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RAMBOLL

ENVIRONMENT
& HEALTH

Laura Corl
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Virginia Department of Environmental Quality
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Virginia Beach, Virginia 23462

Re: **Application for Modification of Stationary Source Permit for Increased Softwood Utilization and Installation of Emission Controls**
Enviva Pellets Southampton, LLC
Southampton County, Virginia
Registration No.: 61653
AFS Id. No.: 51-175-00060

Date September 28, 2018

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Dear Ms. Corl:

Enclosed please find a Virginia Department of Environment Quality (VA DEQ) permit application package for a permit modification to incorporate facility changes at the Enviva Pellets Southampton, LLC (Enviva) (VA DEQ Facility ID #51-175-00060) facility located in Southampton County. This submittal fulfills the requirements to submit a substantially complete permit application on or before September 30, 2018 as required by the August 1, 2018 letter from Michael Dowd of VA DEQ to Enviva. Enviva's wood pellet manufacturing plant (referred to herein as "the Southampton plant" or "the facility") is currently authorized under a Stationary Source Permit to Modify and Operate issued by DEQ on January 6, 2015.

Enviva is submitting this permit modification application to reflect planned changes associated with increased softwood utilization and the installation of emission controls at the Southampton plant. These changes are being implemented to meet new customer softwood percentage and production rate demands and to incorporate significant emission reduction efforts to minimize emissions impacts associated with the project. The Southampton plant's potential emissions for all criteria pollutants will remain below the Prevention of Significant Deterioration (PSD) major source thresholds of 250 tons per year (tpy) following completion of the proposed changes. In addition, the facility will remain below the major hazardous air pollutant (HAP) source thresholds and continue to be classified as an area source of HAP emissions. The facility will continue to be classified as a major source under the Title V program due to criteria pollutant emissions greater than 100 tpy.

As required, two (2) copies of the complete permit application package, including the application fee form for the required $25,000 fee, are enclosed.

Thank you for your prompt attention to this matter. If you have any questions regarding this request, please contact me at (225) 408-2691 or Kai Simonsen, Air Permit Engineer at Enviva, at (984) 789-3628.

Yours sincerely,

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Enclosures: Permit Application including Appendices

cc: Michael Dowd, Virginia DEQ Richmond
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Project Number
1690009469

Date
September 2018

APPLICATION FOR MODIFICATION OF STATIONARY SOURCE PERMIT FOR THE INCREASED UTILIZATION OF SOFTWOOD AND THE INSTALLATION OF EMISSION CONTROLS

ENVIVA PELLETS SOUTHAMPTON, LLC

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ACRONYMS AND ABBREVIATIONS

AP-42	Compilation of Air Pollutant Emission Factors
bhp	brake horsepower
BMP	Best Management Practice
CAA	Clean Air Act
CAM	Compliance Assurance Monitoring
CFR	Code of Federal Regulations
CI	Compression Ignition
CO	Carbon Monoxide
EPA	US Environmental Protection Agency
FSC	Forest Stewardship Council
GEP	Good Engineering Practice
HAP	Hazardous Air Pollutant
hp	horsepower
ICE	Internal Combustion Engine
lb	Pound
MACT	Maximum Achievable Control Technology
MMBtu	Million British thermal units
NAAQS	National Ambient Air Quality Standards
NCASI	National Council for Air and Stream Improvement
NED	National Elevation Dataset
NESHAP	National Emission Standards for Hazardous Air Pollutants
NNSR	Nonattainment New Source Review
NO_X	Nitrogen Oxides ($NO + NO_2$)
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
ODT	Oven Dried Tons
PEFC	Programme for the Endorsement of Forest Certifications
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter Less Than 2.5 Micrometers in Aerodynamic Diameter
PM_{10}	Particulate Matter Less Than 10 Micrometers in Aerodynamic Diameter

PSD	Prevention of Significant Deterioration
PSEU	Pollutant Specific Emission Unit
RICE	Reciprocating Internal Combustion Engine
RCO	Regenerative Catalytic Oxidizer
RTO	Regenerative Thermal Oxidizer
SAAC	Significant Ambient Air Concentrations
SIP	State Implementation Plan
SNCR	Selective Non-Catalytic Reduction
SO_2	Sulfur Dioxide
SFI	Sustainable Forestry Initiative
TAP	Toxic Air Pollutant
TCO	Thermal Catalytic Oxidizer
tph	tons per hour
tpy	tons per year
USGS	U.S. Geological Survey
VA DEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compounds
WESP	Wet Electrostatic Precipitator

1. INTRODUCTION

Enviva Pellets Southampton, LLC (Enviva) owns and operates a wood pellet manufacturing plant (referred to herein as "the Southampton plant" or "the facility") located in Southampton County, Virginia. The Southampton plant currently operates under a Stationary Source Permit to Modify and Operate issued January 6, 2015, by the Virginia Department of Environmental Quality (VA DEQ). The facility is currently permitted to produce up to 535,260 oven-dried tons (ODT) per year of wood pellets utilizing up to 10% softwood on a 12-month rolling basis. The Southampton plant consists of the following processes: Log chipper, Debarker, Bark Hog, Green Wood Hammermills, Rotary Dryer, Dry Hammermills, Pellet Presses and Coolers, product loadout operations and other ancillary activities.

The Southampton plant is a major source with respect to the Title V permitting program because potential facility-wide emissions of one or more criteria pollutants are estimated to be above the major source threshold of 100 tons per year (tpy). Additionally, the facility is classified as an area source of hazardous air pollutants (HAP) because potential total HAP emissions and maximum individual HAP emissions are estimated to be below the major source threshold of 25 tpy and 10 tpy, respectively. The facility is considered minor with respect to New Source Review (NSR) permitting programs because criteria pollutant emissions are estimated to be below the 250 tpy threshold.

Enviva is submitting this permit modification application to request planned changes for the Southampton plant to increase softwood utilization and install emission controls. These changes are being implemented to meet new customer softwood percentage and production rate demands, and to incorporate significant emission reduction efforts to minimize emissions impacts associated with the project. This submittal fulfills the requirement to submit a substantially complete permit application on or before September 30, 2018 as required by the August 1, 2018 letter from Michael Dowd of VA DEQ to Enviva. Incorporation of these changes will allow the facility to increase softwood utilization and production rate while remaining under the PSD major source threshold of 250 tpy for all criteria pollutants and the Title V major source thresholds for HAP. The facility will, however, continue to be classified as a major source under the Title V program due to potential criteria pollutant emissions above the 100 tpy threshold.

