrs (6 hour burn cycle then goes into automated cooldown cycle of 5 hours. Max. 2 batch/day.)	8 hrs (4 hour burn cycle then goes into automated cooldown cycle of 4 hours. Max. 2 batch/day.)
Heat value:	‹J/kg or BTU/lb	15152 or 6500	15152 or 6500	15152 or 6500
Fuel Type (Product Name)		Arctic Diesel/Waste oil	Arctic Diesel/Waste oil	Arctic Diesel/Waste oil
Fuel mixing ratio with waste oil (if applicable)		TBD	N/A	N/A
Capability to burn waste oil with loading rate	kg/h	Max.105 (Max.750 kg/day, 10 hrs burn time)	12 (72 kg/batch, 6 hours burn time)	12 (48 kg/batch, 6 hours burn time)
Applicable auxiliary burner.		North American Waste Oil Burner	Clean Burn Waste Oil Burner	Clean Burn Waste Oil Burner
Incinerator to bear CSA label	Yes/No	Yes (Control Panel)	Yes (Control Panel)	Yes (Control Panel)
Temperature: Primary chamber:	°C	650-850	650-850	650-850
Temperature: Secondary chamber:	°C	1000	1000	1000
Burner Efficiency:		65-75% (Combustion Efficency)	65-75% (Combustion Efficency)	65-75% (Combustion Efficency)
Internal Volume of Primary Chamber:		21.75 m^3	2.7 m^3	1.4 m^3
Internal Volume of Secondary Chamber:		15.21 m^3	4.71 m^3	2.81 m^3
Destruction efficiency		>99.99%	>99.99%	>99.99%
Tested Emission results	**rates**			
Stack internal diameter	mm	813	533	445
Height of Stack	m	11.1	10.3	10.3
Stack materials of construction		Carbon Steel Shell with Refractory lining	Carbon Steel Shell with Refractory lining	Carbon Steel Shell with Refractory lining
Spark Arrester length	mm	1143	794	794
Spark Arrester open area	m^2	0.731	0.221	0.153

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TECHNICAL - PROPOSAL EVALUATION SUMMARY

		PM061
CLIENT:	Sabina Gold and Silver Corp.	Incinerators
PROJECT:	H347078	C. Harmsen
DESCRIPTION:	Back River Feasibility Study	February 24, 2015

