MINOR SOURCE PERMIT APPLICATION

QSS Biosolids, LLC - Pyrolysis Facility
135 All American Way
North Kingstown, Rhode Island

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For Submission to:

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SAGE Project #L5247042 (formerly C096)

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1.0 INTRODUCTION

QSS Biosolids, LLC (QSSB) is proposing a new sewage sludge pyrolysis facility within the Quonset Business Park located in North Kingstown, Rhode Island; (referred to herein as the 'Facility'). Pyrolysis is the process of decomposing organic materials by applying heat in an oxygen-deprived environment. Pyrolysis is a thermochemical treatment process that can be used to manage and reduce the volume of sewage sludge. The pyrolysis process involves heating dried feedstock material in an oxygen-limited environment to break down organic components and produce a carbon-rich solid byproduct, known as biochar, along with other gaseous byproducts (pyrolysis gas). The characteristics of biochar (e.g., surface area, pore structure, nutrient content, etc.) are dependent on the feedstock material. The proposed Facility will accept sewage sludges from wastewater treatment facilities in Rhode Island as a source of organic materials for the pyrolysis process. The pyrolysis gas byproduct can be used as a renewable energy source or feedstock for gas upgrading processes. Additionally, the biochar byproduct of the process has several notable applications, including carbon sequestration, soil improvement, and contamination remediation.

This pyrolysis Facility is being proposed as an alternative solution to the current methods of treating and disposing of sewage sludge in Rhode Island, as aging incineration infrastructure and limited landfill capacity present challenges for future disposal options. Air emissions from current disposal methods like incineration are typically higher and more toxic compared with technologies like pyrolysis, and the resulting ash from incineration typically contains more concentrated harmful substances and requires special handling and ultimate disposal practices. Furthermore, other disposal practices, such as land application, are under increased regulatory scrutiny due to the presence of contaminants of emerging concern in some sewage sludge. Pyrolysis results in a stabilized biochar that is generally considered a beneficial by-product compared to the toxic ash produced by incineration, and the pyrolysis gas can be used as a renewable energy source. Pyrolysis aligns with sustainability goals and waste-to-energy initiatives, contrasting with incineration, which primarily focuses on waste disposal.

QSSB will contribute to the circular economy by up-cycling sewage sludges into valuable and highly marketable materials that effectively sequester carbon while improving crop yield and agricultural efficiency, facilitating site remediation, contributing to cleaner air and water, and enabling QSSB to participate in voluntary carbon markets. QSSB has engaged leading experts in the areas of biochar production, commercial applications, and the voluntary carbon market to help select equipment, analyze the quality and marketability of the feedstock and the end products, and design and build the physical plant.

The Facility has been designed with pollution control equipment to remain below major source air emissions permitting thresholds; however, the controlled Facility-wide emissions exceed the Minimum Quantity (MQ) air dispersion modeling thresholds listed in Part 9 and Part 22 of the Rhode Island Department of Environmental Management's (RIDEM's) Rhode Island Code of Regulations (RICR) (250-RICR-120-05-9 – *Air Pollution Control Permits* and 250-RICR-120-05-22 – *Air Toxics*) for the following pollutants:

- Acetaldehyde
- Acetamide
- Ammonia

- Aniline
- Antimony & compounds, including antimony trioxide
- Arsenic & compounds (inorganic)
- Barium
- Benzene
- Beryllium & compounds
- Biphenyl
- Boron and borates
- Carbon disulfide
- Carbonyl sulfide
- Cadmium & compounds
- Chromium III & compounds, insoluble salts
- Cobalt & compounds
- Copper & compounds, except Copper cyanide
- Cresols/Cresylic acid isomers and mixtures
- Ethyl benzene
- Fluorides & compounds, including Hydrogen fluoride
- Formaldehyde
- Glutaraldehyde
- Hexane
- Hydrochloric acid (Hydrogen chloride)
- Hydrogen cyanide
- Hydrogen bromide
- Hydrogen sulfide
- Lead & compounds, inorganic
- Manganese & compounds
- Mercury & compounds – elemental & inorganic
- Molybdenum and compounds
- Naphthalene
- Nickel and compounds, except Nickel subsulfide
- Phenol
- Polychlorinated biphenyls (PCBs), except Aroclor 1254
- Polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs)
- Propylene
- Quinoline
- Selenium & compounds except Hydrogen selenide and Selenium sulfide
- Styrene
- Toluene
- Vanadium and compounds
- Xylenes, isomers, and mixtures
- Zinc and compounds

The modeling protocol was previously submitted to the Department on March 23, 2025; the protocol was subsequently approved on April 9, 2025. The Facility has conducted an air quality impact analysis for each of the air toxics listed above, and the modeling report is being submitted to RIDEM as part of this application package.

This application package also outlines the regulatory review and Best Available Control Technology (BACT) analysis for the emission units being permitted at the Facility. QSSB respectfully requests expedited review of this Minor Source Air Permit Application. As such, all of the elements required for expedited review have been included in this application in accordance with the requirements detailed in Section 9.7.9 of Part 9 of the RIDEM Office of Air Resources (OAR) Air Pollution Control Regulations (250-RICR-120-05-9 – Air Pollution Control Permits), as detailed below.

1.1 Expedited Application Overview

The following required elements are being submitted as part of this application in accordance with the RIDEM OAR *Expedited Minor Source Permit Application Checklist*:

- Air Permit Pre-Application Meeting with RIDEM (**April 1, 2025**);
- Submission of and Office of Air Resources (OAR) approval of a modeling protocol *prior* to expedited permit application submission (**Submitted March 23, 2025; Approved April 9, 2025**);
- Description of the proposed project and flow process diagrams (**Section 1.3**, **Appendix A**, and **Appendix B**);
- Description of operations at the stationary source (**Section 1.3**, **Section 2.1**, and **Appendix A**);
- Potential to emit calculations for the Facility (**Section 2** and **Appendix C**);
- Demonstration that the proposed Facility is not a "major stationary source" (**Section 2.0, Section 3.0**, and **Appendix C**);
- Identification of all applicable State and Federal Air Pollution Control Regulations the proposed Facility is subject to along with a demonstration explaining how the Facility will comply with each identified regulation (**Section 3.0** and **Appendix D**);
- A "Top-Down" BACT analysis in accordance with Subsection 9.7.3(A)(1) of Part 9 of the RIDEM Air Pollution Control Regulations (**Section 4.0**);
- Air Quality Impact Analysis that demonstrates the emissions from the stationary source will not cause a violation of any applicable State or Federal ambient air quality standard (**Appendix E**);
- A proposed draft permit (**Appendix F**);
- Completed application forms (**Appendix G**) and expedited review checklist (**Appendix H**); and,
- Electronic copies of all spreadsheets (**provided as a separate attachment *via* email**).

1.2 Facility Background

The Facility is proposed for construction within the Quonset Industrial Park, at 135 All American Way, North Kingstown, Rhode Island 02852 (North Kingstown Tax Assessor's Plat 180, Lots 19, 20, 21, and 22). The Facility is sited within the Quonset Industrial Park and is zoned Quonset Business Park District (QBPD), which *"… is established as a mixed use center for economic activity, which may be supported by residential use and recreational opportunities. Due to the presence of significant infrastructure including access highways, a general aviation and military airport, a wastewater treatment facility, freight rail, a working waterfront, and public water supply, the QBP district is uniquely suited to accommodate a high density mix of uses. These uses will potentially include standard commercial (retail/office), light and heavy industry,* *open space and recreation, water-dependent use, freight transport, energy generation, and transit-oriented development. It is the intent of this district to facilitate the development of these uses through a unique relationship between the town and QDC. The QBP is a performance-based development district that will focus on facilitating economic development that recognizes, is protective of, and is consistent with the overall community planning objectives of the town."*

Facility site plans are included in **Appendix B**.

1.3 Project Description

In summary, the Facility is designed to accept dewatered sewage sludge material through two (2) reception buildings. The wet feedstock material will be conveyed to and stored in one (1) of four (4) wet feedstock storage silos and will feed into the process as needed. Wet feedstock is routed from the wet feedstock storage silos to one (1) of two (2) dryers through enclosed conveyance systems. Upon drying the feedstock material, the dried sewage sludge is transferred into one (1) of two (2) dried feedstock storage silos *via* enclosed conveyance systems. To minimize dust in downstream equipment, the dried feedstock can be pelletized in one (1) of two (2) pelletizing units from the dried feedstock storage silos.

The pelletizers can also be bypassed to allow maintenance work without interruption of operations. Bypass of the pelletizers has the potential to increase dust in the pyrolysis gas which will likely increase the maintenance and cleaning requirements for downstream equipment. Bypass of the pelletizers is considered an abnormal operating condition and not intended as a prolonged configuration. However, it is unlikely that bypassing this system will impact expected emissions from downstream equipment, as the increased particle loading will be removed in the catalytic filters. The reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, and pelletizers are designed to be maintained under a negative pressure, and air from these pieces of equipment is routed to the Odor Control Plant, which consists of a biotrickling filter, two-stage acid and alkaline wet scrubbers, and a carbon polishing filter.

From the pelletizing units, the pelletized feedstock is routed to one (1) of two (2) electrically heated pyrolysis reactors, where the feedstock material undergoes the pyrolysis process. Each pyrolysis reactor is equipped with its own pollution control system consisting of a thermal oxidizer and a catalytic filter before exiting through the stack. A portion of the exhaust gas from the catalytic filter is routed back to its respective thermal oxidizer unit for additional Nitrogen Oxides (NO_x) control. It should be noted that each pyrolysis line is equipped with its own emission stack; however, the two (2) stacks are co-located within one (1) stack for a single emission point. The thermal oxidizer combusts the pyrolysis gas that is generated from the pyrolysis of sewage sludge, and the heat generated from this combustion heats a closed-loop thermal oil system that is utilized to heat the drying process. The thermal oxidizers operate at greater than 1000°C with a minimum 2 second residence time. The thermal oxidizer is comprised of three (3) zones: 1) a reducing zone operating between 1000°C (1832°F) and 1315°C (2400°F); 2) a conditioning zone; 3) and a final oxidation zone where air is added to bring the products of combustion up to 1000°C . Surplus heat may be utilized to produce electricity. During initial system start-up, the thermal oxidizers operate on natural gas until the system has met the temperature requirements and pyrolysis gas can be utilized as the heat source. No additional fuel burning equipment is being proposed at this time.

From the pyrolysis units, biochar exits through an enclosed chute in the lower end of the reactor and enters an enclosed biochar cooling screw. Upon cooling and moisturizing, the biochar is transported *via* an enclosed conveyance system to the Biochar Logistics Station, which is a bulk bag packing station within a building at the Facility. An enclosed distribution screw will be used between the station, and automated valves will ensure correct filling of the bags. Once filled, the bags are sealed to prevent evaporation of the water from the biochar. The bulk bags are then transported off-Site by trucks or rail for use or disposal.

Sludge-based biochar is currently being used across a range of commercial applications, as well as some that are showing promise within the context of R&D projects. A partial list of market-driven applications includes concrete, asphalt, pavers, filtration units, soil and mine remediation, and caps for abandoned oil and gas wells. The use of biochar in each of these applications reduces greenhouse gases and the overall carbon footprint, as compared to traditional processes and source materials. In the built environment, the substitution of biochar for traditional materials increases the durability and strength of the end product, while sequestering carbon for hundreds of years and qualifying for income from carbon credits. An increase in market demand for sludge-based biochar in the built environment over the next couple of years is expected as the structural benefits of biochar-as-an-additive become more widely recognized within the construction industry.

A further detailed project description outlining all processes, emission sources, and pollution control equipment to be utilized at the proposed Facility is included in **Appendix A.** VOW ASA, including its affiliates and partners, has been engaged by QSSB to design the proposed sewage sludge treatment process utilizing VOW's proprietary pyrolysis technology. The documents provided in **Appendix A** were prepared by VOW ASA.

2.0 Potential Emissions

Proposed emissions from the Facility are summarized in **Table 1**, below. Detailed emissions calculations, including emissions of each individual hazardous air pollutant (HAP) and established Rhode Island Toxic Air Pollutant (RI Air Toxic) both before and after pollution control equipment, can be found in **Appendix C**.

Table 1.
Facility-Wide Emissions Summary
QSSB Biosolids, LLC
North Kingstown, Rhode Island

Pollutant	Facility-Wide Controlled Emissions (ton/yr)
Nitrogen Oxides (NO_x)	12.536
Carbon Monoxide (CO)	13.000
Methane (CH_4)	0.735
Carbon Dioxide (CO_2)	87,017.679
Particulate Matter (PM)	5.257
Sulfur Dioxide (SO_2)	37.028

Pollutant	Facility-Wide Controlled Emissions (ton/yr)
Volatile Organic Compounds (VOC)	2.082
Total Hazardous Air Pollutants (HAP)	3.102

The emissions for all production processes are based on 8,760 hours of operation per calendar year. Details of the control device efficiencies for each portion of the Facility's processes are included with the calculations in **Appendix C**.

2.1 Description of Operations at the Stationary Source

QSSB will utilize several sequential processes at the Facility to produce their biochar product. These main processes include the reception, drying, transport and intermediary storage of the dewatered sewage sludge feedstock material before delivery to a pyrolysis reactor to be converted into biochar. **Table 2** describes the various emission sources at the Facility. See **Appendix C** calculations for more details.

Table 2.
Stationary Source Summary
QSSB Biosolids, LLC
North Kingstown, Rhode Island

Source Description	Pollutants	Control Device
Wet Feedstock Reception Buildings & Conveyance	RI Air Toxics, HAPs, VOCs	Enclosed Buildings, Negative Pressure, High Moisture, Enclosed Hoppers and Conveyors, Odor Control Plant
Wet Feedstock Storage Silos & Conveyance	RI Air Toxics, HAPs, VOCs	Enclosed, High Moisture, Negative Pressure, Odor Control Plant
Material Dryers & Conveyance	RI Air Toxics, HAPs, VOCs, PM	Enclosed, Negative Pressure, Integral Cyclone and 3-Stage Scrubber, Odor Control Plant
Dry Feedstock Storage Silos & Conveyance	RI Air Toxics HAPs, VOCs, PM	Enclosed, Negative Pressure, Integral Top-Mounted Particulate Filter, Odor Control Plant
Pelletizers & Conveyance	RI Air Toxics, HAPs, VOCs, PM	Enclosed, Negative Pressure, Integral Particulate Filter, Odor Control Plant
Pyrolysis Reactors	RI Air Toxics, HAPs, VOCs, PM	Thermal Oxidizer, Catalytic Filter

3.0 REGULATORY APPLICABILITY

This section addresses the applicability of Federal and State air quality regulations to the Facility.

3.1 Federal New Source Review

The federal New Source Review (NSR) program consists of two (2) primary pre-construction permitting processes: 1) Prevention of Significant Deterioration (PSD) for areas and pollutants in attainment, and 2) Nonattainment New Source Review (NNSR) for areas and pollutants in nonattainment. These programs must be evaluated for any new stationary sources or modifications to existing sources.

The RIDEM implements NSR programs as part of the State Implementation Plan (SIP). According to Air Pollution Control (APC) Regulation 9, Section 9.5(C)(6)(b), the major source threshold (MST) for PSD review is 250 tons per year (tpy) for any regulated NSR pollutant, unless the stationary source is specifically listed in Section 9.5(C)(6)(a), in which case the MST is reduced to 100 tpy for any regulated NSR pollutant. For the NNSR permitting program, as outlined in RIDEM APC Section 9.8 and defined in Section 9.5(B), the MST is 100 tpy for any regulated NNSR pollutant, except for VOC and NO_X, which have a reduced threshold of 50 tpy each due to Rhode Island's classification as part of the U.S. Environmental Protection Agency (EPA)-designated Ozone Transport Region (OTR).

In accordance with RIDEM APC Regulation 9, determining whether PSD/NNSR applies to a project involves a two-step process. The first step is to evaluate whether the Facility is considered a major stationary source. If the Facility is not a major source, then PSD/NNSR does not apply, and the process ends there. If the Facility is a major source, the second step is to assess whether the proposed new construction or modifications will result in a significant net emissions increase. This involves calculating the change in emissions from the project itself (whether it is new construction or a modification), including any contemporaneous emission changes at the Facility.

3.1.1. National Ambient Air Quality Standard (NAAQS) Attainment Status

The Facility is located in Washington County, Rhode Island, which is designated as attainment for the 2008 and 2015 ozone National Ambient Air Quality Standards (NAAQS), as specified in 40 CFR 81.350 and 81.360, respectively. The county is also designated as unclassifiable/attainment for all other criteria pollutants, as outlined in 40 CFR Part 81. In addition, Rhode Island is part of the U.S. Environmental Protection Agency (EPA)-designated Ozone Transport Region (OTR). As a result, the state is subject to stricter ozone regulations due to its inclusion in the OTR. The state is also subject to stricter VOC and NO_X regulations as precursors to ozone.

3.1.2. PSD/NNSR Major Source Status

The Facility's potential to emit does not exceed the applicable MSTs, as demonstrated in **Table 2** above. Therefore, the Facility is classified as a new construction minor stationary source for PSD and NNSR purposes. Based on this, no further PSD/NNSR evaluation is required.

3.1.3. PSD/NNSR Applicability

As noted above, the Facility is not a new major stationary source; therefore, it is not subject to the second step of the process required for new and existing major sources. Consequently, the Facility is not subject to federal PSD or NSR evaluation.

3.2 Other Federal Air Quality Regulatory Requirements

Other potentially applicable federal regulations include the New Source Performance Standards (NSPS; 40 CFR 60), National Emission Standards for Hazardous Air Pollutants (NESHAP; 40 CFR 61), and National Emission Standards for Hazardous Air Pollutants for Source Categories (NESHAP; 40 CFR 63). SAGE has reviewed each of these regulations to assess their applicability to the Facility. Additionally, on March 6, 2025, SAGE submitted an Applicability Determination Request Letter to the U.S. EPA Region 1, seeking clarification on the applicability of specific NSPS regulations for the proposed sewage sludge pyrolysis Facility (see **Appendix D** for the body of the letter correspondence only; attachments to the letter are not included). The request for an applicability determination highlights three (3) select regulations that SAGE believes do not apply to the Facility, for which input from the EPA was requested. These regulations include:

- NSPS Subpart LLLL (Standards of Performance for New Stationary Sources: Emissions from Sewage Sludge Incineration);
- NSPS Subpart CCCC (Standards of Performance for New Stationary Sources: Emissions from Commercial and Industrial Solid Waste Incineration); and,
- NSPS Subpart O (Standards of Performance for Sewage Treatment Plants).

The letter further clarifies that sewage sludge pyrolysis does not meet the definition of incineration and, therefore, does not require major source air permitting. The following sections provide a detailed analysis of the regulatory applicability of each set of standards to the proposed Facility.

3.2.1. New Source Performance Standards (NSPS) – 40 CFR Part 60

Based on SAGE's review, none of the emissions sources at the Facility are subject to any current NSPS regulation. This section summarizes the potential applicability of New Source Performance Standards NSPS regulations codified in 40 CFR Part 60 to the Facility and explains why they do not apply.

3.2.1.1 40 CFR 60, Subpart LLLL (Standards of Performance for New Stationary Sources: Emissions from Sewage Sludge Incineration)

The Standards of Performance for New Sewage Sludge Incineration Units (NSPS Subpart LLLL) applies to Sewage Sludge Incinerators (SSI) for which construction commenced after October 14, 2010, or for which modification commenced after September 21, 2011. The proposed QSSB pyrolysis unit does not meet the definition of an SSI unit.

"Sewage sludge incineration (SSI) unit" is defined in 40 CFR §60.4930 as:

> *"An incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearths. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack."*
>
> "Sewage sludge" is defined as:
>
> *"Solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works."*

In addition, in publishing the final rule Subpart LLLL, EPA described an SSI unit as "*an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter.*"

Based on these definitions, Subpart LLLL does not apply to the proposed QSSB sewage sludge pyrolysis Facility. The proposed Facility does not meet the definition of an SSI unit, as the pyrolysis units are not designed to combust sewage sludge (i.e., no flame). Pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Pyrolysis occurs under oxygen-deprived conditions such that combustion cannot occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. During pyrolysis, pyrolysis gas will be produced from the flameless heating of sewage sludge in electrically heated pyrolysis reactors. The resulting pyrolysis gas will be combusted in thermal oxidizers as part of the air pollution control system. Notably, the definition of sewage sludge does not include gases of any kind, including pyrolysis gas. Therefore, SAGE is of the opinion that this does not meet the definition of an SSI because the material being combusted as part of this process is not a solid, semi-solid, or liquid residue and therefore does not meet the definition of sewage sludge. Rather, the pyrolysis gas consists of volatile constituents, including water vapor, volatile organic compounds, and inorganic gases, which are liberated from the sewage sludge during the flameless heating process. As such, this Subpart does not apply to the proposed Facility.

3.2.1.2 40 CFR 60, Subpart CCCC (Standards of Performance for New Stationary Sources: Emissions from Commercial and Industrial Solid Waste Incineration)

Commercial and industrial solid waste incineration (CISWI) units are subject to the requirements of the Standards of Performance for Commercial and Industrial Solid Waste Incineration Units (NSPS Subpart CCCC) if the unit commenced construction after June 4, 2010, or commenced reconstruction or modification after August 7, 2013. Subsection 60.2265 defines a CISWI unit as the following:

> *"Any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241. If the operating unit burns materials other than traditional fuels as defined in §241.2 that have been discarded, and you do not keep and produce records as required by §60.2175(v), the operating unit is a CISWI unit. While not all CISWI units will include all of the following components, a CISWI unit includes, but is not limited to, the solid waste feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The CISWI unit does not include air pollution control equipment or the stack. The CISWI unit boundary starts at the solid waste hopper (if applicable) and extends through two areas: The combustion unit flue gas system, which ends immediately after the last combustion chamber or after the waste heat recovery equipment, if any; and the combustion unit bottom ash system, which ends at the truck loading station or similar equipment that transfers the ash to final disposal. The CISWI unit includes all ash handling systems connected to the bottom ash handling system."*

Similar to the above discussion related to Subpart LLLL, the proposed pyrolysis Facility does not meet the definition of an incineration unit. The definitions state that an incineration unit must combust fuel with a flame, and the fuel must be in a solid state. As previously described, pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Instead, pyrolysis occurs in a flameless, oxygen-deprived environment such that combustion does not occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. The gases generated from the pyrolysis reaction are combusted in thermal oxidizers and the heat from the combustion will be recovered in a thermal oil loop and used to dry the feedstock, and surplus heat will be utilized to produce electricity.

3.2.1.2 40 CFR 60, Subpart O (Standards of Performance for Sewage Treatment Plants)

The applicability section of the Standards of Performance for Sewage Treatment Plants (NSPS Subpart O) states that *"[the] affected facility is each incinerator that combusts wastes containing more than 10 percent sewage sludge (dry basis) produced by municipal sewage treatment plants, or each incinerator that charges more than 1000 kg (2205 lb) per day municipal sewage sludge (dry basis)".*

Although Subpart O does not define "incinerator," the following definition for "sewage sludge incinerator" was included as 40 CFR § 60.151(a) in the Subpart O proposed rule:

> *"Sewage Sludge Incinerator" means any combustion device used in the processes of burning sewage sludge for the primary purpose of solids sterilization and to reduce the volume of waste by removing combustible matter but does not include portable facilities or facilities used solely for burning scum or other floatable materials, recalcining lime, or regenerating activated carbon.*

The definition of an SSI is specific to the terms 'burning' and 'incineration' rather than inclusive of other terms such as, 'pyrolysis.' A search of EPA information and policy documents did not identify any existing EPA guidance/determinations on the potential applicability of Subpart O to municipal sewage sludge pyrolysis. Lacking such guidance, SAGE opines that the rationale provided to EPA with respect to Subparts CCCC and LLLL (see above) may be applied to Subpart O. SAGE is of the opinion that pyrolysis is not synonymous with incineration, and the combustion of pyrolysis gas is not considered combustion of sewage sludge. The same logic may reasonably apply as it relates to the definition of a sewage sludge incinerator under Subpart O. As such, this Subpart is not applicable to the proposed Facility.

3.2.2. National Emission Standards for Hazardous Air Pollutants (NESHAP) – 40 CFR Part 61

This section addresses the potential applicability of NESHAP regulations codified in 40 CFR Part 61 to the proposed Facility.

3.2.2.1 40 CFR 61, Subpart E - National Emission Standard for Mercury

Section 40 CFR 61, Subpart E applies to *"stationary sources which… incinerate or dry wastewater treatment plant sludge."* Additionally, sewage sludge dryers are defined in this Subpart as *"…a device to reduce the moisture content of sludge by heating to temperatures above 65 °C (ca. 150 °F) directly with combustion gases."*

As previously stated, pyrolysis is distinct from incineration in that it does not involve combustion. Rather, the process takes place in a low-oxygen environment that prevents combustion from taking place. As such, SAGE is of the opinion that the pyrolysis units at the Facility are not combustion units. Furthermore, while these units are not considered incineration units for sewage sludge, based on the potential to emit calculations provided by VOW ASA, the uncontrolled mercury emissions from the pyrolysis process are expected to be below the 7.1 lb/day threshold established in 40 CFR Part 61, Subpart E, at a rate of 0.23 lb/day.

The Facility design also includes two (2) sewage sludge dryers that are heated *via* a closed-loop thermal oil system. The oil is heated during start-up by natural gas combustion in the thermal oxidizer units until the system has reached optimal conditions, at which point the fuel source for the thermal oxidizers becomes pyrolysis gas. The pyrolysis gas is then combusted in the thermal oxidizers as a pollution control technology. The energy recovered as heat from the combustion heats the thermal oil system that is used to dry the incoming dewatered sewage sludge. Note that, based on this Facility design, the sewage sludge within the dryer units is not heated **directly** with combustion gases; therefore, the dryers to be sited at the proposed Facility do not meet the definition of a sewage sludge dryer as defined in 40 CFR 61 Subpart E. SAGE is of the opinion that this regulation does not apply to the proposed Facility. While it has been determined that this regulation does not apply to the proposed Facility, potential to emit calculations provided by VOW ASA included in **Appendix C** demonstrate that no emissions of mercury are expected from the low temperature drying process (100 °C).

3.2.3. National Emission Standards for Hazardous Air Pollutants (NESHAP) for Source Categories – 40 CFR Part 63

This section addresses the potential applicability of NESHAP regulations codified in 40 CFR Part 63 to the proposed Facility. Based on SAGE's review of these regulations, none of the Subparts established in 40 CFR Part 63 are applicable to the proposed Facility based on the current design.

3.3 State Air Quality Regulatory Requirements

This section outlines the RIDEM Air Pollution Control regulations applicable to the Facility, as specified in Chapter 120, Subchapter 05 of Title 250 (Department of Environmental Management) of the Rhode Island Code of Regulations (RICR).

3.3.1 250-RICR-120-05-01 – Visible Emissions

250-RICR-120-05-01 states that no person shall emit any air contaminant from any source into the atmosphere for a period or periods aggregating more than three minutes in any one hour that is equal to or greater than 20 percent opacity. The Facility will comply with this opacity limit by utilizing a control device for particulate emissions associated with pyrolysis and drying processes. Additionally, the dryer, dry sewage sludge silos, and pelletizer units are equipped with integrated dust controls to meet the particulate matter loading requirements for the exhaust air directed to the odor control plant. Visible emissions from other sources of particulate matter, including material handling, are expected to be minimal due to the material's moisture content and/or the use of enclosed buildings and conveyors.

3.3.2 250-RICR-120-05-3 – Particulate Emissions from Industrial Processes

250-RICR-120-05-03 regulates particulate emissions from industrial sources. This rule applies to the reception buildings, wet feedstock storage silos, dryers, dry storage silos, pelletizers, pyrolysis units, and associated conveyance equipment, as each of the processes' throughput weight rate will exceed the minimum threshold process weight rate established in the standard of 100 pounds per hour. As demonstrated in the emission calculations included in **Appendix C**, the controlled emission rate for each piece of process equipment is below the allowable emission rate based on the table in Section 3.8 of this regulation. A summary of the processes, throughput weight rate, allowable particulate emission, and maximum emission from the Facility is detailed in **Table 3**, below.

Table 3.
Particulate Emissions from Industrial Processes Summary
QSSB Biosolids, LLC
North Kingstown, Rhode Island

Process Equipment	Throughput Weight Rate Per Unit (Tons/hr)	Allowable Particulate Rate of Emissions (Lb/Hr)	Maximum Potential Controlled Particulate Emission Rate (Lb/Hr)
Reception Buildings	11.9	19.2	4.23E-05
Wet Feedstock Storage Silos	11.9	19.2	0.0
Dryers	11.9	19.2	0.0
Dry Storage Silos	3.3	8.56	1.71E-05
Pelletizers	3.3	8.56	7.75E-05
Pyrolysis Reactors	3.3	8.56	1.2
Biochar Packaging	3.3	8.56	0.0

3.3.3 250-RICR-120-05-5 – Fugitive Dust

The Facility's roads will be paved and maintained to prevent fugitive airborne dust beyond the Facility's property line. Furthermore, incoming sewage sludge feedstock materials will be transported to the Facility in enclosed containers. Incoming feedstock material is dewatered to 75% Moisture Content (M.C.), and offloading of the feedstock material occurs within enclosed buildings. Additionally, all material handling steps occur within enclosed equipment and/or buildings to prevent airborne particulate matter traveling beyond the property line of the Facility.

3.3.4 250-RICR-120-05-7 – Emission of Air Contaminants Detrimental to Person or Property

The emissions from the Facility will not harm human, plant, or animal life, nor will they cause damage to property or unreasonably affect the enjoyment of life and property. This is demonstrated by the Facility's adherence to the requirements of Air Pollution Control Regulation No. 22, which governs the emissions of listed toxic air contaminants. The Facility's emissions of Rhode Island air toxics were compared to their respective Minimum Quantities (MQs). Any air toxic exceeding its MQ was modeled to ensure compliance with the Acceptable Ambient Levels (AALs) at and beyond the Facility's property line. Additionally, all other emissions from the Facility comply with state and federal minor source air quality permitting regulations, and as such, are not expected to negatively impact human health or property.

3.3.5 250-RICR-120-05-8 – Sulfur Content of Fuels

QSSB will utilize natural gas fuel to heat the thermal oxidizer unit and closed-loop thermal oil system during start-up. No fuel oil will be utilized as part of the Facility's operations. As such, this regulation does not apply. Should fuel oil be proposed for use in future operations, permit modification will be required, and all fuel oil utilized will be required to meet the sulfur content requirements established in this regulation.

3.3.6 250-RICR-120-05-9 – Air Pollution Control Permits

QSSB is meeting the requirements of this regulation by submitting this minor source permit application for the Facility.

3.3.7 250-RICR-120-05-10 – Air Pollution Episodes

Should the Director of RIDEM declare an Air Pollution Alert, QSSB will take all Air Pollution Alert actions as required in this regulation.

3.3.8 250-RICR-120-05-12 – Incinerators

In this regulation, the term "sewage sludge incinerator" is defined as *"an incinerator designed for the thermal degradation of the sludge produced by municipal sewage treatment facilities."* As previously discussed, the pyrolysis process is distinct from incineration, and the pyrolysis reactors are not incineration units given that the sewage sludge material is not combusted during the pyrolysis process. Based on this distinction, SAGE is of the opinion that this regulation does not apply to the proposed Facility.

Additionally, based on the potential to emit calculations included in **Appendix C**, the proposed Facility's maximum particulate matter emissions from the pyrolysis process are expected to be 0.304 lb/hr, which equates to approximately 0.092 lb of particulate matter emitted per ton of dried sewage sludge (M.C. 10%) processed per pyrolysis line (total of approximately 0.184 lb/ton of dried sewage sludge for both pyrolysis lines). As such, the pyrolysis units are expected to meet the emission standard established for sewage sludge incinerators of 1.30 lbs of particulate matter per ton of dry sludge input.

3.3.9 250-RICR-120-05-14 – Record Keeping and Reporting

QSSB will comply by performing general recordkeeping on operational processes, fuel usage, raw materials, exhaust gas flow rate and temperatures, emissions of air contaminants, types of equipment producing air contaminants, and air pollution control systems or other data that may be necessary to determine if the Facility is in compliance with the Air Pollution Control Regulations. These records will be maintained at the Facility for a period of a minimum of five (5) years.

3.3.10 250-RICR-120-05-16 – Operation of Air Pollution Control Systems

The Facility will implement an odor control plant, including a biotrickling filter, a two-stage acidic and alkaline wet scrubber, and a carbon adsorber unit, to reduce odorous emissions from the reception, sewage sludge storage, drying, and pelletizing processes. Furthermore, a thermal oxidizer and a catalytic filter will be installed on each pyrolysis unit to manage emissions from the pyrolysis process. These pollution control devices will be operated following the manufacturer's standard operating procedures and maintained in accordance with the manufacturer's guidelines.

3.3.11 250-RICR-120-05-17 – Odors

It is not anticipated that any objectionable odor will extend beyond the Facility's property line as a result of the Facility's operation. Proposed odor controls include enclosed sewage sludge hauling vehicles, enclosed reception buildings maintained under negative pressure, enclosed storage silos maintained under negative pressure, and an odor control plant that consists of a biotrickling filter, a two-stage scrubber, and a carbon adsorber unit to control odorous emissions.

3.3.12 250-RICR-120-05-20 – Burning of Alternative Fuels

This regulation applies "*to any person burning alternative fuels in fuel burning equipment with a heat input capacity of one million (1,000,000) Btu per hour or greater.*" The thermal oxidizer units have a heat input capacity of 38.6 MMBtu/hr when operating on natural gas. During pyrolysis gas combustion, the burners have a maximum heat input capacity of 42.2 MMBtu/hr. Fuel burning equipment is defined in this regulation as "*any furnace, boiler, apparatus, stack, and all appurtenances thereto used in the process of burning fuel for the primary purpose of producing heat or power.*" The pyrolysis gas generated from the pyrolysis process is combusted in the thermal oxidizer units primarily as a method of air pollution control. The byproduct heat that is produced from this combustion is recovered in a thermal-oil system for re-use in the process to dry the incoming sewage sludge feedstock, and surplus heat may be utilized on-Site for sustainable electricity production at some point; however, the primary purpose of combusting the pyrolysis gas is not for heat or power generation. As such, SAGE is of the opinion that this regulation is not applicable to the proposed Facility.

3.3.13 250-RICR-120-05-22 – Air Toxics

An air quality impact analysis for all pollutants that are air toxics and that have potential annual emission rates above the MQ will be completed and submitted as part of this application. This analysis will show that the Facility meets the requirements of RICR No. 22.

3.3.14 250-RICR-120-05-27 – Control of Nitrogen Oxide Emissions

Once the permit application is approved and the permit is issued, the Facility will be in compliance. BACT conditions are proposed in order to limit NO_X emissions to less than 50 tons per year. Controlled emissions are expected to be approximately 12.536 tons/yr.

3.3.15 250-RICR-120-05-28 – Operating Permit Fees

The Facility is required to obtain an operating permit based on the proposed emissions and use of control equipment. As such, this application is being submitted to comply with the requirement to obtain an operating permit.

3.3.16 250-RICR-120-05-29 – Operating Permits

The Facility is required to obtain an operating permit based on the proposed emissions and use of control equipment, as such, this application is being submitted to comply with the requirement to obtain an operating permit. All required operating permit fees will be paid.

4.0 BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS

This section discusses the basis for the BACT analysis, the approach used in completing the analysis, and the BACT analysis for the emissions from the Facility.

4.1 BACT Requirement

This BACT analysis is being submitted to meet the requirement of a "top-down" BACT analysis as required in Reg 9, Section 3.7.9(A)(7) for a minor source permit application for which expedited review has been requested. BACT is defined in the RIDEM regulations [RICR No. 0, Section 0.5] as:

> *"Best available control technology" or "BACT" means an emissions limitation (including a visible emissions standard) based on the maximum degree of reduction for each air pollutant which would be emitted from any proposed stationary source or modification which the Director, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for such stationary source or modification through application of production processes or available methods, systems and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable state or federal air pollution control rule or regulation. If the Director determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of air emissions standards infeasible, a design, equipment, work practice, operational*

standard or combination thereof, may be prescribed instead to satisfy the requirement of best available control technology. Such standard shall to the degree possible set forth the emission reduction achievable by implementation of such design, equipment, work practice or operation and shall provide for compliance by means which achieve equivalent results.

4.2 BACT Determination Methodology

The top-down methodology guidance was used to determine the most stringent control available for a similar or identical source, or source category. This control option was used to establish the BACT emission limitation, unless the applicant can demonstrate that it is not "achievable" due to technical infeasibility, cost-effectiveness, or other adverse consequences of implementing the technology. If the control option with the highest control efficiency is eliminated, then the next most stringent level of control is evaluated. This process continues until BACT is selected. The five steps in a top-down BACT analysis are listed below.

- Identify possible control technologies
- Eliminate technically infeasible options
- Rank the technically feasible control technologies based upon emission reduction potential
- Evaluate ranked controls based on energy, environmental, and/or economic considerations
- Select BACT

The following resources were consulted when identifying potential technologies:

- RACT/BACT/LAER Clearinghouse (RBLC) database;
- Determinations of BACT by regulatory agencies for other similar sources or air permits and permit files from federal or state agencies;
- Previous engineering experience with similar control applications;
- Information provided by air pollution control equipment vendors with significant market share in the industry; and
- Review of literature from industrial technical or trade organizations.

BACT Analyses are included for the following emission units:

- Odor Control – this emission point includes sludge receipt, wet sludge storage, sludge drying, dry sludge storage, and sludge pelletizing. The emissions from this process are all routed through an odor control plant. The pollutants emitted from this emission unit include ammonia, VOC, H2S, PM, and volatile HAPs.
- Pyrolysis Process – this emission point includes the pyrolysis reactors and emission control devices. The pollutants emitted from this emission unit include PM, VOC, NOx, SO2, CO, ammonia, metals, and volatile HAPs.

4.3 Odor Control

4.3.1 BACT for Ammonia

4.3.1.1 Step 1 - Identify Possible Control Technologies

A review of the RBLC did not provide an example of ammonia control from a sludge pyrolysis facility. In addition, the Massachusetts Department of Environmental Protection (MassDEP) Top Case BACT guidelines were reviewed, and ammonia emissions from sewage sludge handling were not reviewed in this guide. Additional research was completed to identify potential ammonia control technologies. This research identified the following:

- Wet scrubbers
- Biofilters
- Condensers

4.3.1.2 Step 2 – Eliminate Technically Infeasible Options

The second step in the BACT analysis is to eliminate any technically infeasible control technologies. The following sections discuss the technologies identified as potential candidates for ammonia control and the feasibility of each type of control.

4.3.1.2.1 Wet Scrubbers

The use of wet scrubbers to control ammonia emissions is an effective technology that utilizes a liquid stream to remove ammonia from the exhaust stream. Properly designed wet scrubbers can achieve ammonia removal efficiencies of up to 99%.

4.3.1.2.2 Biofilters

Biofilters use a filter medium that contains microorganisms that break down the ammonia in the gas stream. Biofilters have been shown to work well for the removal of ammonia and have been shown to provide a relatively high level of ammonia control at composting facilities. The ammonia reduction indicated in these applications has been in the 95% to 99% range.

4.3.1.2.3 Condensers

Condensers utilize a cooling fluid to reduce the temperature of a gas stream until the partial pressure of the pollutant in the gas stream equals the vapor pressure as a pure substance. This allows the condenser to convert volatile pollutants from the gaseous phase to the liquid phase. Any gas can be reduced to a liquid by sufficiently lowering its temperature and or increasing its pressure. Practical limit for most condensation systems is 40 °F as icing of heat exchangers due to moisture in the exhaust streams becomes a problem and energy costs become prohibitive. At atmospheric pressure, ammonia would not be condensed at this temperature and no removal would be achieved. Therefore, condensation has been deemed technologically infeasible.

4.3.1.2.4 Summary of Technical Feasibility Analysis

The control technologies reviewed for potential control of ammonia emissions and their technical feasibility are summarized in the table below.

Control Technology	Technical Feasibility (Y/N)
Wet Scrubber	Y
Biofiltration	Y
Condensation	N

4.3.1.3 Step 3 – Rank Remaining Control Technologies

The third step in a BACT analysis is to rank the remaining control technologies by their expected control efficiency. Based on the above review, both wet scrubbers and biofilters were deemed technically feasible for control of ammonia. Below is a list that ranks applicable technologies.

1) Wet scrubbers – 99%
2) Biofilters – 95% to 99%

4.3.1.4 Step 4 – Evaluate the Most Effective Control and Document Results

The fourth step in the BACT analysis is to complete a review of the applicable control technologies and document the results. The remaining feasible control technologies are wet scrubbing and biofiltration. These two options have the potential to provide a high level of ammonia control. QSSB has deemed these two control technologies to be cost effective.

4.3.1.5 Step 5 – Select BACT

The fifth step in a BACT analysis is to select BACT based on the most stringent option not eliminated as technically, environmentally, or economically infeasible. QSSB is proposing to utilize a biotrickling filter followed by a two-stage wet scrubbing system and a carbon polishing filter to control emissions from the odor control plant. The plant is designed to reduce ammonia emissions by 99% with biotrickling filter and a two-stage wet scrubber system. The biotrickling filter and the two-stage scrubber system are designed to provide 99% control without utilizing the activated carbon filter. As currently designed, the activated carbon filter will not have a significant capability to reduce ammonia. The supporting information on the Odor Control Plant included in **Appendix A** provides details on emissions of ammonia during a bypass of the biotrickling filter and chemical scrubbers. The specified frequency of maintenance downtime is specified as being 24-hours per year. Based on this design and the supporting information QSSB is proposing that BACT be accepted as 99% reduction of ammonia emissions during normal operations of the Facility. Due to the potential need for maintenance on the biotrickling filter and the wet scrubber system, QSSB is proposing that these bypass events be limited to 24-hours per 12-month rolling period. During these bypass periods, no objectionable odor will be allowed beyond the property line. The intent is to operate all three control units to control ammonia but to provide operational flexibility to address maintenance issues, BACT is proposed as 99% overall reduction of ammonia during normal system operations, limiting bypass periods during maintenance to less than 24-hours per 12-month rolling period and not allowing any objectionable odors beyond the property line.

4.3.2 BACT for Hydrogen Sulfide

Since BACT for control of ammonia is already being proposed as a biotrickling filter followed by a two-stage scrubber system and a carbon polishing filter, these controls are also being proposed as BACT for hydrogen sulfide. The odor control plant is designed to provide 99.5% reduction of hydrogen sulfide, but the system is designed as a redundant system. The biotrickling filter and the two-stage scrubber system are designed to provide 99.5% control without utilizing the carbon filter. Subsequently, the system is also designed to provide 99.5% reduction of hydrogen sulfide while operating only the carbon filter. The biotrickling filter reduces the chemical consumption in the scrubbers for H_2S removal and together these processes increase the life of the carbon bed. The carbon bed is a cost-effective solution to achieving the very low H_2S levels required to avoid detectable odors. Based on the redundant design, QSSB is proposing that BACT be accepted as 99.5% reduction of hydrogen sulfide. The intent is to operate all three control units to control hydrogen sulfide but to provide operational flexibility to address maintenance issues, BACT is proposed as 99.5% reduction of hydrogen sulfide and not an operation of specific control equipment.

4.3.3 BACT for VOC and HAP

The uncontrolled emissions of VOC and HAPs from the process steps vented to the odor control plant are approximately 0.002 tons per year. The exhaust from the odor control plant cannot be routed to the pyrolysis thermal oxidizer for additional control of VOC due to the high exhaust flow rate. It would not be cost effective to install additional VOC controls after the odor control plant due to the low level of emissions. The approximate threshold for cost effective control of VOC emissions is 18 tons per year according to MassDEP's BACT guidance. Therefore, QSSB is proposing that limiting VOC emissions to less than 18 tons per year and including the 75% VOC control efficiency provided by odor control plant be considered BACT.

4.3.4 BACT for PM

The uncontrolled PM emissions from process steps vented to the odor control plant are approximately 1.20tons per year. These emissions will be controlled by the biotrickling filter, the two-stage wet scrubber system, and the activated carbon filter. These controls are designed to reduce the total PM emissions by 99.95% to an emission rate of less than 0.01 grains per dry standard cubic foot.

4.4 Pyrolysis

4.4.1 BACT for PM

The emissions from the pyrolysis process will be controlled by a thermal oxidizer and a catalytic filter. The catalytic filter has been designed to control particulate emissions including metal HAPs down to a guarantee of 0.005 grains per dry standard cubic foot. The controlled emissions of particulate emissions from the pyrolysis stack are 5.256 tons per year. The use of the catalytic filter to limit emissions to less than 0.005 grains per dry standard cubic foot is proposed as BACT. Additional research did not identify other sewage sludge biochar facilities being permitted with a catalytic filter following thermal oxidation.

4.4.2 BACT for VOC and Volatiles HAPs

The VOC and volatile HAP emissions will be controlled using a thermal oxidizer. The control provided by the thermal oxidizer is specified by the manufacturer at 99.99% effective. Thermal oxidizers are commonly considered BACT for sources of VOC and HAP emissions. In addition, MassDEP identifies Top Case BACT for VOC control from painting operations to be 98% overall control using a thermal oxidizer. Based on the manufacturer specified control and that thermal oxidizers have been considered BACT for other VOC emitting sources, the thermal oxidizer with control of 99.99% of VOC and HAP is being proposed as BACT.

4.4.3 BACT for NO_x

NO_x emissions will be generated from the combustion of pyrolysis gases in the thermal oxidizer. QSSB is proposing to utilize ammonia injection with a catalytic filter to reduce NO_x emissions by selective catalytic reduction (SCR). In addition, QSSB will utilize flue gas recirculation into the reducing chamber and the conditioning chamber of the oxidizer to control combustion temperatures to reduce NO_x production. The flue gas recirculation and SCR in the catalytic filter will control NO_x emissions by 80% to a controlled emission rate limit of less than 2.86 pounds per hour. Research of other permitted sewage sludge pyrolysis facilities identified two other such sources, one in Edmonds, WA and one in Redwood, CA. Neither of these facilities proposed control of NO_x emissions following the pyrolysis gas combustion due to both the low emissions and the costs of control. QSSB is proposing to utilize SCR control using a catalytic filter and flue gas recirculation to control NO_x emissions. These controls are above those required for other permitted facilities of a similar type and are therefore being proposed as BACT.