The following summarizes the proposed physical changes and changes in the method of operation associated with this project:

- Increase production rate from 535,260 ODT per year to 781,255 ODT per year while increasing the amount of softwood processed from a maximum of 10% to a maximum of 80%;
- Add a regenerative thermal oxidizer (RTO) (CD-RTO-1) to the existing Dryer (currently identified in the permit as ES-DRYER but requested to be identified as ES-DRYER-1 hereinafter) following the existing wet electrostatic precipitator (WESP), which is identified in the current permit as CD-WESP but is requested to be identified as CD-WESP-1 hereinafter;
- Install a new direct wood fired Dryer (ES-DRYER-2) equipped with a new multicyclone separator (CD-DC-2), new WESP (CD-WESP-2), and new RTO (CD-RTO-2);

- Remove two (2) existing Re-chippers (ES-RCHP-1 and 2) and construct five (5) new closed-loop Green Wood Hammermills (ES-GHM-1 through 5) that will route to the existing WESP (CD-WESP-1), followed by the new RTO (CD-RTO-1);
- Add a chiller with air to air exchanger to cool and dry the pellet cooler air supply for product quality improvement;
- Include dryer and furnace bypass stacks for each Dryer (ES-DRYERBYP-1, ES-DRYERBYP-2, ES-FURNACEBYP-1, and ES-FURNACEBYP-2);
- Add four (4) burners to heat the exhaust gas and recirculation ducts for each Dryer system (two burners per dryer line), herein referred to as Double Duct Burners (ES-DDB-1 through ES-DDB-4);
- Add a second pre-screener prior to the Dry Hammermills (part of ES-DWH) and add a baghouse to control emissions from existing and new pre-screeners (CD-DWH-BF);
- Add chip reclaim automation by adding up to three truck tippers and a stacker reclaimer, and removing most front-end loader usage;
- Route exhaust from the baghouses (CD-HM-BF-1 to 3) that control the Dry Hammermills (ES-HM-1 to 8) to a new wet scrubber (CD-WS-1), followed by a new regenerative catalytic oxidizer (RCO) (CD-RCO-1), that can also operate as an RTO;
- Route the Pellet Cooler (ES-CLR-1 to 6) exhaust through a new wet scrubber (CD-WS-2) and then to the Dry Hammermills (ES-HM-1 to 8), which will exhaust to another wet scrubber (CD-WS-1) and the new RCO/RTO (CD-RCO-1);
- Add four burners to reduce risk of moisture condensation on the ductwork associated with the Pellet Cooler and Dry Hammermill exhaust, hereinafter referred to as Double Duct Burners (ES-DDB-5 through ES-DDB-8);
- Make other pellet mill-related changes, which do not impact emissions from the facility, including upgrades to the pellet mill grease system and replacing the pellet mill gearbox;
- Upgrade the gearbox for the TLO infeed transfer conveyor;
- Rename the Pellet Fines Bin (ES-PFB) to Pellet Cooler HP Relay System (ES-PCHP), and change the ID for the associated baghouse from CD-PFB-BV to CD-PCHP-BF;
- Add a new pellet screener to ES-PCHP, which will also be controlled by the ES-PCHP baghouse (CD-PCHP-BF);
- Create an emissions unit ID for the existing Bark Hog (ES-BARK);
- Add an Additive Silo (ES-ADD) and accompanying baghouse (CD-ADD-BF);
- Add a diesel Storage Tank for mobile sources (ES-TK-3);
- Add a Propane Vaporizer (ES-PVAP) to vaporize liquid propane for combustion by the RTOs, RCO, and double duct burners;
- Add a second walking floor and storage pile for wood fuel (part of ES-GWHS); and
- Remove the Hammermill Area emissions unit (ES-HMA).

A description of the process is provided in Section 2 and methodologies used to quantify potential emissions are summarized in Section 3. Section 4 describes the applicability of federal and state permitting programs. Section 5 includes a detailed applicability analysis of both federal and state regulations. Additionally, Section 6 discusses the facility's compliance with Virginia's Best Available Control Technology (BACT) requirements, and Section 7 discusses the ambient air quality impact analysis for the facility. The completed air permit application forms are included in Appendix D, and a proposed construction and testing schedule is provided in Appendix G as required by the August 1, 2018 letter from Michael Dowd of VA DEQ to Enviva.

2. PROCESS DESCRIPTION

Enviva manufactures wood pellets for use as a renewable fuel for energy generation and industrial customers. Enviva's customers use wood pellets in place of coal, significantly reducing emissions of pollutants such as lifecycle carbon dioxide (CO_2)/greenhouse gases (GHG), mercury, arsenic and lead. The company is dedicated to improving the environmental profile of energy generation while promoting sustainable forestry in the Southeastern United States. Enviva holds certifications from the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), Programme for the Endorsement of Forest Certification (PEFC), and Sustainable Biomass Program (SBP). Enviva requires that all suppliers adhere to state-developed "Best Management Practices" (BMPs) in their activities to protect water quality and sensitive ecosystems. In addition, Enviva is implementing an industry leading "track and trace" system to further ensure that all fiber resources come from responsible harvests. Enviva pays particular attention to: land use change, use and effectiveness of BMPs, wetlands, biodiversity, and certification status. All of this combined ensures that Enviva's forestry activities contribute to healthy forests both today and in the future. A detailed description of Enviva's Responsible Wood Supply Program can be found at: http://www.envivabiomass.com/sustainability/wood-sourcing/responsible-wood-supply-program/

The following sections provide a description of the process and proposed changes to the Southampton plant. An area map and facility layout are provided in Appendix A, and a process flow diagram is provided in Appendix B.

2.1 Green Wood Handling and Storage (ES-GWHS)

"Green" (i.e., fresh cut) wood is delivered to the facility via trucks as either pre-chipped wood or unchipped logs from commercial harvesting for on-site chipping. Pre-chipped wood will be screened, and oversized chips will undergo additional chipping. Logs will be debarked, chipped, and sized in the Green Wood Hammermills (ES-GHM-1 through 5). Chipped wood for drying is conveyed to two (2) green wood storage piles and bark is conveyed to three (3) fuel storage piles. All transfer points and storage piles are captured by the Green Wood Handling and Storage emission ID (ES-GWHS).

2.2 Debarking (ES-DEBARK), Chipping (ES-CHIP), and Bark Hog (ES-BARK)

Logs are debarked by the electric-powered Debarker (ES-DEBARK) and then sent to the Chipper (ES-CHIP) to chip the wood to specification for drying. Purchased chips received by three (3) truck dumps are also transferred to green wood storage piles (part of ES-GWHS). Bark from the Debarker is sent for further processing in the Bark Hog (ES-BARK), and purchased bark and fuel chips from one (1) truck dump or from walking floor trailers are transferred to the bark pile (part of ES-GWHS). As noted above, following storage in the fuel storage piles, fuel chips will be transferred to a blend pile and then transferred via walking floors to a covered conveyor, then to an enclosed fuel storage bin where the material will be pushed into the furnace.

With this application, Enviva proposes to automate the chip reclaim operations by using up to three (3) truck tippers and a stacker reclaimer, as well as removing most front-end loader usage. Enviva also plans to install a second walking floor next to the existing one associated with a new fuel blend pile for the new Dryer line.

2.3 Green Wood Hammermills (ES-GHM-1 - 5)

Prior to drying, chips from the green wood storage piles are currently processed in the two (2) existing Re-chippers (ES-RCHIP-1 and ES-RCHIP-2) to reduce material to the proper size. With this application, Enviva is proposing to remove these Re-chippers and add five (5) new Green Wood Hammermills (ES-GHM-1 through ES-GHM-5), and to route the exhaust of the Green Wood Hammermills to the existing WESP (CD-WESP-1) and to the proposed new RTO (CD-RTO-1) to control PM, VOC, HAP, and toxic air pollutant (TAP) emissions.

2.4 Dryers (ES-DRYER-1 and ES-DRYER-2)

The existing Dryer (ES-DRYER) uses direct contact heat provided to the system via a 175 million British thermal unit per hour (MMBtu/hr) furnace that uses bark and wood chips as fuel. Green wood is fed into the Dryer (ES-DRYER-1) where the moisture content is reduced to the desired level and routed to a product recovery multiclone separator (CD-DC) in series with a wet electrostatic precipitator (CD-WESP-1) for particulate, metallic HAP, and hydrogen chloride removal. With this application, Enviva proposes to rename the existing Dryer from ES-DRYER to ES-DRYER-1, rename the existing multiclone separator from CD-DC to CD-DC-1, and equip the existing Dryer with a new RTO (CD-RTO-1) following the existing WESP (CD-WESP-1). Enviva also proposes to install a new direct contact Rotary Dryer system (ES-DRYER-2) equipped with a new product recovery multiclone separator (CD-DC-2), new WESP (CD-WESP-2), and new RTO (CD-RTO-2) to provide PM, VOC, HAP, and TAP emissions control. The new Dryer, similar to the existing dryer, will use direct contact heat provided to the system via a 180 million British thermal unit per hour (MMBtu/hr) furnace that uses bark and fuel chips as fuel.