	Vendor information				
	Package supplier		**Eco Waste Solutions**	**Eco Waste Solutions**	**Eco Waste Solutions**
	Location		**Burlington, ON. Canada**	**Burlington, ON. Canada**	**Burlington, ON. Canada**
	Scope	Units			
	Equipment Number		**3123-IN-XXXX**	**3323-IN-XXXX**	**7167-IN-XXXX**
	Equipment Name		**Waste Incinerator**	**Waste Incinerator**	**Waste Incinerator**
	Equipment Location		**Goose Lake**	**George Lake**	**MLA Port**
	Burner System		Each Burner Included: Built-in forced draft mechanical blower to supply combustion air, with fuel train ,air pressure switches, integrated controls.	Each Burner Included: Built-in forced draft mechanical blower to supply combustion air, with fuel train ,air pressure switches, integrated controls.	Each Burner Included: Built-in forced draft mechanical blower to supply combustion air, with fuel train ,air pressure switches, integrated controls.
	Valve Train		Included	Included	Included
	Charging System		Front Door Loading	Front Door Loading	Front Door Loading
	Charging opening size		1880 x 1575 mm	914 x 787 mm	737 x 533 mm
	Charging Chute size		N/A	N/A	N/A
	Ash Removal System		Front Door Manual Removal	Front Door Manual Removal	Front Door Manual Removal
	Expected ash production per cycle	kg	125-375	17-51	9-27
	Maximum Capacity of ash removal system		N/A	N/A	N/A
2	**MATERIALS OF CONSTRUCTION**				
	External Casing		Carbon Steel	Carbon Steel	Carbon Steel
	Spark Arrester		SS 316	SS 316	SS 316
	Insulation in Primary Chamber		Wall and Roof: Ceramic Fibre Modules, Floor: Heavy Castable with isolation Board.	Wall : Ceramic Fibre Modules, Dome: light Castable, Floor: Heavy Castable with	Wall : Ceramic Fibre Modules, Dome: light Castable, Floor: Heavy Castable with isolation
	Insulation in Secondary Chamber		Ceramic Fibre Modules	Heavy Castable with Isolation Board	Heavy Castable with Isolation Board
	Insulation in Stack (materials and thickness)		Light Castable	Light Castable	Light Castable
	Charging Chute		N/A	N/A	N/A
	Paint System Used		Rust-inhibitng, high temperature paint, Carboline-Carbozinc 11 Primer/Carboline-Thermaline 4700	Rust-inhibitng, high temperature paint, Carboline-Carbozinc 11 Primer/Carboline-Thermaline 4700	Rust-inhibitng, high temperature paint, Carboline-Carbozinc 11 Primer/Carboline-Thermaline 4700
	Dry Film Thickness of Paint		2.0 — 3.0 per coat	2.0 — 3.0 per coat	2.0 — 3.0 per coat
	Primary Chamber Burner Rating		384/665— 1240 Mj/hr	517— 945 Mj/hr	517— 945 Mj/hr
	Secondary Chamber Burner Rating		1340/2836—4727 Mj/hr	517/1182—2363 Mj/hr	399/945—1802 Mj/hr
3	**BLOWERS**				
	Blower Manufacturer		NewYork Blower	NewYork Blower	NewYork Blower
	Primary Chamber Blower Capacity	m^3/hr	2700	819	340
	Primary Blower Pressure (kPag)	kPag	0.254	0.254	0.127
	HP/ RPM		1.5/1750	0.5/3450	0.33/1725
	Secondary Chamber Blow Capacity (m3/hr)	m^3/hr	4160	2700	1164
	Secondary Blower Pressure (kPag)	kPag	1	0.254	0.254
	HP/ RPM		3.0/3795	1.5/1750	0.5/1725
4	**ELECTRICAL**				
	Input Voltage	V	575	208	208
	Frequency	Hz	60	60	60
	3 phase or single		3	3	3
	2 wire, 3 wire, or 4 wire				
	Input Power	kW	6.2	2.8	1.85
	Power Factor				
	Full Load Current	A			
5	**CONTROL SYSTEM**				
	Please list all instrumentation and details including		**See Proposal for overview**	**See Proposal for overview**	**See Proposal for overview**

HATCH™

TECHNICAL - PROPOSAL EVALUATION SUMMARY

PM061

CLIENT: Sabina Gold and Silver Corp. — Incinerators

PROJECT: H347078 — C. Harmsen

DESCRIPTION: Back River Feasibility Study — February 24, 2015

	Vendor information							
	Package supplier		**Eco Waste Solutions**		**Eco Waste Solutions**		**Eco Waste Solutions**	
	Location		**Burlington, ON. Canada**		**Burlington, ON. Canada**		**Burlington, ON. Canada**	
	Scope	Units						
	Equipment Number		**3123-IN-XXXX**		**3323-IN-XXXX**		**7167-IN-XXXX**	
	Equipment Name		**Waste Incinerator**		**Waste Incinerator**		**Waste Incinerator**	
	Equipment Location		**Goose Lake**		**George Lake**		**MLA Port**	
	CSA approval and labeling:		Yes		Yes		Yes	
6	**DIMENSIONS**							
	Overall Length	mm	7350		3042		2673	
	Overall Width	mm	8100		2995		2618	
	Overall Height	mm	11100		10343		10262	
	Shipping Dimensions	mm (LxWxH)	Primary Chamber:	4770 x 3200 x 3070	Primary Chamber:	2261 x 2210 x 1854	Primary Chamber:	1880 x 1830 x 1638
		mm (LxWxH)	Primary Chamber:	7350 x 2460 x 2800	Secondary Chamber:	2235 x 2108 x 2667	Secondary Chamber:	1854 x 1778 x 2743
		mm (LxWxH)	20 ft Container:	6090 x 2440 x 2590	20 ft Container:	6090 x 2440 x 2590	20 ft Container:	6090 x 2440 x 2590
7	**WEIGHTS**							
	Incinerator	kg	22,800		10,700		8,200	
	Stack	kg	3,000		2,230		1,900	
	Blowers	kg	350		80		50	
	Total Weight	kg	28,500		14,000		11,200	

NOTES:

1. No technical evaluation was done on the second bidder (Ketek) because they are not commercially competitive for the large unit at the Goose site.
2. Ketek recommended two incinerators for the Goose site.
3. Ketek's Goose site incinerator primary chamber volume is 5.5 m^3 which is approximately 1/4 the size of EWS (21.75 m^3).