4.4.4 BACT for Ammonia

The ammonia slips emissions from the SCR in the catalytic filter designed to control NO_x emissions from the thermal oxidizer are specified by the manufacturer not to exceed 10 ppmv at 3 percent oxygen. The annual ammonia emissions are estimated to be 2.724 tons per year. Research was completed to find other sewage sludge pyrolysis facilities with SCR control of the thermal oxidizer exhaust and no sources were identified with this type of control. Therefore, limiting ammonia slip emissions to less than 10 ppmv are being proposed as BACT.

4.4.5 BACT for SO_x

The emissions of both SO_2 or SO_3 will be controlled by dry sorbent injection of calcium or sodium-based sorbents upstream of the catalytic filter. The reaction by-products will be captured as particulates in the filter. The reduction of SO_x emissions utilizing this technology will be 85% to a controlled emission rate 8.45 lbs per hour or 37.028 tons per year. The cost to implement additional controls beyond utilizing the catalytic filter with dry sorbent injection were not evaluated as this technology is proposed as BACT for NO_x, PM, and metal HAP control. QSSB is proposing that utilizing catalytic filter with dry sorbent injection be considered BACT for SO_x due to the costs associated with adding additional control.

4.4.6 BACT for CO

The pyrolysis process is already proposed to be controlled by a thermal oxidizer for the destruction of VOC and volatile HAPs contained in the pyrolysis gas. Due to the high level of control specified by the manufacturer for control of VOC and volatile HAPs, and the fact that thermal oxidizers have been demonstrated to control CO emissions at a high level, QSSB is proposing that use of the thermal oxidizer to reduce CO emissions to the manufacturer specified 50 ppmv at 3% O2 as BACT for this pollutant.

4.4.7 BACT for Hydrochloric Acid

The HCl emissions will be controlled by the catalytic filter with dry sorbent injection. The use of the catalytic filter is also being utilized to control PM, NO_x, SO_x, and metal HAP emissions. This proposed technology is specified to provide 95% control of HCl with controlled emissions of 0.86 tons per year. The dry sorbent injected into the exhaust stream upstream of the catalytic filter will react with the HCl present in the exhaust stream and the products of reaction will be captured by the filter. QSSB is proposing that use of the catalytic filter to control HCl by 95% be considered BACT.

4.4.8 BACT for Hydrofluoric Acid

The HF emissions will be controlled by the catalytic filter with dry sorbent injection. The use of the catalytic filter is also being utilized to control PM, NO_x, SO_x, metal HAP, and HCl emissions. This proposed technology is specified to provide 95% control of HF with controlled emissions of 1.20 tons per year. The dry sorbent injected into the exhaust stream upstream of the catalytic filter will react with the HF present in the exhaust stream and the products of reaction will be captured by the filter. QSSB is proposing that the use of the catalytic filter to control HF by 95% be considered BACT.

4.4.9 BACT for Metal HAPs

The use of a catalytic filter is already being proposed as BACT for control of PM emissions above. The metal HAP emissions from the process include antimony, arsenic, cadmium, chromium, cobalt, manganese, nickel, and selenium. These metal HAPs would all be present as a particulate in the exhaust from the pyrolysis process. The catalytic filter will control particulate emissions down to 0.005 grain/dscf. QSSB is proposing this as BACT for control of the metal HAPs listed above. The emissions of combined metal HAPs will be limited to 0.153 tons per year using the catalytic filter.

4.4.10 BACT for Mercury

4.4.10.1 Step 1 – Identify Possible Control Technologies

The RBLC was reviewed to identify control technologies for controlling mercury at other similar sources and other sewage sludge pyrolysis facilities were not identified. Additional review was completed to identify other potentially applicable sources. Below is a table of the potentially applicable sources from the RBLC.

Permit Date	RBLC ID Number	Facility Name	Process Name	Permitted Hg Limit	Control
11/18/2012	FL-0336	Pinellas County Res Recovery Facility	Three Municipal Waste Combustors	50 mg/dscm	Activated Carbon Injection
12/23/2010	FL-0324	Palm Beach Renewable Energy Park	Three Municipal Solid Waste Combustors	25 µg/dscm, 0.0098 lbs/hr, 37.7 lbs/yr	Activated Carbon Injection
11/3/2006	FL-0284	Hillsborough County Resource Recovery Facility	Municipal Waste Combustion	28 µg/dscm	Activated Carbon Injection
3/24/2003	VA-0271	Harrisonburg Resource Recovery Facility	Municipal Waste Combustion	0.08 ppmv	Activated Cabron Injection

Permit Date	RBLC ID Number	Facility Name	Process Name	Permitted Hg Limit	Control
					and Good Combustion Practices
3/25/2003	VA-0277	Harrisonburg Resource Recovery Facility	Municipal Waste Combustion Units (2)	0.08 mg/dscm	No Control
11/21/2001	CT-144	Riley Energy Systems of Lisbon	Municipal Waste Combustors (2)	0.165 lbs/hr	Activated Cabron Injection with Fabric Filter
9/20/2001	MI-0297	Mineral Detroit, LLC	Sludge Incinerator/Glass Furnace	0.05 mg/dscm, 0.0197 lbs/hr	Quench, Carbon Injection, Baghouse, Testing
7/21/2000	FL-0164	Dade County Resource Recovery Facility	Municipal Waste Combustors, 4 units	0.07 mg/dscm, 0.08 tons/yr	Carbon Injection

The control technologies identified during this search are provided below.

- Activated Carbon Injection followed by fabric filtration
- Fabric Filtration
- Electrostatic Precipitator

4.4.10.2 Step 2 – Eliminate Technically Infeasible Options

The technical feasibility of the control technologies listed above are discussed in the sections below.

4.4.10.2.1 Activated Carbon Injection Followed by Fabric Filtration

Activated carbon injection was the most utilized option for mercury control of applicable sources found during the RBLC review. This technology involves injecting carbon into the exhaust stream to allow mercury to adsorbed onto the carbon. After the injected carbon has adsorbed the mercury, the carbon is then filtered out of the exhaust stream using a fabric filter.

The pyrolysis process exhaust temperature is approximately 334 °C which is above the temperature where it is feasible to inject carbon into the stream. Due to the high temperature, the gas stream would need to be cooled to allow for carbon injection. The addition of a quench system to inject water into the stream to reduce the flue gas temperature prior to injecting carbon, would allow for effective removal of mercury but would require additional capital and operational all costs. However, this technology was deemed technically feasible and would provide 85% removal of mercury.

4.4.10.2.2 Fabric Filtration

Fabric filtration utilizes either filter bags or filter cartridges to capture particulates from an exhaust stream. As described above, this technology is already being utilized in the catalytic filter to remove particulate emissions, metal HAPs, and the reactants from ammonia and dry sorbent injections. However, the exhaust temperature of this process does not allow for the removal of mercury in the catalytic filter. The mercury would be in the vapor phase due to the high exhaust temperatures expected. Since this technology is already being utilized in the catalytic filter but is not expected to remove mercury, the use of additional fabric filters would not provide mercury reduction due to the elevated temperature of exhaust stream. Therefore, fabric filtration is considered technically infeasible and is eliminated as an option for consideration as BACT.

4.4.10.2.3 Electrostatic Precipitator

An electrostatic precipitator is a device that uses electric fields to remove particulate matter, such as dust, soot, and ash, from industrial gases. However, the removal of non-particulate emissions using this technology is limited. Research indicates that the removal efficiency of vapor phase elemental mercury ranges from 0% to 20%. Improved removal efficiency requires injection of oxidizing additives to increase the content of Hg2+ in the flue gas and typically injection of a sorbent to adsorb the mercury to allow effective removal. The exhaust stream from the pyrolysis process is at an elevated temperature where mercury is expected to be in the vapor phase. Although this technology would provide limited removal without additional injection of oxidizing agents or sorbents, this option is deemed to be technically feasible and will be evaluated further.

4.4.10.2.4 Summary of Technical Feasibility

Three control technologies were identified as potential options for control of mercury emissions from the pyrolysis process. These options and their technical feasibility are provided in the table below.

Control Technology	Technical Feasibility
Activate Carbon Injection Followed by Fabric Filtration	Y
Fabric Filtration	N
Electrostatic Precipitator	Y

4.4.10.3 Step 3 – Rank Remaining Control Technologies

The control technologies remaining are activated carbon injections followed by filtration and electrostatic precipitation. Below is a ranking of the technologies by the expected control efficiencies:

- Activated Carbon Injection followed by filtration – 85% estimated control
- Electrostatic Precipitation – Ranging from 0% - 20%

4.4.10.4 Step 4 – Evaluate Most Effective Controls and Document Results

The next step in the BACT analysis is to complete the top-down analysis of the applicable control technologies and document the results. This review will include the economic feasibility of each remaining option and will evaluate any energy or environmental effects.

4.4.10.4.1 Activated Carbon Injection Followed by Fabric Filtration

The use of activated carbon injections is an expensive option for control of mercury. The total annual cost of this system, including both capital investment and annual operating costs, has been evaluated. The estimated emissions of mercury are relatively low at 0.0416 tons per year or approximately 83 pounds per year. The total capital to install the quench system to reduce the temperature of the flue gas, inject the carbon, and then filter the injected carbon out of the flue gas is estimated to be $4,700,000. In addition to high capital cost the annual cost to purchase the carbon needed to control the mercury would be $260,000. The cost to dispose of the contaminated carbon would be significant as well since the carbon would likely require disposal of hazardous waste. Even without including the carbon disposal cost the estimate annual cost per ton is calculated to be $20,530,000 per ton. This cost is above an acceptable range and is deemed not economically feasible to implement. Therefore, this control option is being eliminated from further consideration.

4.4.10.4.2 Electrostatic Precipitator

An electrostatic precipitator (ESP) provides very limited removal of vapor phase elemental mercury without the addition of an oxidizing agent and likely a sorbent to adsorb the mercury to allow removal by the ESP. Based on this information an ESP would require implementation of the carbon injection system described above to be effective. Based on the costs associated with the activated carbon system being above the threshold for economic feasibility, the addition of an ESP system would only cause the overall control system costs to increase. Therefore, this control option is deemed to be not economically feasible to implement. Therefore, this control option is being eliminated from further consideration.

4.4.10.5 Step 5 – Select BACT

Based on the above review of control technologies for mercury removal from the pyrolysis exhaust, all the potential control technologies have been eliminated from consideration either due to being technically infeasible or economically infeasible. In addition, other sewage sludge pyrolysis facilities QSSB is proposing that limiting the emissions of mercury to 0.01 pounds per hour be accepted as BACT for this process.

4.5 BACT Summary

BACT has been evaluated for each relevant pollutant from both the odor control stack and the pyrolysis process. Below is a table providing the proposed BACT for each pollutant evaluated.

Emission Point/Pollutant	Proposed BACT
Odor Control Plant Stack	
Ammonia	Biotrickling Filter, Two-Stage Wet Scrubber, and Activated Carbon Filter to achieve 99% reduction.
VOC and Volatile HAPs	Biotrickling Filter, Two-Stage Wet Scrubber, and Activated Carbon Filter to achieve 75% reduction.

Emission Point/Pollutant	Proposed BACT
Hydrogen Sulfide	Biotrickling Filter, Two-Stage Wet Scrubber, and Activated Carbon Filter to achieve 99.5% reduction.
Particulate Matter	Biotrickling Filter, Two-Stage Wet Scrubber, and Activated Carbon Filter to achieve 99.95% reduction of PM emissions. This control system is designed to limit emissions to 0.01 grains per dry standard cubic foot.
Pyrolysis Stack	
Particulate Matter	Catalytic filter designed to limit emissions to 0.005 grains per dry standard cubic foot of exhaust.
VOC and Volatile HAPs	Thermal oxidizer specified to provide 99.99% reduction.
NO_x	Ammonia injection followed by the catalytic filter to provide SCR removal of 80% of NO_x to less than 2.86 lbs/hr.
Ammonia	The use of ammonia injections to control NO_x emissions results in a slip stream of ammonia emissions. The ammonia will be maintained to less than 10 ppmv in the exhaust stream.
SO_x	Dry sorbent injection followed filtration to provide 85% reduction in SO_x emissions.
CO	Thermal oxidizer is specified to reduce CO emissions to less than 50 ppmv in the exhaust stream.
HCl	Dry sorbent injection followed by filtration to provide 95% reduction in HCl emissions.
HF	Dry sorbent injection followed by filtration to provide 95% reduction in HCl emissions.
Metal HAPs (excluding mercury)	Catalytic filter designed to limit emissions to 0.005 grains per dry standard cubic foot of exhaust.
Mercury	Limiting emissions to less than 0.01 lbs/hr.

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5.0 AIR QUALITY IMPACT ANALYSIS

Appendix E contains the modeling report for the air toxics modeling for Facility-wide emissions, as required by Reg 22.

Appendix A

PROCESS DESCRIPTION

For Permit Application

101510-CRS-P-RD-0001 – Revision: F

VOW

F	24.Apr.2025	Issued for Information	HPD	BF	OKS
E	22.Apr.2025	Issued for Information	HPD	BF	OKS
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C	03.Mar.2025	Issued for Information	HPD	PC	OKS
B	22.Jan.2025	Issued for Information	HPD	PC	OKS
A	14.Jun.2024	Issued for Information	HPD	ING	OKS
Rev	**Date** (dd.mmm.yyyy)	**Reason for Issue**	**Made By**	**Chkd. By**	**Appr. By**

Document Title

PROCESS DESCRIPTION FOR PERMIT APPLICATION

Project Title	**Acceptance Codes**
QSS – Sewage Sludge Pyrolysis	1 Accepted 2 Accepted w/ Comments
System / Equipment	3 Not Accepted
Pyrolysis System	4 For Information Only 5 Interface Frozen
Tag / Node Number(s)	
Complete System	**Date** / **Signature**

Originator	**Client**
VOW	QUONSET SOIL SOLUTIONS – PEOPLE. PLANET. PURPOSE.

Originator Details	**Client Dietails**
VOW ASA Wergelandsveien 7 0244 Oslo NORWAY	QSS Biosolids, LLC 2000 Chapel View Boulevard, Suite 500 Cranston, RI 02920 UNITED STATES OF AMERICA
Originator Ref. No.	**Client PO No.**
101510	23-04-006

Originator Doc. No.	**Orig. Rev.**	**Client Doc. No.**	**Client Rev.**
101510-CRS-P-RD-0001	F	-	-

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CONTENTS

1 ABBREVIATIONS

BTF	Biological Trickling Filter
CPF	Carbon Polishing Filter
CF	Catalytic Filter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CS	Chemical Scrubber
DAF	Dry Ash Free
DS	Dry Solids
H_2	Hydrogen gas
H_2O	Water/Water vapor
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
HR	Heat Recovery
Kg	Kilo
MC	Moisture Content
MJ	Mega Joule
MW	Mega Watt
O_2	Oxygen gas
N	Nitrogen
N_2	Nitrogen gas
NOx	Nitrous Oxides
PFAS	Per- and polyfluoroalkyl substances
PM	Particulate Matter
SCR	Selective Catalytic Reduction
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
TO	Thermal Oxidizer
VOCs	Volatile Organic Compounds
QSS	Quonset Soil Solutions

2 INTRODUCTION

The world's population is increasing and as cities grow in population and area, efficient and safe handling of sewage is becoming increasingly important. Wastewater treatment generates two products: purified water and sewage sludge. Sewage sludges are typically contaminated by PFAS, heavy metals, other organic and inorganic chemical compounds, and micro plastics. These contaminants can leach into soil and water systems ending up in humans and animals through our water and food.

Sewage sludge face increasing scrutiny for traditional disposal methods and beneficial use pathways are being explored. Pyrolysis has emerged as a beneficial solution for sewage sludge treatment. Through high temperature pyrolysis with appropriate treatment conditions, the sewage sludge is transformed to a biochar free from organic pollutants such as PFAS and microplastics, and heavy metals are bound and immobilized.

2.1 Pyrolysis and its products

Pyrolysis is the thermo-chemical conversion of biomass in a low-oxygen environment. It converts organic residues into pyrolysis gas and a stable form of carbon, biochar. In the Pyrolysis Process the sewage sludge undergoes thermal decomposition, where organic materials break down into solid, carbon-rich biochar, with the release of volatile gases that can be utilized for energy recovery.

Biochar is a porous, carbonaceous material with a broad range of applications where the contained carbon remains stored as a long-term carbon sink. While the natural degradation of organic carbon leads to the release of greenhouse gases like CO_2 or CH_4 into the atmosphere, the stable carbon fraction in biochar is extremely durable. Unless it is burned, it resists weathering/degradation and remains stable for way beyond the relevant time scales of several centuries. The temperature and conditions of pyrolysis determine the characteristics of the final biochar product. The biochar has several uses such as soil amendment in agriculture, in materials for the construction industry or as sorbents in contaminated soils.

Pyrolysis Gas refers to the gaseous products produced during the process of pyrolysis. During pyrolysis, volatile matter is decomposed into energy rich gas which can be used to generate renewable industrial heat. This heat can be used to dry incoming sewage sludge and excess heat can be used to offset natural gas consumption or generate electricity. The Pyrolysis Gas contains typically VOCs, CO_2, CO, H_2, N_2 and H_2O.

2.2 Odorous Compounds in Sewage Sludge

Odorous airstreams from sewage sludge are a common environmental concern in wastewater treatment plants and areas where sewage sludge is processed or stored. These airstreams contain gases released from the sewage sludge during its decomposition or treatment processes.

Types of odorous compounds in sewage sludge can be Hydrogen Sulfide (H_2S), Ammonia (NH_3), Volatile Fatty Acids (VFAs), Mercaptans and Other Sulfur Compounds.

Odorous airstreams from sewage sludge can be of nuisance and environmental concern, but with proper management and treatment methods, these odors will be greatly reduced or eliminated.

3 PROCESS OVERVIEW

In brief, the plant will be treating dewatered sewage sludge (Wet Feedstock) in a thermochemical process called pyrolysis to remove organic pollutants from the solids and produce a biochar that can be safely used for various end-applications.

Pyrolysis gas generated during the process is converted into thermal energy through thermal oxidation and heat recovery to hot oil. The energy in the hot oil will be used to dry the Wet Feedstock received at the plant.

The system is delivered with a state-of-the-art emission control system for flue gas treatment, tailored for the Feedstock. The plant will collect all odorous air streams for treatment in a dedicated Odor Control Plant. The plant will be designed with two independent treatment lines.

The plant will have two stacks with emissions to air, one with the treated flue gas from combustion of Pyrolysis Gas and one from the Odor Control Plant.

3.1 Simplified Block Diagram

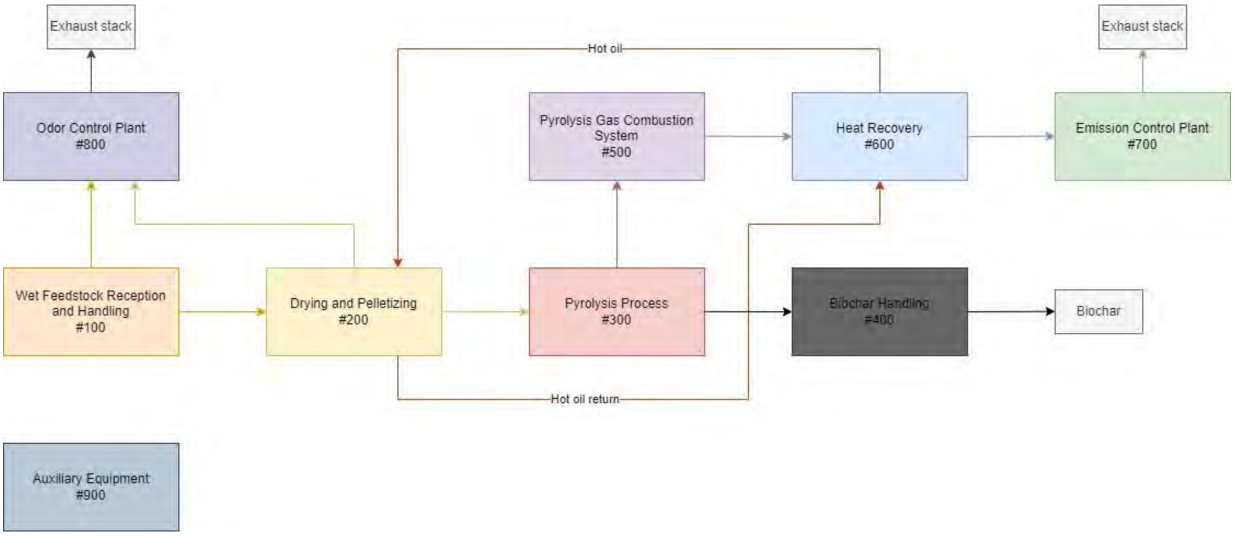


Figure 1 Simplified Block diagram

3.2 Area Description and Scope Responsibility

Table 1 Area description and scope responsibility

PROCESS AREA	DESCRIPTION	SCOPE RESPONSIBILITY
#100	Wet Feedstock Reception and Handling	VOW ASA
#200	Drying and Pelletizing	VOW ASA
#300	Pyrolysis Process	VOW ASA
#400	Biochar Handling	VOW ASA/ QSS
#500	Pyrolysis Gas Combustion System	VOW ASA
#600	Heat Recovery	VOW ASA
#700	Emission Control Plant	VOW ASA
#800	Odor Control Plant	VOW ASA
#900	Auxiliary equipment	VOW ASA
	Civil/Facility	QSS

3.3 Overview of Plant Layout

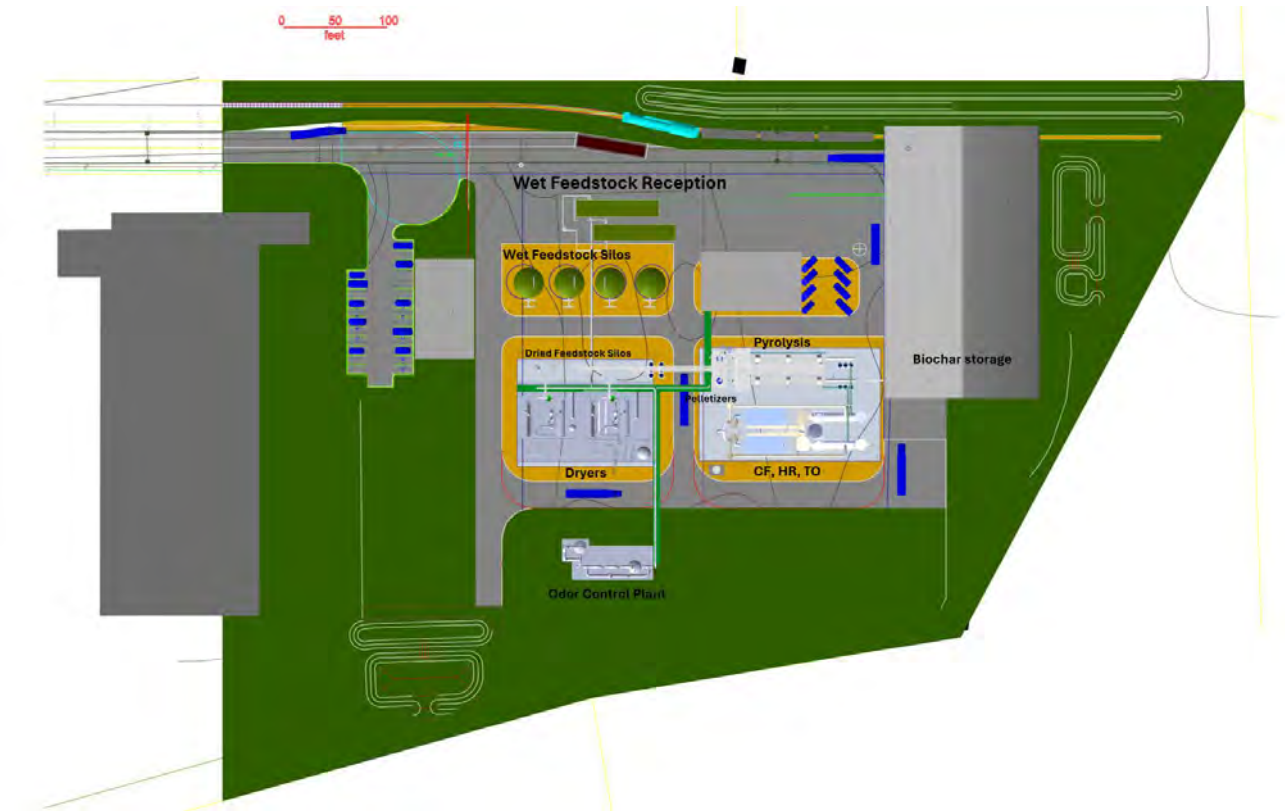


Figure 2 Overview of Plant Layout.

CF = Catalytic Filter, HR = Heat Recovery, TO = Thermal Oxidizers

4 PROCESS DESCRIPTION BY AREA

4.1 #100 – Wet Feedstock Reception and Handling

The plant will, in full operation, process large quantities of sewage sludge (Wet Feedstock) that has been dewatered to 25% dry solids (DS) at a remote location. The Wet Feedstock is transported to the site by trucks. It is expected that the Wet Feedstock will arrive five days a week, in a 12-hour window per day, Monday to Friday. The Wet Feedstock Reception has been sized accordingly, with approximately 4 days of buffer volume in the Wet Feedstock Silos to allow for an adequate buffer over weekends.

4.1.1 Weighbridge

Each truck that arrives on site will pass through a weighbridge (delivered by others) that will be located just after the entrance gate of the plant. The trucks will have to be weighed at arrival and when leaving the plant. This will ensure good control of the amount of Wet Feedstock that is received at the plant.

4.1.2 Wet Feedstock Reception Building & Transport to Silos

Two Wet Feedstock Reception Buildings are planned to optimize the delivery schedule and allow for maintenance stops. Each Wet Feedstock Reception Building will consist of two main zones, a truck cleaning zone and a reception bin zone. The trucks will back into the Wet Feedstock Reception Building for off-loading of the feedstock, first passing through the cleaning zone and then arriving in front of the reception bin for discharge. The trucks will have moving floors that will convey the Wet Feedstock out of the truck and into the reception bin. The reception bin will be a push floor container with two discharge screws. The Wet Feedstock will then be pumped to the silos by positive displacement pumps, through a closed piping system. The reception bin will have a lid which opens when the truck is ready to discharge the Wet Feedstock and close once the truck has finished. The truck will then drive forward into the cleaning zone where the trucks' exterior surfaces will be cleaned to avoid any spill to the environment outside of the Wet Feedstock Reception Building. Once the truck is cleaned, the gate will open and the truck will drive out and over the weighbridge for weight recording, and finally out through the gate of the plant.

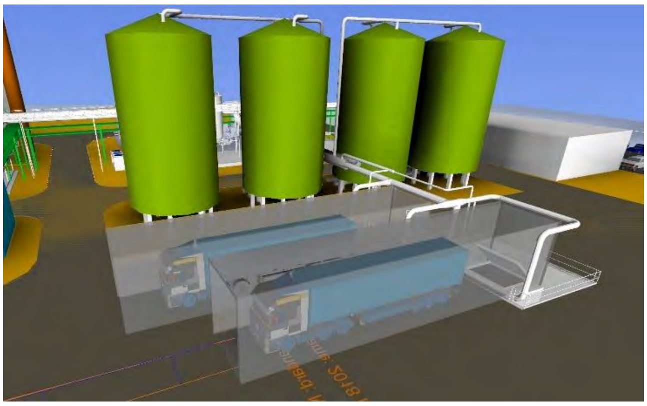


Figure 3 Wet Feedstock Reception Building and Wet Feedstock Silos

4.1.3 Wet Feedstock Silos and Transport to Dryers

Four silos of 800 m^3 are planned to be able to buffer Wet Feedstock for approximately 4 days of operation. Buffer silos are used in the system to balance the mass flow of Wet Feedstock prior to further processing through drying and pyrolysis. Buffer silos will provide autonomy in the system when performing maintenance on other equipment, as well as serve as a buffer to last over long-weekends. Water-tight moving floor silos with outlet screws will be used, ensuring a closed system with no leakages to the surrounding area. All four silos will be able to receive Wet Feedstock from both Wet Feedstock Reception Buildings and further pump their content to both dryers. The Wet Feedstock will be pumped by positive displacement pumps, through a closed piping system to the dryers.

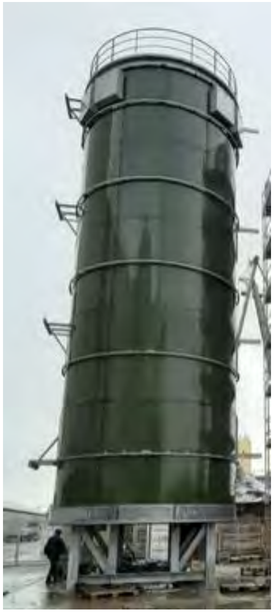


Figure 4 Example of a Wet Feedstock Silo.

4.1.4 Points of Emission

4.1.4.1 Weighbridge

No emissions are expected from the Weighbridge as the trucks will be closed.

4.1.4.2 Wet Feedstock Reception Building & Transport to Silos

The trucks will enter the Wet Feedstock Reception Building by a gate which will open and close immediately before and after the truck has entered the building. The Wet Feedstock Reception Building will enclose the trucks completely when they empty the Wet Feedstock into the reception bin and during cleaning of the trucks afterwards. The airflow through the building will be designed to keep the building at a slight under pressure to control odors from escaping. The only time the building will be open to the surrounding area is when the trucks enter and leave the building. The emptying of the trucks will only happen when the gate is closed. The reception bin will have a lid that will close between each filling to minimize the odors in the building and odor when opening the gate when the trucks are leaving. Air will be evacuated in separate channels from the back of the Wet Feedstock Reception Building to ensure that the flow of air always will be directed away from the entrance gate. One channel will draw air from the main building and another channel from the reception bin. All ventilation air will be directed towards the main Odor Control Plant at the site to avoid any odor and uncontrolled air emissions.

No air emissions are expected when pumping the Wet Feedstock to the silos as this will be a closed system.

4.1.4.3 Wet Feedstock Silos

The Wet Feedstock Silos headspace will have a negative pressure. The headspace gases will be extracted from the top and delivered to the main Odor Control Plant to control and reduce odor and emissions to the atmosphere.

No air emissions are expected when pumping the Wet Feedstock to the dryers as this will be a closed system.

4.2 #200 – Drying and Pelletizing

After initial receival and storage, the Wet Feedstock enters the drying stage. Drying is required to ensure consistency and efficiency in the pyrolysis step. Before the Wet Feedstock can enter the pyrolysis process, the water content needs to be reduced, ideally to approximately 10 %.

4.2.1 Dryer Technology

A Disc Dryer has been chosen for this plant. Two Disc Dryer systems will be installed in parallel.

The Disc Dryer is designed for indirect heating by hot oil. The product to be dried is slowly, but vigorously, transported from the inlet to the outlet end by a paddle system mounted on the disc periphery. Product discharge is done continuously by a speed-controlled extraction screw conveyor. The discs are mounted on a heavy central shaft with a highly efficient condensate removal system integrated. Scraper bars ensure agitation between the discs, which is necessary for efficient evaporation. The moisture evaporated from the product is collected in a high-top vapor dome and continuously removed. The vapor will pass through an internal scrubbing system for heat recovery and condensation of the moisture in the exhaust gas. The scrubber system is an integral part of the drying plant, and not a pollution control device.

The dryer is a closed system and has been optimized to reduce wear and potential leakages. It uses specially designed claws inside each disc to mount the two sides of the plates together. This gives it a superior mechanical strength, departing from the conventional approach that relies on stay bolts to secure disc plates in position. The design effectively eliminates the potential for leaks originating from stay bolt welds. The disc design has a smooth surface that secures maximum heat transfer, increases the level of self-cleaning and reduces fouling problems. The dryer is operating under a slight vacuum to avoid emissions to the atmosphere.

Figure 5 Outside and inside of a Disk Dryer

4.2.2 Transport of Dried Feedstock to Dried Feedstock Silo

The Dried Feedstock will be transported out from the dryer by an inclined tubular screw conveyor, through a bucket elevator and discharged into the Dried Feedstock Silo by a horizontal screw conveyor. This is a dust tight system to ensure no emissions of particulate matter to the atmosphere.

4.2.3 Dried Feedstock Silos

The Dried Feedstock is stored in silos for buffering before the downstream pyrolysis process. This is to ensure that operational variations in the upstream process does not immediately impact the pyrolysis process. Each storage silo will be sized to give the needed autonomy to the system ensuring adequate buffer capacity of the system during routine maintenance and short unplanned downtime.

Two silos of 80 m^3 are planned to be able to buffer approximately 10 hours of operation. The sliding frame silos will be equipped with level and temperature monitors, explosion relief vents, top mounted dust filter and connection for inert gas purging. The inert gas will provide an oxygen reduced environment in the silos' headspace.

Figure 6 Example of Dried Feedstock Silos

4.2.4 Transport of Dried Feedstock to Pelletizer

From each silo the Dried Feedstock will be transported by closed chain conveyors to the pelletizer systems. A crossover is installed at the pelletizer inlet so that both Dried Feedstock Silos can feed both pelletizer units. The conveyors are dust tight to ensure no emissions of particulate matter to the atmosphere.

4.2.5 Pelletizer

The main purpose of the pelletizer is to minimize fines in the downstream equipment. This reduces the need for maintenance and increases the lifetime of the downstream Pyrolysis Gas Combustion System. Two independent lines of pelletizer systems are placed in parallel. Both Dried Feedstock Silos can feed both pelletizers, and both pelletizers can feed either of the Pyrolysis Reactors. The pelletizers can also be bypassed, sending un-pelletized Dried Feedstock directly to the Pyrolysis Reactors. This ensures full flexibility and allows for maintenance work without stopping the Pyrolysis Reactors. When feeding un-pelletized

Dried Feedstock, slightly more maintenance is most likely required on downstream equipment.

The Dried Feedstock will enter the Pelletizer via a pre-bin and screw conveyors to ensure continuous and adjustable flow. To optimize the pelletizing process, a conditioner with water injection mixes the product with the water before it enters the pellet mill. The pellet mill presses the feedstock into pellets.

To reduce dust in the piping and downstream Odor Control Plant, a filter is used on the airstream from the pellet mill.

Figure 7 Example of a Pelletizer

4.2.6 Points of Emission

4.2.6.1 Dryer

The dryer is a closed system and the exhaust air from the dryer will be directed to the Odor Control Plant for treatment.

4.2.6.2 Transport of Dried Feedstock to Dried Feedstock Silo

Aspiration of the Dried Feedstock conveyors will be done through the headspace of the Dried Feedstock Silos where the air will be evacuated to the Odor Control Plant.

4.2.6.3 Dried Feedstock Silos

The Dried Feedstock Silos will have a negative pressure in the headspace and the outlet gas will be led to the Odor Control Plant to control and reduce emissions to the atmosphere. The gas extraction point will be at the top of the silos. To reduce dust in the downstream piping and the Odor Control Plant, a top mounted filter will be installed on the gas extraction point at each silo. The filter is an integral part of the silos, and not a pollution control device.

4.2.6.4 Transport of Dried Feedstock to Pelletizer

No emissions are expected when conveying the Dried Feedstock from the Dried Feedstock Silos to the pelletizer, as this will be a closed system. However, the conveyors will be aspirated through the up- and down-stream equipment, either the Dried Feedstock Silo or the Pelletizer, and sent to the Odor Control Plant to control and reduce emissions to the atmosphere.

4.2.6.5 Pelletizer

The Pelletizers will be continuously aspirated to ensure a slight under pressure in the Pelletizer to avoid any uncontrolled emissions to the atmosphere. To reduce dust in the piping and in the downstream Odor Control Plant a filter is used on the airstream from the Pelletizer. The filter is an integral part of the pelletizer, and not a pollution control device. The filtered air will then be led to the Odor Control Plant to control and reduce emissions to the atmosphere.

4.3 #300 – Pyrolysis Process

4.3.1 Pyrolysis Infeed System

The Dried & Pelletized Feedstock will be transferred to the Pyrolysis Reactor through an infeed system consisting of:

1. Infeed screw
2. A bucket conveyor to gently lift the Dried & Pelletized Feedstock from the Pelletizer to a hopper to minimize breakage of the pellet and dust.
3. Dried & Pelletized Feedstock hopper, to have a small buffering volume to ensure a steady and continuous flow into the Pyrolysis Reactor.
4. An air-lock system to ensure that there will be no air ingress into the Pyrolysis Reactor from the feed-side.
5. Inclined screw with a water lock for fire suppression purposes

A crossover will be installed upstream the hopper to ensure flexibility of the feeding system. The infeed system provides feed rate control into the Pyrolysis Reactor and is a part of the overall process control scheme.

4.3.2 Pyrolysis Reactors

The pyrolysis plant will be delivered with two independent Pyrolysis Reactors. The two parallel reactors ensure flexibility on the desired flow of the system and redundancy. One reactor is displayed in Figure 8.

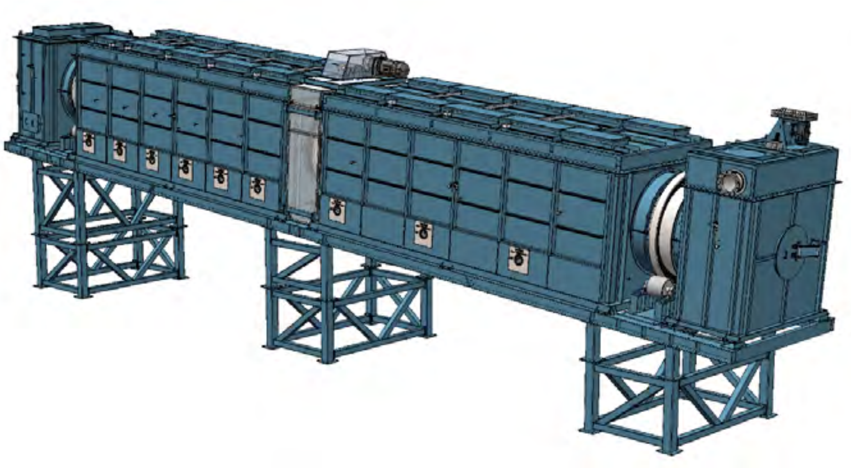


Figure 8 Layout of one pyrolysis reactor, two identical lines will be installed in parallel

The reactors are indirectly heated rotary kilns that are configured to operate with electricity as the heat source.

The Dried & Pelletized Feedstock enters the reactor at one end through a screw conveyor. The Dried & Pelletized Feedstock in the pyrolysis chamber is conveyed through the reactor by rotation of the drum and remains in continuous contact with the heat source (rotating drum wall) while it is being transferred. The particles of the Dried & Pelletized Feedstock are therefore heated in a uniform manner while passing through the reactor.

The Pyrolysis Process is expected to operate in the range 600 – 750 °C. The temperature of the product can be separately adjusted in each Pyrolysis Reactor up to 750 °C by varying the temperature in the reactor. Residence time of the product within the reactor can be controlled by the rotation speed of the drum.

The Pyrolysis Process will create pyrolysis gas and biochar. Hot pyrolysis gas will exit the Pyrolysis Reactor at the hot end and be transferred to the Pyrolysis Gas Combustion System by a fan at the gas outlet. The biochar will exit through a chute in the lower end of the reactor and will enter the Biochar Cooling Screw.

4.3.3 Biochar Cooling Screw

For cooling of the biochar, a cooled screw conveyor is used, cooling the biochar from the pyrolysis temperature to < 60 °C. The cooler is equipped with the possibility for nitrogen purging and a water spray system for moisturizing the biochar to the required humidity for safe storage and handling, and emergency fire-fighting purposes. At the outlet of the cooling screw there is an airlock, ensuring no air ingress into the system. The cooling screw is air- and dust tight.

Figure 9 Cooling screw

4.3.4 Location of airlocks in the Pyrolysis Process

The Pyrolysis System is designed to minimize the air ingress to the Pyrolysis Reactor. This is ensured by having an airlock on the Pyrolysis Infeed System and a second airlock after the Biochar Cooling Screw, as indicated by the red circles in Figure 10.

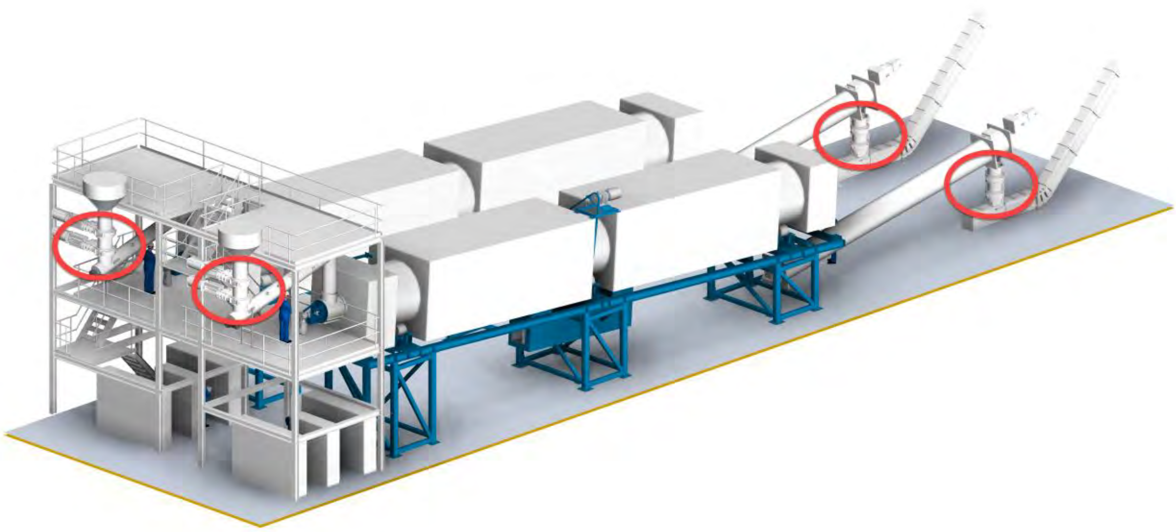


Figure 10 Pyrolysis System. Red circles indicating airlock systems.

4.3.5 Points of Emission

4.3.5.1 Pyrolysis Infeed System

No emissions are expected from the Pyrolysis Infeed System, as this will be a closed system.

4.3.5.2 Pyrolysis Process

The Pyrolysis Process will have two main products: pyrolysis gas and biochar. The pyrolysis gas will be transferred in closed piping to the Pyrolysis Gas Combustion System, followed by Heat Recovery and the Emission Control Plant. The treated flue gas will then be released to the atmosphere.

The Pyrolysis Reactors operate at a slight under-pressure to ensure that any potential minor leaks do not result in the release of process gas to the environment in the production facilities.

4.3.5.3 Biochar Cooling Screw

The Biochar Cooling Screw is a closed process, and no air emissions are expected from this stage.

4.4 #400 – Biochar Handling

4.4.1 Biochar Transport from Cooler to Biochar Logistics Station

After cooling and moisturizing, the biochar is transported with closed chain conveyors to the Biochar Logistics Station. The chute between the Biochar Cooling Screw and transport screw may be purged with nitrogen to avoid air ingress into the Biochar Cooling Screw.

4.4.2 Biochar Logistics Station

A big bag packing station will be used for packaging and storing the biochar. A distribution screw will be used between the stations, and automated valves will ensure correct filling of each big bag. The bags will be blanketed with nitrogen and sealed to avoid evaporation of the water and air ingress. The packing station will be in a separate building. The big bags will be transported out of the site either by trucks or rail.

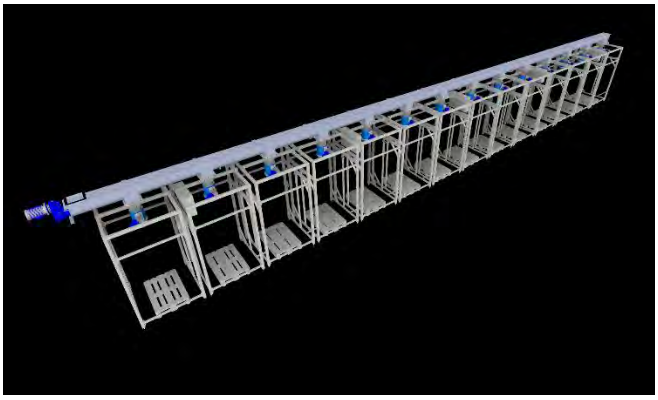


Figure 11 Example of a biochar packing station

4.4.3 Points of Emission

4.4.3.1 Biochar Transport from Cooler to Biochar Logistics Station

The Biochar Transport Screw is considered a closed system with no air emissions to the surrounding area.

4.4.3.2 Biochar Logistics Station

The packing station is considered a closed system with no air emissions expected from this stage.

4.5 #500 – Pyrolysis Gas Combustion Systems

The Pyrolysis Gas Combustion System comprises a multi-stage Thermal Oxidizer. Two Thermal Oxidizers are installed, one per treatment line. The Thermal Oxidizer is a pollution control device used to treat and remove harmful volatile organic compounds (VOCs), hazardous air pollutants (HAPs), and other compounds found in the Pyrolysis Gas. High temperatures oxidize pollutants, converting them into less harmful substances.

Recirculation of treated flue gas from the Emission Control Plant will control the temperature and minimize the formation of NOx. The Thermal Oxidizer will operate with sufficient residence time and temperature to destroy organic contaminants, VOCs and odor causing contaminants. The Thermal Oxidizer can operate on Pyrolysis Gas, Natural Gas or any combination of both. The burner is rated at 44.50 GJ/hr HHV on Pyrolysis Gas, and 40.75 GJ/hr HHV on Natural Gas.

The Thermal Oxidizer is provided with an emergency vent stack to divert exhaust directly to atmosphere upon loss of plant power/ mechanical failure. The emergency vent is only activated in emergency situations to avoid equipment damage or life-threatening conditions after a multi-point failure. The emergency vent is only activated while the plant is shutting down and is, under no circumstance, utilized during normal plant operation. The emergency vent may be exercised regularly to ensure availability in an emergency situation. However, this will not cause any additional emissions.