As the flue gas exits the Dryers and begins to cool, wood tar can condense and coat the inner walls of the dryer ducts creating a fire risk. To prevent condensation from occurring and thus reduce the fire risk, each dryer system will include double ducts which will be heated. For each dryer line, the duct from the cyclone outlet to the ID fan will be heated by one low-NOx burner with a maximum heat input rating of 1 MMBtu/hr and a second 1 MMBtu/hr low-NOx burner will be used to heat the duct used for exhaust gas recirculation and the WESP. The Double Duct Burners (ES-DDB-1 through ES-DDB-4) will combust natural gas, or propane as back-up, and will exhaust directly to atmosphere.

2.4.1 Dryer Bypass Stacks (ES-DRYERBYP-1, ES-DRYERBYP-2, ES-FURNACEBYP-1, and ES-FURNACEBYP-2)

Bypass stacks for each furnace and rotary dryer may be used to exhaust hot gases during start-ups (for temperature control) and malfunctions. Specifically, the furnace bypass stacks will be used in the following situations:

- **Cold Start-ups:** The furnace bypass stacks are used when the furnace is started up from a cold shutdown until the refractory is sufficiently heated and can sustain operations at a low level. The bypass stack will then be closed, and the furnace will slowly be brought up to a normal operating rate.
- **Malfunction:** The furnace itself can abort and open the bypass stack in the event of a malfunction. This may be caused by failsafe interlocks associated with the furnace or dryer and emissions control systems as well as utility supply systems (i.e., electricity, compressed air, water/fire protection). As soon as the furnace aborts it will automatically switch to "idle mode" (defined as operation at up to a maximum heat input rate of 5 MMBtu/hr). The fuel feed is significantly reduced, and the heat input rate drops rapidly.

- **Planned Shutdown:** In the event of a planned shutdown the furnace heat input will be decreased, and all remaining fuel will be moved through the system to prevent a fire during the shutdown period. The remaining fuel will be combusted prior to opening the furnace bypass stack.

Conditions under which the dryer bypass stacks are used are as follows:

- **Malfunction:** The dryer system can abort due to a number of different interlocks such as power failure, equipment failure, or as a result of a furnace abort. If the RTO goes offline as a result of interlock failure the dryer will immediately abort. This can occur if the dryer temperature is out of range or as a result of equipment or power failure. Dryer abort may also be triggered if a spark is detected.
- **Planned Shutdown:** During planned shutdowns, as the remaining fuel is combusted by the furnace, the operator will reduce the chip input to the dryer. When only a small amount of chips remains, these will be emptied to clean the dryer drum out. The dryer bypass stack will then be opened, and a purge air fan used to ensure no explosive build-up occurs in the drum. Emissions during this time will be minimal as the furnace and dryer are no longer operating.

Use of the furnace and dryer bypass stacks for start-up, shutdown, and malfunctions will be limited to 100 hours per year for each dryer line (i.e., 50 hours of furnace bypass at full capacity and 50 hours of dryer bypass at full capacity).

Each furnace may also operate up to 500 hours per year in "idle mode" with emissions routed to the furnace bypass stacks. The purpose of operation in "idle mode" is to maintain the temperature of the fire brick lining the furnaces which may be damaged if it cools too rapidly. Operation in "idle mode" also significantly reduces the amount of time required to restart the dryers.

2.5 Dried Wood Handling (ES-DWH) and Dry Hammermills (ES-HM-1 through ES-HM-8)

Dried materials from the dryer product recovery cyclones will be conveyed to screening operations that remove smaller wood particles, which bypass the Dry Hammermills. Prescreening is accomplished by one existing and one new prescreener (part of ES-DWH), both of which will be controlled by a new baghouse (CD-DWH-BF). Oversized wood is diverted to the eight (8) existing Dry Hammermills (ES-HM-1 through ES-HM-8) for further size reduction prior to pelletization. Each Dry Hammermill includes a product recovery cyclone (CD-HM-CYC-1 through CD-HM-CYC-8), which is routed to one of three (3) baghouses (CD-HM-BF-1 through CD-HM-BF-3) for particulate matter control. With this application, Enviva proposes to route the exhaust from the existing Dry Hammermill baghouses to a proposed new scrubber (CD-WS-1) and RCO/RTO (CD-RCO-1) to control PM, VOC and HAP emissions.

As mentioned above, smaller particles passing through the screens will bypass these hammermills and be pneumatically conveyed directly to the Dry Hammermill product recovery cyclones. Enviva estimates that approximately 15% of the total material leaving the Dryers will bypass the Dry Hammermills and be sent directly to the pelletizing operations. Product from the recovery cyclones is transferred to the hammermill system discharge collection enclosed drag chain conveyor, and then to pellet mill feed silo infeed screw. These transfer points comprise the Dried Wood Handling (ES-DWH) emission source.

2.6 Hammermill Area (ES-HMA)

With this application, Enviva proposes to remove the Hammermill Area (ES-HMA) emission source as this system is no longer required and emissions will be included in the Dried Wood Handling emission point (ES-DWH).

2.7 Pellet Mill Feed Silo (ES-PMFS) and Pellet Cooler HP Fines Relay System (ES-PCHP)

Fine pellet material from the hammermill pollution control system and screening operation is collected in the pellet fines bin which is controlled by a baghouse (CD-PFB-BV). With this application, Enviva proposes to re-name the Pellet Fines Bin (ES-PFB) and associated baghouse (CD-PFB-BV) to Pellet Cooler HP Fines Relay System (ES-PCHP) and associated baghouse (CD-PCHP-BF). The Pellet Cooler HP Fines Relay System (ES-PCHP) will include emissions associated with the existing pellet screener and a second new pellet screener.

Milled wood from the Dry Hammermill product recovery cyclones will be transported by a set of conveyors to the Pellet Mill Feed Silo (ES-PMFS) prior to pelletization. Particulate emissions from the Pellet Mill Feed Silo are controlled by a baghouse (CD-PMFS-BV).

Fines from the hammermill pollution control system and screening operation are collected in the pellet fines bin which is controlled by a baghouse (CD-PCHP-BF).

2.8 Additive Handling and Storage (ES-ADD)

With this application, Enviva proposes to add an Additive Silo (ES-ADD) and baghouse (CD-ADD-BF). A dry powder additive will be used in the pellet production process to increase the durability of the final product. The additive will be added to milled wood from the Pellet Mill Feed Silo discharge screw conveyor prior to transfer to the Pellet Presses. The additive contains no hazardous chemicals or VOCs.

Bulk additive material will be delivered by truck and pneumatically unloaded into a storage silo equipped with a baghouse to control emissions from air displaced during the loading of additive material to the silo. The additive will then be conveyed via screw conveyor from the storage silo to the milled fiber conveyor which transfers milled wood to the Pellet Presses.

2.9 Pellet Press System (ES-PP) and Pellet Coolers (ES-CLR-1 – 6)

Dried processed wood is mechanically compacted through twelve (12) presses in the Pellet Press system (ES-PP). Exhaust from the Pellet Press system and conveyors will be vented through the Pellet Cooler aspiration material recovery cyclones and pollutant controls as described below, and then to the atmosphere. Formed pellets are discharged into one of six (6) Pellet Coolers (ES-CLR-1 thru ES-CLR-6). Chilled cooling air is passed through the pellets. At this point, the pellets contain a small amount of wood fines, which are swept out with the cooling air and are recovered utilizing six (6) cyclones (CD-CLR-1 thru CD-CLR-6).