Appendix C. Waste Streams Suitable For Processing In Eco Waste Solutions Technology

ECO WASTE SOLUTIONS

Acceptable Waste-Streams

The **Eco Waste Solutions Waste Oxidizer** can process a range of waste materials. The following list has some of the potential waste streams that can be effectively processed in our system. This list is only a guide and should not be assumed to be an exhaustive list of materials. Please contact EWS for more details.

Acceptable Waste Materials Suitable for Processing in Eco Waste Solutions Technology

Solid Waste	Description	Origin
Food Waste	Food, food packaging and containers, plastic and paper waste from food preparation	Kitchen and dining areas
Domestic waste	General refuse such as paper, plastics, cans, bottles, cardboard, newsprint	Dormitory areas, recreation facilities, office areas, warehouse, plant and production facilities
Packaging	Cardboard boxes, paper, plastic containers, plastic film, styrofoam, poly-weave bags	Inbound supplies to all work areas.
Wood waste	Skids, pallets, crates, including wood materials contaminated with chemical residues from Cyanide or explosives	Construction activity, inbound supplies, reagent and chemical packaging.
Absorbents	Rags, wipes, spill cleanup materials	From all work areas
Filters – Air and Fluid	Filters coated with fine particles and trapped solids, saturated with water or fluids (glycol, lube oils, fuel)	From water treatment facility, or generated at point of maintenance of vehicles, machinery and equipment
Medical Waste	Bandages, dressings, gloves, swabs, syringes, sharps	Medical clinic or first aid centre
Tires & Rubbers	Tires, belts, hoses	From vehicles and equipment maintenance shop
Low-level radioactive waste[1]	Personal protective equipment (gloves, overalls, etc.), pallets, packaging, rags, construction debris that have come in contact with radioactive elements.	From maintenance activities, operations and construction activities
Liquid Waste[2]	**Description**	**Origin**
Glycol	Used antifreeze	From vehicles and equipment maintenance shop
Used Oils	Used lubricating and hydraulic oils, including synthetics	From vehicles and equipment maintenance shop
Semi-solid Waste[3]	**Description**	**Origin**
Sewage sludge	Dry filter cakes	From sewage treatment plant dewatering equipment
Kitchen grease, oils	Solid kitchen fats, grease, used cooking oil	Kitchen grease traps, fryers

Note: the following items require special features and handling please consult with EWS for details

1. Processing of radioactive materials requires the inclusion of an air pollution control system.
2. Glycol can be blended with waste oil (up to 5%) – only with optional upgraded waste oil burner package.
3. Dewatered sewage sludge and kitchen grease can be comingled with waste – restrictions apply.

Unacceptable Waste-Streams

The following is a list of some of the waste-streams that should not be processed in the Eco Waste Oxidizer. This list is only a guide and should not be assumed to be an exhaustive list of materials. Please contact EWS for more details and to discuss your specific waste processing requirements.

A waste and procurement audit is highly recommended and encouraged to ensure that all sources of heavy metals are identified and diverted to other disposal methods. Small amounts of materials containing heavy metals may be acceptable if air pollution control equipment specially designed for metals removal is included with the package.

Unacceptable Waste Materials - NOT Suitable for Processing in Eco Waste Solutions Technology

Solid Waste	Description	Origin
Bulky Materials	Automotive or heavy equipment parts such as engine blocks and transmissions	From vehicles and equipment maintenance shop
Non-Combustible Materials	Drywall, asbestos, bricks, concrete, soils	Construction activity
Radioactive Materials	Smoke detectors, laboratory wastes	From Buildings, laboratories
Potentially Explosive Materials	Aerosol spray cans, large propane tanks, other pressurized vessels. Actual explosives	From warehouse, plant and production facilities
Heavy Metals	Items containing lead, mercury, cadmium, for example: batteries, electronic devices, fittings, old pipe work, fluorescent light bulbs, electrical switches, thermometers, PVC plastics, aluminum solder, photovoltaic cells	From maintenance activities, operations and construction activities
Liquid Waste	**Description**	**Origin**
High Alkaline or High Acid Materials	By-products of industrial processes, unrefined fuels	From warehouse, plant and production facilities
Solvents	Solvents such as acetone, xylene, methanol	From vehicles and equipment maintenance shop