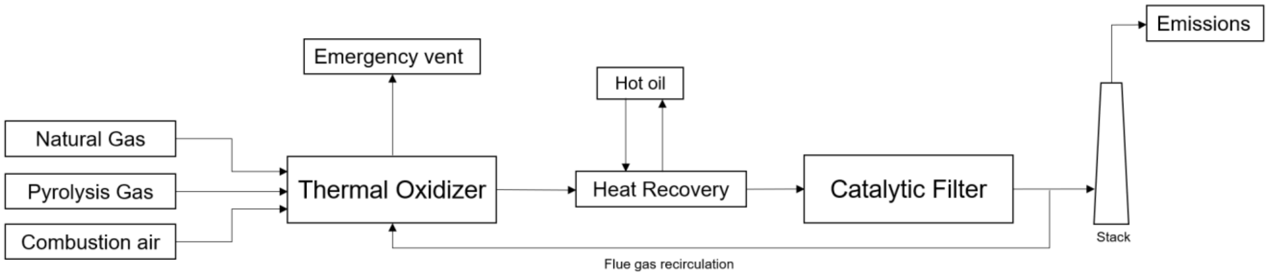


Figure 12 Pyrolysis Gas Combustion System

4.5.1 Points of Emission

During normal operation there will be no uncontrolled air emissions from the Thermal Oxidizer. In an emergency situation, the possibly partially oxidized exhaust will be directed to the atmosphere through the emergency vent stack.

4.6 #600 – Heat Recovery

The flue gas leaving the Thermal Oxidizer is passed through a heat recovery device, which heats a heat transfer fluid (thermal oil, Therminol 66) for process heating purposes.

Heat exchangers downstream of each Thermal Oxidizer will extract heat from the flue gas. The heat exchangers and thermal oil system are designed and sized to maximize heat recovery and to cool the exhaust stream for emission treatment. The main consumers of the recovered heat are the Wet Feedstock dryers.

The thermal oil is heated to ~260 °C. Pump stations and expansion tanks are utilized to deliver and buffer the flow. Control valves and instruments regulate flow to the heat consumers.

The thermal oil system is a closed loop system with no waste streams. The thermal oil cooler is designed to radiate the full heat load of the system if consumers are not available during maintenance or shutdown periods.

Under normal operation, waste heat directly radiated from the thermal oil cooler is minimized. If consumers are offline or unable to use all the heat available in the thermal oil, the excess heat is radiated at the thermal oil cooler to maintain design temperature on the cool thermal oil return.

During initial start-up of the system, process derived heat from the pyrolysis process will not be available for heat consumers (dryers). The thermal oil system will, under these circumstances, be heated by Natural Gas until the pyrolysis process is reliably supplying heat. Natural Gas will be used as fuel to heat the Thermal Oxidizer until it reaches the temperature required for combustion of the Pyrolysis Gas, the hot oil has reached 260 °C and the dryers are running. During cold start of the dryers, a regime will be implemented minimizing the run time with Natural Gas.

4.6.1 Points of Emission

The thermal oil system is a closed loop, and no air emissions are expected from this stage. The flue gas leaving the heat recovery unit is directed to the Emission Control Plant for further treatment.

4.7 #700 – Emission Control Plant

After the flue gas exits the heat recovery unit after the Thermal Oxidizer, it is passed to the Emission Control Plant for further treatment.

4.7.1 Catalytic Filter

A high temperature ceramic/catalytic filter technology is selected to significantly reduce pollutants such as NOx, SOx, HF and PM in the flue gas. Two Catalytic Filters will be installed, one for each treatment line.

This filter combines traditional filtration methods with catalytic processes to enhance pollutant removal efficiency. This ensures that the emissions comply with environmental regulations, contributing to improved air quality and reduced environmental impact.

The catalytic material embedded within the filter facilitates chemical reactions that convert harmful pollutants into less harmful substances. Specifically, nitrogen oxides (NOx) are converted into nitrogen and water through selective catalytic reduction (SCR), while sulfur oxides (SOx) are transformed into less harmful compounds using dry sorbent injection method.

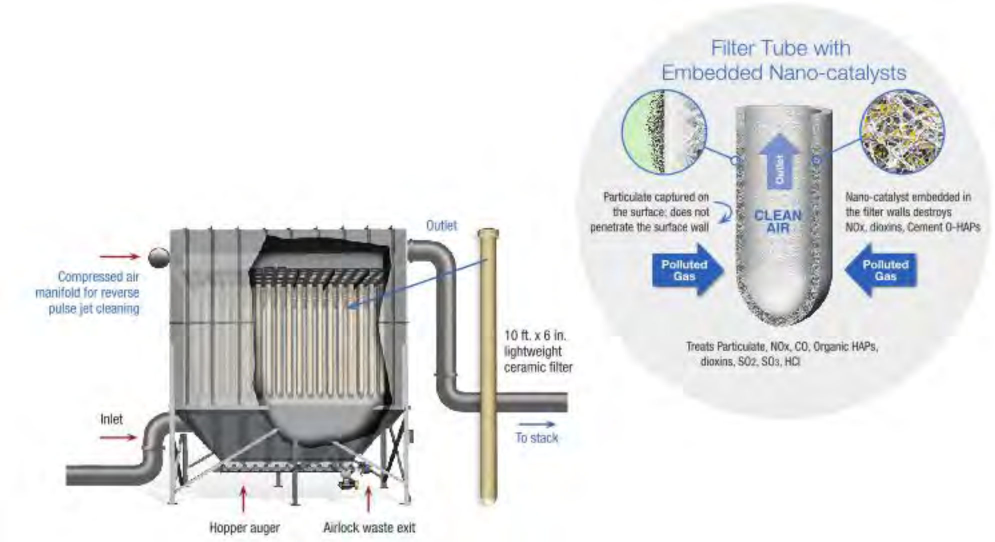


Figure 13 Ceramic catalytic filter

The ceramic catalytic filter captures particulate matter on its surface, achieving high removal efficiency. This technology is advantageous for its ability to control multiple pollutants in a single system and its high efficiency.

The system includes a bank of many self-supporting ¾" thick ceramic filter tubes with embedded catalyst. Filter life is 5-10 years and performs the following duties:

- Acid Gas Control: The system will have a dry sorbent injection of calcium or sodium based sorbents (hydrated lime, sodium bicarbonate and trona) to remove SO_2, SO_3, HCl and HF (Figure 14, 1.). Powdered sorbents are injected upstream of the filters and the reaction by-products are captured as particulate at the filters. The SO_2 removal reaction occurs within the duct leading to the filters and at the sorbent cake that accumulates on the surface of the filters. The chemical reaction of the sorbent with the acid gas creates a solid particle that is captured on the filters, along with the unreacted sorbent and the process particulate.

- NOx Control: NOx will be controlled by two mechanisms to enhance the performance. Firstly, by injection of ammonia, used as a reactant to remove NOx. (Figure 14, 2.).

Secondly, a catalytic filter. The catalytic filter uses nano-bits of catalyst embedded in their walls to facilitate the selective catalytic reduction (SCR) of NOx by NH_3. (Figure 14, 4. And Figure 13). The large reactive surface area of the micronized catalyst produces a high NOx removal at temperatures lower than standard SCR and good results start at 232 °C. The unique structure of the filters captures process particulate on its outer surface, keeping it away from the nano-catalyst inside the filter walls (Figure 13). This prevents PM blinding and poisoning of the catalyst, and greatly extends the catalyst life compared to standard SCR.

- Particulate Control: The filter removes particulates from gas sources above 150 °C, including PM10, PM2.5, and submicron. Heavier loadings require more frequent pulse-jet cleaning of the filters, but outlet levels remain the same as traditional bag filters (Figure 14, 4.).

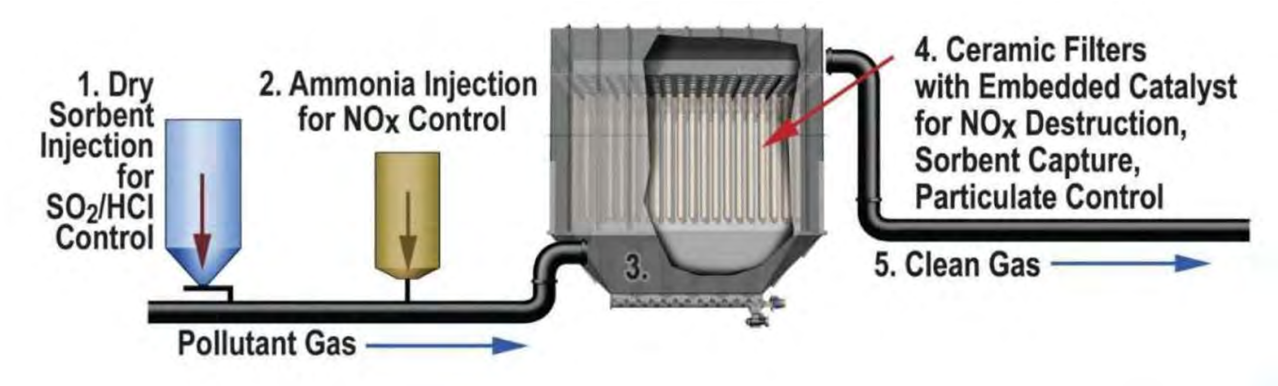


Figure 14 Example of Catalytic Filter as Emission Control Plant

4.7.2 Stack

After treatment in the Catalytic Filter the flue gas will be directed to a flue gas stack. Each Catalytic Filter will have their individual flue gas pipes but combined into a common stack. This will give one point of emission for the flue gas from both treatment lines.

4.7.3 Points of Emission

The catalytic filter is a closed system, and air emissions are only expected to be released in a controlled manner from the stacks after treatment.

4.8 #800 - Odor Control Plant

An Odor Control Plant will be located at the site to treat odorous airstreams from the following sources:

- Wet Feedstock Reception Buildings
- Wet Feedstock Reception Bins
- Wet Feedstock Silos
- Dryers

- Dried silos and conveyor systems
- Pelletizers

The Odor Control Plant shall remove hydrogen sulfide, ammonia, and odors from the air streams, using a biotrickling filter operating in series with Two-stage Chemical Scrubbing and a Carbon Polishing Filter for final polishing.

4.8.1 Odor Treatment Technology

The treatment process consists of three technologies:

- Biotrickling Filter
- Two-stage Chemical Scrubbers
- Carbon Polishing Filter

4.8.1.1 BioTrickling Filter (BTF)

The BioTrickling Filter (BTF) uses biological technology with structured synthetic media to grow a colony of microorganisms that will oxidize a wide range of odorous compounds. The BTF is designed as a once-through, non-recirculating system. It will reduce the concentrations of compounds entering the chemical scrubber stages, thus reducing the expected chemical usage costs and ultimate operating cost. The BTF achieves nearly complete removal of H_2S and removes a large portion of the NH_3.

As illustrated in Figure 15, the air shall enter the system at the bottom of the BTF and flow upward through each of the media layers. The BTF hosts trillions of microorganisms that consume unwanted compounds. Irrigation water containing nutrients introduced at the top of the reactor trickles down through the media, sustaining the environment the microorganisms in the vessel need to thrive and rinsing the byproducts of metabolized compounds toward a drain in the reactor.

The drain water from the system will pass from the sump in the bottom of the reactor vessel and be piped to a discharge point. The BTF can facilitate the growth of both autotrophic and heterotrophic bacteria in a single reactor vessel, thus allowing the oxidation and removal of both organic and inorganic odors in a single reactor.

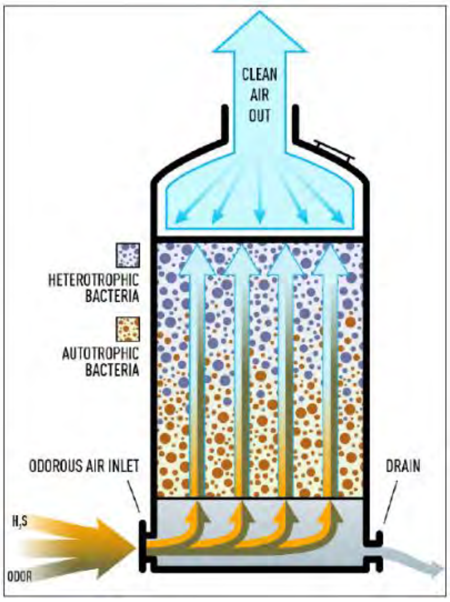


Figure 15 Biotrickling filter (BTF)

4.8.1.2 Chemical Scrubbers (CS)

The airstream is then ducted to the second-stage treatment in a 2-stage Chemical Scrubber System, which will remove most of the odorous compounds remaining after the BTF.

The air will pass through the first (acid) stage of the chemical scrubber, effectively removing ammonia, amines and other reduced nitrogen-based compounds to very low concentrations. The second (caustic / hypochlorite) stage will treat any remaining H_2S, methyl mercaptan, dimethyl sulfide and other ROSCs, and acidic gases, as well as VFAs, to very low levels.

The chemicals are sprayed down over the media as impacted air is forced upward, and the chemicals will then react with the odorous compounds. The clean air is released through a vent at the top of the treatment vessel to the third stage with polishing treatment in an Carbon Polishing Filter. The waste streams from the Chemical Scrubbers will be led to a drain and further to the sewer system.

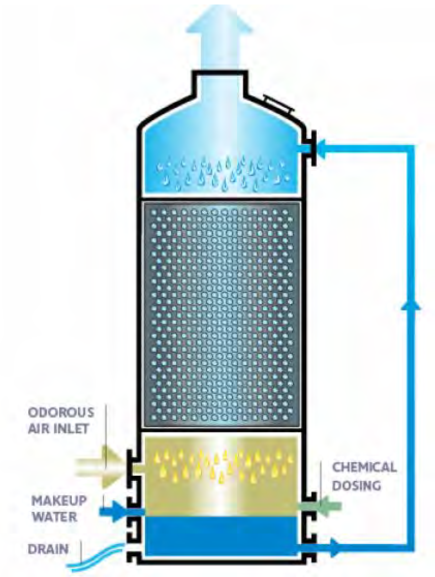


Figure 16 Chemical Scrubber (CS)

4.8.1.3 Carbon Polishing Filter (CPF)

The final stage of treatment will further polish remaining odorous compounds using a vapor phase carbon adsorption system. This is a dual carbon bed configuration, as illustrated in Figure 17. The air shall enter the system (Figure 17, 1.) and flow through the carbon and other adsorptive media layer(s) (Figure 17, 2.), before being discharged into the atmosphere (Figure 17, 3.). Compounds are adsorbed by the large specific surface area provided by the media. The airstream is then released to the atmosphere via the exhaust stack at the top of the system vessel.

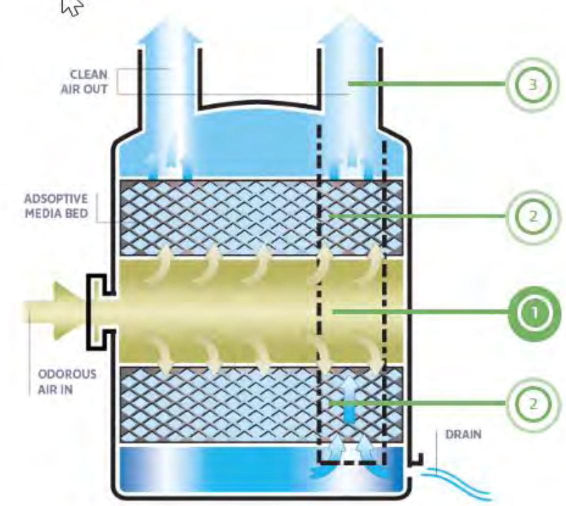


Figure 17 Carbon Polishing Filter (CPF), 1. Foul air entry, 2. Dual carbon beds, 3. Releasing treated air

4.8.2 Points of Emission

The piping transferring the air streams to the Odor Control Plant is closed, and no air emissions are expected from this. The Biotrickling Filter, the Chemical Scrubbers and the Carbon Polishing Filter are closed systems with a stack at the outlet of the Carbon Polishing

Filter releasing the treated gas to the atmosphere. This will be the single point of air emissions from this system.

4.9 #900 – Auxiliary Systems

4.9.1 Electricity

The plant will require approximately 6 MW of installed electric capacity.

4.9.2 Natural Gas

Natural gas will be supplied to the site by local utility on a metered service with the pressure and flow rate to be determined by the utility. If required, a booster station will be installed to maintain the pressure and flow to the plant. Approximately 950 Nm^3/hour of Natural Gas is expected to be used in the Thermal Oxidizer for approximately 24 hours during cold start-up of the system. The initial start-up of the system will require 24 hours operation on Natural Gas. During the annual maintenance stop it is expected that the Dried Feedstock Silos are left full, reducing the required period of Natural Gas consumption to 14 hours. In normal operation no use of Natural Gas is expected.

4.9.3 Water

Water will be consumed in several of the process steps in the plant. The water consumption is expected to be approximately 70 m^3/day.

In addition, several areas in the plant will have a water connection for fire-fighting purposes, including the infeed system to the Pyrolysis Reactor.

4.9.4 Compressed Air

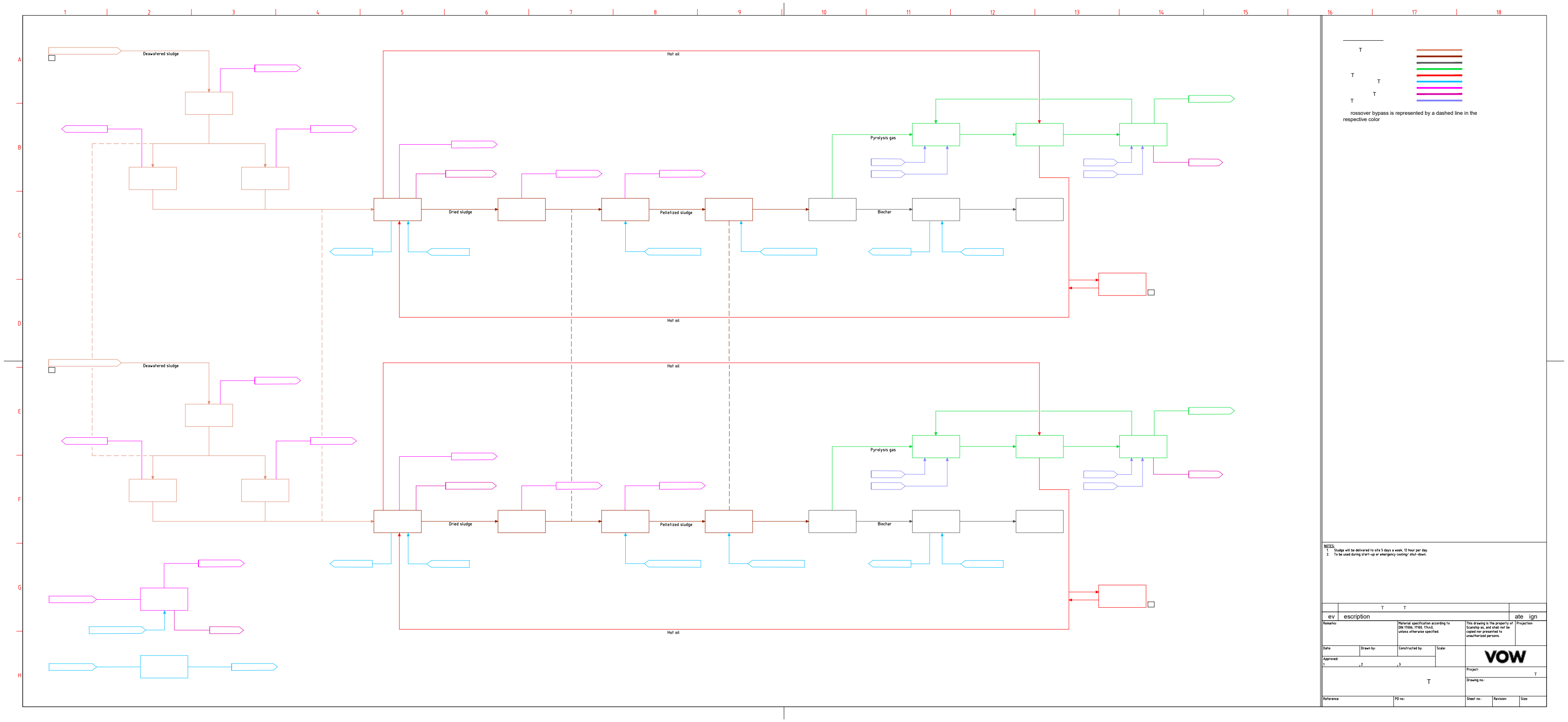
Compressed air is required for operating pneumatic valves, purge cleaning of gas filter, nitrogen production and atomizer (if required) for the thermal oxidizer. Compressors will be installed to deliver compressed air to a buffer vessel. Working pressure is 8 bar.

4.9.5 Nitrogen

Nitrogen as an inert gas is used to displace oxygen/air from the system. Nitrogen will be produced from the compressed air system at the plant with the use of nitrogen generators. Membrane technology or pressure swing adsorption will be used for production. Nitrogen purity is 96 % (4 % residual O_2).

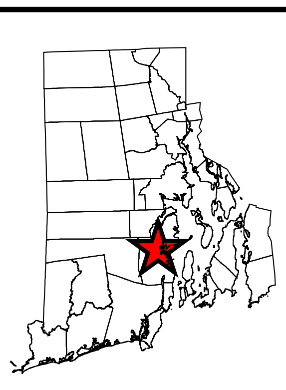
5 APPENDIX

5.1 Appendix A Block Diagram



#110 - MATERIAL HANDLING LINE 1
#120 - MATERIAL HANDLING LINE 2
DEWATERED SEWAGE SLUDGE
ODOR CONTROL
SILO
PUMP STATION
RECEIVING STATION BUILDING
RECEIVING STATION BIN
#800 - ODOR CONTROL
NUTRIENT TANK AND CONTROL PANEL
DRAIN WATER
TOTAL AIR FLOW
BIOTRICLING FILTER
CHEMICALS
ACID SCRUBBER
DUTY STANDBY CIRCULATION PUMPS
CAUSTIC SCRUBBER
DUTY STANDBY BLOWERS
ACTIVATED CARBON FILTER
STACK EMISSIONS
#210 - SLUDGE DRYER LINE 1
#220 - SLUDGE DRYER LINE 2
COOLING WATER
RETURN WATER
SCRUBBER 3
SCRUBBER 2
SCRUBBER 1
SUPPLY AIR FAN & HEAT EXCHANGER
HOT OIL RETURN #610/620
HOT OIL SUPPLY #610/620
CONDENSATE
FILTER
WATER
PELLET PRESS
Pelletized sludge
Vapor
Reflux sludge
CYCLONE
Fines
Recirculation air
DRIED SLUDGE CONVEYORS
BUFFER SILO
PRE DRYER & CONVEYOR SYSTEM
FINAL DRYER & CONVEYOR SYSTEM
DRYER COOLING SCREW
HEAT EXCHANGER
#510 - COMBUSTION UNIT 1
#520 - COMBUSTION UNIT 2
EMERGENCY VENT
DUMP STACK
NATURAL GAS
AMBIENT AIR
AIR FAN
THERMAL OXIDIZER
BOTTOM ASH DISCHARGE
Recirculation gas
Exhaust
#310 - PYROLYSIS LINE 1
#320 - PYROLYSIS LINE 2
AIR LOCK/ INFEED SYSTEM
PYROLYSIS REACTOR
EXTRACTION FAN
Pyrolysis gas
COOLING SCREW
AIR LOCK/ OUTFEED SYSTEM
Biochar
#410 - BIOCHAR HANDLING
#420 - BIOCHAR HANDLING
TRANSPORT CONVEYOR
BIOCHAR LOGISTICS STATION
#610 / #710 - HEAT RECOVERY / EMISSION MONITORING LINE 1
#620 / #720 - HEAT RECOVERY / EMISSION MONITORING LINE 2
HOT OIL COOLER
HOT OIL PUMP SKID/ EXPANSION TANK
Hot oil
HEAT EXCHANGER DRYER #210/220
RECIRCULATION FAN
CATALYTIC BAGHOUSE
INDUCED DRAFT BLOWER
EXHAUST STACK
HYDRATED LIME
UREA
SOLID WASTE
HOT OIL PUMP SKID
#920 / #930 - AIR COMPRESSORS / NITROGEN GENERATORS
AIR COMPRESSORS
NITROGEN GENERATORS
Ring line
MATERIAL HANDLING #210/220
SLUDGE DRYER LINES #310/320
PYROLYSIS LINES #410/420
COMBUSTION UNITS #510/520
HEAT RECOVERY #610/620
EMISSION MONITORING #710/720
BIOCHAR HANDLING #810/820
#900 / #910 - ELECTRICAL / AUXILIARY EQUIPMENT
SCADA SYSTEM
WATER COOLERS
SCRUBBER 2 #210/220
SCRUBBER 3 #210/220
DRYER COOLING SCREW #210/220
BIOCHAR COOLING SCREW #310/320
P&ID/ NODE BOUNDARY
CLIENT SCOPE
VOW SCOPE
CROSSOVER/ BYPASS VOW SCOPE
CLIENT SCOPE OF SUPPLY:
- Piping and heat tracing between equipment
- Electrical cabling between equipment
- Local civil, structural, electrical and environmental engineering
- Structures, shelters, foundation and support
- Supply of utilities for equipment
REVISION NOTES:
1. See revision clouds.
NOTES:
D REISSUED FOR PERMIT APPLICATION 28.02.2025/ING
C REISSUED FOR PERMIT APPLICATION 17.01.2025/ING
B REISSUED FOR PERMIT APPLICATION 08.08.2024/ING
A ISSUED FOR PERMIT APPLICATION 26.04.2024/ING
Rev. Description Date/Sign
Date: 26.04.2024
Drawn by: ING
Constructed by: BF/GL
Scale: N/A
Projection: N/A
Approved: 26.04.2024/GL 26.04.2024/BF 26.04.2024/OKS
VOW
PFD
SEWAGE SLUDGE PYROLYSIS SYSTEM
LINE 1 AND 2
Project: 1510 - SLUDGE PYROLYSIS SYSTEM
Drawing no: 101510-CRS-P-XA-0001
Sheet no: 1
Revision: D
Size: A1+

APPENDIX B



Site Plan

135 All American Way
North Kingstown, Rhode Island

Figure 2

Date: 4/23/2025

Project #: C096

Created By: LCN

Legend

Site Boundary

0 50 100 200 300 400 Feet

N

Data Provided by RIGIS
Orthoimagery provided by nearmap

SAGE ENVIRONMENTAL
A Terracon Company

A	XX.XX.202X	DRAWING RELEASED	XX	XX	XX
Rev.	Date	Description	Drawn	Controlled	Approved

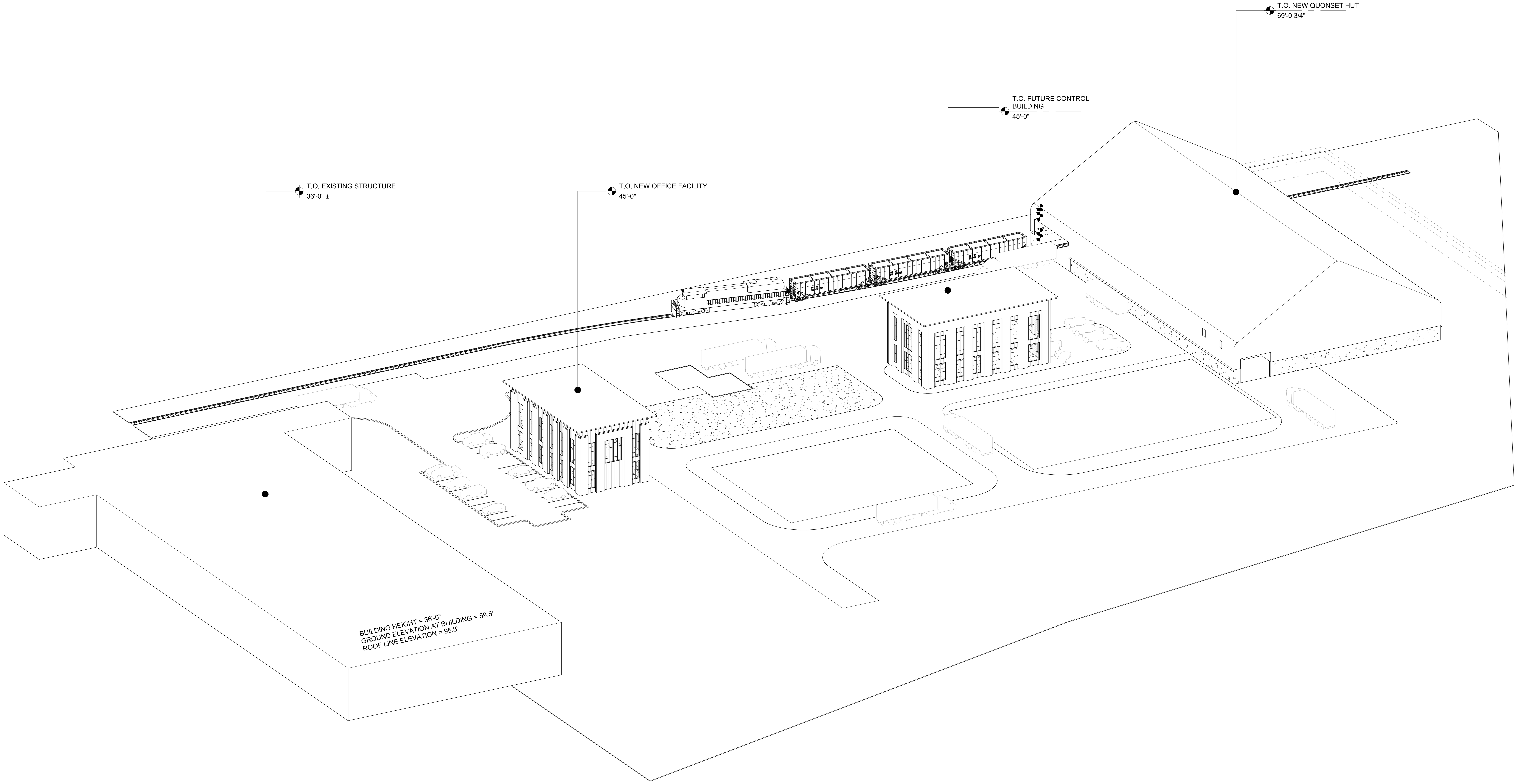
Tolerance, unless otherwise specified: NS-ISO-27681 NS-EN-ISO 13920	Remarks: - - -	Material specification according to DIN 17006, 17100, 17440, unless otherwise specified.	This drawing is the property of Scanship as, and shall not be copied nor presented to unauthorized persons.	Projection:
Date: 14.01.2009	Drawn by: KEG	Constructed by: KEG	Scale: 1:400	SCANSHIP for cleaner oceans
Approved: 1 14.01.2009/KEG	2 -	3 -		

Title, line 1
Title, line 2
Title, line 3

Replacement for: -	Replaced by: -					
Drawing no.: 1234-5678						
Reference: -	PD no.: -	Sheet no.: 1	Revision: -	Size: A1		

GREEN development, LLC

NORTH KINGSTOWN, RI



CLIENT: QSS BIOSOLIDS, LLC

PROJECT #: 6907

DATE: 02/24/2025

SHEET: AP1

135 ALL AMERICAN WAY ELEVATION HEIGHTS

RGB architects

50 HOLDEN STREET, PROVIDENCE, RI 02908 T: 401 272-1730 WWW.RGB.NET

GREEN development, LLC

NORTH KINGSTOWN, RI

1 PERSPECTIVE ALL AMERICAN WAY VIEW

CLIENT: QSS BIOSOLIDS, LLC

PROJECT #: 6907

DATE: 02/24/2025

SHEET: AP2

135 ALL AMERICAN WAY ELEVATION

RGB architects

50 HOLDEN STREET, PROVIDENCE, RI 02908 T: 401 272-1730 WWW.RGB.NET

APPENDIX C

Redacted Potential to Emit Summary Pending

APPENDIX D

SAGE ENVIRONMENTAL
A Terracon Company

March 6, 2025

Jessica Kilpatrick
US EPA Region 1, Air and Radiation Division
5 Post Office Square
Boston, MA 02109
Sent via Email: *Kilpatrick.Jessica@epa.gov*

And

Ariel Garcia
US EPA Region 1, Air and Radiation Division
5 Post Office Square
Boston, MA 02109
Sent via Email: *Garcia.Ariel@epa.gov*

RE: Request for EPA Applicability Determination of Clean Air Act
QSS Biosolids, LLC - Pyrolysis Facility (Site)
135 All American Way
North Kingstown, Rhode Island
SAGE/Terracon Project No. C096/L5247042

Dear Ms. Kilpatrick and Ms. Garcia,

On behalf of QSS Biosolids, LLC (QSSB), SAGE Environmental, Inc. (SAGE), A Terracon Company, formally requests the Environmental Protection Agency's (EPA) applicability determination and clarification regarding select New Source Performance Standards (NSPS) associated with a proposed sewage sludge pyrolysis facility. The facility is proposed to be located at 135 All American Way (Plat 180/Lots 19, 20, 21, and 22) in North Kingstown, Rhode Island (hereinafter referred to as "Facility" or "Site"). Vow ASA, including its affiliates and partners, has been engaged by QSSB to design a sewage sludge treatment process utilizing Vow's proprietary pyrolysis technology. Vow ASA is represented in this document as an associated party.

Executive Summary

The Clean Air Act (CAA) and related regulations establish permitting thresholds that classify facilities as either Major or Minor sources of emissions. Some regulations also specify emission standards, operating requirements, and permitting conditions based on the type of facility and/or emissions source. The regulatory requirements, including permitting processes, differ significantly between Major and Minor sources, resulting in notable differences in time and costs. The purpose of this correspondence is to document the exemptions from Major Source permitting requirements concerning the proposed sewage sludge pyrolysis Facility. The regulations discussed within, for which input from EPA is being sought, include:

- NSPS Subpart LLLL (Standards of Performance for New Stationary Sources: Emissions from Sewage Sludge Incineration);
- NSPS Subpart CCCC (Standards of Performance for New Stationary Sources: Emissions from Commercial and Industrial Solid Waste Incineration); and,
- NSPS Subpart O (Standards of Performance for Sewage Treatment Plants).

The following discussion demonstrates that sewage sludge pyrolysis does not meet the definition of incineration and, as such, does not require Major source air permitting. Based on the information detailed herein, the Facility will seek a Minor Source Air Permit in accordance with the RIDEM Air Pollution Control (APC) Regulations.

This correspondence is organized as follows:

- Pyrolysis Compared to Incineration
- Proposed Pyrolysis Facility Background
- Regulatory Discussion
- Summary and Recommendations

Pyrolysis Compared to Incineration

Pyrolysis of sewage sludge is a thermochemical treatment process that can be used to manage and reduce the volume of sewage sludge. The pyrolysis process involves heating dried feedstock material in an oxygen-limited environment to break down organic components and produce a carbon-rich solid byproduct, known as biochar, along with other gaseous byproducts (pyrolysis gas). The characteristics of biochar (e.g., surface area, pore structure, nutrient content, etc.) are dependent on the feedstock material. Pyrolysis does not meet the definition of, and is distinct from, incineration for several reasons, including process differentiation, emission profiles, final product value, and regulatory definitions.

As previously mentioned, pyrolysis is a process that occurs when feedstock material is heated in an oxygen-deprived environment, leading to the breakdown of organic materials into gases and biochar. In contrast, incineration involves the combustion of materials in the presence of oxygen, resulting in a flame and the production of gases, heat, and ash. The emissions produced by pyrolysis differ significantly from those of incineration. Pyrolysis typically generates fewer harmful pollutants that are often associated with combustion processes. In addition, pyrolysis produces valuable byproducts, such as pyrolysis gas, which can be used as renewable energy sources or feedstocks for other processes and biochar, which has several notable applications, including carbon sequestration, soil improvement, and contamination remediation. In contrast, the byproduct of incineration is primarily residual ash, which may contain heavy metals or other contaminants. Residual ash is often disposed of in landfills or specialized treatment facilities. Pyrolysis aligns with sustainability goals and waste-to-energy initiatives, contrasting with incineration, which primarily focuses on waste disposal.

The EPA has established definitions and regulatory frameworks for both incineration and thermal treatment processes. Pyrolysis fits more appropriately within the category of thermal treatment technologies that utilize controlled thermal decomposition rather than combustion, which is the basis of incineration. Pyrolysis can also contribute to waste reduction and resource recovery, making it a more environmentally friendly option compared to traditional incineration.

Based on this information and the details presented in the following sections, pyrolysis does not meet the definition of incineration for air permitting purposes.

Proposed Pyrolysis Facility Background

This pyrolysis Facility is being proposed as an alternative solution to the current methods of treating and disposing of sewage sludge in Rhode Island, as aging incineration infrastructure and limited landfill capacity present challenges for future disposal options. Furthermore, other disposal practices, such as land application, are under increased regulatory scrutiny due to the presence of emerging contaminants in some sewage sludge.

The Facility is currently in the process of being designed and is proposed for construction within the Quonset Industrial Park at 135 All American Way in North Kingstown, Rhode Island. Upon approval, construction is anticipated to begin in 2027, with the anticipated Facility commissioning/optimization period planned for 2028. The Facility will be equipped with an enclosed reception area, wet feedstock storage silos, sewage sludge dryers, dried feedstock silos, feedstock pelletizers, and electrically heated pyrolysis reactors. The conveyance systems between these Facility components will be enclosed. The Facility will also be equipped with pollution control equipment consisting of a biotrickling filter, two-stage scrubber system, and carbon adsorber for odorous emissions related to reception and drying operations as well as a thermal oxidizer and catalytic filter related to emissions from the pyrolysis process.

Once constructed, the Facility will have the capacity to pyrolyze up to approximately 160 tons of sewage sludge per day *via* two (2) pyrolysis reactors. The process generates biochar and a pyrolysis gas. The proposed Facility will recover the energy in the pyrolysis gas as heat through combustion in the thermal oxidizer units. This heat will be recovered in a thermal oil loop and used to dry the feedstock, and surplus heat will be utilized to produce electricity. Additional detail of the Facility operations and the proposed QSSB pyrolysis system are further described below and included in **Attachment A** to aid in the Agency's determination.

Regulatory Discussion

The following sections provide a discussion of the regulations identified as potentially applicable to the proposed Facility, for which input from EPA is being sought, as it relates to the currently proposed sewage sludge pyrolysis Facility. In addition, SAGE has researched other entities which have successfully sought, and been granted, an EPA determination that the identified select regulations do not apply to pyrolysis and/or gasification facilities that are similar to the proposed Facility. The following sections provide supporting details on such determinations of inapplicability by EPA.

NSPS Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units

The Standards of Performance for New Sewage Sludge Incineration Units (NSPS Subpart LLLL) applies to Sewage Sludge Incinerators (SSI) for which construction commenced after October 14, 2010, or for which modification commenced after September 21, 2011. The proposed QSSB pyrolysis unit does not meet the definition of an SSI unit.

"Sewage sludge incineration (SSI) unit" is defined in 40 CFR §60.4930 as:

an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearths. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.

"Sewage sludge" is defined as:

solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

In addition, in publishing the final rule Subpart LLLL, EPA described an SSI unit as "*an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter.*"

Based on these definitions, Subpart LLLL does not apply to the proposed QSSB sewage sludge pyrolysis facility. The proposed Facility does not meet the definition of an SSI unit, as the pyrolysis units are not designed to combust sewage sludge (i.e., no flame). As described above, pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Pyrolysis occurs under oxygen-deprived conditions such that combustion cannot occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. During pyrolysis, pyrolysis gas will be produced from the flameless heating of sewage sludge in electrically heated pyrolysis reactors. The resulting pyrolysis gas will be combusted in thermal oxidizers as part of the air pollution control system. Notably, the definition of sewage sludge does not include gases of any kind, including pyrolysis gas. Therefore, SAGE is of the opinion that this does not meet the definition of an SSI because the material being combusted as part of this process is not a solid, semi-solid, or liquid residue and therefore does not meet the definition of sewage sludge. Rather, the pyrolysis gas consists of the volatile constituents, including water vapor, volatile organic compounds, and inorganic gases, that are liberated from the sewage sludge during the flameless heating process.

Supporting Documentation for Subpart LLLL

Ecoremedy - Edmonds, Washington (Pyrolysis/Gasification)

EPA Region 10 issued an applicability determination dated September 9, 2021, finding that Subpart LLLL does not apply to the Ecoremedy sewage sludge pyrolysis/gasification facility in Edmonds, Washington.

> *"Based on all the information provided in connection with your request for an applicability determination, we conclude that Subpart LLLL does not apply to the proposed Ecoremedy gasification unit for the City of Edmonds because the unit is not an "SSI unit." It is not an SSI unit, as defined in 40 CFR §60.4930, because it does not combust sewage, also as defined in section 60.4930."*

According to information submitted to EPA in support of this determination of inapplicability, Ecoremedy indicated that there is no flame or burning involved in the gasification process, as the conversion of the biosolids feedstock to syngas takes place in an oxygen deficient environment. In addition, the combustion of syngas occurs in an oxidizing unit, where no sewage sludge solids, semi-solids, or liquids remain. Please note that pyrolysis and gasification are similar as they are both thermal decomposition processes. Pyrolysis occurs in the full absence or near absence of oxygen, leading to the production of solid and gaseous products, whereas gasification occurs in a partial absence of oxygen, primarily producing some biochar and syngas. A copy of the Edmonds, Washington determination of inapplicability is included in **Attachment B.**

BioForceTech - Silicon Valley, California (Pyrolysis)

EPA Region 9 issued a determination letter to BioForceTech (BFT) on July 25, 2016, for a sewage sludge pyrolysis facility at the Silicon Valley wastewater treatment plant in Redwood City, CA.

> *"EPA determines, based on the information provided and the statements made by BFT, that:*
>
> 1. *The pyrolysis reactor in the BFT process is not an SSI unit as that term is defined in the SSI NSPS, because there is no flame in the pyrolysis reactor; and*
> 2. *The syn-gas is a gas and is not a solid, semi-solid or liquid. Therefore, the syn-gas is not sewage sludge (even though it is derived from sewage sludge) as that term is defined in the SSI NSPS; therefore, the FLOX® chamber is not combusting sewage sludge and therefore also not an SSI unit.*
>
> *Consequently, the BFT pyrolysis system is not subject to the requirements in the SSI NSPS."*

According to information submitted to EPA in support of this determination of inapplicability, BioForceTech indicated that biosolids will be transferred into a pyrolysis reactor following dewatering/drying steps. The elevated temperatures and lack of oxygen in the pyrolysis reactor would then produce a flow of high-heat-content pyrolysis gas, which is then combusted in a separate oxidation unit. Copies of the Silicon Valley BFT facility permit application and referenced determinations of inapplicability are included in **Attachment C.**

NSPS Subpart CCCC - Standards of Performance for Commercial and Industrial Solid Waste Incineration Units

Commercial and industrial solid waste incineration (CISWI) units are subject to the requirements of the Standards of Performance for Commercial and Industrial Solid Waste Incineration Units (NSPS Subpart CCCC) if the unit commenced construction after June 4, 2010, or commenced reconstruction or modification after August 7, 2013. §60.2265 which defines a CISWI unit as the following:

> *"Any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part 241. If the operating unit burns materials other than traditional fuels as defined in §241.2 that have been discarded, and you do not keep and produce records as required by §60.2175(v), the operating unit is a CISWI unit. While not all CISWI units will include all of the following components, a CISWI unit includes, but is not limited to, the solid waste feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The CISWI unit does not include air pollution control equipment or the stack. The CISWI unit boundary starts at the solid waste hopper (if applicable) and extends through two areas: The combustion unit flue gas system, which ends immediately after the last combustion chamber or after the waste heat recovery equipment, if any; and the combustion unit bottom ash system, which ends at the truck loading station or similar equipment that transfers the ash to final disposal. The CISWI unit includes all ash handling systems connected to the bottom ash handling system."*

Similar to the above discussion related to Subpart LLLL, the proposed pyrolysis Facility does not meet the definition of an incineration unit. The definitions state that an incineration unit must combust fuel with a flame, and the fuel must be in a solid state. As previously described, pyrolysis is distinct from incineration/combustion, which is performed in the presence of excess oxygen, resulting in the oxidation of the material. Instead, pyrolysis occurs in a flameless, oxygen-deprived environment such that combustion does not occur. The process does not rely on combustion or oxidation as incineration does. Additionally, the proposed design will not include the use of a controlled flame to combust the sewage sludge. The heat from the combustion will be recovered in a thermal oil loop and used to dry the feedstock, and surplus heat will be utilized to produce electricity.

Supporting Documentation for Subpart CCCC

BioForceTech - Silicon Valley, California (Pyrolysis)

As previously mentioned, EPA Region 9 issued a determination letter to BFT on July 25, 2016, for a sewage sludge pyrolysis facility at the Silicon Valley wastewater treatment plant in Redwood City, CA. The determination letter provided further clarification on the definition of an incineration unit under Subpart CCCC. The determination states that an incineration unit must combust fuel with a flame. In addition, the fuel must be in a solid state. Due to the determination made by the U.S. EPA, the proposed project from BFT did not fit the definition of a CISWI unit in accordance with the guidelines. Copies of the Silicon Valley BFT facility permit and determinations of inapplicability are included in **Attachment C.**

Carbon Black Global - Dunlap, Tennessee (Gasification)

EPA Region 4 previously provided a determination letter, on March 2, 2017, to Carbon Black Global that confirmed that Subpart CCCC is not applicable to gasification. The Carbon Black Global unit performs gasification of a variety of carbon-based waste feedstocks, including wood. The unit does not perform gasification of sewage sludge.