As previously discussed, Enviva proposes to add a new scrubber (CD-WS-2) to control the Pellet Cooler exhaust prior to routing it through the existing Dry Hammermills. The combined pellet cooler exhaust and dry hammermill exhaust will be routed through the proposed new scrubber (CD-WS-1) and RCO/RTO (CD-RCO-1), as detailed in Section 2.5 above, to control PM, VOC, HAP, and TAP emissions leaving the Pellet Coolers. During periods when the Dry Hammermills are not operating, the exhaust from the new Pellet Cooler scrubber (CD-WS-2) will not be fed into the Dry Hammermills and, instead, will be routed directly to the inlet of the new Dry Hammermill scrubber (CD-WS-1) followed by the new RCO/RTO (CD-RCO-1). Finally, Double Duct Burners (ES-DDB-5 through ES-DDB-8) will

be installed to reduce the risk of moisture condensation on the ductwork associated with the Pellet Cooler and Dry Hammermill exhaust.

2.10 Finished Product Handling (ES-FPH) and Truck Loadout (ES-TL)

Final product is conveyed to four (4) storage bins (ES-FPH) that will feed the truck loadout station (ES-TL). Pellet loadout is accomplished by gravity feed of the pellets through a covered chute to reduce emissions. Atmospheric emissions from pellet loadout will be minimal because dried wood fines will have been removed in the pellet screener, and a slight negative pressure will be maintained in the loadout building as a fire prevention measure to prevent any build-up of dust on surfaces within the building. This slight negative pressure is produced via an induced draft fan that exhausts to the finished product handling baghouse (CD-FPH-BF). This baghouse will control emissions from finished product handling and storage (ES-FPH). Truck Loadout (ES-TL) emissions will be controlled by the Pellet Cooler HP Fines Relay System baghouse (CD-PCHP-BF).

2.11 Emergency Generator (ES-EG), Fire Water Pump Engine (ES-FWP), and Diesel Storage Tanks (ES-TK-1 – 3)

The facility has a 350-brake horsepower (bhp) diesel-fired Emergency Generator engine (ES-EG) and a 300 bhp diesel-fired Fire Water Pump engine (ES-FWP). Aside from maintenance and readiness testing, the generator and fire water pump engines are only utilized for emergency operations.

Diesel for the Emergency Generator is stored in a 2,500-gallon tank (ES-TK-1) and diesel for the Fire Water Pump engine is stored in a 500-gallon storage tank (ES-TK-2). With this application, Enviva proposes to add a third diesel Storage Tank to the permit, which has a capacity of up to 5,000 gallons (ES-TK-3) for distributing diesel fuel to mobile equipment.

2.12 Propane Vaporizer (ES-PVAP)

With this application, Enviva proposes to add a Propane Vaporizer. The direct-fired Propane Vaporizer (ES-PVAP) will be located on-site to vaporize propane gas for combustion by the RTO burners, RCO burners, dryer system Double Duct Burners (ES-DDB-1 through ES-DDB-4), and the pellet cooler and dry hammermill system Double Duct Burners (ES-DDB-5 through ES-DDB-8). The Propane Vaporizer will have a maximum heat input capacity of 1 MMBtu/hr and will combust propane. Propane may be used initially until natural gas service is completed when natural gas will be the primary fuel for all burners; however, propane may be used as a back-up fuel.

3. POTENTIAL EMISSIONS QUANTIFICATION

The following summarizes the data sources and calculation methodologies used in quantifying potential emissions from the Southampton plant. Detailed potential emissions calculations are provided in Appendix C. Note that Enviva has quantified potential greenhouse gas (GHG) emissions from all applicable emissions sources; however, GHG emissions are not discussed in detail below. Please refer to the detailed emission calculations provided in Appendix C for GHG emission estimates.

3.1 Green Wood Handling and Storage (ES-GWHS)

Fugitive PM emissions will result from unloading purchased chips from trucks into hoppers and transfer of these materials to storage piles and the fuel storage bin via conveyors, as well as from erosion of, and volatilization from, storage piles.

Fugitive PM emissions from chip and bark transfer operations were calculated based on AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles*. Emissions were only quantified for the final drop points (i.e., from conveyor to pile). Green wood and bark contain a high moisture content approaching 50 percent water by weight. Therefore, chip and bark transfer operations will have insignificant PM emissions

Particulate emission factors used to quantify emissions from storage pile wind erosion for the green wood storage piles and fuel storage piles were calculated based on EPA's *Control of Open Fugitive Dust Sources*.[1] The number of days with rainfall greater than 0.01 inch was obtained from AP-42 Section 13.2.2, *Unpaved Roads*[2], and the percentage of time that wind speed exceeds 12 miles per hour (mph) was determined based on the AERMOD-ready meteorological dataset for the Richmond National Weather Service (NWS) Station provided by VA DEQ. The mean silt content of 8.4% for unpaved roads at lumber mills from AP-42 Section 13.2.2 was conservatively applied in the absence of site-specific data. The exposed surface area of the pile was calculated based on worst-case pile dimensions.

VOC emissions from storage piles were quantified based on the exposed surface area of the pile and emission factors from the National Council for Air and Stream Improvement (NCASI). NCASI emission factors range from 1.6 to 3.6 pounds (lb) VOC as carbon/acre-day; however, emissions were conservatively based on the maximum emission factor.

The Green Wood Handling and Storage (ES-GWHS) activities are exempt from construction permitting requirements per 9VAC5-80-1105.B(11) as these activities are consistent with those conducted at exempt wood sawmills and planing mills.

3.2 Debarker (ES-DEBARK) and Bark Hog (ES-Bark)

PM emissions occur as a result of log debarking and processing. Potential PM emissions from debarking and the bark hog were quantified based on emission factors from EPA's AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants for Source Classification Code (SCC) 3-07-008-01 (Log Debarking).[3] All PM was assumed to be larger than 2.5 microns in diameter. PM emissions from debarking will be minimal due to the high moisture content of green wood (~50%) and fact that bark is

[3] USEPA. Office of Air Quality Planning and Standards. *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants.* EPA 450/4-90-003. March 1990.

removed in pieces larger than that which can become airborne. A 90% control efficiency was applied for the use of water spray. The Bark Hog is also primarily enclosed, and a 90% control efficiency was applied for partial enclosure. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, Medium Density Fiberboard.[4]

The Debarker and Bark Hog are exempt from construction permitting requirements per 9VAC5-80-1105.B(11) as these activities are consistent with those conducted at exempt wood sawmills and planing mills.

3.3 Chipper (ES-CHIP)

The chipping process will result in emissions of VOC and methanol. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, *Medium Density Fiberboard* and AP-42 Section 10.6.4, *Hardboard and Fiberboard*.[5]

The Chipper is exempt from construction permitting requirements per 9VAC5-80-1105.B(11) as chipping is consistent with activities conducted at exempt wood sawmills and planing mills.

3.4 Fuel Storage Bin

Bark will be transferred from the fuel storage piles via a walking floor to a covered conveyor and then to the fully enclosed Fuel Storage Bin. Due to complete enclosure of the Fuel Storage Bin, emissions from transfer of material into the bin were not specifically quantified.

The Fuel Storage Bin is exempt from construction permitting requirements per 9VAC5-80-1105.B(11) as wood storage is consistent with activities conducted at exempt wood sawmills and planing mills.