Please note that pyrolysis and gasification are similar, as they are both thermal decomposition processes. Pyrolysis occurs in the full absence or near absence of oxygen, leading to the production of solid and gaseous products, whereas gasification occurs in a partial absence of oxygen, primarily producing some biochar and syngas. In their rationale to EPA, Carbon Black Global indicated that during the gasification process, the flame never makes contact with the feedstock material. Additionally, the fuel source and air/oxygen source are cut off, and the gasification unit is sealed to prevent combustion within the gasification unit. The unit was reportedly equipped with holes at the top of the vessel that draw all syngas upwards and into the scrubber *via* pressure differentiation; however, this design is not conducive to combustion. Therefore, as the gasification process begins, there is no longer sufficient air/oxygen, and therefore combustion does not occur. In the determination letter, the EPA recognized that gasification, by itself, is not combustion. EPA determined that the process design regulates the presence of oxygen in the gasification unit to prevent combustion of the waste feedstock. Even though the feedstock is wood, and not sewage sludge, the argument remains that the gasification process is not considered combustion/incineration. Therefore, EPA concluded that the unit did not qualify as "*any distinct operating unit of any commercial or industrial facility that combusts, or has combusted in the preceding 6 months, any solid waste as that term is defined in 40 CFR part CBG. 241.*" For this reason, Subpart CCCC did not apply to the gasification process. A copy of the Carbon Black Global determination of inapplicability is included in **Attachment D.**

NSPS Subpart O – Standards of Performance for Sewage Treatment Plants

The applicability section of the Standards of Performance for Sewage Treatment Plants (NSPS Subpart O) states that *"[the] affected facility is each incinerator that combusts wastes containing more than 10 percent sewage sludge (dry basis) produced by municipal sewage treatment plants, or each incinerator that charges more than 1000 kg (2205 lb) per day municipal sewage sludge (dry basis)".*

Although Subpart O does not define "incinerator", the following definition for "sewage sludge incinerator' was included as 40 CFR § 60.151(a) in the Subpart O proposed rule:

> *"Sewage Sludge Incinerator" means any combustion device used in the processes of burning sewage sludge for the primary purpose of solids sterilization and to reduce the volume of waste by removing combustible matter but does not include portable facilities or facilities used solely for burning scum or other floatable materials, recalcining lime, or regenerating activated carbon.*

The definition of an SSI is specific to the terms 'burning' and 'incineration' rather than inclusive of other terms such as, 'gasification' or 'pyrolysis'. A search of EPA information and policy documents did not identify any existing EPA guidance/determinations on the potential applicability of Subpart O to municipal sewage sludge pyrolysis. Lacking such guidance, SAGE opines that the rationale provided to

EPA with respect to Subparts CCCC and LLLL (see above) may be applied to Subpart O. In accordance with the EPA's previous determinations that pyrolysis and gasification are not synonymous with incineration, and the combustion of pyrolysis gas or syngas is not considered combustion of sewage sludge, the same logic and determination may reasonably apply as it relates to the definition of a sewage sludge incinerator under Subpart O. As such, this Subpart is not applicable to the proposed facility.

Supporting Documentation for Subpart O

Ecoremedy - Edmonds, Washington (Pyrolysis)

In addition to the EPA submission and determinations noted above, Ecoremedy (the project proponent) submitted a Notice of Construction Worksheet (#12135) to the Puget Sound Clean Air Agency providing extensive rationale as to why Subpart O is not applicable to their pyrolysis facility.

A copy of this worksheet may be found in **Attachment E.**

Summary and Recommendations

The QSSB facility will have similar operating characteristics to the pyrolysis and gasification units evaluated by EPA in the above mentioned determinations. The proposed pyrolysis reactors flamelessly convert sewage sludge to pyrolysis gas and biochar, and the pyrolysis gas is oxidized in a physically separate unit from the pyrolysis unit. No oxidation of pyrolysis gas occurs in the presence of sewage sludge. Based on this process information, it is SAGE's opinion that the aforementioned Subparts are not applicable to the proposed sewage sludge pyrolysis facility.

Based on the above discussion and attached supporting materials, we respectfully request EPA's confirmation that sewage sludge pyrolysis is not incineration by definition and is therefore not subject to Major source permitting requirements. The facility will pursue a Minor Source Air Permit per the RIDEM Air Pollution Control Regulations.

We appreciate your time and attention to this matter. Should you need additional information, please contact the undersigned.

Sincerely,

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____
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Attachments

APPENDIX E

Air Dispersion Modeling Report

QSS Biosolids, LLC – Pyrolysis Facility

North Kingstown, Rhode Island

April 22, 2025 | Terracon Project No. MP247328

Prepared for:
QSS Biosolids, LLC

Prepared by:
Terracon Consultants, Inc.
Minneapolis, Minnesota

Contents

1.0 Introduction

QSS Biosolids, LLC (QSSB) is proposing a new sewage sludge pyrolysis facility within the Quonset Business Park in North Kingstown, Rhode Island. Pyrolysis is the process of decomposing organic materials by applying heat in an oxygen-deprived environment, which results in the production of valuable by-products such as biochar and pyrolysis gas, while reducing the volume of the original organic material. The proposed Facility will accept sewage sludges from wastewater treatment facilities in Rhode Island as a source of organic materials for the pyrolysis process. The biochar produced through the pyrolysis of sewage sludge is a carbon-rich material with a high market value for the physical product, as well as the associated carbon credits. Additionally, the energy from the pyrolysis produced can be recovered as heat through combustion of the gas. The heat can then be used in the Facility's operations. The heat at the proposed Facility will be recovered in a thermal oil loop and used to dry the incoming feedstock, and surplus heat may be utilized to produce electricity.

The air dispersion modeling analysis for this Facility was done in accordance with the Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources (March 2013 Revision). Criteria pollutant modeling is required for new facilities that exceed the significant emissions rate thresholds listed in the Guidelines. Table 1 below includes the Facility emission rate of each criteria pollutant compared to the Significant Emission Rate. None of the criteria pollutants emitted by the facility exceed the significant emissions rate thresholds.

Table 1: Criteria Pollutant Air Dispersion Modeling Thresholds

Criteria Pollutant	Facility Emission Rate (tons/yr)	Significant Emission Rate[1] (tons/yr)	Modeling Required?
Carbon monoxide (CO)	13.0	100	No
Nitrogen oxides (NOx)	12.5	25	No
Sulfur dioxide (SO_2)	16.8	40	No
Particulate matter <10 µ (PM_{10})	5.3	15	No
Particulate matter <2.5 µ ($PM_{2.5}$)	5.3	10	No
Lead (Pb)	0.005	0.6	No

[1] Table I in the Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources (March 2013 Revision)

Per Rhode Island Air Pollution Control Regulation 22.6A (250-RICR-120-05-22), air permitting is required for Rhode Island air toxics that exceed the established Minimum Quantity of that contaminant. Per Regulation 22.6C, for all air toxics that exceed the Minimum Quantity, a facility must demonstrate that "any listed toxic air contaminant…shall not cause an impact at or beyond the property line of the facility, which exceeds the Acceptable Ambient Levels for that contaminant…." Appendix A includes the list of all expected air toxics from the emission sources at the facility and whether air dispersion modeling is required. Air dispersion modeling is required for twenty-three (23) air toxics.

A modeling protocol was submitted electronically on March 20, 2025, and was conditionally approved on April 9, 2025. The conditions in the modeling protocol approval letter have been incorporated into the final modeling analysis.

2.0 Modeling Methodology and Parameters

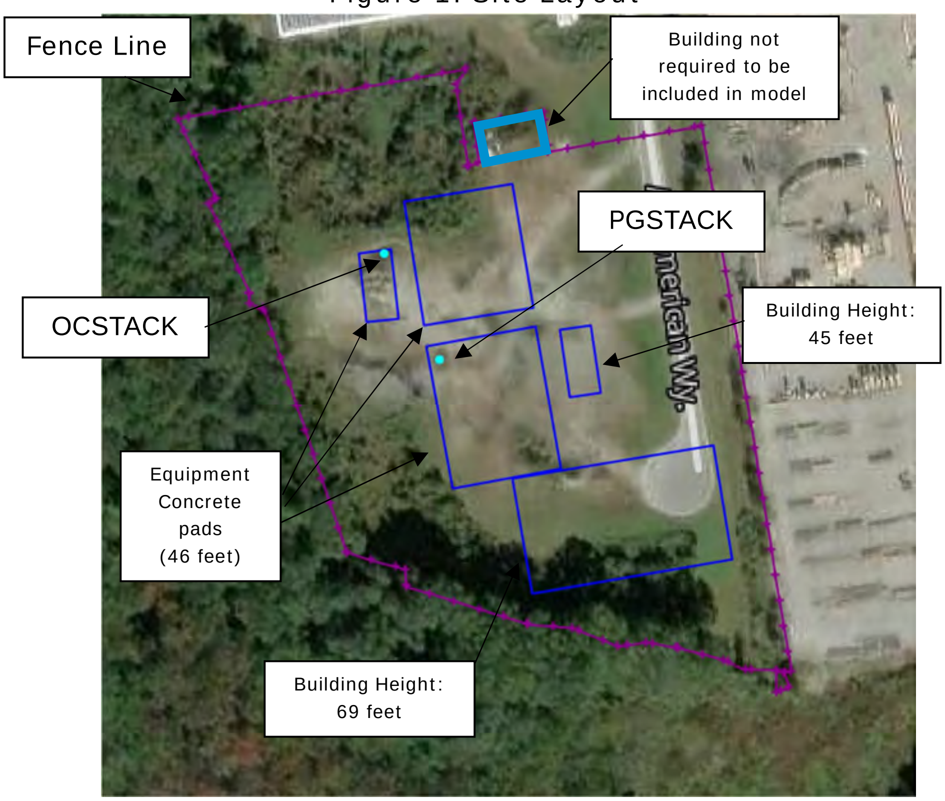
2.1 Dispersion Model

Air dispersion modeling was conducted with the latest version of AERMOD (v24142). The Urban option was utilized with a population of 27,732 based on census data from 2020 for North Kingstown.

2.2 Site Layout

The site is located at an Easting of 294101 and a Northing of 4608443 in Zone 19 (based on NAD83 datum). A fence will be located on the property, and the boundary receptors will be placed along the fence line and around the building north of the site. The equipment will be located on multiple concrete pads which will be covered with a roof for weather protection that will allow air to flow across the equipment. To be conservative in the air dispersion model, the concrete pads will be modeled as buildings that are 46 feet tall (estimated height of the roof over the equipment). All buildings were considered in the modeling analysis. Buildings that are greater than five times the building height from either of the stacks at the facility were excluded in the modeling analysis. Figure 1 below includes the buildings and boundary receptors included in the modeling analysis.

Figure 1: Site Layout



2.3 Source Types and Stack Parameters

Emissions from the processes at the site vent through two emission points. The first emission point is the stack from the Odor Control Plant, which functions to collect and treat emissions from emission sources prior to the pyrolysis process. All emissions prior to the Pyrolysis process will be collected in the odor control plant and treated. There will be one exhaust stack from the Odor Control Plant. This stack will exhaust vertically and be unobstructed. As such, the Odor Control Plant stack (OCSTACK) was modeled as a point source in the air dispersion model.

The second emission point is the stack from the Pyrolysis Emission Control Plant. All emissions from the Pyrolysis process will be collected in the pyrolysis emission control plant and treated. Two exhaust stacks vent the emissions but will be contained inside of a larger stack. As such, the air dispersion model assumes one stack for this emission point. This stack will exhaust vertically and be unobstructed. As such, the Pyrolysis Emission Control Plant stack (PGSTACK) was modeled as a point source in the air dispersion model. The stack parameters for each of the stacks is presented in Table 2 below.

Table 2: Point Source Parameters

Source	UTM Easting (m)	UTM Northing (m)	Stack Height (ft)	Temp. (°F)	Flow Rate (cfm)	Stack Diameter (in)
OCSTACK (Odor Control Stack)	294066.5	4608414.9	54	75	14,145	28
PGSTACK (Pyrolysis Emissions Control Stack)	294078.2	4608441.1	120	633.2	14,408	25.6

2.4 Receptor Grids

The air dispersion model will utilize a polar receptor grid. Receptor spacing for the boundary receptors at the fence line will be 10 meters. The polar receptor grid includes 36 radials. Ring spacing was 25 meters out to 1,000 meters from the property line, 100 meters out to 2,000 meters from the property line, and 200 meters out to 10,000 meters from the property line.

2.5 Terrain Elevations

The air dispersion model utilized terrain elevations acquired from the National Map Viewer from the U.S. Geological Survey (GeoTIFF 1/3 arc-second data). The elevation data was incorporated into the model by running the AERMAP program (v18081). AERMAP defines the elevations of the emission points, buildings, and receptors.

2.6 Meteorological Data

The air dispersion model utilizes five years of meteorological data (from 2016 to 2020). The surface data is from the Rhode Island TF Green International Airport weather station (WBAN ID: 14765). The upper air data is from the Chatham upper air station (WBAN ID: 14684). The data was processed through the AERMET program (v24142). AERMINUTE (v15272) and AERSURFACE (v24142) was also utilized in the meteorological data processing. The information that was utilized is summarized below.

Hourly Surface Station Met Data Information

Parameter	Value
Surface Station Name	PROVIDENCE/GREEN ST, RI
Latitude, Longitude	41.72252 N, 71.43248 W
Station ID (WBAN)	14765
ASOS Station?	Yes
File Format	NCDC TD-3505 (ISHD)
Base Elevation	18.9 m
Adjustment to Local Time	5 hours
Anemometer Height	10.05 m

1-Minute & 5-Minute ASOS Wind Data Information

Parameter	Value
AERMINUTE Data Used?	Yes
Station Name	PROVIDENCE/GREEN ST, RI
Latitude, Longitude	41.72252 N, 71.43248 W
Station Code	PVD
Station ID (WBAN)	14765
File Format	NCDC TD-6405
IFW Installation Date	July 17, 2009

Upper Air Station Met Data Information

Parameter	Value
Upper Air Station Name	CHATHAM, MA
Latitude, Longitude	41.657 N, 69.959 W
Station ID (WBAN)	14684
File Format	IGRA
Adjustment to Local Time	5 hours

AERSURFACE Parameters

Parameter	Value
Land Use Data File	MRLC NLCD – GeoTIFF Format
Center Lat/Long	41.72252 N, 71.43248 W
Datum	NAD83
Radius for Surface Roughness	1km
Number of Sectors	12 sectors of 30° (starting at 0°)
Period	Monthly
Surface Moisture	Year 2016: Average Year 2017: Average Year 2018: Wet Year 2019: Average Year 2020: Average
Other Settings	Continuous Snow: No Airport Site: Yes Airport Sectors: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 Arid Region: No

2.7 Downwash

The air dispersion model utilizes BPIPPRM (v04274) to account for downwash from the applicable buildings on the site. One building on the site and the buildings off site are greater than five times the heights of those buildings from each of the stacks. As such, those buildings are not included in the modeling analysis.

3.0 Modeling Analysis

As described in Section 1.0 of this Report, 23 air toxics were analyzed as part of this analysis. Of those 23 air toxics, only two of the contaminants are emitted from both the Odor Control Plant stack and the Pyrolysis Emissions Control Plant stack (hydrogen sulfide and ammonia). The remainder of the air toxics that exceed the respective Minimum Quantity and require modeling are emitted from the Pyrolysis Emissions Control Plant stack only. As such, for 21 of the air toxics, the air dispersion model was run for the Pyrolysis Emissions Control Plant at a 1 lb/hr emission rate. The maximum result for the 1-hour, 24-hour, and annual averaging periods were then multiplied by each air toxic contaminant's emission rate and compared to the applicable Acceptable Ambient Levels (AALs) identified in Appendix A. The annual averaging period utilized the maximum individual year and was not averaged over the five applicable years. Tables 3, 4, and 5 include the modeling results for the 21 air toxics that are only emitted from the Pyrolysis Emissions Control Plant stack.

Table 3: 1-Hour Averaging Period Modeling Results

Contaminant	Emission Rate (lb/hr)	Model Result at 1 lb/hr (µg/m^3)	Model Result (µg/m^3)	Acceptable Ambient Level (µg/m^3)	% of AAL
Arsenic & compounds (inorganic)	1.18E-04	1.8755	0.0002	0.2	0.11%
Benzene	2.36E-03		0.004	30	0.01%
Boron and borates	4.85E-04		0.001	10	0.01%
Copper & compounds, except Copper cyanide	6.48E-03		0.012	100	0.01%
Fluorides & compounds, including Hydrogen fluoride	2.74E-01		0.513	20	2.57%
Formaldehyde	5.47E-03		0.010	50	0.02%
Hydrochloric acid (Hydrogen chloride)	1.96E-01		0.368	2000	0.02%
Hydrogen cyanide	2.29E-02		0.043	300	0.01%
Mercury & compounds – elemental & inorganic	9.52E-03		0.018	2	0.89%
Nickel and compounds, except Nickel subsulfide	2.27E-04		0.0004	6	0.01%
Vanadium and compounds	2.94E-04		0.001	0.2	0.28%

Table 4: 24-Hour Averaging Period Modeling Results

Contaminant	Emission Rate (lb/hr)	Model Result at 1 lb/hr (µg/m^3)	Model Result (µg/m^3)	Acceptable Ambient Level (µg/m^3)	% of AAL
Aniline	2.63E-03	1.09411	0.003	1	0.29%
Antimony & compounds, including antimony trioxide	1.26E-03		0.001	0.2	0.69%
Benzene	2.36E-03		0.003	20	0.01%
Cadmium & compounds	1.60E-04		0.000	0.1	0.17%
Fluorides & compounds, including Hydrogen fluoride	2.74E-01		0.299	3	9.98%
Formaldehyde	5.47E-03		0.006	40	0.01%
Manganese & compounds	6.30E-03		0.007	0.05	13.79%
Mercury & compounds – elemental & inorganic	9.52E-03		0.010	0.3	3.47%
Naphthalene	1.93E-03		0.002	3	0.07%
Nickel and compounds, except Nickel subsulfide	2.27E-04		0.0002	0.2	0.12%

Table 5: Annual Averaging Period Modeling Results

Contaminant	Emission Rate (lb/hr)	Model Result at 1 lb/hr (µg/m³)	Model Result (µg/m³)	Acceptable Ambient Level (µg/m³)	% of AAL
Acetamide	2.31E-02	0.06374	0.001	0.05	2.94%
Aniline	2.63E-03		0.0002	0.6	0.03%
Arsenic & compounds (inorganic)	1.18E-04		7.52E-06	0.0002	3.76%
Benzene	2.36E-03		0.0002	0.1	0.15%
Cadmium & compounds	1.60E-04		1.02E-05	0.0006	1.69%
Cobalt & compounds	4.87E-05		3.11E-06	0.001	0.31%
Copper & compounds, except Copper cyanide	6.48E-03		0.0004	2	0.02%
Formaldehyde	5.47E-03		0.0003	0.08	0.44%
Hydrochloric acid (Hydrogen chloride)	1.96E-01		0.012	9	0.14%
Hydrogen cyanide	2.29E-02		0.001	3	0.05%
Lead & compounds, inorganic	1.19E-03		0.0001	0.008	0.95%
Manganese & compounds	6.30E-03		0.0004	0.04	1.00%
Mercury & compounds – elemental & inorganic	9.52E-03		0.001	0.009	6.74%
Naphthalene	1.93E-03		0.0001	0.03	0.41%
Nickel and compounds, except Nickel subsulfide	2.27E-04		1.45E-05	0.004	0.36%
Polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs)	4.33E-08		3.00E-09	2.76E-09	92.1%
Quinoline	2.33E-04		0.00001	0.001	1.48%

The two contaminants that are emitted in both the Odor Control Plant stack and Pyrolysis Emissions Control Plant stack had separate modeling runs. The emission rates from each stack for each of the pollutants is included in Table 6. It should be noted that there is a bypass scenario during maintenance where the odor control stack will emit uncontrolled emissions of ammonia. This maintenance is projected to occur for one day every year. However, to be conservative, the uncontrolled emission rate for ammonia was used in the modeling analysis. Results from the modeling for those runs is summarized in Table 7.

Table 6: Emission Rates for Hydrogen Sulfide and Ammonia

Contaminant	OGSTACK Emission Rate (lbs/hr)	PGSTACK Emission Rate (lbs/hr)
Hydrogen Sulfide	0.00604	0.00509
Ammonia	2.83	0.622

Table 7: Modeling Results for Hydrogen Sulfide and Ammonia

Contaminant	1-Hour Model Result (µg/m³)	1-Hour AAL (µg/m³)	24-Hour Model Result (µg/m³)	24-Hour AAL (µg/m³)	Annual Model Result (µg/m³)	Annual AAL (µg/m³)
Hydrogen Sulfide	0.298	40	0.102	30	0.017	10
Ammonia	139.8	1000	47.73	100	8.00	70

4.0 Summary

All modeling results are below the respective Acceptable Ambient Levels. Concentration isopleths of the highest years modeled for each modeling run and averaging period are included in Appendix B. Electronic copies of the modeling files will be submitted with this modeling report (including the AERMET input and output files).

Appendix A

Appendix Table A-1: Air Toxic List

Pollutant	PGSTACK Emission Rate (lbs/hr)	OCSTACK Emission Rate (lbs/hr)	Total Emissions (lbs/year)	MQ (lbs/year)	Modeling Required?	1-hour AAL (µg/m3)	24-hour AAL (µg/m3)	Annual AAL (µg/m3)
Acetamide	2.31E-02	-	201.990	5	Yes			0.05
Ammonia	6.22E-01	2.83	5696.663	300	Yes	1000	100	70
Aniline	2.63E-03	-	23.004	3	Yes		1	0.6
Antimony & compoundsa, including antimony trioxide	1.26E-03	-	11.073	0.6	Yes		0.2	
Arsenic & compoundsa (inorganic)	1.18E-04	-	1.033	0.02	Yes	0.2		0.0002
Benzene	2.36E-03	-	20.689	10	Yes	30	20	0.1
Boron and borates	4.85E-04	-	4.246	4	Yes	10		
Cadmium & compounds	1.60E-04	-	1.397	0.07	Yes		0.1	0.0006
Cobalt & compounds	4.87E-05	-	0.427	0.1	Yes			0.001
Copper & compounds, except Copper cyanide	6.48E-03	-	56.763	40	Yes	100		2
Fluorides & compounds, including Hydrogen fluoride	5.47E-01	-	2397.094	7	Yes	20	3	
Formaldehyde	5.47E-03	-	47.906	9	Yes	50	40	0.08
Hydrochloric acid (Hydrogen chloride)	3.92E-01	-	1717.135	700	Yes	2000		9
Hydrogen cyanide	2.29E-02	-	200.558	100	Yes	300		3
Hydrogen sulfide	5.09E-03	6.04E-03	97.552	10	Yes	40	30	10
Lead & compounds, inorganic	1.19E-03	-	10.412	0.9	Yes			0.008
Manganese & compounds	6.30E-03	-	55.191	0.2	Yes		0.05	0.04
Mercury & compounds – elemental & inorganic	9.52E-03	-	83.421	0.7	Yes	2	0.3	0.009
Naphthalene	1.93E-03	-	16.868	3	Yes		3	0.03
Nickel and compounds, except Nickel subsulfide	2.27E-04	-	1.990	0.4	Yes	6	0.2	0.004
Polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs)*	4.33E-08	-	3.80E-04	3.00E-07	Yes			3.00E-09
Quinoline	2.33E-04	-	2.038	0.1	Yes			0.001
Vanadium and compounds	2.94E-04	-	2.574	0.07	Yes	0.2		
Acetaldehyde	1.45E-03	-	12.686	50	No			
Barium	4.10E-03	-	35.912	2000	No			
Beryllium & compounds	8.75E-07	-	0.008	0.04	No			
Biphenyl	1.43E-04	-	1.249	600	No			
Carbon Disulfide	-	2.98E-07	0.003	2000	No			
Carbonyl sulfide	4.49E-04	-	3.934	70	No			
Chromium III & compounds, insoluble salts	5.59E-04	-	4.900	20000	No			
Cresols/Cresylic acid isomers and mixtures	5.09E-03	-	44.575	20000	No			
Ethyl benzene	1.30E-03	-	11.377	9000	No			
Glutaraldehyde	5.94E-05	-	0.520	9	No			
Hexane	1.35E-01	-	1178.435	20000	No			
Hydrogen bromide	4.91E-02	-	214.902	2000	No			
Molybdenum and compoundsa	1.88E-04	-	1.643	60	No			
Phenol	2.57E-03	-	22.530	30	No			
Polychlorinated biphenyls (PCBs), except Aroclor 1254	9.25E-06	-	0.081	0.1	No			
Propylene	1.45E-02	-	127.348	36500	No			
Selenium & compounds except Hydrogen selenide and Selenium sulfide	2.06E-04	-	1.805	2000	No			
Styrene	4.95E-03	8.52E-07	43.351	3000	No			
Toluene	7.85E-03	4.26E-06	68.817	1000	No			
Xylenes, isomers and mixtures	2.01E-03	4.26E-07	17.578	3000	No			
Zinc and compounds	9.86E-03	-	86.403	3000	No			

* In terms of 2,3,7,8-tetrachlorobenzodioxin equivalents. See Appendix Table A-2

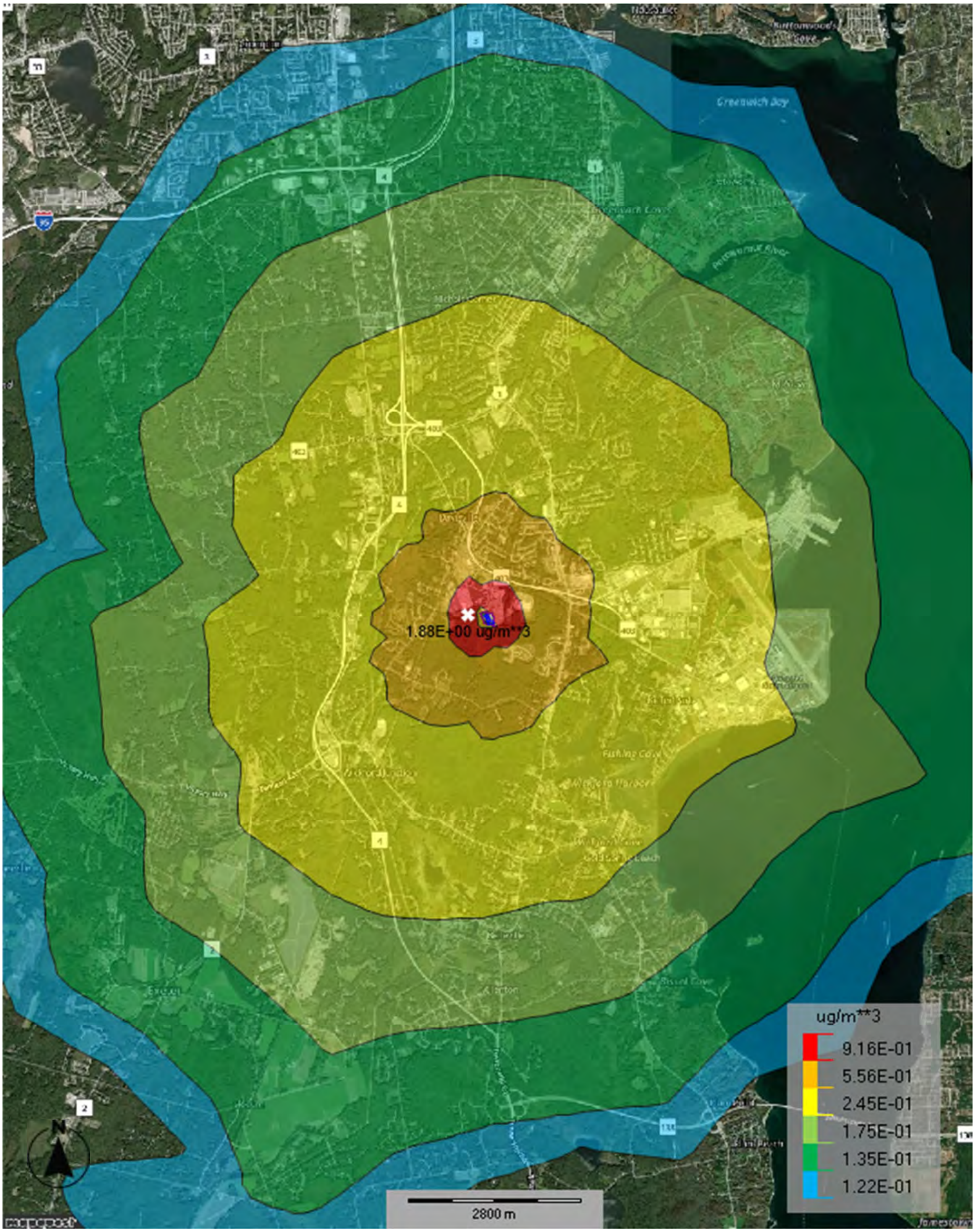
Appendix Table A-2: 2,3,7,8-tetrachlorobenzodioxin equivalents

Pollutant	Emission Rate (lbs/hr)	WHO Weighting Factor**	2,3,7,8-tetrachlorobenzodioxin equivalent Emission Rate (lbs/hr)
OCDD	1.07E-06	0.0001	1.07E-10
OCDF	1.34E-07	0.0001	1.34E-11
Total HxCDD	3.92E-08	0.1	3.92E-09
Total HxCDF	9.09E-08	0.1	9.09E-09
Total HpCDD	2.32E-07	0.01	2.32E-09
Total HpCDF	1.51E-07	0.01	1.51E-09
Total PeCDD	5.70E-09	1	5.70E-09
Total PeCDF	3.39E-08	0.5	1.69E-08
Total TCDD	2.14E-09	1	2.14E-09
Total TCDF	1.30E-08	0.1	1.30E-09
PCB 77	7.48E-08	0.0001	7.48E-12
PCB 81	0.00E+00	0.0001	0.00E+00
PCB 126	0.00E+00	0.1	0.00E+00
PCB 169	0.00E+00	0.01	0.00E+00
PCB 105	4.81E-07	0.0001	4.81E-11
PCB 114	3.03E-08	0.0005	1.51E-11
PCB 118	1.18E-06	0.0001	1.18E-10
PCB 123	9.80E-08	0.0001	9.80E-12
PCB 156/157	2.14E-07	0.0005	1.07E-10
PCB 167	7.48E-08	0.00001	7.48E-13
PCB 189	1.48E-08	0.0001	1.48E-12
Total PCDDs, PCDFs, and Dioxin-like PCBs (as 2,3,7,8-tetrachlorobenodioxin equivalents)			4.33E-08

**WHO Weighting Factor per Table G in Rhode Island Air Toxics Guideline (September 2008)

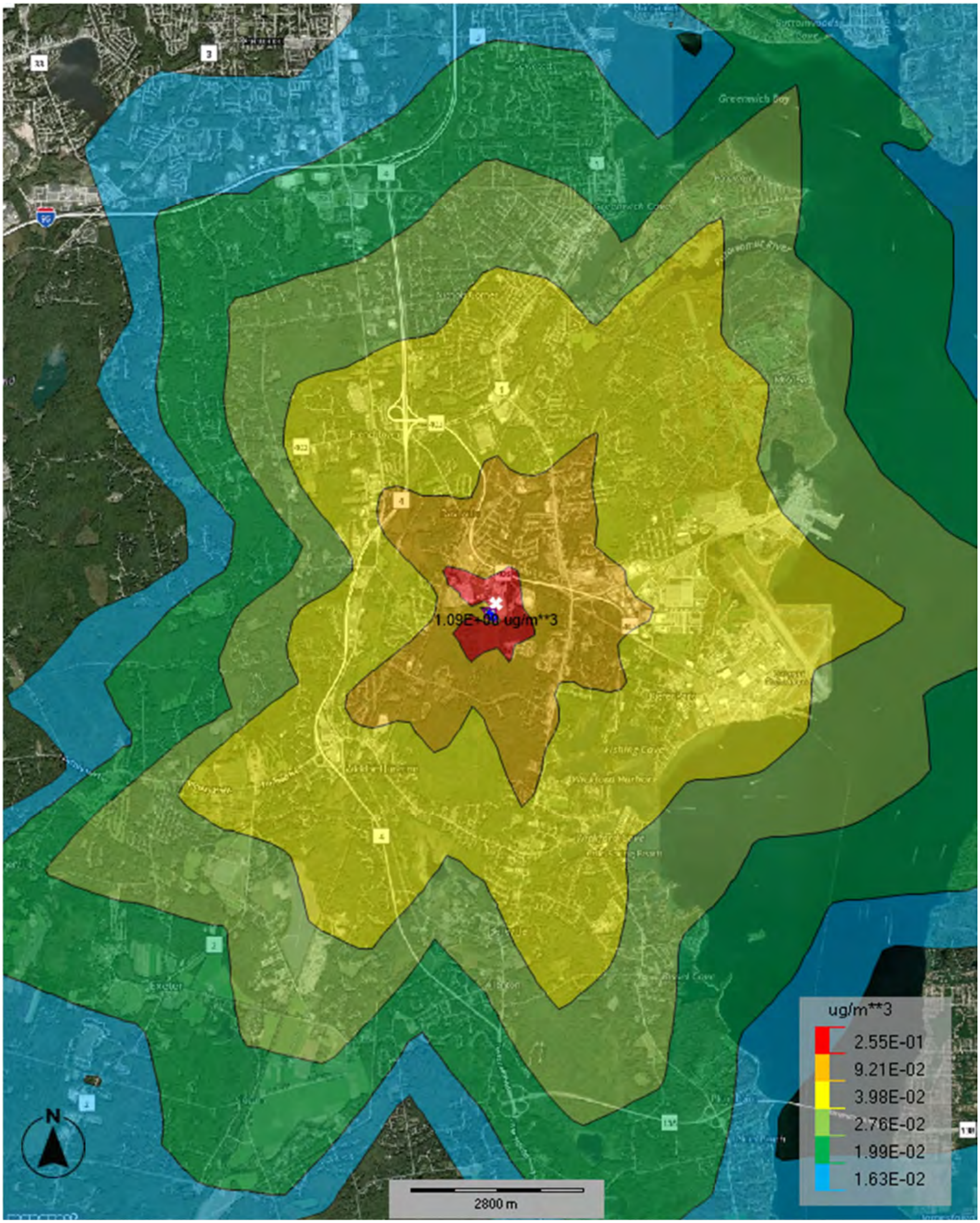
Appendix B

1 lb/hr Emission Rate: 1-Hour



Project No. MP247328 Scale: AS SHOWN Client: QSS Biosolids Date: 4/22/2025	Terracon 13400 15th Ave N Plymouth, MN 55441-4532	1-Hour – 1 lb/hr Emission Rate QSS Biosolids, LLC Pyrolysis Facility North Kingstown, RI	Exhibit 1

1 lb/hr Emission Rate: 24-Hour



Project No.	MP247328
Scale:	AS SHOWN
Client:	QSS Biosolids
Date:	4/22/2025

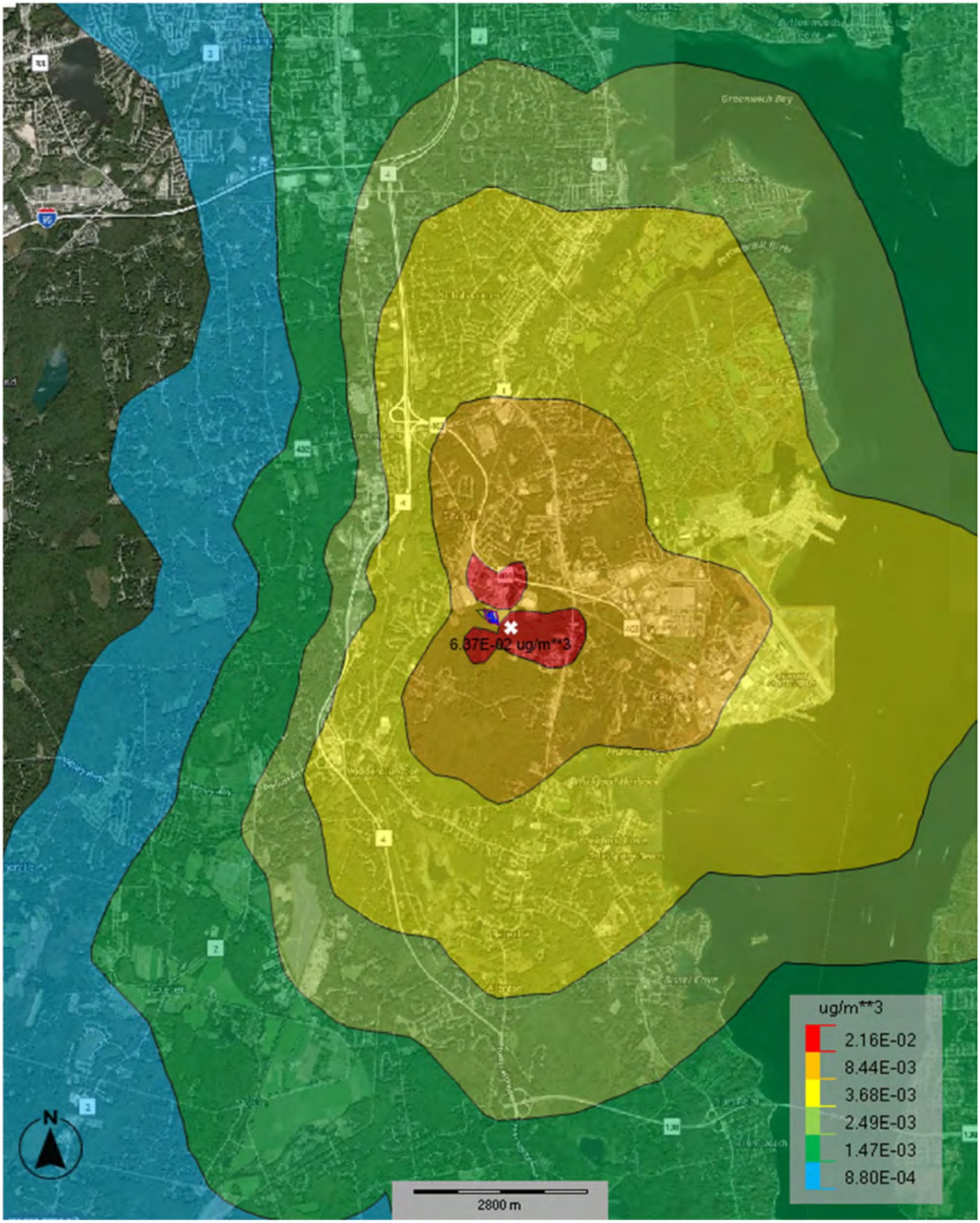
Terracon
13400 15th Ave N
Plymouth, MN 55441-4532

24-Hour – 1 lb/hr Emission Rate

QSS Biosolids, LLC
Pyrolysis Facility
North Kingstown, RI

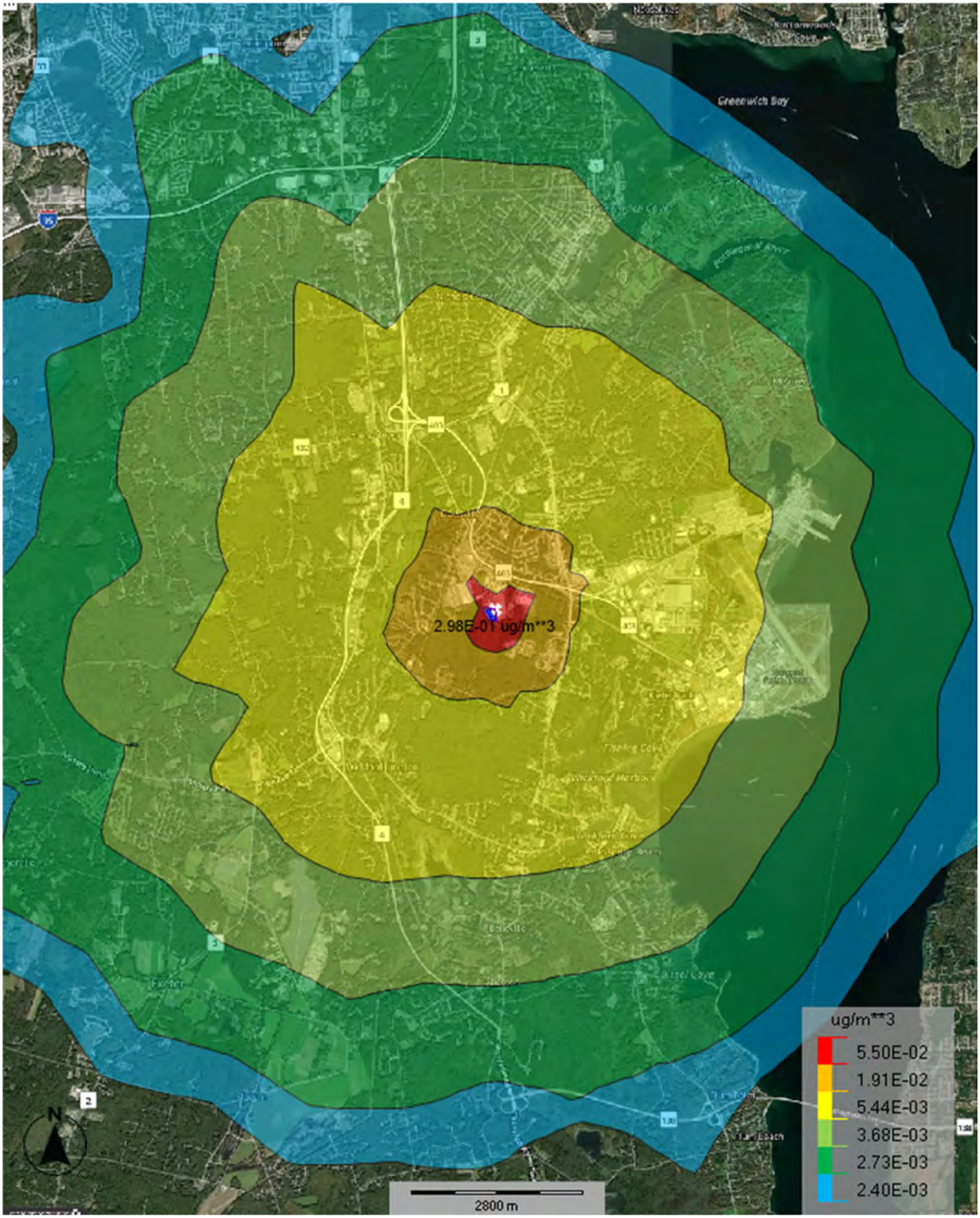
Exhibit
2

1 lb/hr Emission Rate: Annual



Project No. MP247328 Scale: AS SHOWN Client: QSS Biosolids Date: 4/22/2025	Terracon 13400 15th Ave N Plymouth, MN 55441-4532	Annual– 1 lb/hr Emission Rate QSS Biosolids, LLC Pyrolysis Facility North Kingstown, RI	Exhibit 3

Hydrogen Sulfide: 1-Hour



Project No.	MP247328
Scale:	AS SHOWN
Client:	QSS Biosolids
Date:	4/22/2025

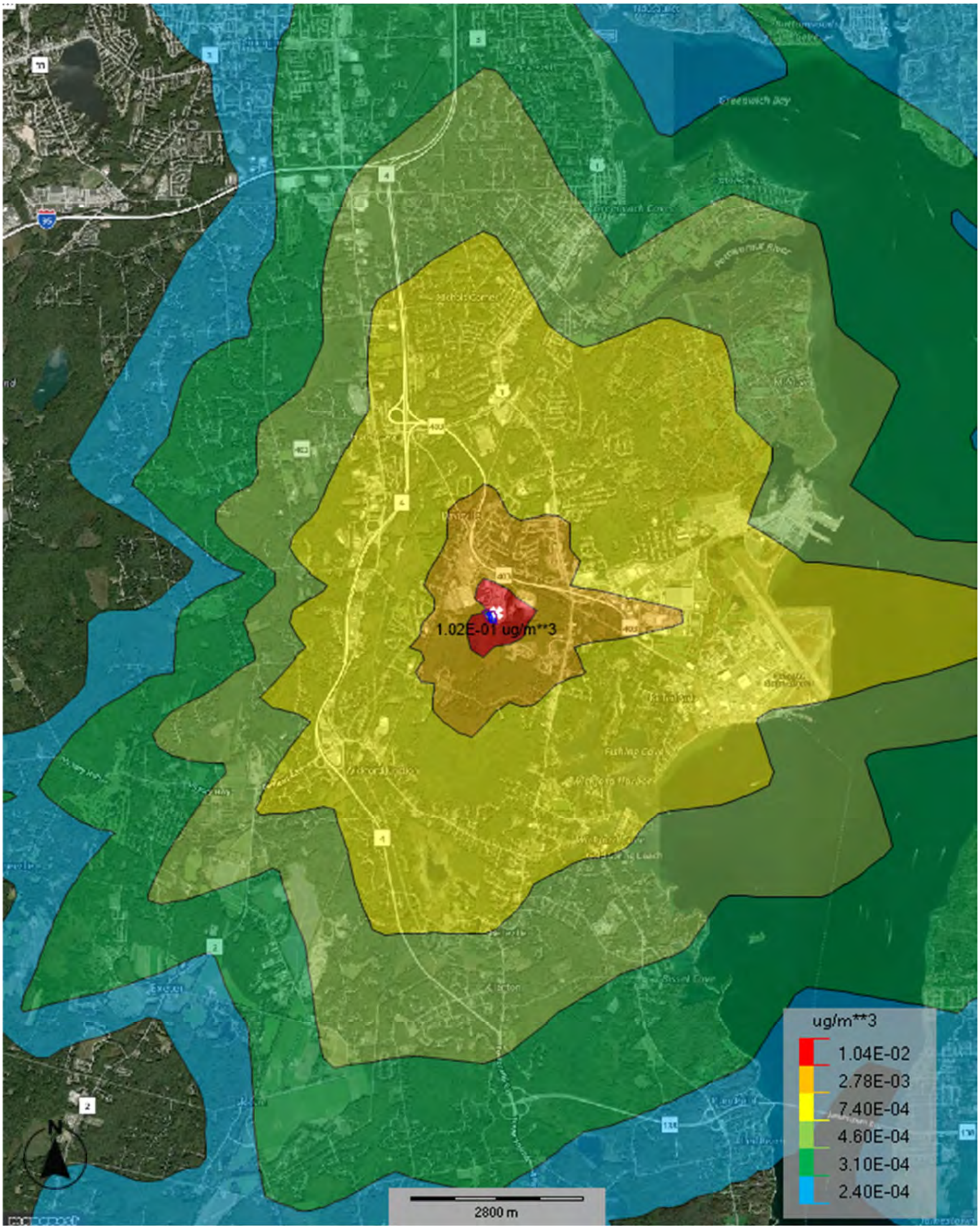
Terracon
13400 15th Ave N
Plymouth, MN 55441-4532