3.5 Dryers (ES-DRYER-1 and ES-DRYER-2) and Green Wood Hammermills (ES-GHM-1 - 5)

As described in Section 2, in addition to normal operation there are several other potential operating conditions for the Dryer lines. Emissions for the different operating conditions were quantified as described in the following subsections.

3.5.1 Normal Operation

As discussed above, exhaust from the Dryers will be routed to a product recovery multicyclone separator followed by a WESP and RTO for control of PM, VOC, HAP, and TAP. The existing Dryer furnace is also equipped with a selective non-catalytic reduction system (CD-SNCR) for control of NO_X. The Green Wood Hammermills will share the existing Dryer's WESP/RTO control system for control of PM, VOC, HAP, and TAP. Potential emissions of PM, PM less than 10 microns in diameter (PM_{10}), PM less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO), sulfur dioxide (SO_2), NO_x, and VOC are based on data from the following sources: stack testing data from comparable Enviva facilities and/or engineering estimates with included contingency factors; information from the NCASI database; and AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.

HAP and TAP emissions were calculated based on emission factors from several data sources including stack testing data from comparable Enviva facilities and/or engineering estimates

[4] USEPA AP-42 Section 10.6.3, *Medium Density Fiberboard Manufacturing* (08/02).

(with contingency factors), emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*[6], and NC DAQ's Wood Waste Combustion Spreadsheet[7]. HAP and TAP emissions from natural gas and propane combustion by the RTO burners were calculated based on AP-42 Section 1.4, *Natural Gas Combustion* and emission factors from the South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool, respectively.[8]

3.5.2 Dryer Bypass (Full Capacity)

Bypass stacks following each furnace and rotary drum dryer may be used to exhaust hot gases during start-ups (for temperature control) and malfunctions. Potential emissions of CO, NO_X, and VOC associated with dryer bypass were calculated based on stack testing data from comparable Enviva facilities. Condensable PM and SO_2 emissions were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.[9] Filterable PM, HAP, and TAP emissions were calculated based on stack testing data from similar Enviva plants and from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*. Emissions were based on the full capacity of the furnaces and 50 hours per year per dryer of bypass.

3.5.3 Furnace Bypass (Full Capacity)

Potential emissions of PM, CO, NO_X, SO_2, VOC, HAP, and TAP for furnace bypass conditions were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*. Emissions were based on the full capacity of the furnaces and 50 hours of bypass per year per furnace.

3.5.4 Furnace Bypass (Idle Mode)

Each furnace will operate up to 500 hours per year in "idle mode", which is defined as operation up to a maximum heat input rate of 5 MMBtu/hr. During this time, emissions will exhaust out of the furnace bypass stack. Potential emissions of PM, CO, NO_X, SO_2, VOC, HAP, and TAP were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.

3.6 Dried Wood Handling (ES-DWH)

As previously described in Section 2, Dried Wood Handling (ES-DWH) includes conveyor transfer points located between the Dryer and Dry Hammermills, the Dry Hammermills and Pellet Presses, and the Dry Hammermill cyclones and the Dry Hammermills. Dried Wood Handling emissions at the pre-screener inlet before the dry hammermills will be routed to a new baghouse (CD-DWH-BF). Potential VOC, HAP, and TAP emissions were calculated based on dry wood handling emission factors from the NCASI Wood Products Database.[10] Emissions of PM were calculated based on the exit grain loading rate and the maximum nominal exhaust flow rate for the new baghouse.

3.7 Dry Hammermills (ES-HM-1 – 8)

The Dry Hammermills generate PM, VOC, HAP, and TAP emissions during the process of reducing wood chips to the required size for pelletization. Exhaust from the Dry

[6] USEPA AP-42 Section 1.6, *Wood Residue Combustion in Boilers* (09/03).

[7] NCDAQ Wood Waste Combustion Spreadsheet for a wood stoker boiler. Available online at: https://files.nc.gov/ncdeq/Air%20Quality/permits/files/WWC_rev_K_20170308.xlsx.

[8] USEPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).

[9] USEPA AP-42, Section 1.6, *Wood Residue Combustion in Boilers*, (09/03).

[10] NCASI VOC Dry Wood handling factor based on oriented-strand board operations.

Hammermills is routed through existing individual high efficiency cyclones (CD-HM-CYC-1 through 8) for product recovery, followed by existing baghouses (CD-HM-BH-1 through 8) and a new scrubber (CD-WS-1) for PM emissions control. Particulate emissions from each baghouse were based on the exit grain loading rate and the maximum nominal exhaust flow rate of the baghouses.

VOC, HAP, and TAP emissions will be controlled by a new RCO/RTO (CD-RCO-1). Emissions were calculated based on stack testing data from comparable Enviva facilities and/or engineering estimates and include a contingency factor.

3.8 Pellet Mill Feed Silo (ES-PMFS)

The Pellet Mill Feed Silo will be equipped with a baghouse (CD-PMFS-BF) to control PM emissions associated with silo loading and unloading operations. PM emissions are calculated based on the exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

3.9 Additive Handling and Storage (ES-ADD)

An additive will be used in the pellet production process to increase the durability of the final product. Material will be pneumatically conveyed from delivery trucks to the storage silo equipped with a baghouse (CD-ADD-BF). PM emissions from the baghouse were calculated based on engineering judgement for the exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

3.10 Pellet Press System and Pellet Coolers (ES-PP and ES-CLR-1 - 6)

Pellet Press and Pellet Cooler operations will generate PM, VOC, HAP, and TAP emissions during the forming and cooling of wood pellets. The Pellet Presses and Coolers are equipped with six (6) simple cyclones (CD-CLR-1 through 6) for product recovery. As part of the proposed project, a new scrubber (CD-WS-2) will be added for PM control. Exhaust from this new scrubber will be fed into the Dry Hammermills and ultimately controlled by the new control devices proposed for those units (i.e., CD-WS-1 and CD-RCO-1). In the event that the Dry Hammermills are not operating, exhaust from the Pellet Cooler wet scrubber (CD-WS-2) will be routed directly to the Dry Hammermill wet scrubber (CD-WS-1) and RCO/RTO (CD-RCO-1).

PM emissions from the Pellet Presses and Pellet Coolers were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the cyclones.

Uncontrolled VOC, HAP, and TAP emissions from the Pellet Presses and Coolers were quantified based on stack testing data from comparable Enviva facilities and/or engineering estimates and include a contingency factor. Controlled emissions were conservatively estimated using a 95% control efficiency for the RCO based on correspondence with the vendor. NO_X and CO emissions resulting from thermal oxidation were calculated using AP-42 Section 1.4, *Natural Gas Combustion*[11], and the maximum high heating value of the anticipated VOC constituents.

Emissions of criteria pollutants, HAP, and TAP from natural gas or propane combustion by the RCO burner were estimated using emission factors from AP-42 Section 1.4 and AP-42 Section 1.5.

[11] USEPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).