1-Hour– Hydrogen Sulfide

QSS Biosolids, LLC
Pyrolysis Facility
North Kingstown, RI

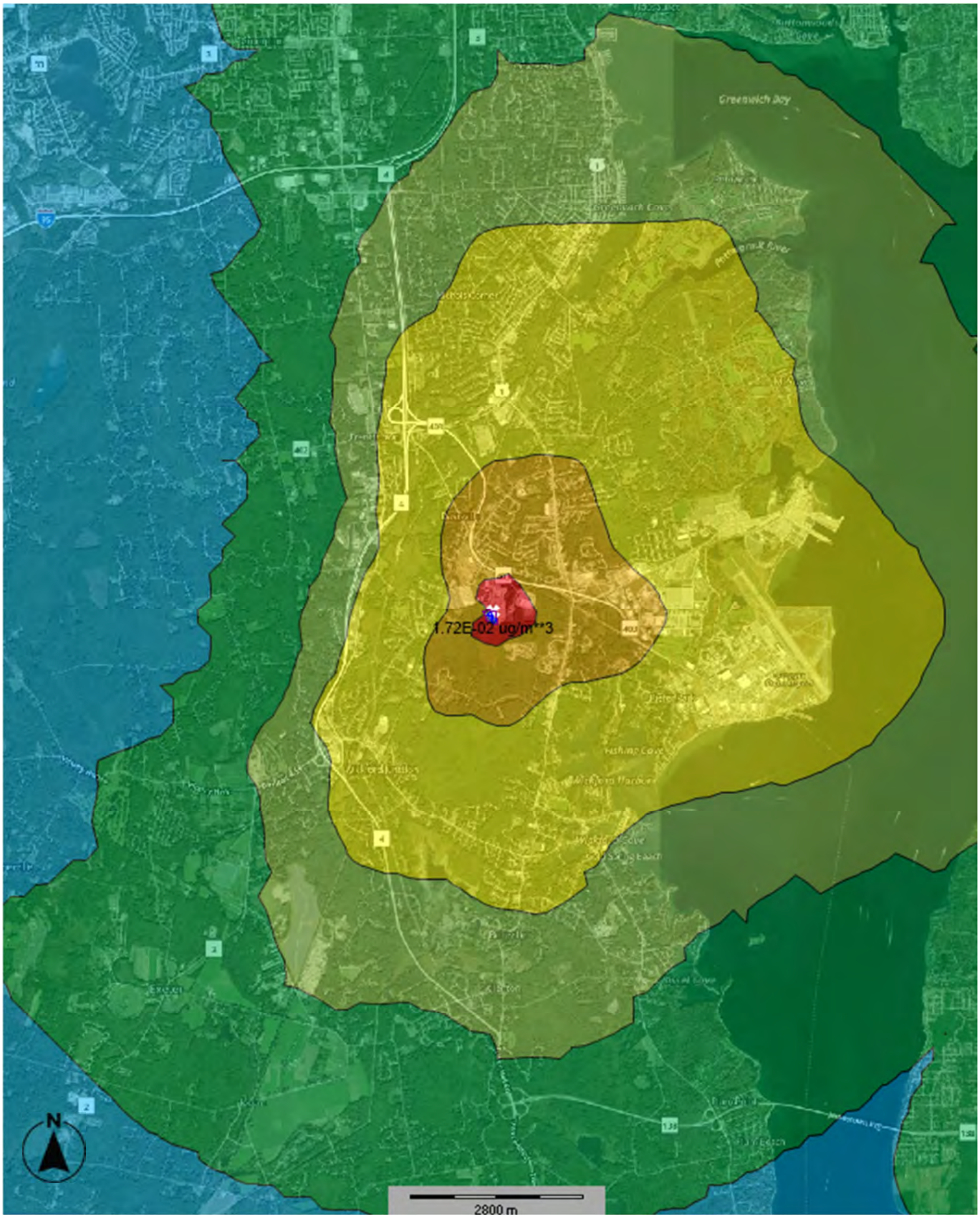
Exhibit
4

Hydrogen Sulfide: 24-Hour



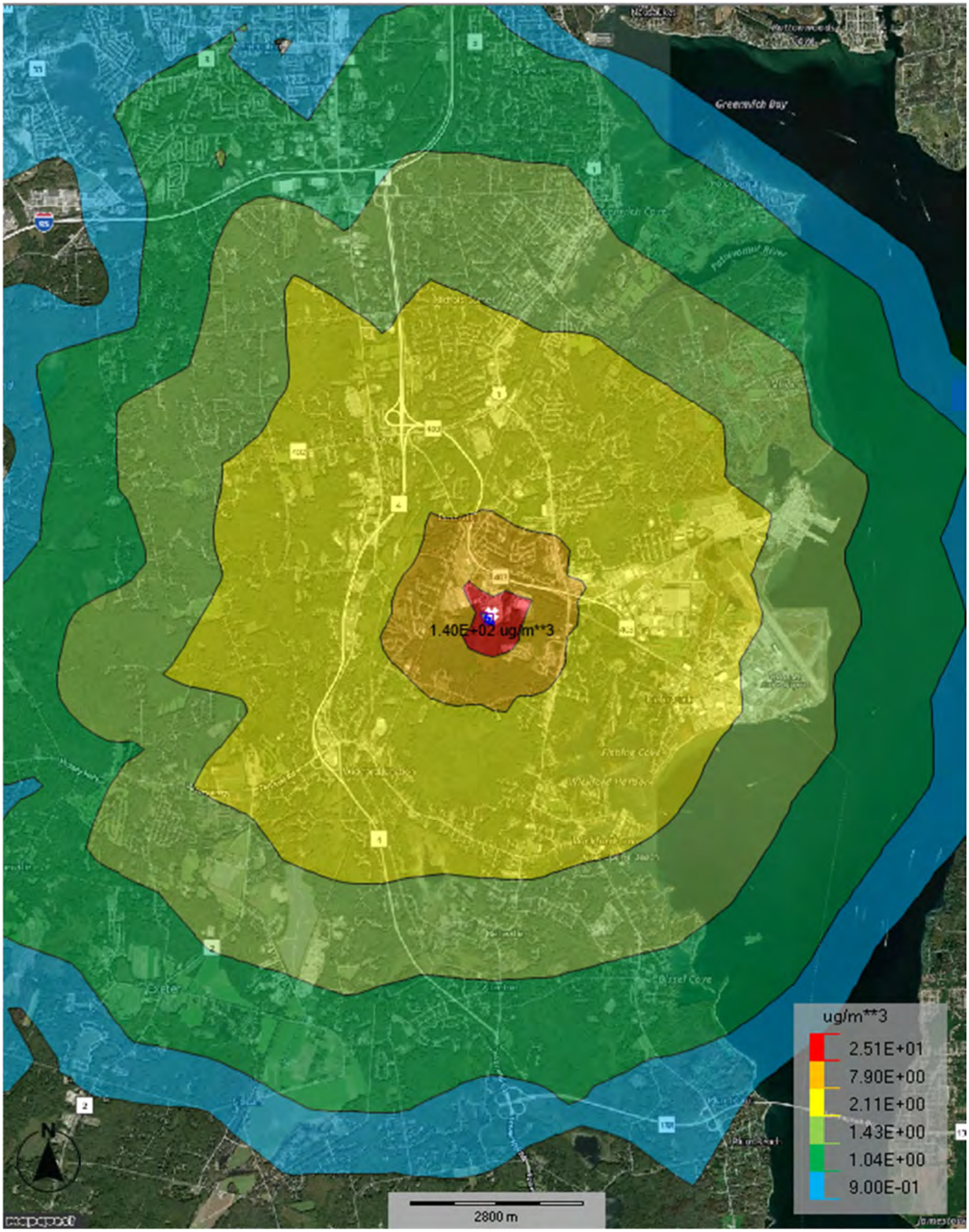
Project No. MP247328	Terracon	24-Hour – Hydrogen Sulfide	Exhibit
Scale: AS SHOWN	13400 15th Ave N	QSS Biosolids, LLC	5
Client: QSS Biosolids	Plymouth, MN 55441-4532	Pyrolysis Facility	
Date: 4/22/2025		North Kingstown, RI	

Hydrogen Sulfide: Annual



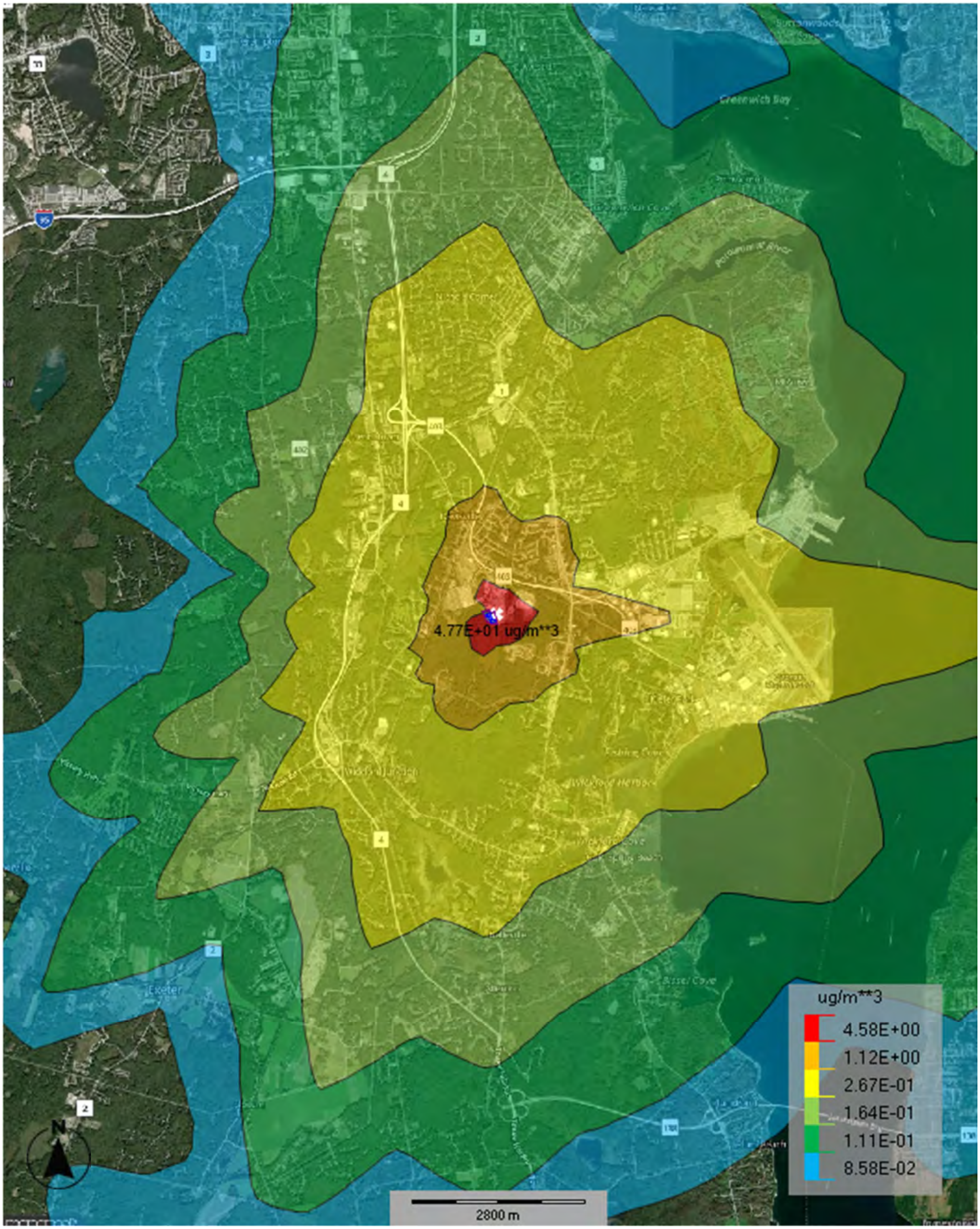
Project No. MP247328	Terracon 13400 15th Ave N Plymouth, MN 55441-4532	Annual– Hydrogen Sulfide	Exhibit
Scale: AS SHOWN		QSS Biosolids, LLC Pyrolysis Facility North Kingstown, RI	6
Client: QSS Biosolids			
Date: 4/22/2025			

Ammonia: 1-Hour



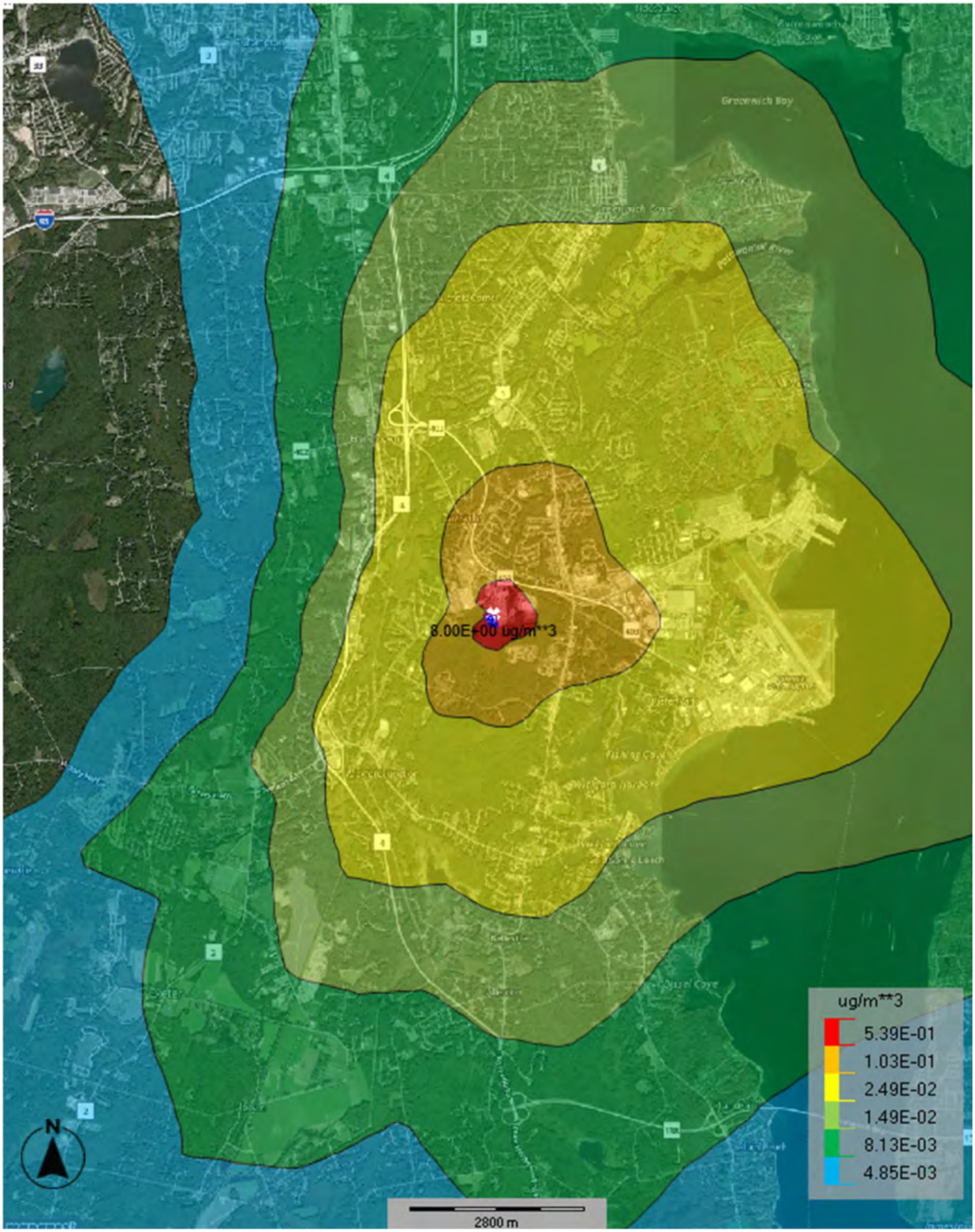
Project No.	MP247328	Terracon	1-Hour – Ammonia	Exhibit
Scale:	AS SHOWN	13400 15th Ave N	QSS Biosolids, LLC	7
Client:	QSS Biosolids	Plymouth, MN 55441-4532	Pyrolysis Facility	
Date:	4/22/2025		North Kingstown, RI	

Ammonia: 24-Hour



Project No. MP247328 Scale: AS SHOWN Client: QSS Biosolids Date: 4/22/2025	Terracon 13400 15th Ave N Plymouth, MN 55441-4532	24-Hour – Ammonia QSS Biosolids, LLC Pyrolysis Facility North Kingstown, RI	Exhibit 8

Ammonia: Annual



Project No.	MP247328
Scale:	AS SHOWN
Client:	QSS Biosolids
Date:	4/22/2025

Terracon
13400 15th Ave N
Plymouth, MN 55441-4532

Annual– Ammonia

QSS Biosolids, LLC
Pyrolysis Facility
North Kingstown, RI

Exhibit
9

APPENDIX F

xxxx xx, 2025

Mr. Mark De Pasquale
Managing Member
QSS Biosolids, LLC
2000 Chapel View Blvd, Suite 500
Cranston, RI 02920

Dear Mr. De Pasquale:

The Department of Environmental Management, Office of Air Resources has reviewed and approved your application for a new facility which will convert dewatered sewage sludge material through pyrolysis to high-carbon-content biochar.

Enclosed is a minor source permit issued pursuant to our review of your application (Approval Nos. XXXX-XXXX).

Any source with the potential to emit greater than major source thresholds as defined under Operating Permits, 250-RICR-120-05-29, is subject to the Operating Permit Program. With the issuance of this permit your facility located at 135 All American Way, North Kingstown is subject to the Operating Permit Program as an Emissions Cap Source, with allowable emissions restricted to below the major source thresholds. An emissions cap means any emission limitation or physical or operational limitation, imposed in a federally enforceable document that establishes the maximum quantity of emissions which may be released from a stationary source. The Office of Air Resources considers this minor source permit an emissions cap. Operating Permit Fees, 250-RICR-120-05-28, requires stationary sources with an emissions cap to pay an annual compliance/assurance fee of $350.00. Notification concerning the payment of this fee will be mailed to you this upcoming fall.

If there are any questions concerning this permit, please contact me by telephone at xxx-xxx-xxxx or by email at xxxxxx@dem.ri.gov.

Sincerely,

cc: Quonset Development Corporation
ec: Rick Mandile – Sage Environmental, Inc.
Lacy Reyna – Sage Environmental, Inc.
Travis Knisely – Terracon Consultants, Inc.

STATE OF RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

MINOR SOURCE PERMIT

QSS Biosolids, LLC

APPROVAL NOs. XXXX-XXXX

Pursuant to the provisions of Air Pollution Control Permits, 250-RICR-120-05-9, this minor source permit is issued to:

QSS Biosolids, LLC

For the following:

Installation of two (2) reception buildings and associated conveyance equipment (Approval Nos. XXXX-XXXX). Installation of four (4) wet feedstock storage silos and associated conveyance equipment (Approval Nos. XXXX-XXXX). Installation of two (2) sewage sludge dryers (Approval Nos. XXXX-XXXX). Installation of two (2) dried feedstock storage silos (Approval Nos. XXXX-XXXX). Installation of and two (2) dried sewage sludge pelletizer units (Approval Nos. XXXX-XXXX). Installation of one (1) odor control system consisting of one (1) biotrickling filter, one (1) two-stage scrubber system, and one (1) carbon adsorber. Installation of two (2) electric pyrolysis units for biochar production (Approval Nos. XXXX-XXXX). Installation of two (2) thermal oxidizers, each equipped with a 38.6 MMBtu/hr natural gas-fired start-up burner/42.2 MMBtu/hr pyrolysis gas burner (Approval Nos. XXXX-XXXX). Installation two (2) catalytic filters to treat pyrolysis emissions (Approval Nos. XXXX-XXXX).

Located at: *135 All American Way, Plat 180, Lots 19, 20, 21, and 22*

Quonset Development Park, North Kingstown, RI 02852

This permit shall be effective from the date of its issuance and shall remain in effect until revoked by or surrendered to the Department. This permit does not relieve *QSS Biosolids, LLC* **from compliance with applicable state and federal air pollution control rules and regulations. The design, construction and operation of this equipment shall be subject to the attached permit conditions and emission limitations.**

Laurie Grandchamp, P.E., Administrator
Office of Air Resources

Date of Issuance

STATE OF RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

Permit Conditions and Emissions Limitations

QSS Biosolids, LLC

APPROVAL NOs. XXXX-XXXX

I. The following requirements are applicable to:

- Two (2) reception buildings and associated conveyance equipment (RB-01, RB-02), four (4) wet feedstock storage silos and associated conveyance equipment (WSS-01, WSS-02, WSS-03, WSS-04), two (2) disc dryer units and associated conveyance equipment (DD-01, DD-02), two (2) dried feedstock storage silos and associate conveyance equipment (DSS-01, DSS-02), and two (2) pelletizing units and associated conveyance equipment (PE-01, PE-02), all equipped with a biotrickling filter (BTF-01), a two-stage wet scrubber (WS-01, WS-02), and a carbon adsorber (CA-01).

A. Emission Limitations

1. RB-01, RB-02, WSS-01, WSS-02, WSS-03, WSS-04, DD-01, DD-02, DSS-01, DSS-02, PE-01, PE-02, BTF-01, WS-01, WS-02, CA-01

a. Volatile Organic Compounds (VOC)

(1) The VOC control efficiency of the odor control plant shall be at least 75%.

b. Particulate Matter

(1) Particulate matter generated from each of the reception, wet storage, drying, dry storage, and pelletizing equipment shall be captured, contained, and routed to the odor control system. Particulate matter from these operations shall not exceed 20 mg/m^3 (0.01 gr/dscf) before being discharged to the atmosphere.

c. Hazardous Air Pollutants (HAP)

(1) The HAP control efficiency of the odor control plant shall be at least 75%;

d. Listed Toxic Air Contaminants

The emissions of the following listed toxic air contaminants discharged to the atmosphere from the two (2) reception buildings, four (4) wet feedstock storage silos, two (2) disc dryers, two (2) dried feedstock storage silos, and two (2) pelletizer units, treated by the odor control system consisting of one (1) biotrickling filter, one (1) two-stage wet scrubber, and one (1) carbon adsorber shall not exceed the levels specified in the following table:

Pollutant	**Allowable Emissions**		
	lbs/hour	**lbs/day**	**lbs/year**
Ammonia	2.831	67.943	24,799.337
Hydrogen Sulfide	0.00604	0.145	52.921

(1) The H_2S control efficiency of the odor control plant shall be at least 99.5%.

(2) The ammonia control efficiency of the odor control plant shall be at least 99%.

e. Opacity

Visible emissions from the odor control system exhaust shall not exceed 20% opacity (three-minute average).

f. Odors

Any air contaminant or combination of air contaminants discharged to the atmosphere from the facility shall not create an objectionable odor beyond the property line of this facility.

B. Operating Requirements

1. The maximum throughput of each reception building shall not exceed 10,800 kilograms (kg) per hour (kg/hr) of sewage sludge material at 75% moisture content (MC) on a weekly average. The reception process is surge and transfer with peak surge designed for 32,000 kg/hr at 75% MC. The total plant throughput shall not exceed 21,600 kg/hr at 75% MC.

2. The maximum throughput of each wet feedstock storage silo shall not exceed 5,400 kg/hr of sewage sludge material at 75% MC on a weekly average. Reception of feedstock into the silos is based on peak surge capacity as stated above. The total throughput of the wet feedstock storage silos shall not exceed 21,600 kg/hr at 75% MC.

3. The maximum throughput of each dryer shall not exceed 10,800 kg /hr at 75% MC. The total plant throughput shall not exceed 21,600 kg/hr at 75% MC.

4. The dryers shall be equipped with a closed-loop thermal oil system that is externally heated *via* heat exchangers associated with the combustion downstream of the thermal oxidizer units that treat the pyrolysis gas. No combustion gas shall be

utilized to dry the sewage sludge feedstock material in either disc dryer unit.

5. The dryer shall be equipped with an integral cyclone and three-stage scrubber unit for exhaust conditioning to meet the requirements of the odor control system. This equipment shall not be bypassed to prevent failure of the odor control system.

6. In the event that a dryer is not operational, materials received must be adjusted so as not to exceed plant storage capacity.

7. The maximum throughput of each dried feedstock storage silo shall not exceed 3,000 kg/hr (10% MC). The total plant throughput shall not exceed 6,000 kg/hr (10% MC).

8. The dried feedstock storage silos shall be equipped with a top-mounted filter for exhaust conditioning to meet the requirements of the odor control system. This filter shall not be bypassed to prevent failure of the odor control system.

9. The maximum throughput of each pelletizer unit shall not exceed 3,000 kg/hr (10% MC). The total plant throughput shall not exceed 6,000 kg/hr (10% MC).

10. The pelletizer units shall be equipped with an in-line filter for exhaust conditioning to meet the requirements of the odor control system. This filter shall not be bypassed to prevent failure of the odor control system.

11. The pelletizer units may be bypassed in the event of a maintenance activity. In such an event, maintenance of downstream equipment shall be adjusted accordingly to prevent equipment malfunctions.

12. Emissions from the reception buildings and associated conveyance equipment, wet feedstock storage silos and associated conveyance equipment, disc dryers and associated conveyance equipment, dried feedstock storage silos and associated conveyance equipment, and pelletizer units and associated conveyance equipment shall be captured, contained, and routed to the odor control plant consisting of a biotrickling filter, two-stage scrubber, and carbon adsorber prior to discharge to the atmosphere.

13. There shall be no bypassing of the entire odor control plant (air pollution control system) for the reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, or pelletizer units during start-up, operation, or shutdown. However, individual components of the odor control plant can be bypassed for maintenance purposes, so long as bypassing the biotrickling filter and two-stage wet scrubber but not the carbon adsorber OR bypassing the carbon adsorber but not the biotrickling filter and two-stage wet scrubber does not exceed the permitted emission rates. If individual components of the odor control system are bypassed, the duration of the bypass must be documented, and the total bypass time must not exceed (24) hours per rolling (12) months.

14. The owner/operator shall maintain and operate the components of the odor control plant according to the manufacturer's design specifications and operating

procedures.

15. The owner/operator shall develop, maintain, and follow a preventative maintenance procedure (e.g., periodic inspections and filter changes) for each reception building, wet feedstock storage silos, dryers, dried feedstock storage silos, and pelletizer units and air pollution control systems (i.e., biotrickling filter, two-stage wet scrubber, and carbon adsorber) in accordance with manufacturer's instructions to ensure that the odor control plant efficiency does not degrade.

16. The activated carbon or the entire carbon adsorber unit shall be replaced at a minimum every third year. The owner/operator shall maintain an active contract or account with a vendor, to supply or replace the activated carbon or the complete activated carbon vessel at all times.

C. Monitoring Requirements

1. The owner/operator shall monitor and record the amount of sewage sludge entering the dryers on a monthly basis such that the emissions can be determined based on the amount of sewage sludge.

2. The following parameters for the odor control plant shall be monitored continuously and checked a minimum of once per day and the date, time, and measurement shall be recorded:
   a. The pressure drop across the biotrickling filter;
   b. The liquid flow rate in the biotrickling filter;
   c. The pH of the scrubbing liquid in the first stage of the two-stage wet scrubber;
   d. The pressure drop across the first stage of the two-stage wet scrubber;
   e. The scrubbing liquid flow rate in the first stage of the two-stage wet scrubber;
   f. The pH of the scrubbing liquid in the second stage of the two-stage wet scrubber; and
   g. The pressure drop across the second stage of the two-stage wet scrubber;
   h. The scrubbing liquid flow rate in the second stage of the two-stage wet scrubber.

3. The owner/operator shall, on a monthly basis, conduct visual inspections of the reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, pelletizer units, associated sewage sludge conveyance equipment, biotrickling filter, two-stage wet scrubber, and carbon adsorber to evaluate these systems for leaks. If leaks or abnormal conditions are detected, action to correct the abnormal condition shall be implemented before any systems are put back into service.

4. All monitoring equipment used for measuring all parameters required by this permit shall be calibrated periodically in accordance with the manufacturer's recommendations.

D. Recordkeeping and Reporting

1. The owner/operator shall collect, record, and maintain the following records on a monthly basis, no later than 15 days after the first of each month, for the month prior

and provide such records to the Office of Air Resources upon request:

a. The total amount of sewage sludge delivered to the Facility.

b. The gross throughput of each dryer.

c. The hours of operation for each dryer unit for the previous month and the total hours of operation for the prior consecutive 12-month period.

d. The hours of operation for each pelletizer unit for the previous month and the total hours of operation for the prior consecutive 12-month period.

e. The pressure drops across the biotrickling filter and each stage of the wet scrubber on a daily basis.

f. The pH of the scrubbing liquid in each stage of the wet scrubber on a daily basis.

g. The liquid flow rate in the biotrickling filter and each stage of the wet scrubber on a daily weekly basis.

h. Inspection logs of inspections of the reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, pelletizer units, associated sewage sludge conveyance equipment, biotrickling filter, two-stage wet scrubber, carbon adsorber.

i. Records of all maintenance performed on or after the inspections of the reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, pelletizer units, associated sewage sludge conveyance equipment, biotrickling filter, two-stage wet scrubber, carbon adsorber and monitoring equipment.

2. The owner/operator shall notify the Office of Air Resources, in writing, within 15 days of determining that the combined maximum throughput for any consecutive 12-month period exceeds 189,216 metric tons (75% MC) or 52,560 metric tons (10% MC) for the entire facility.

3. The owner/operator shall notify the Office of Air Resources, in writing, within 15 days of identifying a leak or abnormal condition within the odor control plant. The date, time, and corrective and potential preventative actions taken shall be provided.

4. The owner/operator shall, on a daily basis, measure and record pressure upstream of the odor control plant. The upstream pressure shall be controlled by the downstream fan. The speed of the fan and upstream pressure shall be monitored and recorded in the supervisory control and data acquisition (SCADA) system. Operation of the scrubber liquid recirculation pumps is required for the odor control plant to be in operation. Circulation pump operation shall be monitored and recorded in the SCADA system. The owner/operator shall keep records of this information and provide such records to

the Office of Air Resources or its authorized representative and USEPA upon request.

II. The following requirements are applicable to:

- Pyrolysis unit (PY-01), which is equipped with a 38.6 MMBtu/hr natural gas(start-up)/ 42.2 MMBtu/hr pyrolysis gas thermal oxidizer (TO-01), followed by a catalytic filter unit (CF-01).

- Pyrolysis unit (PY-02), which is equipped with a 38.6 MMBtu/hr natural gas(start-up)/42.2 MMBtu/hr pyrolysis gas thermal oxidizer (TO-02), followed by a catalytic filter unit (CF-02).

A. Emission Limitations

1. PY-01, TO-01, CF-01, PY-02, TO-02, CF-02

a. Nitrogen Oxides (as Nitrogen Dioxide (NO_2))

(1) The overall NO_x control efficiency of the catalytic filter and flue gas recirculation shall be at least 80%.

(2) The emission rate of nitrogen oxides discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers, and two catalytic filters in parallel shall not exceed 2.87 pounds per hour.

(3) The emission rate of nitrogen oxides discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters shall not exceed 25,072 pounds per 12-month rolling average.

b. Carbon Monoxide (CO)

(1) The thermal oxidizer shall reduce the concentration of CO in the exhaust gas to less than 50 ppmv.

(2) The emission rate of carbon monoxide discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 2.97 pounds per hour.

(3) The emission rate of carbon monoxide discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 26,000 pounds per 12-month rolling average.

c. Volatile Organic Compounds (VOC)

(1) The overall VOC control efficiency of each thermal oxidizer shall be

at least 99.99%.

(2) The emission rate of volatile organic compounds discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 0.476 pounds per hour.

(3) The emission rate of volatile organic compounds discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 4,163 pounds per 12-month rolling average.

d. Sulfur Dioxide (SO_2)

(1) The overall SO_2 control efficiency of the dry sorbent injection and catalytic filter shall be at least 85%.

(2) The emission rate of sulfur dioxide discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 8.46 pounds per hour.

(3) The emission rate of sulfur dioxide discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 74,057 pounds per 12-month rolling average.

e. Particulate Matter (as PM)

(1) The catalytic filter shall reduce the concentration of PM in the exhaust gas to less than 0.005 gr/dscf.

(2) The emission rate of particulate matter discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 1.2 pounds per hour.

(3) The emission rate of particulate matter discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 10,513 pounds per 12-month rolling average.

f. Hazardous Air Pollutants (HAP)

(1) The emission rate of hazardous air pollutants discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 0.71 pounds per hour.

(2) The emission rate of hazardous air pollutants discharged to the

atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 6,204 pounds per 12-month rolling average.

(3) Listed Toxic Air Contaminants

The emissions of the following listed toxic air contaminants discharged to the atmosphere from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed the levels specified in the following table:

Pollutant	**Allowable Emissions**		
	lbs/hour	**lbs/day**	**lbs/year**
Acetamide	---	---	201.990
Ammonia	0.622	14.9	5,448.67
Aniline	---	0.063	23.004
Antimony & compounds, including antimony trioxide	---	0.0303	---
Arsenic & compounds (inorganic)	1.18E-04	---	1.033
Benzene	2.36E-03	0.0567	20.689
Boron & borates	4.85E-04	---	---
Cadmium & compounds	---	3.83E-03	1.397
Cobalt & compounds	---	---	0.427
Copper & compounds, except copper cyanide	6.48E-03	---	56.763
Fluorides & compounds	0.274	6.57	---
Formaldehyde	5.47E-03	0.131	47.906
Hydrochloric acid (hydrogen chloride)	0.196	---	1,717.135
Hydrogen cyanide	0.0229	---	200.558
Hydrogen sulfide	5.09E-03	0.122	44.631
Lead & compounds (inorganic)	---	---	10.412
Manganese & compounds	---	0.151	55.191
Mercury & compounds (elemental & inorganic)	9.52E-03	0.229	83.421
Naphthalene	---	0.0462	16.868
Nickel & compounds, except nickel subsulfide	2.27E-04	5.45E-03	1.990
Polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs)*	---	---	3.80E-04
Quinoline	---	---	2.038
Vanadium & compounds	2.94E-04	---	---
Notes: *In terms of 2,3,7,8-tetrachlorobenzodioxin equivalents. --- = No Acceptable Ambient Air Level has been established.			

g. Opacity

Visible emissions from the two pyrolysis units treated by the two thermal oxidizers and two catalytic filters in parallel shall not exceed 20% opacity (three-minute average).

B. Operating Requirements

1. The pyrolysis units shall be operated and maintained according to the manufacturer specifications.

2. Airlock systems on the pyrolysis infeed system and after the biochar cooling screw shall always be operational when pyrolysis reactors are receiving sewage sludge feedstock materials.

3. All pyrolysis gas will be captured, contained, and routed to the thermal oxidizers.

4. Pyrolysis gas and natural gas shall be the only fuels fired in the thermal oxidizers.

5. The thermal oxidizers shall be operated and maintained according to the manufacturer's design specifications whenever pyrolysis gas is being routed to the thermal oxidizers.

6. The minimum operating temperature of each thermal oxidizer shall be 1,832° F when receiving pyrolysis gas from the pyrolysis process, or at a lower temperature that has been demonstrated in the most recent compliance test to achieve the required 99.99% control efficiency.

7. The minimum residence time of pyrolysis gas in the 3-stage thermal oxidizer is 2.0 seconds. Each pyrolysis line provides gas to a dedicated thermal oxidizer. Each thermal oxidizer has 3 stages: 1) reducing zone, 2) conditioning zone, 3) oxidizing zone.

8. Each thermal oxidizer shall be operated at all times when pyrolysis gas is being sent to it.

9. Temperature sensors shall be utilized to monitor the temperature within the thermal oxidizers.

10. The owner/operator shall maintain and operate the dry sorbent injection, ammonia injection, and catalytic filter system according to the manufacturer's design specifications and operating procedures whenever the pyrolysis process is operating.

11. The dry sorbent injection, ammonia injection, and catalytic filter systems shall be operated at all times that pyrolysis systems (including the thermal oxidizers) are operating.

12. The dry sorbent material shall be injected into the upstream piping of the catalytic filter system to control SO_2 emissions by 85% and HF and HCl emissions by 95%.

13. The ammonia injection and catalytic filter shall be operated to maintain 80% reduction of NOx.

14. The pressure drop across the catalytic filter shall not exceed the manufacturer specifications. The specific operating pressure range is to be established during the detailed design phase.

15. There shall be no bypassing of any of the air pollution control systems for each pyrolysis unit during start-up, operation, or shutdown as part of normal facility operations.

16. Each thermal oxidizer shall be equipped with a failure monitoring system and safety programable logic controller (PLC). During normal shutdown, the unit shall be designed to ensure combustion of the pyrolysis gas is treated by the air pollution control equipment completely, before being discharged to the atmosphere. During normal shutdown there shall be no bypassing of the thermal oxidizer, dry sorbent injection, ammonia injection, and catalytic filter system.

17. In the event that a thermal oxidizer requires an emergency shutdown, which would require the stopping of the air fans, the pyrolysis gas remaining in the pyrolysis reactors shall be pushed through the thermal oxidizers *via* the pyrolysis gas fans. In this scenario involving, at minimum, a double point of failure, each thermal oxidizer is specifically designed to operate as an emergency flare. Residual heat within the thermal oxidizer during such failure ensures continued treatment of the pyrolysis gas stream during the maximum twenty-minute interval of emergency shutdown. The owner/operator shall notify the Office of Air Resources within 24 hours of becoming aware of this occurrence. During emergency shutdown, generation of pyrolysis gas rapidly decreases, and the reactor is purged of feedstock through the sealed biochar cooling and conveyance systems, both of which are designed for this surge flow.

18. Each thermal oxidizer shall be equipped with an interlock system that ensures safe conditions before pyrolysis gas is discharged to the device.

19. Each thermal oxidizer shall be pre-heated prior to pyrolysis gas being sent to it.

20. The owner/operator shall ensure that the installation, operation, and maintenance of the ductwork, pipes, connections, conduits, vessels, etc., that are used to convey emissions are properly designed, constructed, and maintained to prevent leaks.

C. Monitoring Requirements

1. The owner/operator shall install and operate a thermocouple to continuously measure the temperature in each chamber of each of the two thermal oxidizers. The temperature should be recorded a minimum of once per day.

2. Natural gas fuel mass flow to each thermal oxidizer shall be continuously measured and recorded separately.

3. Pyrolysis gas mass flow quantity shall be calculated based on feedstock flow rate and biochar yield.

4. Each thermal oxidizer shall be equipped with a flue gas oxygen concentration controller.

5. The owner/operator shall install and operate a thermocouple to continuously measure inlet temperature to the injection/catalytic filter system.

6. The owner/operator shall install equipment to monitor the flow of dry sorbent to continuously monitor overall dry sorbent consumption.

7. The owner/operator shall install equipment to monitor the flow of ammonia to continuously monitor overall ammonia consumption.

8. The owner/operator shall install and operate a differential pressure transmitter to continuously monitor pressure drop across the catalytic filter.

9. The owner/operator shall install and operate an alarm system on each dry sorbent injector and ammonia injector unit in such a manner that an operator will be alerted if the dry sorbent or ammonia flow is outside the manufacturer's design range.

10. The equipment to continuously monitor the temperature in each chamber of the thermal oxidizer, the inlet temperature to the injection/catalytic system, the overall dry sorbent consumption, the overall ammonia consumption, and the pressure drop across the catalytic filter system shall be calibrated and maintained according to the manufacturer's specifications.

D. Recordkeeping and Reporting

1. The owner/operator shall collect, record, and maintain the following records on a monthly basis, no later than 15 days after the first of each month, and provide such records to the Office of Air Resources upon request:

   a. The hours of operation for each pyrolysis unit for the previous month and the total hours of operation for the prior consecutive 12-month period.

   b. The operating temperature of each thermal oxidizer's combustion chamber.

   c. Natural gas usage in each thermal oxidizer unit during the month.

   d. The calculated pyrolysis gas flowrate and total pyrolysis gas combusted in each thermal oxidizer during the month.

   e. Pressure drop across the catalytic filter unit.

   f. A maintenance log for the capture systems, control devices, and monitoring equipment detailing all routine and non-routine maintenance performed including dates and duration of any outages.

g. An operating log for each pyrolysis unit, including the date(s) and time(s) each pyrolysis unit is in operation.

h. The total dried sewage sludge feedstock processed by each pyrolysis reactor.

i. The flow rate on the dry sorbent supply line.

j. The flow rate on the ammonia supply line.

2. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the dry sorbent or ammonia solution injection rate was outside of the range recommended by the manufacturer. The date, time, duration of exceedance, and the measured injection rate shall be provided.

3. The owner/operator shall notify the Office of Air Resources, in writing, within 15 days of determining the total quantity of sewage sludge processed through the pyrolysis lines exceeds 57,937.5 (at 10% MC) US short tons on a rolling 12-month basis.

4. The owner/operator shall notify the Office of Air Resources in writing within 15 days of the date that the tubes within the catalyst filter are replaced.

III. The following requirements are applicable to operations on a facility-wide basis:

A. Emission Limitations

1. Criteria Pollutants

The total quantity of VOC and Nitrogen Oxides (NO_x) emissions discharged to the atmosphere from all operations conducted at the entire facility shall not exceed 8,167 pounds per pollutant per calendar month based upon a 12-month rolling average.

The total quantity of Carbon Monoxide (CO), Sulfur Dioxide (SO_2), and Particulate Matter (PM) emissions, discharged to the atmosphere from all operations conducted at the entire facility shall not exceed 16,500 pounds per pollutant per calendar month based upon a 12-month rolling average.

2. Hazardous Air Pollutants (HAPs)

The total quantity of HAP emissions discharged to the atmosphere from the entire facility shall not exceed 1,500 pounds of any one (1) HAP or 4,000 pounds of any combination of HAPs per calendar month based upon a 12-month rolling average. HAP shall mean an air pollutant which has been listed pursuant to Section 112(b) of the Clean Air Act Amendments of 1990.

3. Listed Toxic Air Contaminants

a. The total quantity of emissions discharged to the atmosphere from the entire facility, of any listed toxic air contaminant, with the exception of: acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic); benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; and vanadium and compounds shall not exceed the minimum quantity for that contaminant as specified in 250-RICR-120-05-9.17, Appendix A, based upon a 12-month rolling total. Emissions from activities exempted from the provisions of "Air Toxics" 250-RICR-120-05-22.5(B) are not included in this limitation.

4. Odors

Any air contaminant or combination of air contaminants discharged to the atmosphere from the facility shall not create an objectionable odor beyond the property line of this facility. Odor evaluations shall be conducted according to the provisions of Air Pollution Control Regulation, "Odors" 250-RICR-120-05-17.

B. Operating Requirements

a. The owner/operator shall only be allowed to process municipal sewage sludge through any of the pyrolysis line(s). For purposes of this permit, municipal sewage sludge shall be defined as sewage sludge that is obtained from a municipal wastewater treatment facility and was not obtained from an industrial wastewater pre-treatment system.

C. Compliance Demonstration/Stack Testing

1. Compliance with the emission limitations specified in Conditions I.A.1.d, II.A.1.c(1) and II.A.1.f(3) shall be demonstrated within 180 days of startup of each pyrolysis unit and dryer.

   Thereafter, performance testing shall be conducted every 10 years to demonstrate compliance with the control efficiency limitation specified in Condition II.A.1.c(1) of this permit.

2. A stack testing protocol shall be submitted to the Office of Air Resources at least 60 days prior to the performance of any stack tests. The owner/operator shall provide the Office of Air Resources at least 60 days prior notice of any performance test.

3. All test procedures used for stack testing shall be approved by the Office of Air Resources prior to the performance of any stack tests.

4. The owner/operator shall install any and all test ports or platforms necessary to conduct the required stack testing, provide safe access to any platforms and provide the necessary utilities for sampling and testing equipment.

5. All testing shall be conducted under operating conditions deemed acceptable and representative for the purpose of assessing compliance with the applicable emissions limitation.

6. All stack testing must be observed by a representative of the Office of Air Resources or its authorized representatives to be considered acceptable unless the Office of Air Resources provides prior written authorization to the owner/operator to conduct the testing without an observer present.

7. A final report of the results of stack testing shall be submitted to the Office of Air Resources no later than 60 days following completion of testing.

D. Recordkeeping and Reporting

1. The owner/operator shall, on a monthly basis, no later than the last day of the following month, determine the total quantity of VOC discharged to the atmosphere from all operations at the entire facility. Monthly and 12-month rolling averages shall be calculated. The owner/operator shall keep records of this determination and provide such records to the Office of Air Resources upon request.

2. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the total quantity of VOCs and NO_x discharged to the atmosphere from all operations at this facility exceeds 8,167 pounds per calendar month (12-month rolling average).

3. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the total quantity of CO, PM, and SO_2 discharged to the atmosphere from all operations at this facility exceeds 16,500 pounds per calendar month (12-month rolling average).

4. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the total quantity of individual HAPs discharged to the atmosphere from all operations at this facility exceeds 1,500 pounds or 4,000 pounds of any combination of HAPs per calendar month (12-month rolling average).

5. The owner/operator shall, on a monthly basis, no later than the last day of the following month, determine the total quantity of HAP emissions discharged to the atmosphere from all operations at the entire facility. Monthly and 12-month rolling averages shall be calculated. The owner/operator shall keep records of this determination and provide such records to the Office of Air Resources upon request.

5. The owner/operator shall, on a monthly basis, no later than 15 days after the first of the month, determine the total quantity of acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic);

benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; and vanadium and compounds discharged to the atmosphere from the facility during the previous month. Hourly emission averages shall be calculated for the aforementioned air toxics. These hourly averages shall be used for comparison to the hourly emission limitations specified in II.A.f.(3) of this permit. Daily emission totals shall be calculated for the aforementioned air toxics to be used for comparison to the daily emission limitations specified in II.A.f.(3) of this permit. Monthly and annual emission averages shall be calculated for the aforementioned air toxics to be used for comparison to the annual emission limitations specified in II.A.f.(3) of this permit. The owner/operator shall keep records of this determination and provide such records to the Office of Air Resources upon request.

6. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the total quantity of acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic); benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; or vanadium and compounds discharged to the atmosphere from the facility exceeds the respective hourly, daily or annual emission limitations specified in Condition II.A.f.(3) of this permit.

7. The owner/operator shall, on a monthly basis, no later than 15 days after the first of the month, determine the total quantity of each listed toxic air contaminant in 250-RICR-120-05-9.17, Appendix A discharged to the atmosphere from all operations at the entire facility excluding acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic); benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; and vanadium and compounds. The owner/operator shall keep records of this determination and provide such records to the Office of Air Resources upon request.