3.11 Pellet Cooler HP Fines Relay System and Truck Loadout (ES-PCHP)

As previously described in Section 2, an induced draft fan will be used to transfer dust generated by the Pellet Coolers and pellet screening to the Pellet Cooler HP Fines Relay System, controlled by a new baghouse (CD-PCHP-BF). This baghouse will also control emissions from the Truck Loadout (ES-TL) operations. PM emissions were calculated based on the exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

3.12 Pellet Loadout Bins (ES-FPH)

PM emissions result from the transfer of finished product to the pellet loadout bins (ES-FPH). PM emissions from pellet loadout bins will be controlled by a baghouse (CD-FPH-BF). Potential PM emissions from the baghouse were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

3.13 Emergency Generator (ES-EG) and Fire Water Pump Engine (ES-FWP)

Operation of the Emergency Generator and Fire Water Pump engines will generate emissions of criteria pollutants, HAP, and TAP. Potential criteria pollutant, excluding VOC, emissions from operation of the Emergency Generator and Fire Water Pump engine were calculated based on emission standards in Table 4 of NSPS Subpart IIII and the maximum horsepower rating of the engines. Potential SO_2 emissions were calculated based on the fuel sulfur restriction in NSPS Subpart IIII, and by assuming that all of the sulfur present in the diesel fuel becomes SO_2 air emissions.[12] Potential VOC, HAP, and TAP emissions were quantified based on emission factors from AP-42 Section 3.3, *Stationary Internal Combustion Engines*.[13] Annual potential emissions were conservatively calculated based on 500 hours per year.

The Emergency Generator and Fire Water Pump engines are not impacted by the proposed project.

3.14 Diesel Storage Tanks (ES-TK-1 – 3)

The storage of diesel in on-site Storage Tanks will generate emissions of VOC. Emissions of VOC from the three (3) Diesel Storage Tanks were calculated using EPA's TANKS 4.0 software based on actual tank characteristics (e.g., orientation, dimensions, etc.) and potential annual throughput. The diesel Storage Tanks are exempt from construction permitting requirements per 9VAC5-80-1105.B(8).

3.15 Paved and Unpaved Roads

Fugitive PM emissions will occur as a result of trucks and employee vehicles traveling on Paved and Unpaved Roads on the Southampton plant property. Emission factors for Unpaved Road emissions were calculated based on Equation 1a from AP-42 Section 13.2.2, *Unpaved Roads*[14] using a surface material silt content of 8.4% and 120 days with rainfall greater than 0.01 inch based on Figure 13.2.1-2. Emissions factors for Paved Road emissions were calculated based on Equation 2 from AP-42 Section 13.2.1, *Paved Roads*[15] using a surface material silt content of 8.2% and 120 days with rainfall greater than 0.01 inch based on Figure 13.2.1-2. A 90% control efficiency was applied to Unpaved and Paved

[12] Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(b) as required by NSPS Subpart IIII.

[13] USEPA AP-42 Section 3.3, *Stationary Internal Combustion Engines* (10/96).

[14] USEPA AP-42 Section 13.2.2, *Unpaved Roads* (11/06).

[15] USEPA AP-42 Section 13.2.1, *Paved Roads* (01/11).

Road emissions for water/dust suppression activities. This control efficiency is based on data from the *Air Pollution Engineering Manual* of the Air and Waste Management Association.

3.16 Double Duct Burners (ES-DDB-1 through ES-DDB-8) and Propane Vaporizer (ES-PVAP)

Emissions from natural gas and propane combustion by the Double Duct Burners (ES-DDB-1 through ES-DDB-8) and Propane Vaporizer (ES-PVAP) were calculated based on AP-42 Section 1.4, *Natural Gas Combustion*, AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*, and emission factors from the SCAQMD AER Tool.[16, 17, 18] Potential SO_2 emissions from propane combustion assume a sulfur content of 0.54 grains per 100 cubic feet for propane.[19]

The Double Duct Burners and Propane Vaporizer are exempt from construction permitting requirements per 9VAC5-80-1105B.1.

[16] USEPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).

[17] USEPA AP-42 Section 1.5 *Liquefied Petroleum Gas Production* (7/08).

[18] South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting.

[19] *A National Methodology and Emission Inventory for Residential Fuel Combustion* (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

4. STATE AND FEDERAL PERMITTING APPLICABILITY

The Enviva Southampton plant is potentially subject to federal and state air quality permitting requirements. The following sections summarize the applicability of federal and state permitting programs.

4.1 Federal Permitting Programs

The federal NSR permitting program includes requirements for construction of new major sources, and modifications to existing major sources, while the Title V Operating Permit Program includes requirements for operation of Title V major sources. The following sections discuss the applicability of these requirements to the Southampton plant.

4.1.1 New Source Review

NSR is a federal pre-construction permitting program that applies to certain major stationary sources. The federal NSR permitting program is implemented in Virginia pursuant to 9VAC5-80-1120. The primary purpose of NSR is to support the attainment and maintenance of ambient air quality standards across the country. There are two distinct permitting programs under NSR. The specific program that applies to a facility depends on the ambient air quality in the geographic area in which the source is located. The two programs are nonattainment NSR (NNSR) (9VAC-80-2000) and PSD (9VAC5-80-1605). Because NNSR and PSD requirements are pollutant-specific, a stationary source can be subject to NNSR requirements for one or more regulated NSR pollutants and to PSD requirements for the remaining regulated NSR pollutants.

NNSR permitting requirements apply to an existing stationary source located in an area where concentrations of a "criteria pollutant"[20] exceed the National Ambient Air Quality Standard (NAAQS) for that pollutant. PSD permitting requirements apply to stationary sources located in an area where concentrations of criteria pollutants do not exceed a NAAQS.

The Southampton plant is located in Southampton County which is classified as attainment or unclassifiable for all criteria pollutants.[21] The Southampton plant is classified as a PSD minor source because facility-wide potential emissions of each individual criteria pollutant are below the major source threshold of 250 tpy. As shown in Table 4-1 below, following the proposed project the facility will remain a PSD minor source.

Table 4-1. Change in Potential to Emit

Emissions Scenario	CO (tpy)	NO_X (tpy)	TSP (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	Total HAPs (tpy)
Proposed PTE[1]	176.82	135.73	144.54	114.53	79.73	39.49	119.41	20.97
Previous PTE	56.54	82.14	96.41	92.49	77.14	17.79	179.80	21.81

[20] The following are "criteria pollutants" under current NSR regulations: CO, nitrogen dioxide, SO_2, PM_{10}, $PM_{2.5}$, ozone (VOCs and NO_X), and lead.

[21] 40 CFR 81.347

Table 4-1. Change in Potential to Emit

Emissions Scenario	CO (tpy)	NO_X (tpy)	TSP (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	Total HAPs (tpy)
Change in PTE	+120.28	+53.59	+48.13	+22.04	+2.59	+21.70	-60.39	-0.84

[1.] Proposed PTE (excluding fugitive emission sources) from Appendix C, Tables 1 and 2.

4.1.2 Title V Operating Permit Program

The federal Title V Operating Permit program is promulgated in 40 CFR Part 70 and is implemented in Virginia via 9VAC5-80 Article 1. The Southampton plant is a major source with respect to the Title V Operating Permit Program because facility-wide emissions of one or more criteria pollutants exceed the major source threshold of 100 tpy. Additionally, the facility is considered an area source of HAP due to total HAP emissions and maximum individual HAP emissions below the major source thresholds of 25 tpy and 10 tpy, respectively. The proposed proposed project will not change the facility's Title V or HAP source status.

4.2 State Permitting Programs

Virginia's state construction permitting requirements are codified under 9VAC5-80, Article 6. In accordance with 9VAC5-80-1120.A, and unless otherwise exempt, facilities must obtain a permit prior to beginning construction of new or modified emissions units. The Southampton plant is currently classified as a "Major stationary source" as defined in 9VAC5-80-1110.C. In addition, the proposed project will result in emissions increases above the significance thresholds specified in 9VAC5-80-1105.D. Therefore, the proposed project will be considered a "Major modification" and will be subject to Article 6 permitting requirements. The required application forms are included in Appendix D. In addition, Enviva will submit a Local Governing Body Certification Form to the Southampton County Board of Supervisors. Proof of receipt of the form by Southampton County will be provided to VA DEQ under separate cover.