8. The owner/operator shall notify the Office of Air Resources in writing, within 15 days of determining that the total quantity of emissions discharged to the atmosphere from the entire facility, of any listed toxic air contaminant excluding acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic); benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; and vanadium and compounds, exceeds the minimum quantity for that contaminant as specified in 250-RICR-120-05-9.17, Appendix A. In accordance with "Air Toxics," 250-RICR-120-05-22, this notification shall be included in the annual air pollution inventory.

9. The owner/operator shall notify the Office of Air Resources in writing of the date of actual initial start-up of each device permitted under this permit no later than fifteen days after such date.

10. Any breakdown or malfunction of any air pollution control system resulting in the discharge of uncontrolled emission of pyrolysis gas, or emissions from reception buildings, wet feedstock storage silos, dryers, dried feedstock storage silos, and pelletizer units shall be reported to the Office of Air Resources within one hour after the occurrence. A written report of any breakdown or malfunction shall be submitted within five (5) days of the breakdown or malfunction. The following information shall be provided in each report:

    a. The date the breakdown or malfunction occurred

    b. The suspected reason for the malfunction

    c. The corrective action taken

    d. The time needed to make repairs

    e. Preventative measures taken or planned, if needed

    A copy of each report shall be kept at the facility.

11. The owner/operator shall notify the Office of Air Resources of any anticipated noncompliance with the terms of this permit or any other applicable air pollution control rules and regulations.

12. The owner/operator shall notify the Office of Air Resources in writing of any planned physical or operational change to any equipment that would:

a. Change the representation of the facility in the application.

b. Alter the applicability of any state or federal air pollution rules or regulations.

c. Result in the violation of any terms or conditions of this permit.

d. Qualify as a modification under 250-RICR-120-05-9.

Such notification shall include:

- Information describing the nature of the change.
- Information describing the effect of the change on the emission of any air contaminant.
- The scheduled completion date of the planned change.

Any such change shall be consistent with the appropriate regulation and have the prior approval of the Director.

13. The owner/operator shall notify the Office of Air Resources, in writing, of any noncompliance with the terms of this permit within 30 calendar days of becoming aware of such occurrence and supply the Director with the following information:

a. The name and location of the facility.

b. The subject source(s) that caused the noncompliance with the permit term.

c. The time and date of first observation of the incident of noncompliance.

d. The cause and expected duration of the incident of noncompliance.

e. The estimated rate of emissions (expressed in lbs/hr or lbs/day) during the incident and the operating data and calculations used in estimating the emission rate.

f. The proposed corrective and preventative actions and schedule to correct the conditions causing the incidence of noncompliance.

14. The owner/operator shall maintain properly signed, contemporaneous operating logs or other relevant evidence to document actions during startup/shutdown periods.

15. All records required in this permit shall be maintained for a minimum of five years after the date of each record and shall be made available to representatives of the Office of Air Resources or its authorized representative and the USEPA upon request.

E. Other Permit Conditions

1. To the extent consistent with the requirements of this permit and applicable federal and state laws, the equipment shall be designed, constructed, and operated in accordance with the representation of the equipment in the permit application.

2. Employees of the Office of Air Resources and its authorized representatives shall be allowed to enter the facility at all times for the purpose of inspecting any air pollution source, investigating any condition it believes may be causing air pollution or examining any records required to be maintained by the Office of Air Resources.

3. At all times, including periods of startup, shutdown and malfunction, the owner/operator shall, to the extent practicable, maintain and operate the facility in a manner consistent with good air pollution control practice for minimizing emissions. The general duty to minimize emissions does not require you to make any further efforts to reduce emissions if levels required by this permit have been achieved. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Office of Air Resources which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures and inspection of the source.

4. The emission and dispersion characteristics of all sources of acetamide; ammonia; aniline; antimony & compounds, including antimony trioxide; arsenic & compounds (inorganic); benzene; boron & borates; cadmium & compounds; cobalt & compounds; copper & compounds, except copper cyanide; fluorides & compounds, including hydrogen fluoride; formaldehyde; hydrochloric acid (hydrogen chloride); hydrogen cyanide; hydrogen sulfide; lead & compounds, inorganic; manganese & compounds; mercury & compounds (elemental & inorganic); naphthalene; nickel & compounds, except nickel subsulfide; polychlorinated dibenzo dioxins (PCDDs), polychlorinated dibenzo furans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs); Quinoline; and vanadium and compounds at the facility shall be consistent with the parameters used in the air quality modeling to demonstrate that the emissions of the aforementioned air toxics do not cause an impact, at or beyond the property line of the facility, which exceeds the Acceptable Ambient Level for the aforementioned air toxics. The Office of Air Resources, in its sole discretion, may reopen this minor source permit if it determines that the emission and dispersion characteristics have changed significantly and that emission limitations must be revised and/or added to this permit to ensure compliance with 250-RICR-120-05-22.

5. The Office of Air Resources may reopen and revise this permit if it determines that:

   a. a material mistake was made in establishing the operating restrictions; or,

   b. inaccurate emission factors were used in establishing the operating restrictions; or,

c. emission factors have changed as a result of stack testing or emissions monitoring; or,

d. revisions that are necessary due to additional applicable requirements pursuant to state or federal law or from any regulatory agency.

F. Malfunctions

1. A malfunction of any air pollution control system that would result in the exceedance of any emission limitation applicable to this facility will necessitate the shutdown of the process discharging to the associated air pollution control equipment. The process must remain shut down until the malfunction has been identified and corrected.

APPENDIX G

Reception Buildings

Note: The information provided in this form is per reception building & associated conveyance equipment. Please note that there are two reception buildings operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Reception Buildings
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:

1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).

1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the sewage sludge reception process.
2. TYPE OF EQUIPMENT USED IN PROCESS 2 wet sludge reception buildings and associated reception bins, truck cleaning zones, and sewage sludge conveyance systems.
3. EXHAUST GAS FLOW RATE: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
   Total odor control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 12 HRS/DAY 5 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

RAW MATERIALS AND FUELS:

1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

Note: Feedstock off-loading will occur 12hr/day, 5days/week. Ventilation to the odor control system is continuous and will occur 24/7 Annual amounts are based on total plant throughput for one line; however, feedstock reception will occur during a limited time. Emission and plant throughput calculations are based on 8,760 hours of operation per year.

MATERIAL	BATCH/CONT.	ANN. AMT
Sewage Sludge (75% M.C.)	continuous	104,287.35 US Ton/yr

Note: 208,574.7 US Ton per year plant-wide

END PRODUCTS: Sewage sludge feedstock for drying process.

Section E	EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Note: Provided emissions are based on the combined airflow to the odor control plant from the reception buildings, wet feedstock silos, dryers, dried feedstock silos, pelletizers, and associated conveyance equipment.

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 28 INCHES OR _____ INCHES X _____ INCHES
2. STACK HEIGHT ABOVE GROUND 54 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 14054 ACFM @ 75 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature] Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____

   B. NUMBER OF ZONES _______

   C. TEMPERATURE IN EACH ZONE ___________________________

   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____ ^{o}F

   ________ MAXIMUM ACFM @ _____ ^{o}F

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐ CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR

   ☐ BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION

   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK

   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK

   D. VOLUME % OF SOLIDS IN COATING OR INK

   E. APPROXIMATE ANNUAL CONSUMPTION

   F. APPLICATION RATE OF COATING

   G. SUPPLIER'S NAME AND ADDRESS

   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the sewage sludge reception process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting,

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

check no. 9127
received 04/30/2025

Wet Feedstock Storage Silos

Note: The information provided in this form is per wet feedstock silo and associated conveyance equipment. Please note that there are four wet feedstock silos operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Storage Silos
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:
1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).
1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the wet feedstock storage process.
2. TYPE OF EQUIPMENT USED IN PROCESS Four 800 m^3 wet feedstock storage silos and associated enclosed sewage sludge conveyance systems.
3. EXHAUST GAS FLOW RATE: NORMAL 14054 ACFM @ 75 °F
MAXIMUM 14054 ACFM @ 75 °F
Total odor control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

RAW MATERIALS AND FUELS:
1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

MATERIAL	BATCH/CONT.	ANN. AMT
Sewage Sludge (75% M.C.)	continuous	~52,143.68 US Ton/yr

Note: ~208,574.7 US Ton per year plant-wide

Note: Feedstock off-loading will occur 12hr/day, 5days/week. Wet feedstock storage and ventilation to the odor control system is continuous and will occur 24/7 Annual amounts are based on total plant throughput for one line; however, feedstock reception will occur during a limited time. Emission and plant throughput calculations are based on 8,760 hours of operation per year.

END PRODUCTS: Sewage sludge feedstock for drying process.

Section E	EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Note: Provided emissions are based on the combined airflow to the odor control plant from the reception buildings, wet feedstock silos, dryers, dried feedstock silos, pelletizers, and associated conveyance equipment.

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 28 INCHES OR ____ INCHES X ____ INCHES
2. STACK HEIGHT ABOVE GROUND 54 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 14054 ACFM @ 75 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____
   B. NUMBER OF ZONES _______
   C. TEMPERATURE IN EACH ZONE ___________________________
   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____ ^{o}F
   ________ MAXIMUM ACFM @ _____ ^{o}F

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐ CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR
   ☐ BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION
   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK
   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK
   D. VOLUME % OF SOLIDS IN COATING OR INK
   E. APPROXIMATE ANNUAL CONSUMPTION
   F. APPLICATION RATE OF COATING
   G. SUPPLIER'S NAME AND ADDRESS
   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the wet feedstock storage process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	______
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	______
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting,

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

Dryers

Note: The information provided in this form is per dryer unit and associated conveyance equipment. Please note there are two disc dryers operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:
1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

Note: the dryers are equipped with a cyclone and 3-stage scrubbing system that are required for heat recovery and condensation of the moisture in the exhaust gas and reduce dust in the downstream piping and odor control system. The cyclone and scrubber system are integral to the operation of the dryers, and the equipment ultimately vents to the odor control plant

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).

1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the sludge drying process.
2. TYPE OF EQUIPMENT USED IN PROCESS Two disc dryer systems equipped with a cyclone and 3 scrubbers on the airstream and associated thermal oil loops and enclosed sewage sludge conveyance equipment.
3. EXHAUST GAS FLOW RATE: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
   Total odor control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

Note: Feedstock off-loading will occur 12hr/day, 5days/week. Drying and ventilation to the odor control system is continuous and will occur 24/7 Annual amounts are based on total plant throughput for one line; however, feedstock reception will occur during a limited time. Emission and plant throughput calculations are based on 8,760 hours of operation per year.

RAW MATERIALS AND FUELS:
1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

MATERIAL	BATCH/CONT.	ANN. AMT
Sewage Sludge (75% M.C.)	continuous	104,287.35 US Ton/yr

Note: ~208,574.7 US Ton/year plant-wide.

END PRODUCTS: Dried sewage sludge feedstock for pyrolysis process.

Section E

EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Note: Provided emissions are based on the combined airflow to the odor control plant from the reception buildings, wet feedstock silos, dryers, dried feedstock silos, pelletizers, and associated conveyance equipment.

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 28 INCHES OR _____ INCHES X _____ INCHES
2. STACK HEIGHT ABOVE GROUND 54 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 14054 ACFM @ 75 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____

   B. NUMBER OF ZONES _______

   C. TEMPERATURE IN EACH ZONE ____________________________

   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____ ^{o}F

   ________ MAXIMUM ACFM @ _____ ^{o}F

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐ CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR

   ☐ BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION

   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK

   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK

   D. VOLUME % OF SOLIDS IN COATING OR INK

   E. APPROXIMATE ANNUAL CONSUMPTION

   F. APPLICATION RATE OF COATING

   G. SUPPLIER'S NAME AND ADDRESS

   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the sludge drying process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	______
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	______
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

Dried Feedstock Storage Silos

Note: The information provided in this form is per dried feedstock storage silo. Please note that there are two dried feedstock storage silos operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Feedstock Storage Silos
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:

1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

Note: the dry feedstock silos are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the silos, and the equipment ultimately vents to the odor control plant

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).

1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the dried feedstock storage process.
2. TYPE OF EQUIPMENT USED IN PROCESS Two 80m^3 dried feedstock storage silos equipped with a top-mounted dust filter as well as associated sewage sludge conveyance systems.
3. EXHAUST GAS FLOW RATE: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
   Total odor control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

RAW MATERIALS AND FUELS:

1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

MATERIAL	BATCH/CONT.	ANN. AMT
Dried Sewage Sludge (10% M.C.)	Continuous	~28968.74 US Ton/yr

Note: ~57,937.48 US Ton per year plant-wide

END PRODUCTS: Dried sewage sludge feedstock for pyrolysis process.

Section E	EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Note: Provided emissions are based on the combined airflow to the odor control plant from the reception buildings, wet feedstock silos, dryers, dried feedstock silos, pelletizers, and associated conveyance equipment.

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 28 INCHES OR ____ INCHES X ____ INCHES
2. STACK HEIGHT ABOVE GROUND 54 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 14054 ACFM @ 75 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____

   B. NUMBER OF ZONES _______

   C. TEMPERATURE IN EACH ZONE ____________________________

   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____ ^oF

   ________ MAXIMUM ACFM @ _____ ^oF

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐ CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR

   ☐ BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION

   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK

   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK

   D. VOLUME % OF SOLIDS IN COATING OR INK

   E. APPROXIMATE ANNUAL CONSUMPTION

   F. APPLICATION RATE OF COATING

   G. SUPPLIER'S NAME AND ADDRESS

   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

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Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the dried feedstock storage process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

Pelletizers

Note: The information provided in this form is per pelletizer unit and associated conveyance equipment. Please note that there are two pelletizers operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:
1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

Note: the pelletizers are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the pelletizers, and the equipment ultimately vents to the odor control plant

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).

1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the dried feedstock pelletizing process.
2. TYPE OF EQUIPMENT USED IN PROCESS Two pelletizer units equipped with a dust filter on the airstream and associated sewage sludge conveyance systems.
3. EXHAUST GAS FLOW RATE: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
   Total odor control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

RAW MATERIALS AND FUELS:
1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

MATERIAL	BATCH/CONT.	ANN. AMT
Dried Sewage Sludge (10% M.C.)	continuous	~28968.74 US Ton/yr

Note: ~57,937.48 US Ton per year plant-wide

END PRODUCTS: Dried & pelletized sewage sludge feedstock for pyrolysis process.

Section E	EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Note: Provided emissions are based on the combined airflow to the odor control plant from the reception buildings, wet feedstock silos, dryers, dried feedstock silos, pelletizers, and associated conveyance equipment.

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 28 INCHES OR ____ INCHES X ____ INCHES
2. STACK HEIGHT ABOVE GROUND 54 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 14054 ACFM @ 75 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____

   B. NUMBER OF ZONES _______

   C. TEMPERATURE IN EACH ZONE ____________________________

   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____°F

   ________ MAXIMUM ACFM @ _____°F

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐ CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR

   ☐ BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION

   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK

   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK

   D. VOLUME % OF SOLIDS IN COATING OR INK

   E. APPROXIMATE ANNUAL CONSUMPTION

   F. APPLICATION RATE OF COATING

   G. SUPPLIER'S NAME AND ADDRESS

   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the dried feedstock pelletizing process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ____________________
For Deposit into Account 1752-80600

Odor Control Plant

Note: The information provided in this form is for one biotrickling filter at the plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☐ SCRUBBER ☐ AFTERBURNER ☐ SCR ☐ CARBON ADSORBER ☑ OTHER (SPECIFY) Biotrickling Filter
3. MAKE AND MODEL NO.: BioAir EcoFilter EF137
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Material delivery, conveyance, storag drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.
2. PROCESS EQUIPMENT USED IN OPERATION 2 wet feedstock reception buildings, 2 wet feedstock reception bins, 4 wet feedstock silos, 2 dryers, 2 dry feedstock silos, 2 pelletizers, and associated enclosed conveyance systems.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ___ HRS/BATCH ___ BATCHES/WEEK ___ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET. Note: the dry feedstock silos and pelletizer units are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the silos and pelletizers, and the equipment ultimately vents to the odor control plant.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

INDICATE METHOD USED TO DETERMINE EMISSIONS Pilot testing and vendor-provided emissions

Section E

EMISSION STREAM CHARACTERISTICS 14054 @ 75 F ACFM

1. MAXIMUM FLOW RATE (SCFM) 13630
2. TEMPERATURE (°F) 75
3. MOISTURE CONTENT 90-100 %
4. HALOGENATED ORGANICS: ☐ YES ☑ NO
5. HEAT CONTENT (IF APPLICABLE) N/A BTU/SCF

Note: The biotrickling filter is followed by a two-stage wet chemical scrubber system and subsequently a carbon adsorption system before exiting a stack to the atmosphere. Emission stream characteristics are based on the final exhaust from the stack.

Section F

Note: while the biotrickling filter is not a scrubber, this section has been completed as the operating parameters of the biotrickling filter most closely align with those of a scrubber.

SCRUBBER

1. WET:SCRUBBING LIQUID
   - (A) COMPOSITION Water
   - (B) FLOW RATE (GAL/MIN) 3.14 17117 liter/day
   - (C) INJECTION RATE (PSI) 15 — From vendor - maximum pressure drop in the irrigation header spray nozzle.
   - (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) Not applicable

   PACKING-IF APPLICABLE
   - (A) TYPE EcoBase® structured, synthetic media
   - (B) DEPTH OF BED 29 (FEET)
   - (C) PACKING SURFACE N/A (FT^2) Volume media bed 3946 ft3.
2. DRY:SCRUBBING REAGENT: ________ USAGE ________ LB/HR.
   INJECTION RATIO: ________ ( )
   MIXING METHOD ________
3. PRESSURE DROP ACROSS CONTROL UNIT: ________ INCHES WATER

BAGHOUSE/FABRIC FILTER

1. BAG/FILTER MATERIAL ________ 2. NUMBER OF BAGS ________
3. AIR/CLOTH RATIO ________ FEET/MINUTE
4. METHOD OF CLEANING: (A) ☐ SHAKER ☐ PULSE ☐ REVERSE AIR ☐ OTHER-SPECIFY
   (B) FREQUENCY OF CLEANING ________
   (C) IS CLEANING AUTOMATIC OR MANUAL ________

CARBON ADSORBER

1. VOLUME OF EACH CARBON BED ________ (FT^3)
2. NUMBER OF BEDS ________
3. DIAMETER OF EACH BED ________ (FT)
4. DEPTH OF EACH BED ________ (FT)
5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) ________
6. ADSORBTION CYCLE TIME ________ (HR)
7. REGENERATION CYCLE TIME ________ (HR)
8. STEAM RATIO (LB STEAM/LB CARBON) ________
9. STEAM SOURCE ________
10. REMOVAL EFFICIENCY (%) ________

INCINERATION

1. THERMAL AFTERBURNER
   - A. VOLUME OF COMBUSTION CHAMBER ________ (FT^3)
   - B. MINIMUM OPERATING TEMPERATURE ________ (°F)
   - C. RESIDENCE TIME ________ (SECONDS)
   - D. EXCESS AIR ________ %
2. CATALYTIC INCINERATION
   - A. TYPE OF CATALYST ________
   - B. VOLUME OF CATALYST ________ (FT^3)
   - C. SPACE VELOCITY ________ (HR^{-1})
   - D. CATALYST OPERATING TEMPERATURE ________ (°F)

INCINERATION (CONT.)

3. BURNER MAKE AND MODEL NO.______________________________
CAPACITY (BTU/HR)______________________________

4. HEAT RECOVERY: ☐ YES ☐ NO
TYPE:______________________________ EFFICIENCY:__________%

4. DESTRUCTION EFFICIENCY:__________%

Section G

OPERATING CONDITIONS

1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 14054 ACFM @ 75 °F
MAXIMUM 14054 ACFM @ 75 °F
2. GAS TEMPERATURE: INLET 88.5 °F OUTLET 75 °F
3. STACK INFORMATION: (A) I.D. 28 INCHES OR _____ INCHES X _____ INCHES
(B) STACK HEIGHT ABOVE GROUND 54 FEET
(C) CFM EXHAUSTED 13050
(D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 100 FEET.

Section H

COLLECTION DATA

1. DESCRIPTION OF COLLECTED MATERIAL Liquid waste stream
2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.) 4521.6 GAL/DAY
3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL Discharged to the municipal sewer system

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Section I

IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED:

1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM.
2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT.
3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS.
4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]	Managing Member
Signature	Title
Mark DePasquale	4/23/2025
Printed Name	Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

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APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Material delivery, conveyance, storage, drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	________
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	________
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ____________________
For Deposit into Account 1752-80600

bioair

Breathe Better.

ecofilter®

Sustainable. Easy to Operate. Simply Odorless.

bioairsolutions.com

Say “Hello” to EcoFilter®

A scalable biological odor control solution for every odor source, EcoFilter utilizes BioAir’s breakthrough EcoBase® structured, synthetic biotrickling media to deliver unmatched odor and air emission control performance. EcoFilter systems provide consistent, proven, long-term removal of both inorganic and organic odors thanks to the unique structured characteristics of BioAir’s proprietary EcoBase media. EcoBase media delivers uniform performance across the media bed and throughout the life of the system, all without hazardous, expensive chemicals or carbon. EcoFilter is the ideal environmentally-friendly, sustainable solution to the odor and air emission control needs of municipalities and industry.

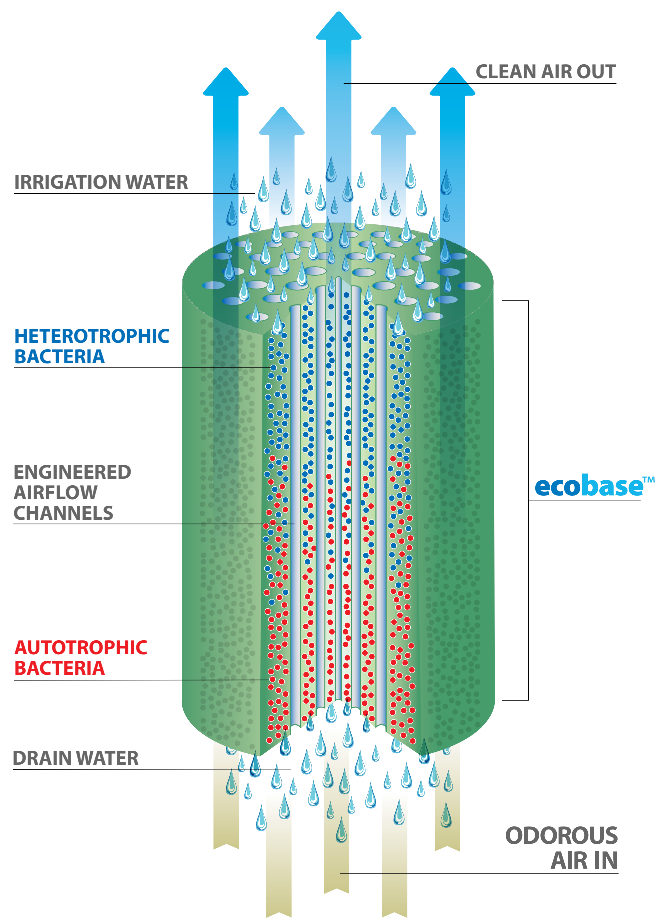
EcoFilter Features

- EcoBase® Media – Engineered for optimal mass transfer and high odor loadings
- Total odor control (>99.9% H_2S and >95% odor removal)
- From 200 CFM to 200,000+ CFM, EcoFilter systems are scalable to fit your needs
- Removal of organic and inorganic odors
- Small Footprint: EcoBase® media allows for optimal odor control in 1/3 the space
- No hazardous, expensive chemicals
- Extremely low operation and maintenance costs
- No recirculation, no backup carbon and no chemical scrubbers
- No pH meters
- Easy controls and minimal instrumentation

EcoBase® Advantages:

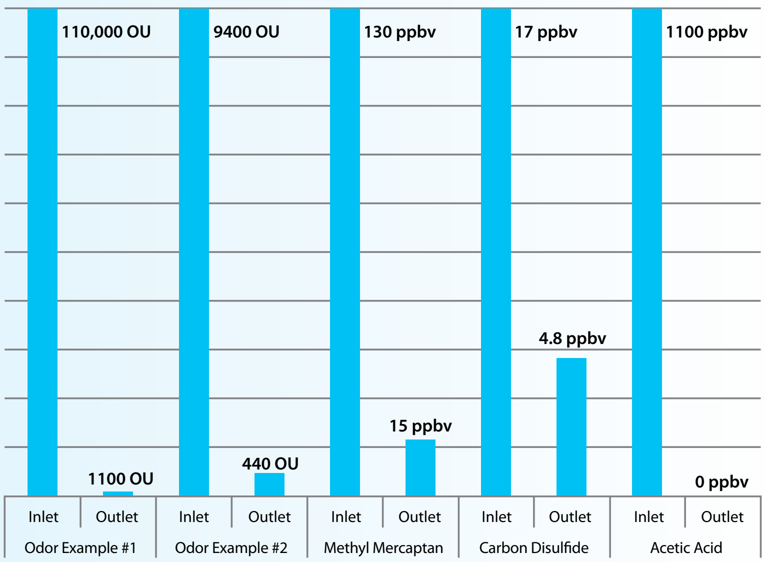
Every EcoFilter unit includes BioAir’s proprietary EcoBase® structured, synthetic media. EcoBase has measurable, uniform characteristics that provide a uniform surface area, uniform flow distribution and uniform biomass contact time, leading to consistent, reliable performance.

- Higher specific surface area means higher microbial density, which in turn leads to higher odor treatment capacity
- Uniform engineered flow channels provide uniform airflow throughout the media, with no channeling or media bypass
- Stable performance is possible at very high H_2S mass loadings and very low residence times



Why Fresh Water Matters

BioAir's EcoFilter® products use fresh water for the removal of organic odors which cannot be treated using acidic recycled water. Although H_2S is often the primary odorous compound, all airstreams contain some organic reduced sulfur compounds, such as methyl mercaptan, dimethyl sulfide and many other volatile organic compounds that contribute to odors. Systems that recirculate acidic drain water are scientifically unable to maintain the proper bacteria for the removal of organic odors. It has been demonstrated that EcoFilter is capable of facilitating the growth of both autotrophic and heterotrophic bacteria in a single reactor vessel, thus allowing the oxidation and removal of both organic and inorganic odors in a single reactor without the need for secondary polishing in a carbon or chemical scrubber.



CASE STUDY

JEA Buckman Facility
Jacksonville, FL

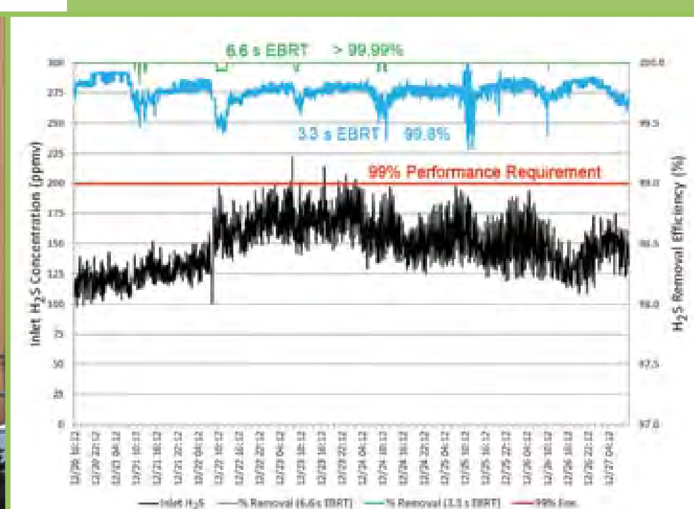
- *Equipment: EcoFilter® EF1242*
- *Odor Source: WWTP Biosolids Disposal Building*
- *Empty Bed Residence Time (EBRT): 6.6 seconds*
- *Airflow: 15,500 cfm (26,350 m3/hr)*
- *Actual Inlet H_2S Treated: 100-225 ppmv*
- *Actual H_2S Removal Efficiency: 99.8% @ 3.3 seconds*

An EcoFilter EF1242 was installed at the JEA Buckman facility in Jacksonville, FL in 2011.

The EcoFilter system treats a high-concentration H_2S airstream in an industry-leading EBRT of only 6.6 seconds, exceeding the 99.0% performance requirement in just the lower half of the reactor. The graph below shows the performance of the system in a typical week. The blue line indicates 99.8% average H_2S removal at the midpoint of the reactor, 3.3 seconds after the air enters the vessel. The green line indicates removal exceeding 99.99% at the reactor outlet.

Results: Performance of the EcoFilter far surpasses the customer's requirements, providing a significant margin of safety. The cost of ownership is far less than competing technologies, and with none of the chemical costs or risks inherent to chemical scrubbers

Happier neighbors. Happier operators. Zero odors.

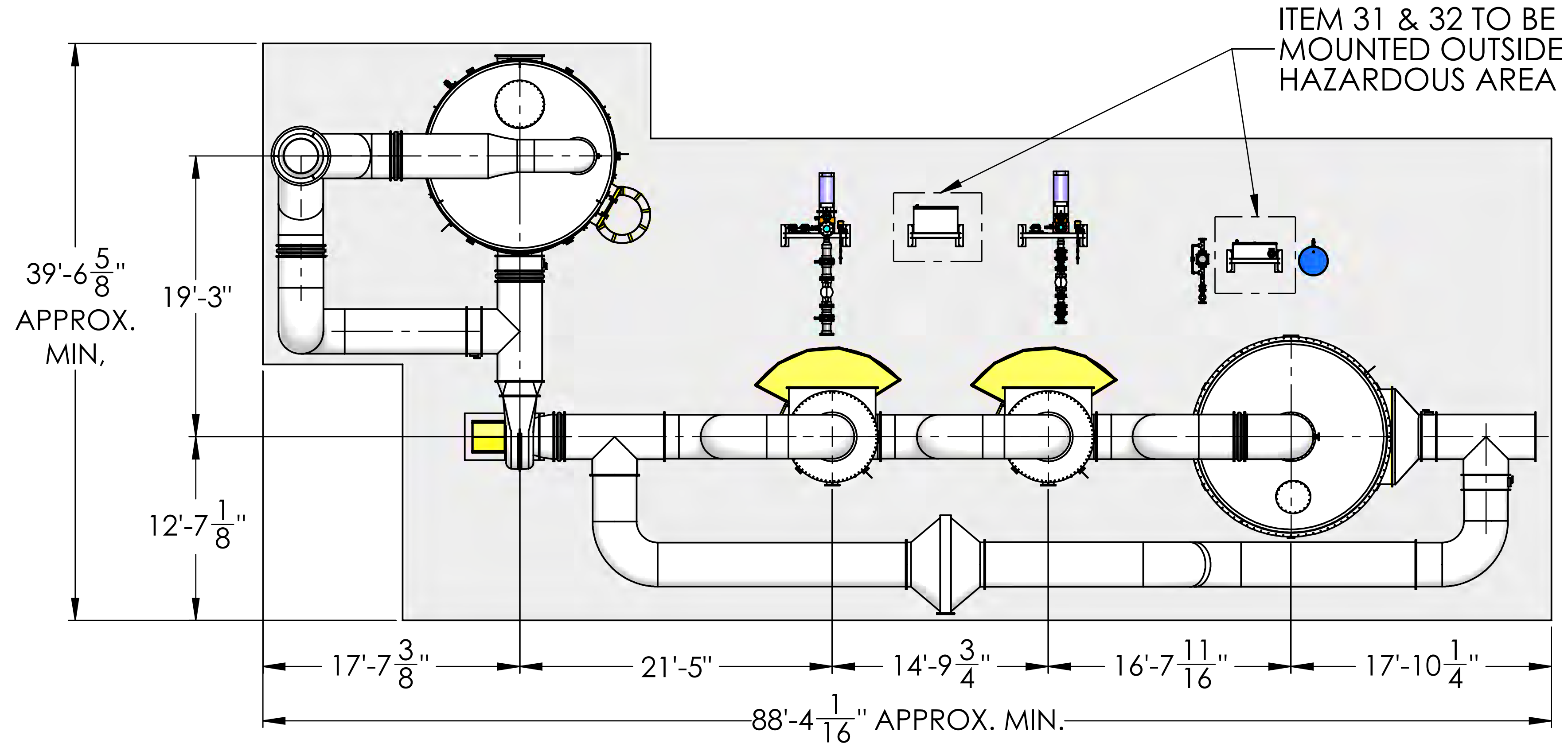


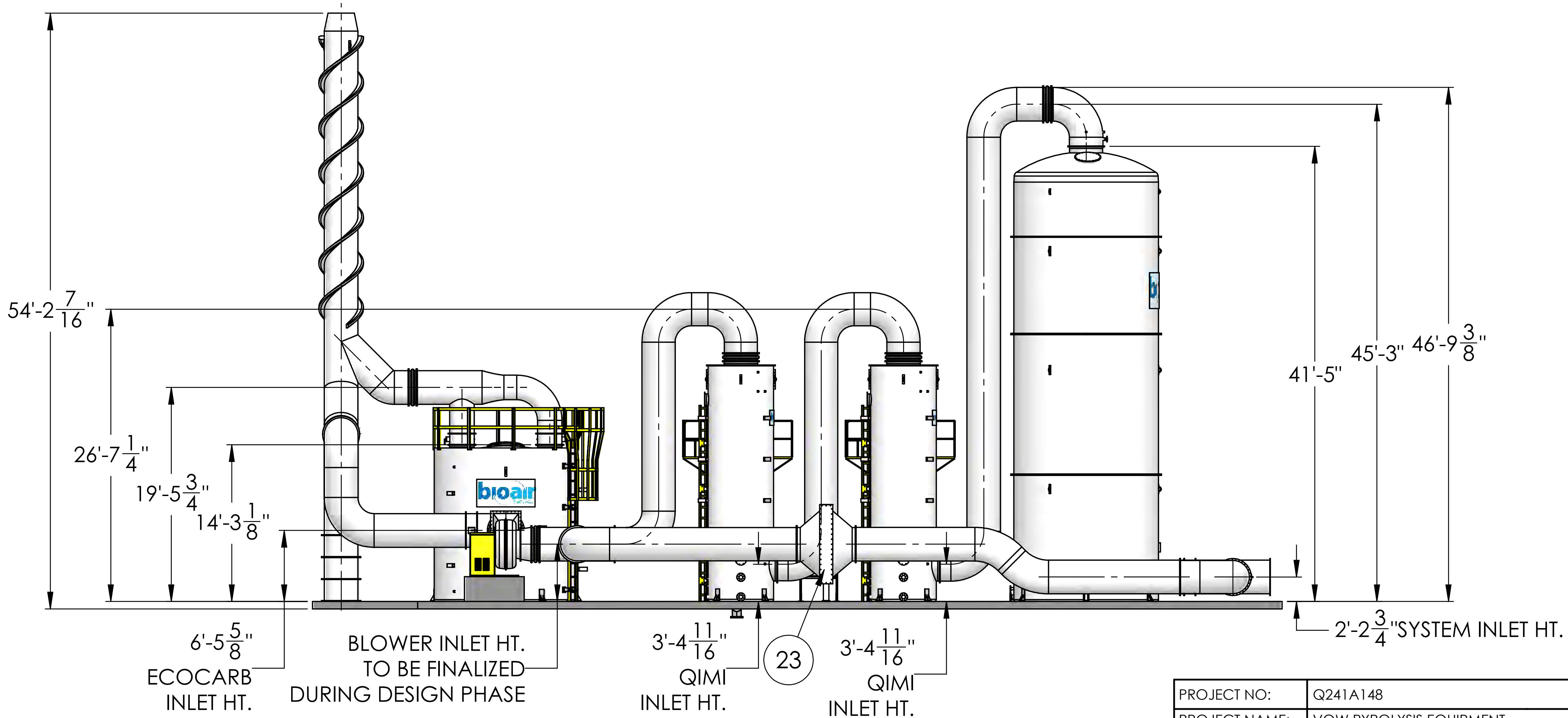
bioair®
Breathe Better.

BioAir Solutions, LLC
110 Kresson-Gibbsboro Road, Suite 303
Voorhees, NJ 08043

P 856.258.6969
F 856.258.6975

info@bioairsolutions.com
bioairsolutions.com





PROJECT NO:	Q241A148	DRAWN BY:	VL	CHK. JH
PROJECT NAME:	VOW PYROLYSIS EQUIPMENT	DRAWN DATE:	01/06/2025	
DRAWING TITLE: GENERAL ARRANGEMENT ECOFILTER EF137+2xQIMI CS67+ECOCARB EB13D			DWG SIZE: A3	SHT No.: 2/4
DRAWING No.: EF137+2xCS67+EB13D_Q241A148			SCALE: 1:140	REV. No.: D

Note: The information provided in this form is for the first stage of a single two-stage wet scrubber at the plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☑ SCRUBBER ☐ AFTERBURNER ☐ SCR ☐ CARBON ADSORBER ☐ OTHER (SPECIFY)
3. MAKE AND MODEL NO.: BioAir Qimi CS67 (acid scrubber)
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Material delivery, conveyance, storag
   drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.
2. PROCESS EQUIPMENT USED IN OPERATION 2 wet feedstock reception buildings, 2 wet feedstock reception bins, 4 wet feedstock silos, 2 dryers, 2 dry feedstock silos, 2 pelletizers, and associated conveyance systems.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET.

Note: the dry feedstock silos and pelletizer units are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the silos and pelletizers, and the equipment ultimately vents to the odor control plant.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

INDICATE METHOD USED TO DETERMINE EMISSIONS Pilot testing and vendor-provided emissions

AP-CE

Section E

EMISSION STREAM CHARACTERISTICS 14054 @ 75 F ACFM

1. MAXIMUM FLOW RATE (SCFM) 13630
2. TEMPERATURE (^{o}F) 75
3. MOISTURE CONTENT 90-100 %
4. HALOGENATED ORGANICS: ☐ YES ☑ NO
5. HEAT CONTENT (IF APPLICABLE) N/A BTU/SCF

Note: The two-stage chemical scrubber is preceded by a biotrickling filter system and is followed by a carbon adsorber before exiting a stack to the atmosphere. Emission stream characteristics are based on the final exhaust from the stack.

Section F

SCRUBBER

1. WET:SCRUBBING LIQUID
   - (A) COMPOSITION H2SO4
   - (B) FLOW RATE (GAL/MIN) 0.005
   - (C) INJECTION RATE (PSI) 60-100
   - (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) 0.09

   Recirculation flow: 154 gpm
   Chemical feed flow: 0.32 gal/hr (93%)

   PACKING-IF APPLICABLE
   - (A) TYPE BioAir Qimi Media
   - (B) DEPTH OF BED 7.1 (FEET)
   - (C) PACKING SURFACE 14391 (FT^2) Surface: 74 ft^{2}/ft^{3}
2. DRY:SCRUBBING REAGENT: N/A USAGE N/A LB/HR.
   INJECTION RATIO: N/A ( )
   MIXING METHOD N/A
3. PRESSURE DROP ACROSS CONTROL UNIT: N/A INCHES WATER

BAGHOUSE/FABRIC FILTER

1. BAG/FILTER MATERIAL ______ 2. NUMBER OF BAGS ______
3. AIR/CLOTH RATIO ______ FEET/MINUTE
4. METHOD OF CLEANING: (A) ☐ SHAKER ☐ PULSE ☐ REVERSE AIR ☐ OTHER-SPECIFY
   - (B) FREQUENCY OF CLEANING ______
   - (C) IS CLEANING AUTOMATIC OR MANUAL ______

CARBON ADSORBER

1. VOLUME OF EACH CARBON BED ______ (FT^3)
2. NUMBER OF BEDS ______
3. DIAMETER OF EACH BED ______ (FT)
4. DEPTH OF EACH BED ______ (FT)
5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) ______
6. ADSORBTION CYCLE TIME ______ (HR)
7. REGENERATION CYCLE TIME ______ (HR)
8. STEAM RATIO (LB STEAM/LB CARBON) ______
9. STEAM SOURCE ______
10. REMOVAL EFFICIENCY (%) ______

INCINERATION

1. THERMAL AFTERBURNER
   - A. VOLUME OF COMBUSTION CHAMBER ______ (FT^3)
   - B. MINIMUM OPERATING TEMPERATURE ______ (^{o}F)
   - C. RESIDENCE TIME ______ (SECONDS)
   - D. EXCESS AIR ______ %
2. CATALYTIC INCINERATION
   - A. TYPE OF CATALYST ______
   - B. VOLUME OF CATALYST ______ (FT^3)
   - C. SPACE VELOCITY ______ (HR^{-1})
   - D. CATALYST OPERATING TEMPERATURE ______ (^{o}F)

INCINERATION (CONT.)

3. BURNER MAKE AND MODEL NO.____________________
   CAPACITY (BTU/HR)____________________
4. HEAT RECOVERY: ☐ YES ☐ NO
   TYPE:____________________ EFFICIENCY:__________%
4. DESTRUCTION EFFICIENCY:______________%

Section G

OPERATING CONDITIONS

1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
2. GAS TEMPERATURE: INLET 75 °F OUTLET 75 °F
3. STACK INFORMATION: (A) I.D. 28 INCHES OR _____ INCHES X _____ INCHES
   (B) STACK HEIGHT ABOVE GROUND 54 FEET
   (C) CFM EXHAUSTED 13650
   (D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET.

Section H

COLLECTION DATA

1. DESCRIPTION OF COLLECTED MATERIAL Liquid waste stream
2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.) 63.137 GAL/DAY
3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL Discharged to the municipal sewer system.

Section I

IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED:

1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM.
2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT.
3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS.
4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

____
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

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APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Material delivery, conveyance, storage,drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	________
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	________
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ____________________
For Deposit into Account 1752-80600

Note: The information provided in this form is for the second stage of a single two-stage wet scrubber at the plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☑ SCRUBBER ☐ AFTERBURNER ☐ SCR ☐ CARBON ADSORBER ☐ OTHER (SPECIFY)
3. MAKE AND MODEL NO.: BioAir Qimi CS67 (caustic/hypo scrubber)
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Material delivery, conveyance, storag drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.
2. PROCESS EQUIPMENT USED IN OPERATION 2 wet feedstock reception buildings, 2 wet feedstock reception bins, 4 wet feedstock silos, 2 dryers, 2 dry feedstock silos, 2 pelletizers, and associated conveyance systems.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET. Note: the dry feedstock silos and pelletizer units are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the silos and pelletizers, and the equipment ultimately vents to the odor control plant.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

INDICATE METHOD USED TO DETERMINE EMISSIONS Pilot testing and vendor-provided emissions

Section E

EMISSION STREAM CHARACTERISTICS 14054 @ 75 F ACFM
1. MAXIMUM FLOW RATE (SCFM) 13630
2. TEMPERATURE (^oF) 75
3. MOISTURE CONTENT 90-100 %
4. HALOGENATED ORGANICS: ☐ YES ☑ NO
5. HEAT CONTENT (IF APPLICABLE) N/A BTU/SCF

Note: The two-stage chemical scrubber is preceded by a biotrickling filter system and is followed by a carbon adsorber before exiting a stack to the atmosphere. Emission stream characteristics are based on the final exhaust from the stack.

Section F

SCRUBBER

Recirculation flow: 220 gpm

1. WET:SCRUBBING LIQUID
   (A) COMPOSITION NaOH / NaOCl
   (B) FLOW RATE (GAL/MIN) 0.003 / 0.0135
   (C) INJECTION RATE (PSI) 60-100
   (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) 0.07

Chemical feed flow: NaOH= 0.18 gal/hr(25%) / NaOCl = 0.81 gal/hr (12%)

   PACKING-IF APPLICABLE
   (A) TYPE BioAir Qimi Media
   (B) DEPTH OF BED 7.1 (FEET)
   (C) PACKING SURFACE 14391 (FT^2) Surface: 74 ft^2/ft^3
2. DRY:SCRUBBING REAGENT: N/A USAGE N/A LB/HR.
   INJECTION RATIO: N/A ( )
   MIXING METHOD N/A
3. PRESSURE DROP ACROSS CONTROL UNIT: N/A INCHES WATER

BAGHOUSE/FABRIC FILTER
1. BAG/FILTER MATERIAL ______ 2. NUMBER OF BAGS ______
3. AIR/CLOTH RATIO ______ FEET/MINUTE
4. METHOD OF CLEANING: (A) ☐ SHAKER ☐ PULSE ☐ REVERSE AIR ☐ OTHER-SPECIFY
   (B) FREQUENCY OF CLEANING ______
   (C) IS CLEANING AUTOMATIC OR MANUAL ______

CARBON ADSORBER
1. VOLUME OF EACH CARBON BED ______ (FT^3)
2. NUMBER OF BEDS ______
3. DIAMETER OF EACH BED ______ (FT)
4. DEPTH OF EACH BED ______ (FT)
5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) ______
6. ADSORBTION CYCLE TIME ______ (HR)
7. REGENERATION CYCLE TIME ______ (HR)
8. STEAM RATIO (LB STEAM/LB CARBON) ______
9. STEAM SOURCE ______
10. REMOVAL EFFICIENCY (%) ______

INCINERATION
1. THERMAL AFTERBURNER
   A. VOLUME OF COMBUSTION CHAMBER ______ (FT^3)
   B. MINIMUM OPERATING TEMPERATURE ______ (^oF)
   C. RESIDENCE TIME ______ (SECONDS)
   D. EXCESS AIR ______ %
2. CATALYTIC INCINERATION
   A. TYPE OF CATALYST ______
   B. VOLUME OF CATALYST ______ (FT^3)
   C. SPACE VELOCITY ______ (HR^{-1})
   D. CATALYST OPERATING TEMPERATURE ______ (^oF)

INCINERATION (CONT.)

3. BURNER MAKE AND MODEL NO.____________________
   CAPACITY (BTU/HR)____________________
4. HEAT RECOVERY: ☐ YES ☐ NO
   TYPE:____________________ EFFICIENCY:__________ %
4. DESTRUCTION EFFICIENCY:__________ %

Section G

OPERATING CONDITIONS

1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
2. GAS TEMPERATURE: INLET 75 °F OUTLET 75 °F
3. STACK INFORMATION: (A) I.D. 28 INCHES OR ____ INCHES X ____ INCHES
   (B) STACK HEIGHT ABOVE GROUND 64 FEET
   (C) CFM EXHAUSTED [illegible]
   (D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET.

Section H

COLLECTION DATA

1. DESCRIPTION OF COLLECTED MATERIAL Liquid waste stream.
2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.) 34.34 GAL/DAY
3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL Discharged to the municipal sewer system.