5. REGULATORY APPLICABILITY

The Southampton plant will be subject to federal and state air quality regulations. The following addresses all potentially applicable regulations.

5.1 New Source Performance Standards

New Source Performance Standards (NSPS) apply to new and modified sources and require sources to control emissions in accordance with standards set forth at 40 CFR Part 60. NSPS standards in 40 CFR Part 60 have been incorporated by reference in Chapter 50 of 9VAC5.

5.1.1 40 CFR 60 Subpart A – General Provisions

All sources subject to a NSPS are subject to the general requirements under Subpart A unless excluded by the source-specific subpart. Subpart A includes requirements for initial notification, performance testing, recordkeeping, monitoring, and reporting. Subpart A is applicable because the Emergency Generator and Fire Water Pump Engine are subject to NSPS Subpart IIII.

5.1.2 40 CFR 60 Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

NSPS Subpart Dc applies to owners or operators of steam generating units for which construction, modification, or reconstruction is commenced after June 9, 1989 and that have a max design heat input of 100 MMBtu/hr or less but greater than or equal to 10 MMBtu/hr. The proposed Propane Vaporizer and Double Duct Burners each have a max heat input of 1 MMBtu/hr and are not a steam generating units; therefore, NSPS Subpart Dc does not apply.

5.1.3 40 CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

NSPS Subpart IIII applies to owners or operators of compression ignition (CI) internal combustion engines (ICE) manufactured after April 1, 2006 that are not fire pump engines, and fire pump engines manufactured after July 1, 2006. The existing 350 bhp Emergency Generator and 300 bhp Fire Water Pump engines at the Southampton plant are subject to NSPS Subpart IIII and the facility's proposed changes do no impact the applicability of NSPS Subpart IIII requirements for the engines.

5.2 National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAP) regulate HAP emissions and are applicable to certain major and area sources of HAP. NESHAP can be found in 40 CFR Part 63. NESHAP standards in 40 CFR Part 63 have been incorporated by reference in Chapter 60 of 9VAC5. As previously discussed, the Southampton plant will remain a minor source of HAP due to facility-wide total HAP emissions being below 25 tpy and maximum individual HAP emissions below 10 tpy (refer to emissions calculations in Appendix C).

5.2.1 40 CFR 63 Subpart A – General Provisions

All sources subject to a NESHAP are subject to the general requirements under Subpart A unless excluded by the source-specific subpart. Subpart A includes requirements for initial notification, performance testing, recordkeeping, monitoring, and reporting. The Southampton plant has sources subject to ZZZZ of this part and thus, Subpart A is also applicable to these sources.

5.2.2 40 CFR 63 Subpart B – Requirements for Control Technology Determinations for Major Sources in Accordance with Clean Air Act Section 112(g)

Section 112(g)(2)(B) of the Clean Air Act (CAA) requires that a new or reconstructed stationary source that does not belong to a regulated "source category" for which a NESHAP has been promulgated control emissions to levels that reflect "maximum achievable control technology" (MACT). As provided in §63.40(b), a case-by-case MACT evaluation is only required prior to the construction or reconstruction of a major source of HAP emissions. The Southampton plant will not be subject to 112(g) since it is currently, and will remain, an area source of HAP emissions.

5.2.3 40 CFR 63 Subpart DDDD – NESHAP for Plywood and Composite Wood Products

Subpart DDDD regulates HAP emissions from plywood and composite wood products (PCWP) manufacturing facilities located at major sources of HAPs. The facility is not a major source of HAP emissions and, further, the wood pellets manufactured at the facility do not meet the definition for any of the PCWP products under §63.2292 that are subject to Subpart DDDD. Specifically, the wood pellets are not an engineered wood product, as they are not bound together with resin or other chemical agent. Therefore, this regulation is not applicable.

5.2.4 40 CFR 63 Subpart ZZZZ – NESHAP for Stationary Reciprocating Internal Combustion Engines

Subpart ZZZZ applies to reciprocating internal combustion engines (RICE) located at a major or area source of HAP emissions. Emergency stationary RICE are defined in §63.6675 as any stationary RICE that operates in an emergency situation. These situations include engines used for power generation when a normal power source is interrupted, or when engines are used to pump water in the case of fire or flood. The Southampton plant's Emergency Generator and emergency Fire Water Pump Engine are both classified as emergency RICE under Subpart ZZZZ. New or reconstructed CI engines located at an area source of HAP, such as the facility's Emergency Generator and Fire Water Pump engine, are only required to comply with the applicable provisions of NSPS Subpart IIII, per §63.6590(c)(1), and no further requirements apply under Subpart ZZZZ. The applicable requirements of this regulation have previously been incorporated into the facility's current permit and will not be impacted by the proposed permit changes.

5.2.5 40 CFR 63 Subpart DDDDD – NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters

Subpart DDDDD, also referred to as the Boiler MACT, provides emission standards for boilers and process heaters located at major sources of HAP emissions. The facility is not a major source of HAP emissions. As such, Subpart DDDDD does not apply. Further, the rule defines a process heater in §63.7575 as an enclosed device using a controlled flame, and the unit's primary purpose is to transfer heat indirectly to a process material (liquid, gas, or solid) or to a heat transfer material (e.g., glycol or a mixture of glycol and water) for use in a process unit, instead of generating steam. The Southampton plant's dryers will each be heated by a wood-fired furnace burner system; however, the furnace burner systems will provide direct heating of the wood chips, not indirect. As such, the furnace burner systems do not meet the Subpart DDDDD definition of process heater.

As described in Section 2, a Propane Vaporizer will be used to convert liquid propane to a gas for combustion by the RTO burners, RCO burners, and burners for the dryer double ducts. The vaporizer will be used to heat liquid propane which is a fuel and not a process material or heat transfer material. As such, the Propane Vaporizer is not a process heater under Subpart DDDDD.

Double Duct Burners will be used to heat the dryer double ducts; however, these burners will provide direct heating of the ducts. As such, they also do not meet the Subpart DDDDD of process heaters.

5.2.6 40 CFR 63 Subpart JJJJJ – NESHAP for Area Sources: Industrial, Commercial, and Institutional Boilers

Subpart DDDDD provides emission standards for boilers located at area sources of HAP emissions. The rule defines a boiler in §63.11237 as "enclosed device using controlled flame combustion in which water is heated to recover thermal energy in the form of steam and/or hot water […]." The facility does not currently operate any units that meet the Subpart DDDDD definition of a boiler and Enviva is not proposing to add boilers to the facility as part of the proposed project. Therefore, Subpart JJJJJ does not apply to the proposed changes.

5.3 Compliance Assurance Monitoring

Compliance Assurance Monitoring (CAM) under 40 CFR Part 64 applies to emission units located at a Title V major source that use a control device to achieve compliance with an emission limit and whose pre-controlled emissions exceed the major source thresholds. A CAM plan is required to be submitted with the initial Title V operating permit application for emission units whose post-controlled emissions exceed the major source thresholds (i.e., large pollutant-specific emission units [PSEU]). For emission units with post-controlled emissions below the major source thresholds, a CAM plan must be submitted with the first Title V permit renewal application.

CAM will potentially be applicable to sources at the Southampton plant. However, no emissions units have post-controlled emissions above major source thresholds and, therefore, any CAM plans that may be required will not be due until submittal of the initial Title V renewal. Applicability of 40 CFR 64 requirements will be fully assessed at that time.