Section I

IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED:

1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM.
2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT.
3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS.
4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

____________________ Managing Member
Signature Title

Mark DePasquale 4/23/2025
Printed Name Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

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APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Material delivery, conveyance, storage,drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	________
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	________
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

Qimi® Chemical Scrubber

BioAir utilizes years of odor control experience to effectively design its Qimi® chemical scrubbers for odor treatment applications, with the same care and quality found in BioAir's line of industry-leading biotrickling filters.

BioAir Quality

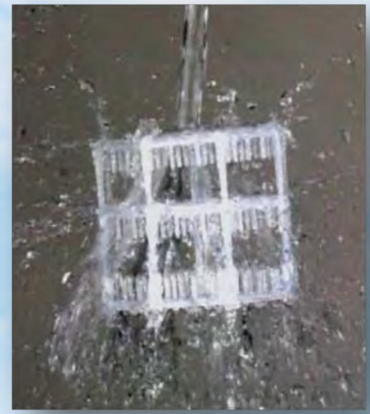
Qimi chemical scrubbers are custom-designed by the same team of expert engineers responsible for the design of BioAir's industry-leading EcoFilter® and EcoPure® technologies. BioAir utilizes only the finest materials from premier vendors, and all products are put through rigorous quality control testing, ensuring that every Qimi unit is built to BioAir's high quality standards, capable of maximum efficiency.

Outstanding Resistance to Fouling

Qimi chemical scrubbers utilize high-efficiency polypropylene media with a uniformly-spaced bar-and-rod design and inherent self-cleaning properties, minimizing plugging by both mineral scale and biological growth. This means less downtime for maintenance, and more effective uptime.

Higher Gas Velocity

Qimi chemical scrubbers utilize media designed for use at higher gas velocities than old-fashioned tower packings. This media, along with BioAir's custom-engineered vessels and instrumentation and control system, allows for a significantly more efficient chemical scrubber in a smaller footprint than previously possible with conventional technologies.



A photograph of liquid dispersion over Qimi's polypropylene media.

Media Characteristics

The following table summarizes the physical characteristics of Qimi chemical scrubber media:

Characteristic	Measurement
Dimensions	3.25” x 3.75”
Void Fraction	96.3%
Weight	2.1 lb/ft^3
Number of Pieces	33 / ft^3
Packing Factor	7 / ft
Drip Points	11,000 / ft^3

Note: The information provided in this form is for a single carbon adsorber unit at the plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☐ SCRUBBER ☐ AFTERBURNER ☐ SCR ☑ CARBON ADSORBER ☐ OTHER (SPECIFY)
3. MAKE AND MODEL NO.: BioAir EcoCarb EB13D
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Material delivery, conveyance, storag
   drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.
2. PROCESS EQUIPMENT USED IN OPERATION 2 wet feedstock reception buildings, 2 wet feedstock reception bins, 4 wet feedstock silos, 2 dryers, 2 dry feedstock silos, 2 pelletizers, and associated conveyance systems.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET. Note: the dry feedstock silos and pelletizer units are equipped with dust filters that are required to reduce dust in the downstream piping and odor control system. The filters are integral to the operation of the silos and pelletizers, and the equipment ultimately vents to the odor control plant.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

INDICATE METHOD USED TO DETERMINE EMISSIONS Pilot testing and vendor-provided emissions

Section E	EMISSION STREAM CHARACTERISTICS 14054 @ 75 F ACFM 1. MAXIMUM FLOW RATE (SCFM) 13 630 2. TEMPERATURE (^oF) 75 3. MOISTURE CONTENT 90-100 % 4. HALOGENATED ORGANICS: ☐ YES ☑ NO 5. HEAT CONTENT (IF APPLICABLE) N/A BTU/SCF Note: The carbon adsorber is preceded by a two stage wet chemical scrubber system & biotrickling filter system. The carbon adsorber is the final control step before exiting a stack to the atmosphere. Emission stream characteristics are based on the final exhaust from the stack.
Section F	SCRUBBER 1. WET:SCRUBBING LIQUID (A) COMPOSITION ______ (B) FLOW RATE (GAL/MIN) ______ (C) INJECTION RATE (PSI) ______ (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) ______ PACKING-IF APPLICABLE (A) TYPE ______ (B) DEPTH OF BED ______ (FEET) (C) PACKING SURFACE ______ (FT^2) 2. DRY:SCRUBBING REAGENT: ______ USAGE ______ LB/HR. INJECTION RATIO: ______ ( ) MIXING METHOD ______ 3. PRESSURE DROP ACROSS CONTROL UNIT: ______ INCHES WATER
	BAGHOUSE/FABRIC FILTER 1. BAG/FILTER MATERIAL ______ 2. NUMBER OF BAGS ______ 3. AIR/CLOTH RATIO ______ FEET/MINUTE 4. METHOD OF CLEANING: (A) ☐ SHAKER ☐ PULSE ☐ REVERSE AIR ☐ OTHER-SPECIFY (B) FREQUENCY OF CLEANING ______ (C) IS CLEANING AUTOMATIC OR MANUAL ______
	CARBON ADSORBER 1. VOLUME OF EACH CARBON BED 398.3 (FT^3) 2. NUMBER OF BEDS 2 3. DIAMETER OF EACH BED 13 (FT) 4. DEPTH OF EACH BED 3 (FT) 5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) 19 H2S 6. ADSORBTION CYCLE TIME Not applicable (HR) 7. REGENERATION CYCLE TIME Not applicable (HR) 8. STEAM RATIO (LB STEAM/LB CARBON) Not applicable 9. STEAM SOURCE Not applicable 10. REMOVAL EFFICIENCY (%) Pollutant specific - see attached PTE
	INCINERATION 1. THERMAL AFTERBURNER A. VOLUME OF COMBUSTION CHAMBER ______ (FT^3) B. MINIMUM OPERATING TEMPERATURE ______ (^oF) C. RESIDENCE TIME ______ (SECONDS) D. EXCESS AIR ______ % 2. CATALYTIC INCINERATION A. TYPE OF CATALYST ______ B. VOLUME OF CATALYST ______ (FT^3) C. SPACE VELOCITY ______ (HR^{-1}) D. CATALYST OPERATING TEMPERATURE ______ (^oF)

INCINERATION (CONT.)

3. BURNER MAKE AND MODEL NO.________________________________
   CAPACITY (BTU/HR)__________________________
4. HEAT RECOVERY: ☐ YES ☐ NO
   TYPE:___________________________ EFFICIENCY:__________%
4. DESTRUCTION EFFICIENCY:______________%

Section G

OPERATING CONDITIONS

1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 14054 ACFM @ 75 °F
   MAXIMUM 14054 ACFM @ 75 °F
2. GAS TEMPERATURE: INLET 75 °F OUTLET 75 °F
3. STACK INFORMATION: (A) I.D. 28 INCHES OR _____ INCHES X _____ INCHES
   (B) STACK HEIGHT ABOVE GROUND 54 FEET
   (C) CFM EXHAUSTED [illegible]
   (D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 180 FEET.

Section H

COLLECTION DATA

1. DESCRIPTION OF COLLECTED MATERIAL________________________________
2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.)__________________________
3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL__________________________

Section I

IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED:

1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM.
2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT.
3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS.
4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]	Managing Member
Signature	Title
Mark DePasquale	4/23/2025
Printed Name	Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

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APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Material delivery, conveyance, storage,drying, dry storage, and pelletizing will give rise to odorous air containing hydrogen sulfide, ammonia, and other odorous compounds such as nitrogen-based compounds, reduced organic sulfur compounds, acidic gases, and volatile fatty acids.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

EcoCarb® Adsorptive Filters

EcoCarb® adsorptive filters provide extremely low outlet odor concentrations of H_2S, VOCs, reduced organic sulfur compounds, ammonia, amines, and many other regulated compounds. BioAir utilizes its deep experience in odor and air emissions treatment to custom-design EcoCarb filters for each unique application, with the same care and quality found in BioAir's industry-leading biotrickling filters and related technologies.

Optia® Media

As adsorptive filters are best suited for sites with the strictest emissions requirements, media selection is very important; carbon alone is not always the solution. BioAir offers a wide range of its Optia adsorptive media products, each with unique qualities. These Optia media products are carefully selected, blended and layered by BioAir's process engineers to target and control specific odorous or toxic compounds found in each facility's unique airstream, to ensure the airstream meets regulatory and community requirements.

The Right Size

EcoCarb filters are available in a wide range of sizes, to minimize cost and footprint. BioAir also offers several styles of its EcoCarb filter, each with specific benefits (see the chart below). BioAir's process engineers carefully consider the compounds in each airstream, then select the most efficient and cost-effective combination of size, style, and Optia media for a given facility.

Convenience Features

Sample ports with ball valves are included on all EcoCarb filters, located at various depths throughout the media bed. This allows operators to easily test the remaining life of the media, and minimizes costs due to early media replacement. EcoCarb filters are also provided with rain stacks, to prevent precipitation from entering the carbon bed. In addition, dual-bed EcoCarb vessels are provided with balancing dampers, to allow operators full control over the airflow to each bed.

Pair with Biological Pre-treatment

EcoCarb filters can be combined with BioAir's industry-leading EcoFilter biotrickling filters, allowing for pre-treatment of high odor concentrations while extending the Optia media life by up to 10 times, significantly reducing operating costs.

EcoCarb Filter Styles:

Configuration	Benefit
Single Bed	Simple, cost-effective adsorptive treatment
Dual Bed	Doubles the Optia media, without increasing footprint or pressure drop.
Radial Flow	Smallest-footprint solution for higher airflows
Horizontal Flow	Increased capacity with long media life and small footprint

Pyrolysis Reactors

Note: The information provided in this form is per pyrolysis unit and associated conveyance equipment. Please note that there are two pyrolysis reactors operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY PROCESS EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

APPROVAL REQUESTED FOR:
1. CONSTRUCTION ☑ INSTALLATION ☐ MODIFICATION ☐
2. ESTIMATED STARTING DATE Spring 2027 ESTIMATED COMPLETION DATE Spring 2028

Section C

EQUIPMENT INFORMATION (IF PROCESS IS A SURFACE COATING OPERATION, I.E. SPRAY PAINTING, PRINTING, COATING, ETC., COMPLETE SURFACE COATING SUPPLEMENT IN LIEU OF SECTIONS C AND D).

1. GENERAL DESCRIPTION OF PROCESS OR OPERATION The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the pyrolysis process.
2. TYPE OF EQUIPMENT USED IN PROCESS Pyrolysis infeed systems, 2 electric pyrolysis units, pyrolysis gas handling and conveyance systems, biochar cooling screw, biochar conveyance system, and biochar packaging equipment
3. EXHAUST GAS FLOW RATE: NORMAL 23042.88 ACFM @ 633 °F
   MAXIMUM 28803.6 ACFM @ 633 °F
   Total pyrolysis control plant stack flow rate.
4. AIR POLLUTION CONTROL EQUIPMENT: YES ☑ NO ☐ IF YES, FILE FORM AP-ICE
5. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR

Section D

RAW MATERIALS AND FUELS:
1. LIST RAW MATERIALS (STARTING MATERIAL USED IN PROCESS) AND FUELS (TYPE AND AMOUNT):

MATERIAL	BATCH/CONT.	ANN. AMT
Dried & Pelletized Sewage Sludge (10% M.C.)	continuous	~28968.74 US Ton/yr

Note: ~57,937.48 US tons/year plant-wide

END PRODUCTS: Biochar and pyrolysis gas

Section E

EMISSIONS INFORMATION:

POLLUTANT	RATE OF EMISSIONS (LB/HR)	METHOD USED TO DETERMINE EMISSIONS
See attached PTE		

Section F

STACK INFORMATION:

1. STACK EXIT DIMENSIONS I.D. 25.59 INCHES OR _____ INCHES X _____ INCHES
2. STACK HEIGHT ABOVE GROUND 120 FEET
3. VOLUME OF GAS DISCHARGED INTO OPEN AIR 28803.6 ACFM @ 633 °F
4. IS STACK EQUIPPED WITH A RAIN HAT? YES ☐ NO ☑
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 190 FEET

ADDITIONAL INFORMATION:

INCLUDE WITH THE SUBMITTAL ANY ADDITIONAL INFORMATION, PLANS, SPECIFICATIONS, EVIDENCE OR DOCUMENTATION TO ASSIST THE REVIEWER IN HIS ASSESSMENT.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]
Signature

Managing Member
Title

Mark DePasquale
Printed Name

4/23/2025
Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

SUPPLEMENT TO FORM AP-1PE
TO BE FILED FOR SURFACE COATING OPERATIONS

Section C

PROCESS/OPERATION

1. INDICATE TYPE OF PROCESS APPROVAL IS REQUESTED FOR:

PRINTING		SURFACE COATING	
LETTERPRESS	____________	SPRAY PAINTING	____________
LITHOGRAPH	____________	DIRECT ROLL	____________
GRAVURE	____________	REVERSE ROLL	____________
FLEXOGRAPHIC	____________	KNIFE COATING	____________
SCREEN	____________	FLOW COATING	____________
OFFSET	____________	ADHESIVE	____________
OTHER (SPECIFY)	____________	OTHER (SPECIFY)	____________

2. INDICATE MATERIAL BEING COATED ____

3. ARE OVENS USED IN PROCESS? YES ☐ NO ☐

   IF YES, COMPLETE THE FOLLOWING:

   A. DIRECTED FIRED_____ INDIRECT FIRED_____ FUEL TYPE _____

   B. NUMBER OF ZONES _______

   C. TEMPERATURE IN EACH ZONE ___________________________

   D. NUMBER OF PASSES ____________

4. EXHAUST GAS FLOW RATE/STACK ________ NORMAL ACFM @ _____ ^{o}F

   ________ MAXIMUM ACFM @ _____ ^{o}F

5. AIR POLLUTION CONTROL EQUIPMENT: YES ☐ NO ☐ IF YES, FILE FORM AP-1CE

6. OPERATING PROCEDURE: ☐CONTINUOUS ____HRS/DAY ____DAYS/WEEK ____WEEKS/YEAR

   ☐BATCH ____HRS/BATCH ____BATCHES/WEEK ____WEEKS/YEAR

Section D

COATINGS/INKS

1. PROVIDE THE FOLLOWING INFORMATION FOR EACH COATING OR INK USED IN PROCESS:

   A. BRAND NAME OR COMPANY DESIGNATION

   B. GENERIC NAME AND VOLUME % OF SOLVENTS IN COATING OR INK

   C. GENERIC NAME AND VOLUME % OF THINNERS ADDED TO COATING OR INK

   D. VOLUME % OF SOLIDS IN COATING OR INK

   E. APPROXIMATE ANNUAL CONSUMPTION

   F. APPLICATION RATE OF COATING

   G. SUPPLIER'S NAME AND ADDRESS

   H. DRAWINGS AND CALCULATIONS SHOWING COMPLIANCE WITH THE "GUIDELINES FOR DETERMINING CAPTURE EFFICIENCY FOR ADD-ON CONTROL DEVICES FOR WEB COATING OPERATIONS."

2. LIST THE END PRODUCTS

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

The system converts sewage sludge through pyrolysis to high carbon-content Biochar. Pyrolysis gas generated during production is converted into energy as hot air that is used to heat a closed-loop oil system for process heat. This form provides information for the pyrolysis process.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	______
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	______
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

Thermal Oxidizers

Note: The information provided in this form is per thermal oxidizer unit. Please note that there are two thermal oxidizers operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 PROMENADE STREET
PROVIDENCE, RI 02908

Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☐ SCRUBBER ☑ AFTERBURNER ☐ SCR ☐ CARBON ADSORBER ☐ OTHER (SPECIFY)
3. MAKE AND MODEL NO.: PCC, TO-4500-PYR
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Pyrolysis of sewage sludge generates a pyrolysis gas. The pyrolysis gas generated during biochar production is then treated by an afterburner unit (thermal oxidizer). A portion of the exhaust from the catalytic filter is recirculated to the thermal oxidizer for additional NOx control.
2. PROCESS EQUIPMENT USED IN OPERATION Pyrolysis infeed systems, pyrolysis reactors, pyrolysis gas conveyance system, catalytic filter exhaust recirculation system.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

INDICATE METHOD USED TO DETERMINE EMISSIONS Based on information provided by vendor.

Section E

EMISSION STREAM CHARACTERISTICS
1. MAXIMUM FLOW RATE (SCFM) 17532
2. TEMPERATURE (^{o}F) 1832
3. MOISTURE CONTENT 21.2 (% vol) %
4. HALOGENATED ORGANICS: ☑ YES ☐ NO
5. HEAT CONTENT (IF APPLICABLE) 34.2 BTU/SCF

Note: The thermal oxidizer is followed by a catalytic filter and partial exhaust recirculation system, which is the final control step before exiting a stack to the atmosphere. Emission stream characteristics presented here are after the thermal oxidizer.

Section F

SCRUBBER
1. WET:SCRUBBING LIQUID
   - (A) COMPOSITION ________
   - (B) FLOW RATE (GAL/MIN) ________
   - (C) INJECTION RATE (PSI) ________
   - (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) ________

   PACKING-IF APPLICABLE
   - (A) TYPE ________
   - (B) DEPTH OF BED ________ (FEET)
   - (C) PACKING SURFACE ________ (FT^2)
2. DRY:SCRUBBING REAGENT: ________ USAGE ________ LB/HR.
   INJECTION RATIO: ________ (   )
   MIXING METHOD ________
3. PRESSURE DROP ACROSS CONTROL UNIT: ________ INCHES WATER

BAGHOUSE/FABRIC FILTER
1. BAG/FILTER MATERIAL ________ 2. NUMBER OF BAGS ________
3. AIR/CLOTH RATIO ________ FEET/MINUTE
4. METHOD OF CLEANING: (A) ☐ SHAKER ☐ PULSE ☐ REVERSE AIR ☐ OTHER-SPECIFY
   (B) FREQUENCY OF CLEANING ________
   (C) IS CLEANING AUTOMATIC OR MANUAL ________

CARBON ADSORBER
1. VOLUME OF EACH CARBON BED ________ (FT^3)
2. NUMBER OF BEDS ________
3. DIAMETER OF EACH BED ________ (FT)
4. DEPTH OF EACH BED ________ (FT)
5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) ________
6. ADSORBTION CYCLE TIME ________ (HR)
7. REGENERATION CYCLE TIME ________ (HR)
8. STEAM RATIO (LB STEAM/LB CARBON) ________
9. STEAM SOURCE ________
10. REMOVAL EFFICIENCY (%) ________

INCINERATION
1. THERMAL AFTERBURNER
   - A. VOLUME OF COMBUSTION CHAMBER 2482.86 (FT^3)
   - B. MINIMUM OPERATING TEMPERATURE 1832 (^{o}F)
   - C. RESIDENCE TIME >2 (SECONDS)
   - D. EXCESS AIR 10.5 %
2. CATALYTIC INCINERATION
   - A. TYPE OF CATALYST N/A
   - B. VOLUME OF CATALYST N/A (FT^3)
   - C. SPACE VELOCITY N/A (HR^{-1})
   - D. CATALYST OPERATING TEMPERATURE N/A (^{o}F)

The thermal oxidizer is a three-stage process. Air is injected in the following steps. First chamber: Recirculated flue gas and combustion air.
Second chamber: Recirculated flue gas
Third chamber: Combustion air.

Total flow of recirculated flue gas is 32986 Nm3/hr. Total flow of combustion air is 13760 Nm3/hr.

INCINERATION (CONT.)

Note: The thermal oxidizer is heated by natural gas during start-up to pre-heat the oxidizer units and the closed-loop thermal oil system used to heat the dryers until pyrolysis gas can be combusted in the thermal oxidizers for the system heat.

3. BURNER MAKE AND MODEL NO. PCC-Bloom, 1030-031-DFS
   CAPACITY (BTU/HR) 42200000 (pyrolysis gas), 38600000 (natural gas)
4. HEAT RECOVERY: ☑ YES ☐ NO
   TYPE: Flue gas-to-closed loop thermal oil heat exchangers EFFICIENCY: 81 %
4. DESTRUCTION EFFICIENCY: See attachment %

Section G

OPERATING CONDITIONS

1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 60656 ACFM @ 1832 °F
   MAXIMUM 75820 ACFM @ 1832 °F

   Gas flow though the system varies because of the combustion. This flow reflects the gas flow post combustion. (Total for both thermal oxidizers)
2. GAS TEMPERATURE: INLET 1382 °F OUTLET 1832 °F
3. STACK INFORMATION: (A) I.D. 25.59 INCHES OR ______ INCHES X ______ INCHES
   (B) STACK HEIGHT ABOVE GROUND 120 FEET
   (C) CFM EXHAUSTED 7022 11245 ACFM @ 633 F and 7822 SCFM
   (D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO
5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 190 FEET.

Section H

COLLECTION DATA

1. DESCRIPTION OF COLLECTED MATERIAL Not applicable
2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.) Not applicable
3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL Not applicable

Section I

IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED:

1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM.
2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT.
3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS.
4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

Signature — Managing Member (Title)

Mark DePasquale (Printed Name) — 4/23/2025 (Date)

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

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APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Pyrolysis of sewage sludge generates a pyrolysis gas. The pyrolysis gas generated during biochar production is then treated by an afterburner unit (thermal oxidizer). A portion of the exhaust from the catalytic filter is recirculated to the thermal oxidizer for additional NOx control.

FEE SUBMITTED:

Major Source or Major Modification @ $25,410 each	
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ____________________
For Deposit into Account 1752-80600

Thermal Oxidizers • Regenerative Thermal Oxidizers • BioOxidizers • Flameless Thermal Oxidizers • Burners • Burner Systems • Air Heaters

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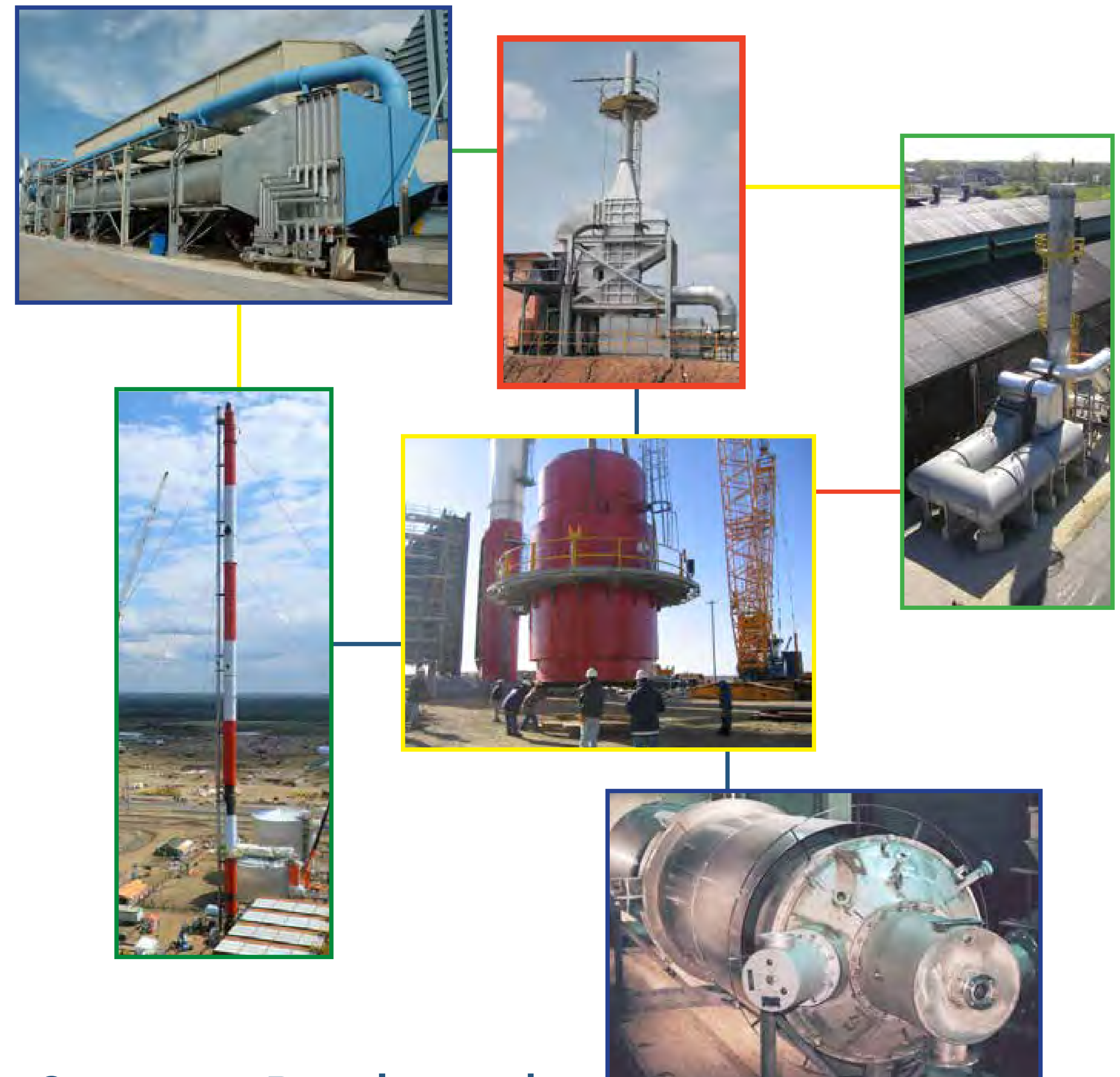
PCC®

PROCESS COMBUSTION CORPORATION

Thermal Oxidation Systems



Custom Designed Pollution Control Solutions

US Headquarters

300 Weyman Road, Suite 400
Pittsburgh, PA 15236
(412) 655-0955 Phone
pcc@pcc-group.com
www.pcc-group.com

China Office

E-507, E-508 , Fuli Morgan Center
No. 6 Taiping Street
Xicheng District, Bejing, 100031
86-10-83131505 Phone
kyao@pcc-group.com
www.pccchina.cn

India Office

Mumbai, India

Opening Fall 2020

jgeorge@pcc-group.com

United Kingdom Office

Brunel Road, Rabans Lane
Aylesbury, Bucks HP198TD UK
+44 (0) 1296 487171 Phone
pcc@pcc-group.com
www.pcc-group.com

Thermal Oxidation Systems for Liquids and Gases

Why Thermal Oxidation?

The basis of any gaseous or liquid waste incineration system is a thermal oxidizer.

The thermal oxidizer is a thermal reactor where the hazardous compounds of the waste stream are converted by combustion to harmless compounds (usually carbon dioxide, water vapour, nitrogen and oxygen).

Combined with other techniques (e.g. wet or dry flue gas scrubbing), an incineration system often provide the most effective and least expensive method of pollution control.

Why PCC?

PCC has many years of experience with all types of abatement systems, ranging from simple hydrocarbon waste incinerators, to halogenic wastes, nitrogenous wastes, aqueous wastes and water containing inorganic salts. Each waste stream demands a different approach in order to provide the best solution.

Simple Thermal Oxidizer

The simple thermal oxidizer consists of a refractory lined cylinder, into which waste, air and fuel are introduced.

Temperature and residence time are selected to give the degree of destruction efficiency required.

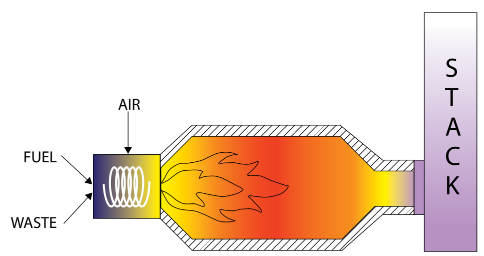
Thermal Oxidation with Heat Recovery

It is often desirable, especially with larger units, to generate some useful heat from the thermal oxidation, which will otherwise be wasted.

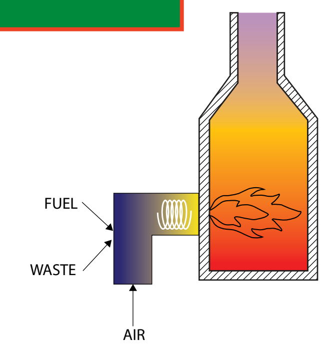
Heat may be recovered in the form of hot water, steam, hot oil, hot asphalt, heated process air, or the efficiency of the unit may be improved by preheating the incoming air or waste stream.

Systems to:
- EC Hazwaste
- IPC Guidance Note S25.01
- TA Luft
- NER
- EPA
- Other International Standards

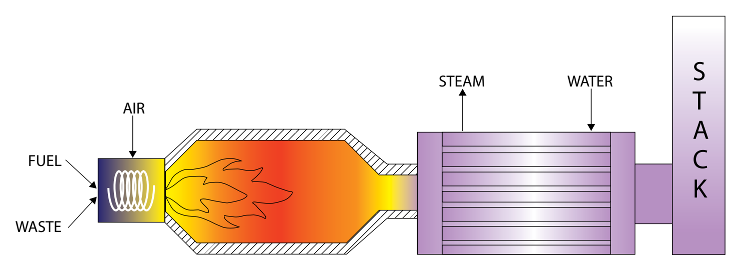
Waste Types
- Liquid and Gaseous Hydrocarbons
- Solvent Fumes
- SRU Tail Gas
- Acid Gas
- Waste Oil
- Other



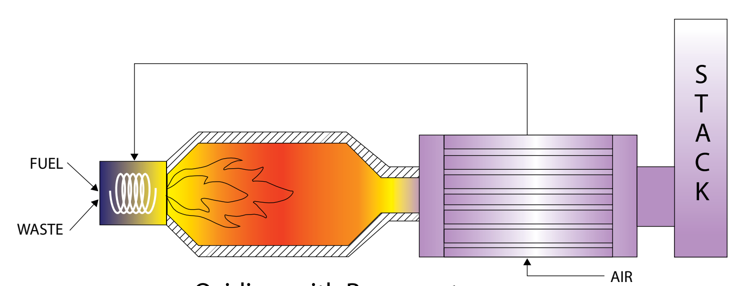
Horizontal Oxidizer



Vertical Thermal Oxidizer

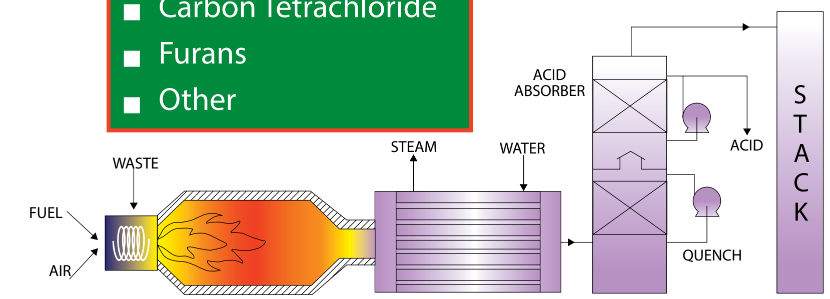


Oxidizer with Waste Heat Boiler

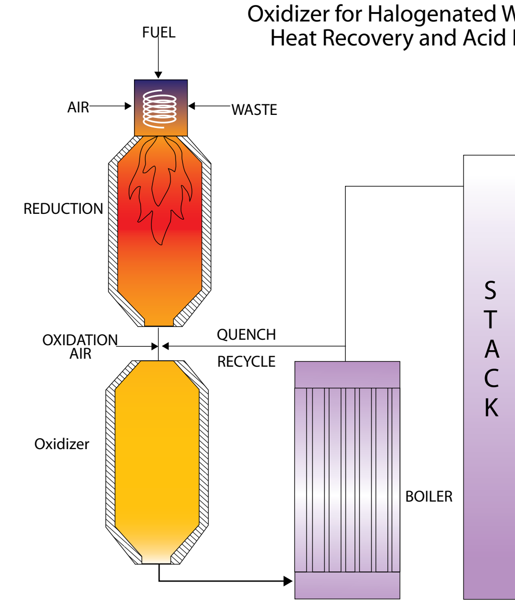


Oxidizer with Recuperator

Waste Types
- Methyl Chloride
- Chloroform
- Carbon Tetrachloride
- Furans
- Other

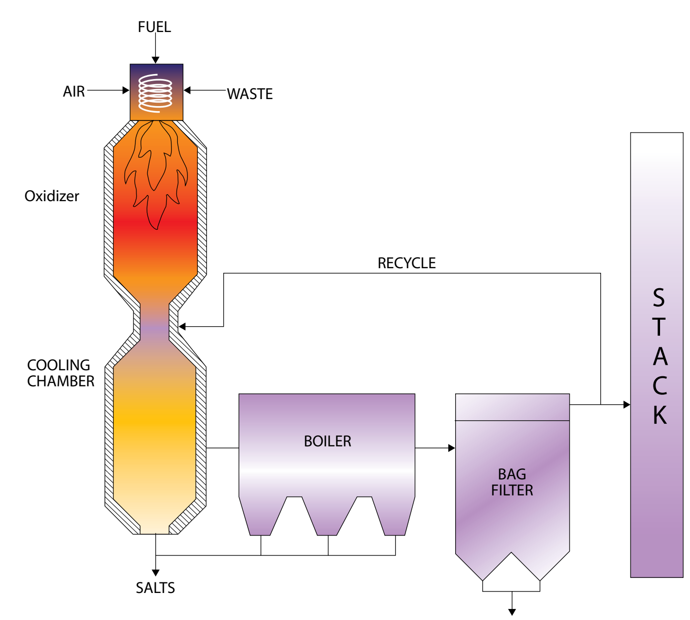


Oxidizer for Halogenated Wastes with Heat Recovery and Acid Removal



Oxidizer for Nitrogenous Wastes

Waste Types
- Acrylonitrile
- Ammonia
- Amines
- HCN



Oxidizer for Wastes with Inorganic Salts

Thermal Oxidation for Wastes Containing Halogens

If a waste stream contains a halogenated compound (containing chlorine, bromine, fluorine etc), a high temperature (1100°C) is required to oxidize these thermally resistant compounds, HCl, HBr or HF etc will be produced as a product of thermal oxidation.

The acid gas must be removed prior to emission to the atmosphere, usually using a wet scrubbing technique.

The gases are cooled by water quenching, sometimes in conjunction with a waste heat boiler, before the acid gas is removed in a packed bed absorber and the clean gas allowed to exit to atmosphere.

Thermal Oxidation for Waste Containing Bound Nitrogen

Where a waste contains chemically combined nitrogen, then a high emission of oxides of nitrogen (NOx) is possible. PCC provide a solution by introducing a reducing zone, where combined nitrogen is reduced at high temperature to molecular nitrogen without forming NOx. The products are quenched with recycled flue gas to freeze the equilibrium prior to oxidation of the remaining products with air in the oxidizing zone.

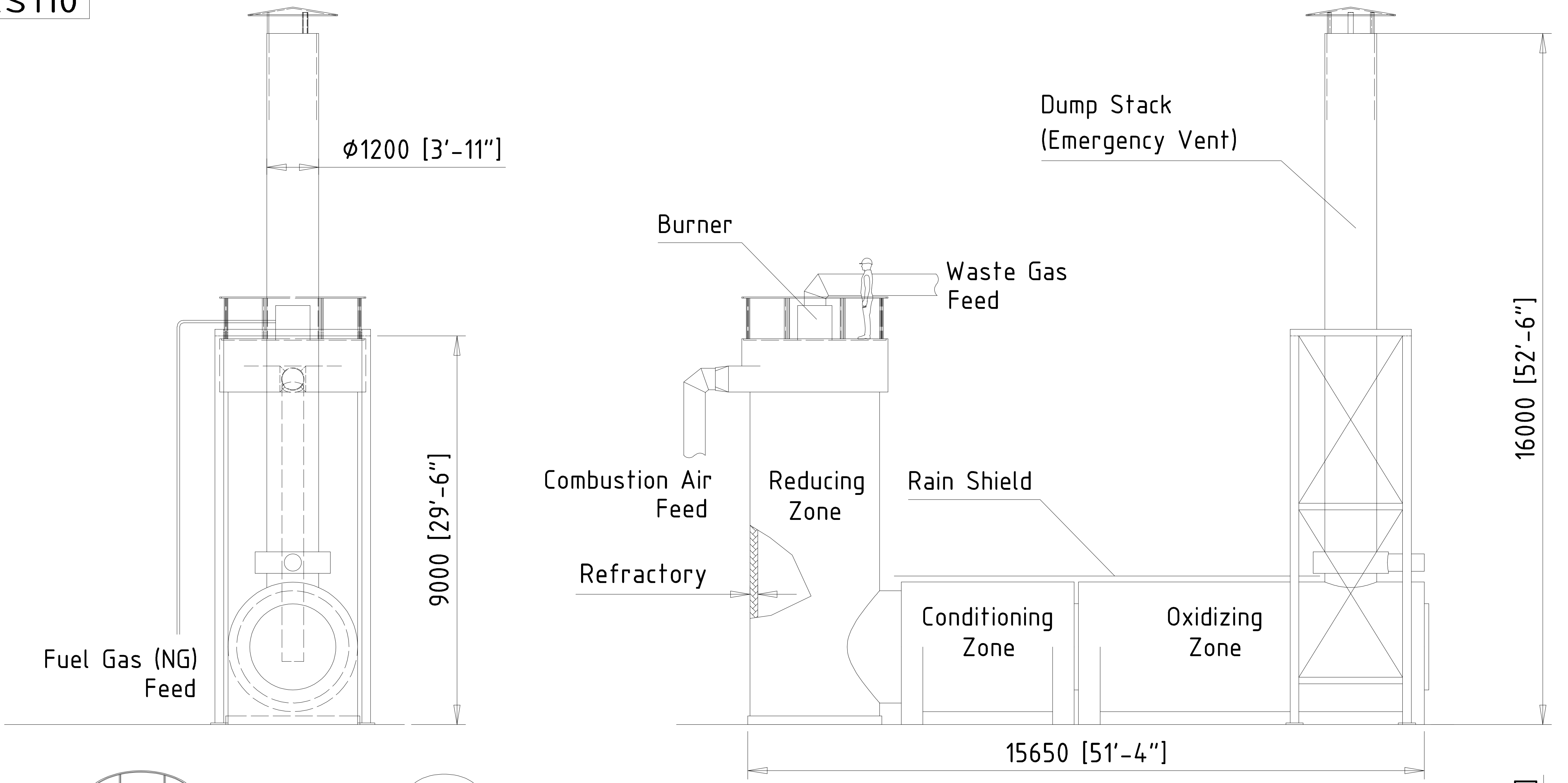
Thermal Oxidation for Waste Containing Inorganic salts

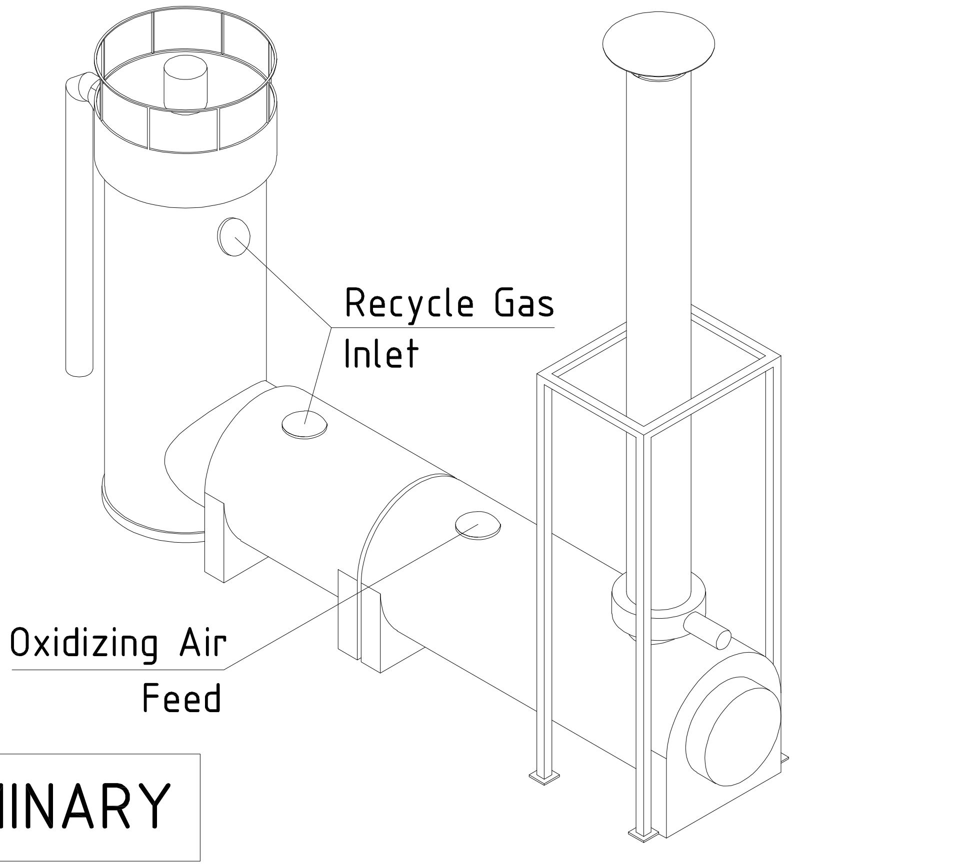
Inorganic salts present in waste streams give rise to particular problems to which PCC have solutions

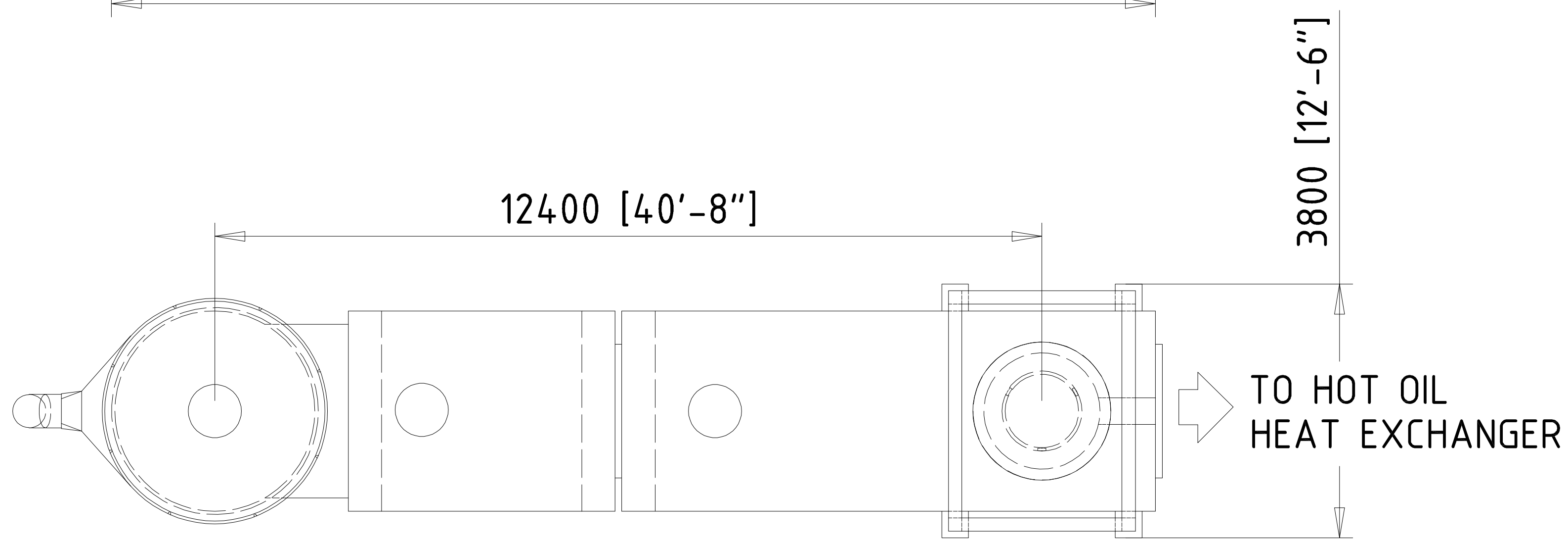
The salts tend to form a eutectic mixture, which is molten at the oxidation temperature. Without careful design the salts will crystallize on downstream heat transfer surfaces etc. The PCC solution is to cool the gases to below the eutectec temperature usingrecycledfluegases. Salts are then collected and removed using a hopper arrangement. Particulate is removed down-stream using a bag filter.

Waste Types
- Spent Caustic
- Salt Containing Solvents
- Salt Contaminated Oils
- Aqueous Salt Solutions

DWG. NO. 5272S110







PRELIMINARY

MARK	DATE	REVISION	BY
A	3/12/25	INITIAL RELEASE	KC MHP

P.C.C. PROJECT NO. 5272

SHOP NOTES:

FABRICATION TOLERANCES - SEE P.C.C. SPECIFICATIONS
ALL MACHINING TOLERANCE DIMENSIONS ARE
DECIMAL ± 0.005"
FRACTIONAL ± 1/64" } UNLESS OTHERWISE NOTED.

- CONFIDENTIAL -

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VOW ASA PYROLYSIS OFF GAS
THERMAL OXIDIZER TO-4500-PYR
GENERAL ARRANGEMENT

DATE:	3/12/25	APVD:	MHP 3/12/25	DWG. No.:	REV.
SCALE:	N/A	CHKD:	MHP 3/12/25	5272S110	A
DRAWN:	KC				

Catalytic Filters

Note: The information provided in this form is per catalytic filter unit. Please note that there are two catalytic filters operating in parallel within the total plant.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

APPLICATION FOR APPROVAL OF PLANS TO CONSTRUCT, INSTALL, OR MODIFY AIR POLLUTION CONTROL EQUIPMENT

Return to: RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
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Section A

1. FULL BUSINESS NAME QSS Biosolids, LLC PHONE (401) 244-7676
2. ADDRESS OF EQUIPMENT LOCATION 135 All American Way, North Kingstown, Rhode Island 02852
   SIC CODE 4953 # EMPLOYEES 25
3. LOCATION ON PREMISES (BLDG., DEPT., AREA, ETC.) Equipment Pad
4. NATURE OF BUSINESS Biochar production through pyrolysis of sewage sludge.

Section B

1. APPROVAL REQUESTED FOR: ☑ CONSTRUCTION ☐ MODIFICATION
2. TYPE OF EQUIPMENT: ☐ BAGHOUSE ☐ SCRUBBER ☐ AFTERBURNER ☐ SCR ☐ CARBON ADSORBER ☑ OTHER (SPECIFY) Catalytic Filter
3. MAKE AND MODEL NO.: Tri-Mer, UCF-HE800
4. ESTIMATED STARTING DATE: Spring 2027 ESTIMATED COMPLETION DATE: Spring 2028

Section C

1. GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE Pyrolysis of sewage sludge generates a pyrolysis gas. The pyrolysis gas generated during biochar production is then treated by a thermal oxidizer. Exhaust from the thermal oxidizer is routed to a catalytic filter unit for SO2, SO3, HCl, HF, NOx, and PM reduction
2. PROCESS EQUIPMENT USED IN OPERATION Pyrolysis infeed systems, pyrolysis reactors, and pyrolysis gas conveyance systems, thermal oxidizers, catalytic filter exhaust recirculation system.
3. OPERATING PROCEDURE: ☑ CONTINUOUS 24 HRS/DAY 7 DAYS/WEEK 52 WEEKS/YEAR
   ☐ BATCH ____ HRS/BATCH ____ BATCHES/WEEK ____ WEEKS/YEAR
4. LIST THE TYPE AND QUANTITY OF RAW MATERIALS USED PER HOUR OR PER BATCH ON AN ATTACHED SHEET.

Section D

EMISSIONS INFORMATION:

POLLUTANT	EMISSIONS BEFORE CONTROL EQUIPMENT	AFTER
See attached PTE		

Note: A portion of the exhaust from the catalytic filter is recirculated to the thermal oxidizer for additional NOx control. PTE calculations are based on the flue gas discharged from stack.

INDICATE METHOD USED TO DETERMINE EMISSIONS Based on information provided by vendor.

Section E

30874 Nm3/hr - Flowrate after catalytic filter per line, before recirculation.

EMISSION STREAM CHARACTERISTICS

1. MAXIMUM FLOW RATE (SCFM) 19574
2. TEMPERATURE (°F) 575
3. MOISTURE CONTENT 21.2 (% vol) %
4. HALOGENATED ORGANICS: ☑ YES ☐ NO
5. HEAT CONTENT (IF APPLICABLE) 11 BTU/SCF

Note: The catalytic filter is preceded by a multi-stage thermal oxidizing unit and followed by a partial exhaust recirculation system to the thermal oxidizer for additional NOx control. The emission stream characteristics presented here are after the catalytic filter but before the recirculation system.

Section F

SCRUBBER

1. WET:SCRUBBING LIQUID
   (A) COMPOSITION ______
   (B) FLOW RATE (GAL/MIN) ______
   (C) INJECTION RATE (PSI) ______
   (D) MAKE-UP RATE IF RE-CIRCULATED (GAL/MIN) ______

   PACKING-IF APPLICABLE
   (A) TYPE ______
   (B) DEPTH OF BED ______ (FEET)
   (C) PACKING SURFACE ______ (FT^2)
2. DRY:SCRUBBING REAGENT: Hydrated Lime and Ammonia USAGE 58 and 12 LB/HR.
   INJECTION RATIO: ______ ( )
   MIXING METHOD Turbulence in the pipe
3. PRESSURE DROP ACROSS CONTROL UNIT: N/A INCHES WATER

26 kg/hr per line, total 52 kg/hr (Lime)

12.2 kg/hr per line, total 24.4 kg/hr (Aqueous Ammonia)

Lime is primarily for SOx removal and Ammonia is for NOx removal.

BAGHOUSE/FABRIC FILTER

800 catalyst tubes per line, 1600 tubes in total.

1. BAG/FILTER MATERIAL Ceramic 2. NUMBER OF BAGS 800
3. AIR/CLOTH RATIO N/A FEET/MINUTE
4. METHOD OF CLEANING: (A) ☐ SHAKER ☑ PULSE ☑ REVERSE AIR ☐ OTHER-SPECIFY
   (B) FREQUENCY OF CLEANING Cleaned at high pressure drop
   (C) IS CLEANING AUTOMATIC OR MANUAL Automatic

Note: This filter combines traditional filtration methods with catalytic processes to enhance pollutant removal efficiency. See the attached process description for additional information on the catalytic technology.

CARBON ADSORBER

1. VOLUME OF EACH CARBON BED ______ (FT^3)
2. NUMBER OF BEDS ______
3. DIAMETER OF EACH BED ______ (FT)
4. DEPTH OF EACH BED ______ (FT)
5. ADSORBTION CAPACITY OF CARBON (LB/100 LB CARBON) ______
6. ADSORBTION CYCLE TIME ______ (HR)
7. REGENERATION CYCLE TIME ______ (HR)
8. STEAM RATIO (LB STEAM/LB CARBON) ______
9. STEAM SOURCE ______
10. REMOVAL EFFICIENCY (%) ______

INCINERATION

1. THERMAL AFTERBURNER
   A. VOLUME OF COMBUSTION CHAMBER ______ (FT^3)
   B. MINIMUM OPERATING TEMPERATURE ______ (°F)
   C. RESIDENCE TIME ______ (SECONDS)
   D. EXCESS AIR ______ %
2. CATALYTIC INCINERATION
   A. TYPE OF CATALYST ______
   B. VOLUME OF CATALYST ______ (FT^3)
   C. SPACE VELOCITY ______ (HR^{-1})
   D. CATALYST OPERATING TEMPERATURE ______ (°F)

	INCINERATION (CONT.) 3. BURNER MAKE AND MODEL NO.____________________ CAPACITY (BTU/HR)____________________ 4. HEAT RECOVERY: ☐ YES ☐ NO TYPE:____________________ EFFICIENCY:__________ % 4. DESTRUCTION EFFICIENCY:_______________ %
Section G	OPERATING CONDITIONS 1. GAS VOLUME THROUGH CONTROL SYSTEM: NORMAL 30577 ACFM @ 620 °F MAXIMUM 38221 ACFM @ 620 °F 2. GAS TEMPERATURE: INLET 620 °F OUTLET 575 °F 3. STACK INFORMATION: (A) I.D. 25.59 INCHES OR _____ INCHES X _____ INCHES (B) STACK HEIGHT ABOVE GROUND 120 FEET (C) CFM EXHAUSTED 7022 11245 ACFM @ 633 F and 7822 SCFM (D) IS STACK EQUIPPED WITH RAIN HAT? ☐ YES ☑ NO 5. DISTANCE FROM DISCHARGE TO NEAREST PROPERTY LINE 190 FEET.
Section H	COLLECTION DATA 1. DESCRIPTION OF COLLECTED MATERIAL Particulate matter from pyrolysis and the catalytic reaction byproducts from powdered sorbents that are injected upstream of the filters are captured as particulate. 2. AMOUNT COLLECTED (LBS/DAY; GAL/DAY; ETC.) 3767 LBS/DAY 3. ULTIMATE DISPOSITION OF COLLECTED MATERIAL Disposal ____________________ Collected 71.2 kg/hr per TO and 142.4 kg/hr from both lines in total.
Section I	IN ADDITION TO THE ABOVE INFORMATION, THE FOLLOWING INFORMATION IS REQUIRED: 1. FLOW DIAGRAM SHOWING RELATIVE LOCATION OF EQUIPMENT ATTACHED TO THIS CONTROL SYSTEM. 2. MANUFACTURER'S LITERATURE FOR THE CONTROL EQUIPMENT. 3. ENGINEERING DRAWINGS FOR THE CONTROL EQUIPMENT WITH PHYSICAL DIMENSIONS. 4. PARTICULATE COLLECTION EQUIPMENT SHOULD HAVE SIZE EFFICIENCY CURVES. ABSORPTION AND ADSORPTION EQUIPMENT SHOULD HAVE SIZING CALCULATIONS, GRAPHS, EQUILIBRIUM DATA, ETC.

This application is submitted in accordance with the provisions of Chapter 23-23 of the General Laws, as amended, in "Air Pollution Control Permits" 250-RICR-120-05-09 and to the best of my knowledge and belief is true and correct.

[signature]	Managing Member
Signature	Title
Mark DePasquale	4/23/2025
Printed Name	Date

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL PERMIT FEES

The Department's rules and regulations require the payment of fees for air pollution permits. All application fees must be submitted with permit application to:

RI Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, RI 02908

THE APPLICATION FORM AND ANY ACCOMPANYING DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF AIR RESOURCES AT THE ADDRESS SHOWN ON THE APPLICATION FORM.

Please complete this form, attach it to the check or money order and submit it to the Office of Air Resources. Payment should be made payable to General Treasurer, State of Rhode Island. The information requested below must be provided to coordinate the filing of your fee with your application(s). This fee is a filing fee and therefore it must be paid before we can begin review of your application(s).

APPLICANT'S NAME: Mark DePasquale - QSS Biosolids, LLC

GENERAL DESCRIPTION OF PROCESS FROM WHICH POLLUTANTS ARISE:

Pyrolysis of sewage sludge generates a pyrolysis gas. The pyrolysis gas generated during biochar production is then treated by a thermal oxidizer. Exhaust from the thermal oxidizer is routed to a catalytic filter unit for SO2, SO3, HCl, HF, NOx, HAPs, dioxins, and PM reduction (including metals except mercury).

FEE SUBMITTED:

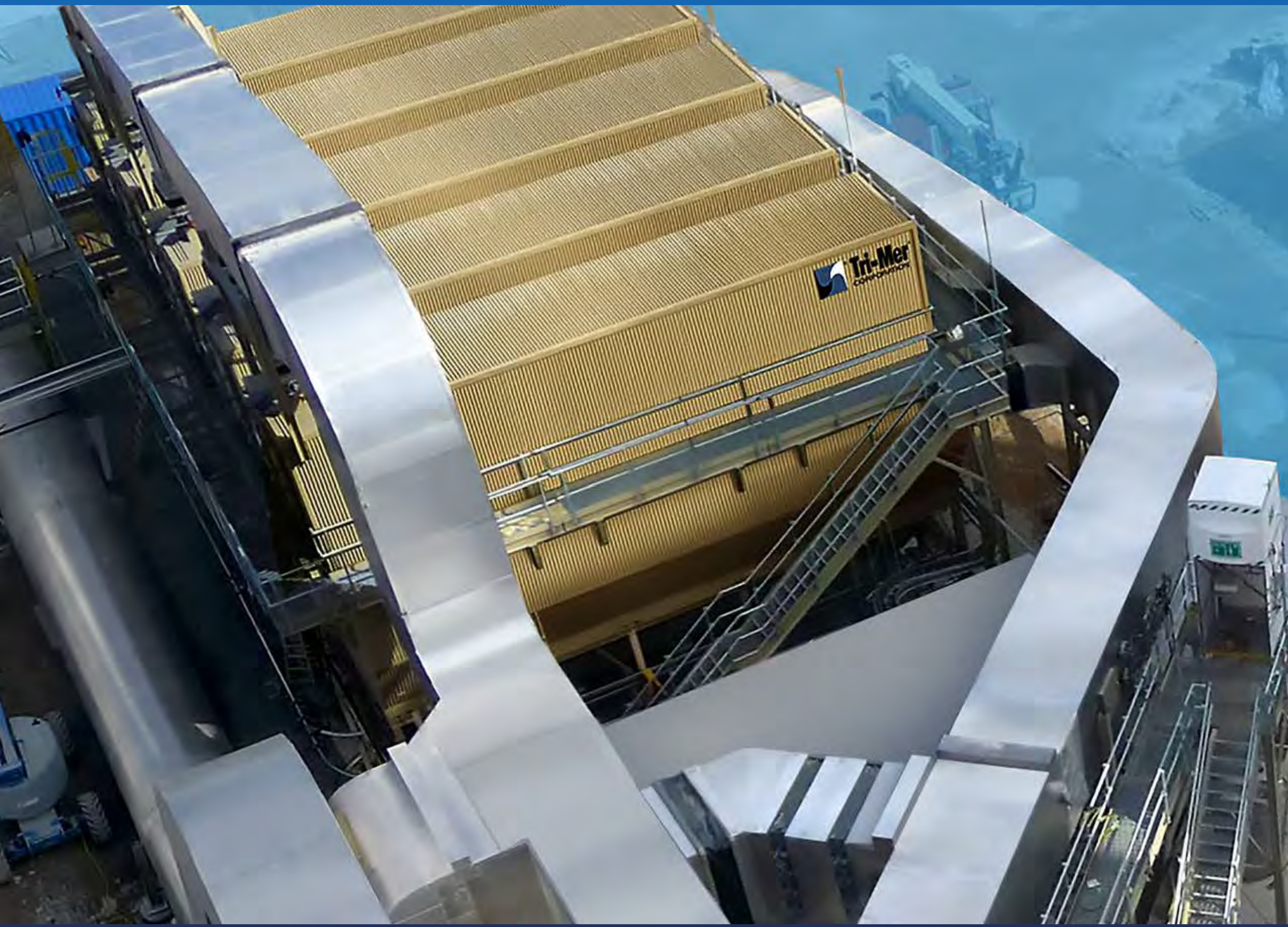
Major Source or Major Modification @ $25,410 each	______
Complex Minor source or Modification @ $4,620.00 each	x2
Minor source or Modification @ $ 1,271.00 each	______
TOTAL	$9,240

For entire permit application per RIDEM during pre-application meeting.

FOR OFFICE USE ONLY:
Fee Amount Received: $ ___________
Date Received: ___________________
Received By: ___________________
For Deposit into Account 1752-80600

UltraCat

Catalytic Filter Systems



Particulate • NOx • SOx • HCl • VOC • O-HAP • Hg • D/F • CO

Tri-Mer® CORPORATION

Tri-Mer has installed more Catalytic Ceramic Filter Systems than all other suppliers combined, ***worldwide.***

Tri-Mer Corporation is the World's Largest Supplier of Ceramic Catalyst Filter Systems

All-in-One Solution

Tri-Mer UltraCat Catalytic Filter Systems are state-of-the art for removing particulate (PM), SO_2, HCl, mercury and heavy metals. Simultaneously, the ceramic catalyst filters destroy NOx, cement organic HAPs, and dioxins. Systems can be configured for any combination of the pollutants.

The system is completely dry, with no water consumption. Disposal of the dry collected waste is straightforward. Large gas flow volumes can be accommodated.

PM • SOx • NOx • VOC • Dioxins • HCL • Hg • CO

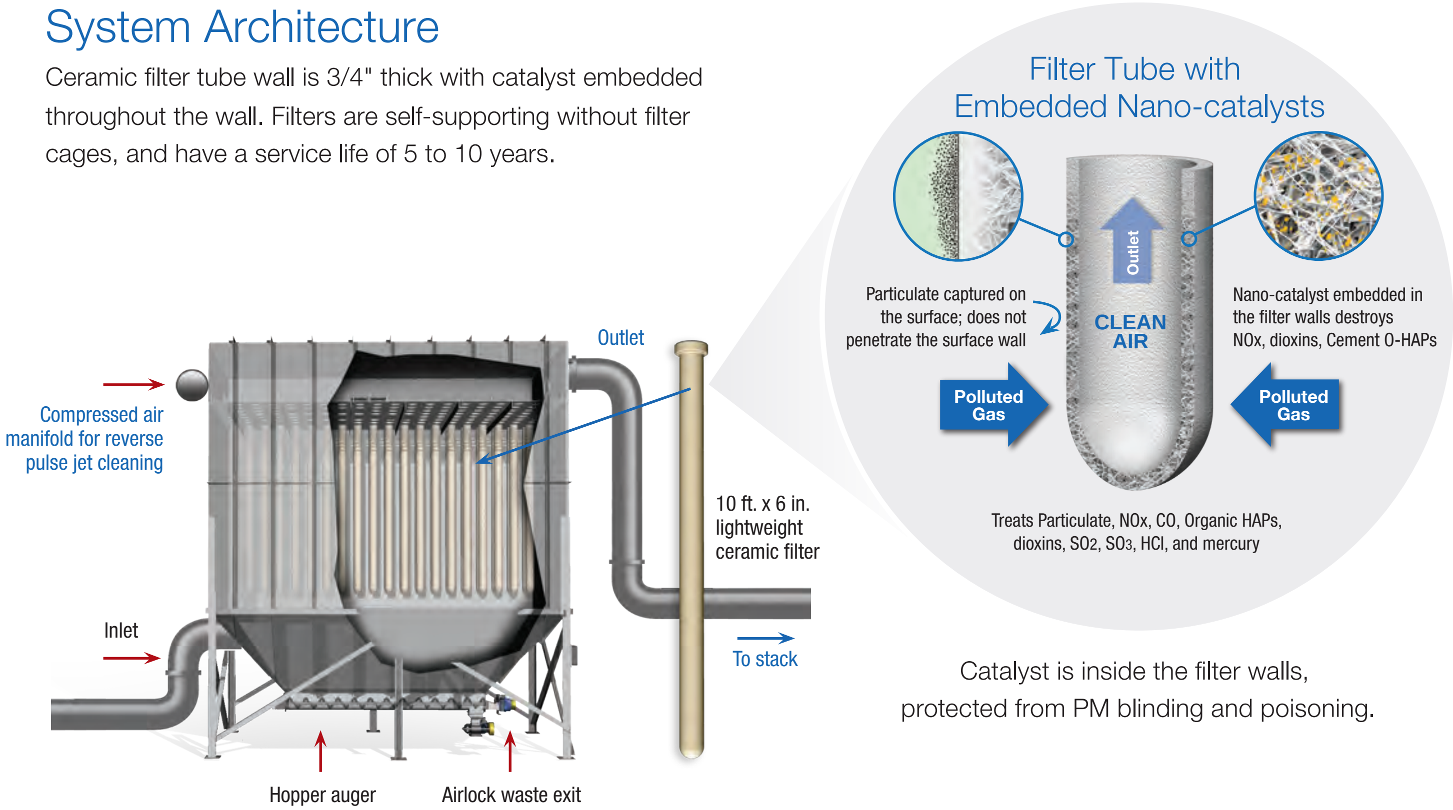
Boiler MACT • CISWI MACT • Lime MACT 2

HWC MACT • Cement NESHAP • Title V Compliance

CARB Diesel Regs • EPA Glass Regs • EPA Ceramics Regs

System Architecture

Ceramic filter tube wall is 3/4" thick with catalyst embedded throughout the wall. Filters are self-supporting without filter cages, and have a service life of 5 to 10 years.



Catalyst is inside the filter walls, protected from PM blinding and poisoning.

Particulate Control

Tri-Mer's UltraCat Filter System removes particulate from gas sources above 300°F, including PM10, PM2.5, and submicron. Typical outlet levels are less than 0.001 grains / dscf (2.0 mg/Nm^3) regardless of inlet loading. Heavier loadings require more frequent pulse-jet cleaning of the filters but outlet levels remain the same.

NOx Control

UltraCat Catalytic filter tubes have nanobits of SCR catalyst embedded in the filter walls. Operating range is 350°F to 950°F. The large reactive surface area of the micronized catalyst produces high NOx removal at temperatures lower than standard SCR. Good results start at 350°F and improve to 95% removal at 450°F and above.

The unique structure of the filters captures process particulate on its outer surface, keeping it away from the nano-catalyst inside the filter walls. This prevents PM blinding and poisoning of the catalyst, and greatly extends the catalyst life compared to standard SCR.

Cement O-HAPs, Dioxin, VOCs

The VOCs designated as organic HAPs in cement regulations are destroyed by the embedded catalyst. Good removal on the primary Cement O-HAPs occurs at temperatures over 400°F, with excellent results on all Cement O-HAPs approaching 500°F. Other VOCs are also selectively destroyed. Dioxins are eliminated by the filters, typically with 95% efficiency or higher.

SO_2, SO_3, HCI, HF Removal Using Dry Sorbent Injection

Systems have an option for dry sorbent injection of calcium or sodium-based sorbents (hydrated lime, sodium bicarbonate and trona) to remove SO_2, SO_3, HCI and HF.

Powdered sorbents are injected upstream of the filters and the reaction by-products captured as particulate at the filters. The SO_2 removal reaction occurs within the duct leading to the filters and at the sorbent cake that accumulates on the surface of the filters. The chemical reaction of the sorbent with the acid gas creates a solid particle that is captured on the filters, along with the unreacted sorbent and the process particulate.

With dry sorbent injection, SO_2 removal is typically 90-95%, with removal efficiencies as high as 97%. HCl removal is typically 95%, and often as high as 99%. The temperature range for effective removal is 300°F to 1600°F.

Mercury Control

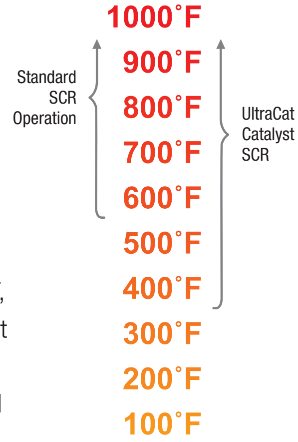
The system removes mercury using injection of dry sorbents. Powder activated carbon and other sorbents, some pre-blended with the acid gas sorbents, are selected on a case-by-case basis. Mercury control is a key feature.

CO Removal

Tri-Mer systems can be configured to remove Carbon Monoxide, simultanously with other pollutants, at temperatures of 450°F and above.

A Revolution in NOx Control

- Very high removal efficiency, greater than 90%
- Greater than 90% removal at 400°F.
- Extended catalyst life because the micronized catalyst is embedded within the body of the filter and protected from blinding and poisoning.



The combination of these factors has revolutionized NOx removal, especially for applications that have temperature limitations and/or require the simultaneous removal of other pollutants.

At even lower temperatures, 350°F, the UCF system will remove NOx at approximately 70% efficiency. In addition to NOx, catalytic filters will remove PM, Cement O-HAPs and dioxins, and can be configured to remove CO, SO_2, HCl, and HF. Regulatory authorities have recognized the Tri-Mer UCF system to be a major advance in NOx and multi-pollutant control technology.

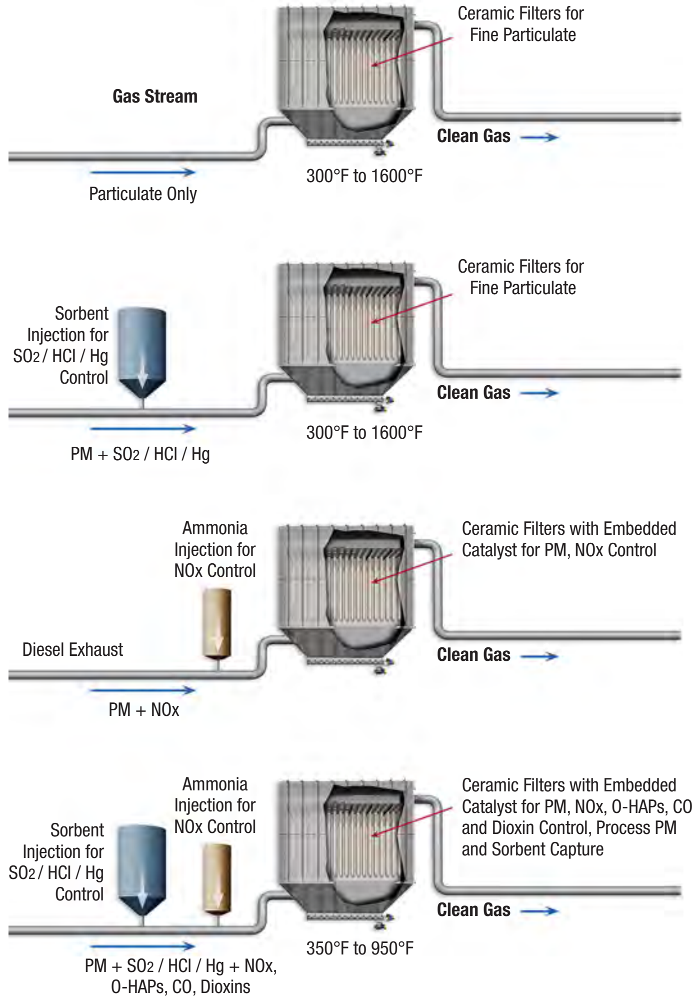
UltraCat Catalytic Filter and Power Generation Systems

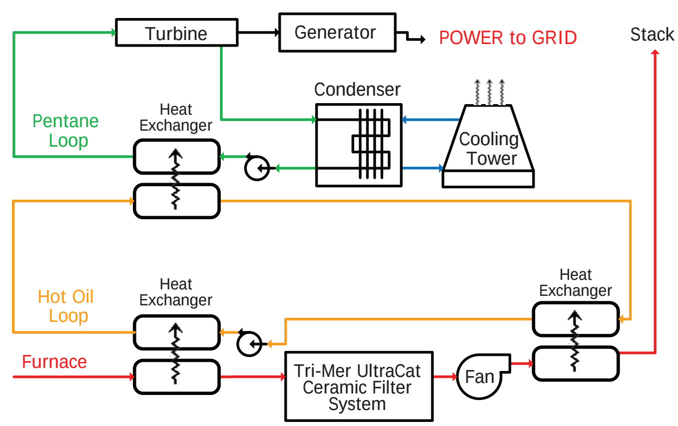
Tri-Mer UltraCat filter systems are ideal for maximizing the energy that can be extracted from furnace exhaust for use in an Organic Rankine Cycle (ORC) power generation loop. The heat is transferred to a hot oil intermediate loop, and then to an ORC loop (see figure below right).

Conventional technologies such as ESP and SCR have narrow hot operating ranges, and sizable heat loss across their combination. In contrast, the UCF is equally effective for pollutant removal over a very wide temperature range, including cooler temperatures (see NOx figure above), with a very low heat loss. The high tie-in temperature at the upstream heat exchanger, combined with a much lower exit temperature to the UCF system creates a greater ΔT. This increases thermodynamic efficiency. After the UCF cleans the gas, a second downstream stage of heat removal is incorporated.

The UCF flexibility allows continued control of emissions in the event the power generation loop goes offline for maintenance, making the UCF system the ideal pollution control technology to pair with heat recovery.

Several Versions of One Highly Effective System

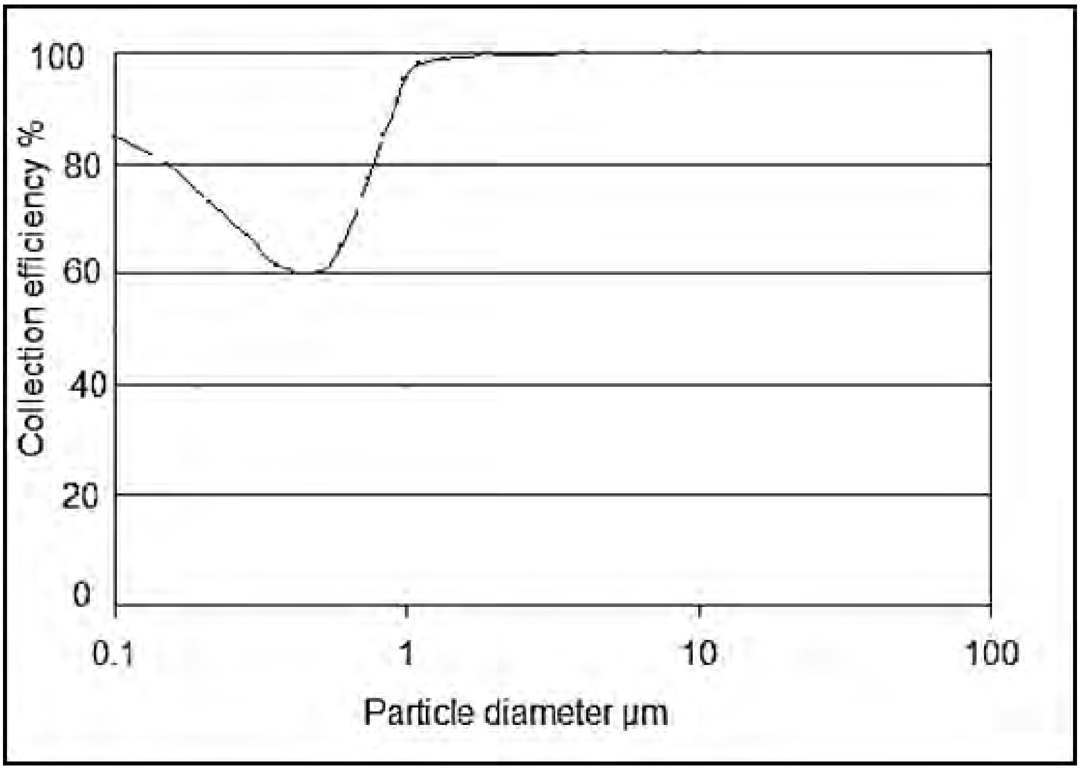


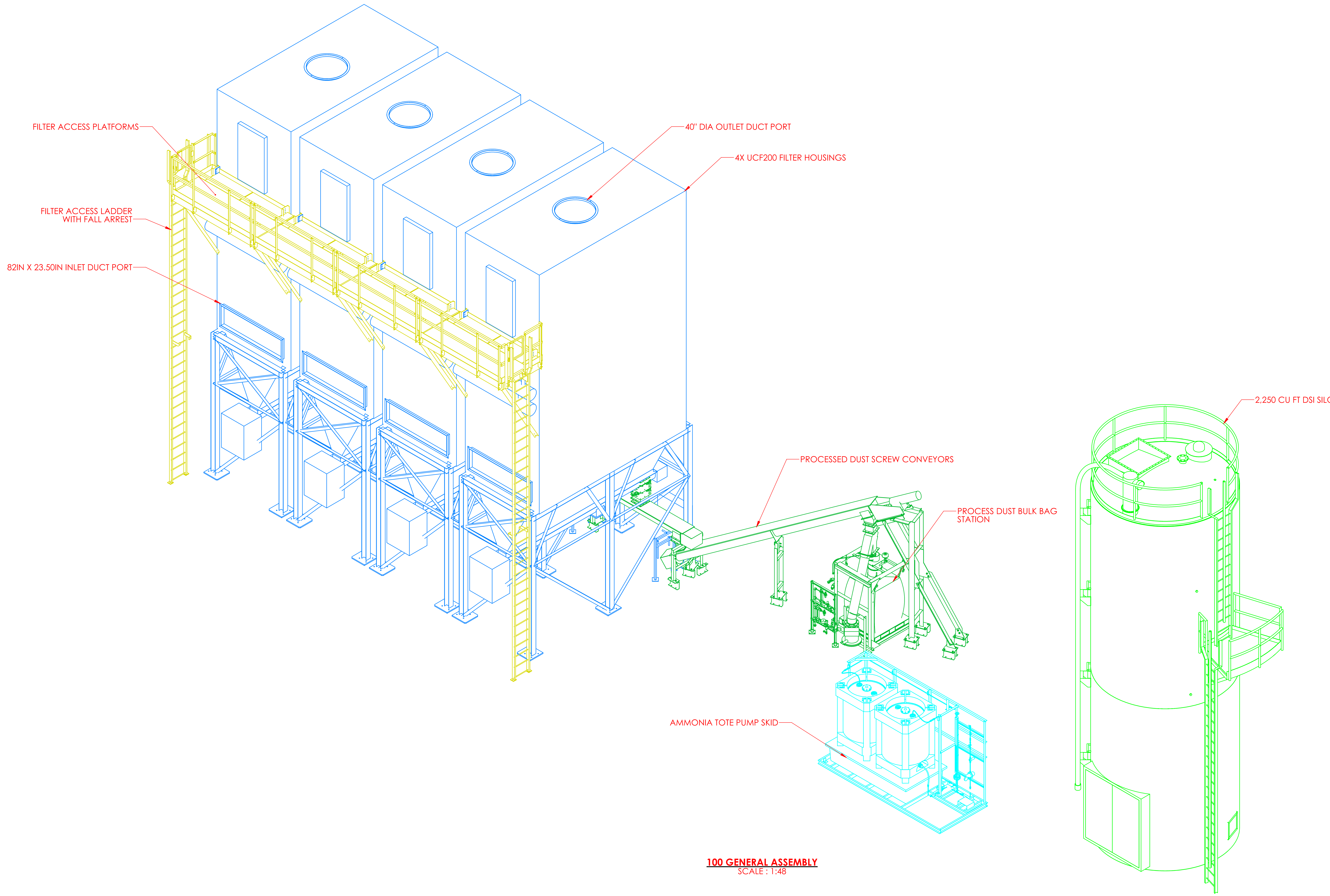


The Tri-Mer System presents the optimal combination for pollution control performance and electrical power generation.

Tri-Mer® CORPORATION Technology Leader *air pollution control*

PM size/collection efficiency curve for Catalytic Filter





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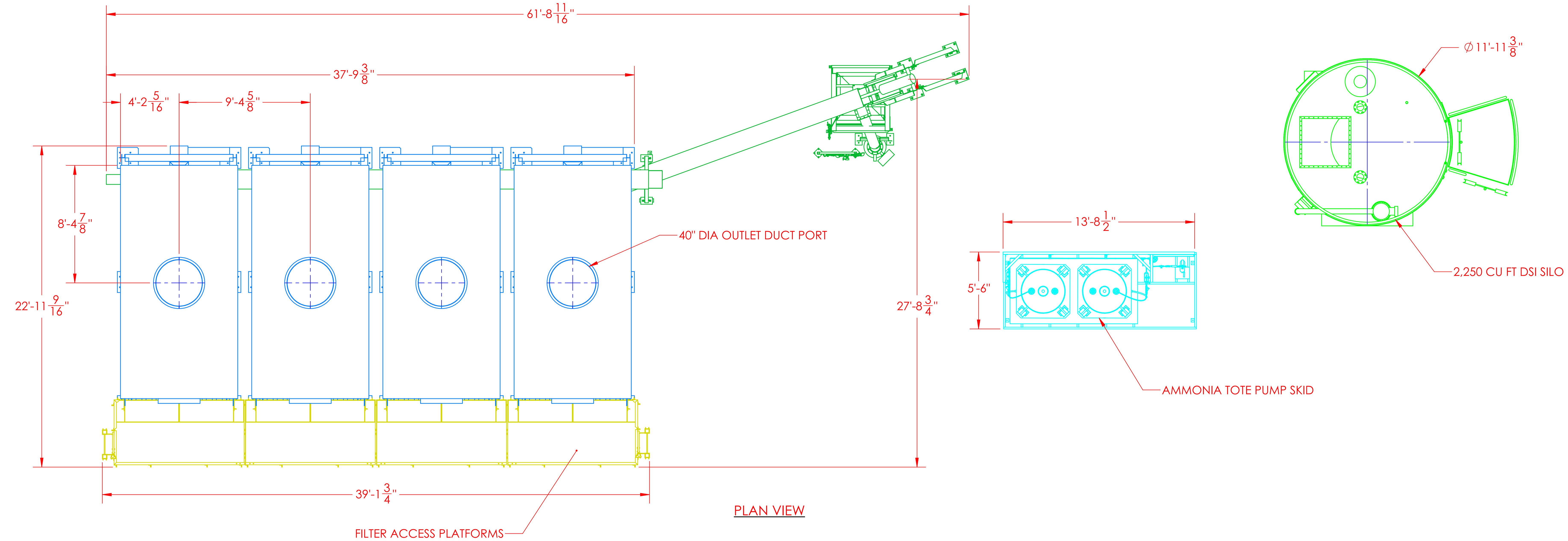
Tri-Mer® CORPORATION

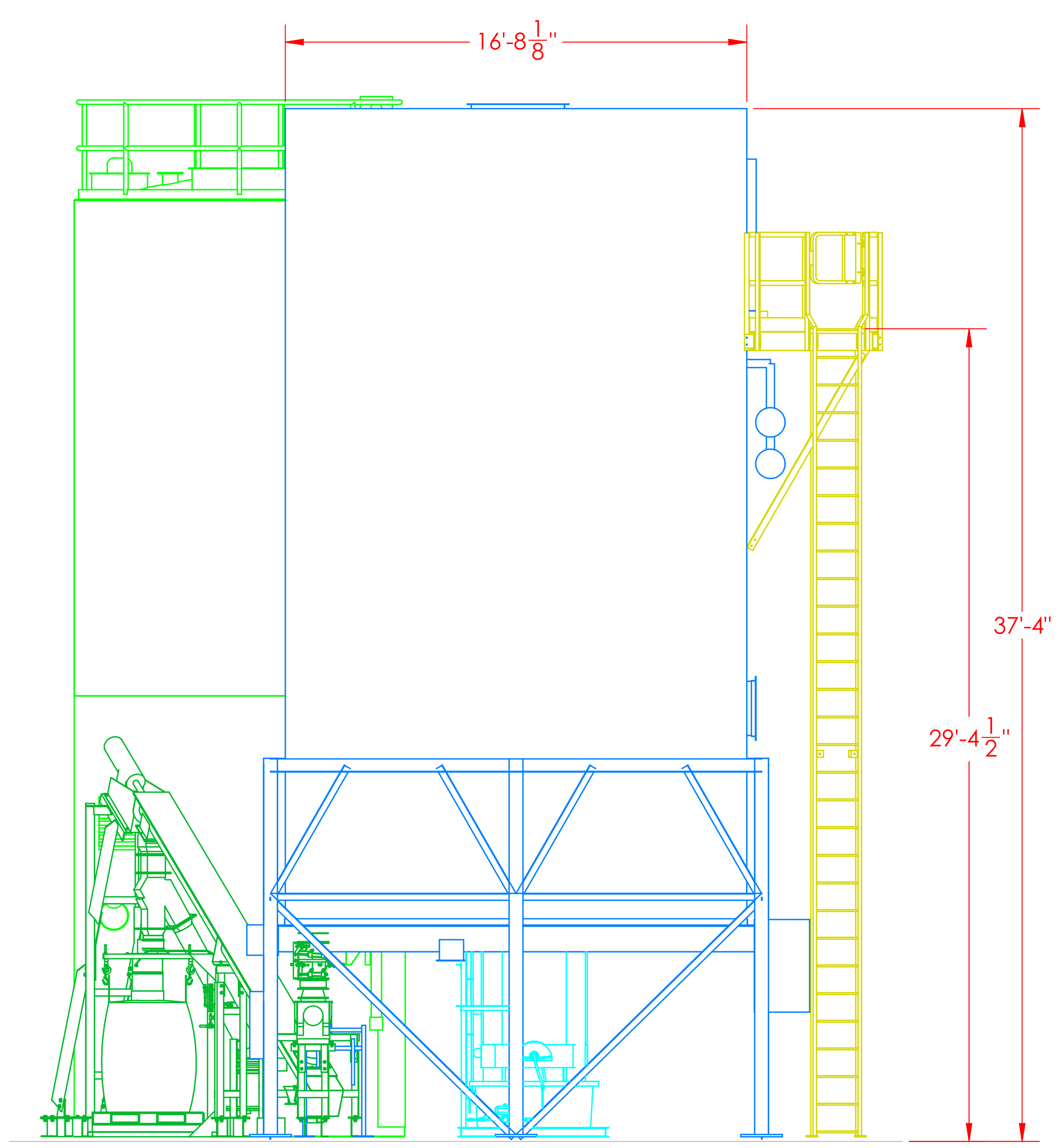
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ± 1/64
ANGULAR: MACH ± .05 BEND ± .5
TWO PLACE DECIMAL ± .03
THREE PLACE DECIMAL ± .005
MATERIAL
VARIOUS
FINISH

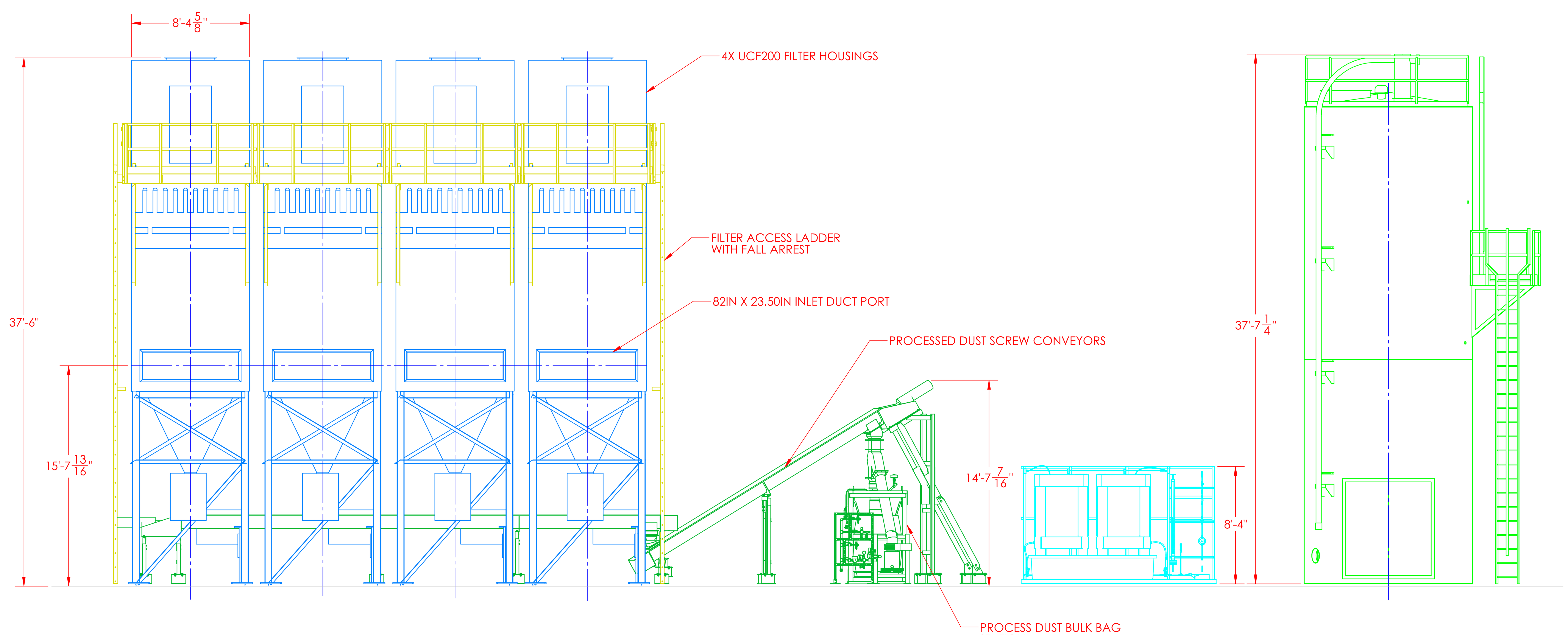
PN: P26.242-100
REV 0
DESCRIPTION: GENERAL ASSEMBLY
DRAWN BY: C.A.E. DATE: 1/15/2025
CHECKED BY: D.B. DATE: 1/15/2025
SIZE D
SHEET 1 OF 2



PLAN VIEW



LEFT ELEVATION



FRONT ELEVATION

PROPRIETARY AND CONFIDENTIAL

THIS DRAWING IS CONFIDENTIAL AND MUST NOT BE COPIED OR SUBMITTED TO OUTSIDE PARTIES FOR USE OR EXAMINATION. IT IS SUBJECT TO RETURN ON DEMAND.

Tri-Mer® CORPORATION

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TOLERANCES:
FRACTIONAL ± 1/64
ANGULAR: MACH ± .05 BEND ± .5
TWO PLACE DECIMAL ± .03
THREE PLACE DECIMAL ± .005
MATERIAL
VARIOUS
FINISH

PN: P26.242-101 REV 0

DESCRIPTION: GENERAL ASSEMBLY

DRAWN BY: C.A.E. DATE: 1/15/2025

CHECKED BY: D.B. DATE: 1/15/2025

SIZE D

SHEET 2 OF 2

APPENDIX H

Rhode Island Department of Environmental Management

OFFICE OF AIR RESOURCES
Expedited Minor Source Permit Application Checklist

This checklist should be used by an applicant that is preparing a minor source permit application for which expedited processing is requested. The completed checklist shall accompany the permit application when it is submitted to the Office of Air Resources.

- ☑ Pre-application meeting was requested prior to submission of minor source permit application.
- ☑ Date of Pre-application Meeting (if required by OAR): April 1, 2025
- ☑ Submission and OAR approval of a modeling protocol as required in the *Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources* was submitted **prior to** submitting an expedited permit application. Submitted March 23, 2025; Approved April 9, 2025
- ☑ Two (2) copies of the completed application for each installation or modification of a device, piece of equipment or air pollution control system as described in "Air Pollution Control Permits" 250-RICR-120-05-9.7.1. Per email correspondence from RIDEM on March 13, 2024, the RIDEM OAR is converting all paper files to digital, so only an electronic application is being submitted.
- ☑ Description of the proposed project, including narrative and process flow diagram(s).
- ☑ Description of operations at the existing stationary source, if applicable. See Section 1.3, Appendix A, and Appendix B of the air permit application.
- ☑ Potential to emit calculations of the proposed project. (Supporting calculations shall be included) See Section 2.0 and Appendix C of the air permit application
- ☑ Potential to emit calculations of the existing stationary source, if applicable. (Supporting calculations shall be included) Not applicable - new source.
- ☑ For **proposed new sources**, demonstration that the new source is not a "major stationary source". (Supporting calculations shall be included) See Section 2.0, Section 3.1, and Appendix C of the air permit application.
- ☑ For **existing sources**, demonstration that the proposed modification to the existing stationary source is not a "major modification". (Supporting calculations shall be included) Not applicable - new source.
- ☑ Identification of all applicable State Air Pollution Control Regulations the proposed project is subject to. A demonstration shall be included explaining how the proposed project will comply with each identified state regulation. See Section 3.2, Section 3.3, and Appendix D of the air permit application.
- ☑ Identification of all applicable federal Air Pollution Control Regulations the proposed project is subject to. A demonstration shall be included explaining how the proposed project will comply with each identified federal regulation. See Section 3.2, Section 3.3, and Appendix D of the air permit application.

Expedited Minor Source Permit Application Checklist (continued)

☑ A demonstration that the stationary source will comply with all applicable state and federal regulations at the time the stationary source or modification commences operation. See Section 3.2, Section 3.3, and Appendix D of the air permit application.

☑ Best Available Control Technology (BACT) "top-down" analysis that complies with 250-RICR-120-05-9.7.3(A)(1). The analysis shall clearly indicate the information sources that were utilized for the proposed project's BACT analysis. See Section 4 of the air permit application

☑ Air Quality Impact Analysis that demonstrates that the emissions from the stationary source will not cause the following:

- Air pollution in violation of any applicable state or federal ambient air quality standard; and
- An increase in ground level ambient concentrations at or beyond the property line in excess of that allowed by "Air Toxics", 250-RICR-120-05-22 and any calculated Acceptable Ambient Levels (AALs). See Appendix E of the air permit application.

☑ A proposed draft permit (electronic and hard copy submissions). See Appendix F of the air permit application.

☑ Electronic copies of all spreadsheets. Provided as a separate attachment *via* email.

Application received by OAR:________________________

Completeness review conducted:______________________