5.4 Chemical Accident Prevention Provisions

The Chemical Accident Prevention Provisions, promulgated in 40 CFR Part 68, provide requirements for the development of risk management plans (RMP) for regulated substances. Applicability of RMP requirements is based on the types and amounts of chemicals stored at a facility. Propane, which is a regulated substance under Subpart F of this rule, will be stored at the Southampton plant to be used as a back-up fuel for the RTO burners, RCO burners, and dryer system double duct burners. Per §68.126, substances used as a fuel or held for sale as a fuel at a retail facility are excluded from all provisions; therefore, an RMP is not required for the Southampton plant.

5.5 Virginia Administrative Code

In addition to federal regulations, 9VAC5 establishes regulations applicable at the emission unit level and at the facility level in Virginia. The state regulations also include general requirements for facilities, such as the requirement to obtain construction and operating permits (discussed in Section 4.2 above). Source-specific standards in 9VAC5 that are

potentially applicable to the facility as a result of this project are discussed in the following sections.

5.5.1 9VAC5-40 Existing Stationary Sources

Emissions standards for stationary sources, including process weight rate-based PM emissions standards, are established under 9VAC5-40. These regulations apply to stationary sources constructed, modified, or relocated prior to March 17, 1972, or reconstructed prior to December 10, 1976. Therefore, these standards are not applicable to the Southampton plant. Requirements applicable to new stationary sources are discussed in the following sections.

5.5.2 9VAC5-50-80 Control of Visible Emissions

Under this regulation, visible emissions from all sources are limited to no more than 20% opacity, except for one six-minute period in any one hour of not more than 30% opacity. This rule applies to all processes at the facility that may have visible emissions. The Southampton plant complies with this rule by operating PM control devices and using best operating practices for uncontrolled sources at the facility.

5.5.3 9VAC5-50-90 Standard for Fugitive Dust/Emissions

The Southampton plant is required to take reasonable measures, as outlined in 9VAC5-50-90, to prevent fugitive dust from becoming airborne during construction, modification or operation of the facility. The facility will continue to comply with this regulation.

5.5.4 9VAC5-50-260 Standard for Stationary Sources

Pursuant to 9VAC5-50-260(A), new and modified sources of air emissions in Virginia are required to implement BACT for control of emissions when applying to construct or modify a source. A BACT analysis for each new and modified source that is impacted by the proposed project is provided in Section 6.

5.5.5 9VAC5-60, Article 5 (Rule 6-5)

Article 5 of 9VAC5-60 establishes Virginia's Emissions Standards for Toxic Pollutants from New and Modified Sources. The standards apply to facilities with TAP emissions above Virginia's Toxic Air Pollutant Permitting Emission Rates unless specifically exempt from these requirements (e.g., emissions units subject to an emissions standard or other requirement under Article 2 of 9VAC5-60 or an emissions standard or other requirement established pursuant to §112 of the Clean Air Act).

In accordance with 9VAC5-60-320, sources subject to Virginia's TAP standards must employ BACT for TAP and must not "cause, or contribute to, any significant ambient air concentration that may cause, or contribute to, the endangerment of human health." As noted above, a BACT analysis for new and modified sources that are impacted by the proposed changes is provided in Section 6. In addition, an ambient air quality impact analysis for TAP emissions is provided in Section 7.

6. BACT ANALYSIS

9VAC5-50-260(A) requires the utilization of BACT to minimize emissions of regulated pollutants from new and modified sources of air emissions. BACT is defined in 9VAC5-50-250.C as follows:

> *"Best available control technology" or "BACT" means, as used in 9VAC5-50-260 , an emissions limitation (including a visible emission standard) based on the maximum degree of emission reduction for any pollutant which would be emitted from a new stationary source or project which the board, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for the new stationary source or project through the application of production processes or available methods, systems and techniques, including fuel cleaning 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 standard in Article 5 (9VAC5-50-400 et seq.) of this part or Article 1 (9VAC5-60-60 et seq.) or Article 2 (9VAC5-60-90 et seq.) of Part II of 9VAC5-60 (Hazardous Air Pollutant Sources). If the board determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard, or combination of them, may be prescribed instead of requiring the application 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. In determining best available control technology for stationary sources subject to Article 6 (9VAC5-80-1100 et seq.) of Part II of 9VAC5-80 (Permits for Stationary Sources), consideration shall be given to the nature and amount of the emissions, emission control efficiencies achieved in the industry for the source type, total cost effectiveness, and where appropriate, the cost effectiveness of the incremental emissions reduction achieved between control alternatives.*

In accordance with 9VAC5-50-260.C, a project at an existing facility must apply BACT for each pollutant for which there would be an increase in the uncontrolled emissions rate equal to or greater than the levels specified in 9VAC5-80-1105D. The proposed project will result in uncontrolled emissions increases above the specified thresholds for CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC. Further, in accordance with 9VAC5-60-320, the facility is required to employ BACT for emissions of TAP.

The following sub-sections provide a BACT analysis for all emissions units impacted by the proposed project with the exception of those units that are exempt from permitting requirements in accordance with 9VAC5-80-1105.B or are not impacted by the proposed project, as summarized in the table below.

Table 6-1. Summary of BACT Analysis

Emissions Unit	Pollutants	Control Technology or Work Practice
Green Wood Handling and Storage (ES-GWHS)	Not included in BACT analysis (permit-exempt source)	
Debarker (ES-DEBARK)	Not included in BACT analysis (permit-exempt source)	
Bark Hog (ES-BARK)	Not included in BACT analysis (permit-exempt source)	
Chipper (ES-CHIP)	Not included in BACT analysis (permit-exempt source)	
Green Wood Hammermills (ES-GHM-1 – 5)	PM	WESP
	VOC (as propane)	RTO
	TAP	RTO
Dryer 1 (ES-DRYER-1) and Dryer 2 (ES-DRYER-2)	CO	None
	NO_X	SNCR (Dryer 1) Good Combustion Practices (Dryer 2)
	PM	WESP
	SO_2	None
	VOC (as propane)	RTO
	TAP	RTO
Dryer and Furnace Bypass Stacks (ES-DRYERBYP-1, ES-FURNACEBYP-1, ES-DRYERBYP-2, ES-FURNACEBYP-2)	CO, NO_X, PM, SO_2, VOC, TAP	None
Dried Wood Handling (ES-DWH)	PM	Enclosure and Baghouse
	VOC (as propane)	None
	TAP	None

Emissions Unit	Pollutants	Control Technology or Work Practice
Dry Hammermills (ES-HM-1 – 8)	PM	Wet Scrubber
	VOC (as propane)	RCO
	TAP	RCO
Pellet Mill Feed Silo (ES-PMFS)	PM	Baghouse
Additive Handling and Storage (ES-ADD)	PM	Baghouse
Pellet Presses (ES-PP) and Pellet Coolers (ES-CLR-1 – 6)	PM	Wet Scrubber
	VOC (as propane)	RCO
	TAP	RCO
Pellet Cooler HP Fines Relay System (ES-PCHP)	PM	Baghouse
Finished Product Handling (ES-FPH)	PM	Baghouse
Paved and Unpaved Roads	PM	Good Work Practices
RTO 1 and 2 (CD-RTO-1 and 2)	CO, NO_X, PM, SO_2, VOC, TAP	Use of Propane/Natural Gas and Good Combustion Practices
RCO 1 (CD-RCO-1)	CO, NO_X, PM, SO_2, VOC, TAP	Use of Propane/Natural Gas and Good Combustion Practices
Double duct burners (ES-DDB-1 through ES-DDB-8)	Not included in BACT analysis (permit-exempt source)	
Propane vaporizer	Not included in BACT analysis (permit-exempt source)	
Emergency Generator and Firewater Pump Engines (ES-EG and ES-FWP)	Not included in BACT analysis (not impacted by project and permit-exempt sources)	
Diesel Fuel Tanks 1 and 2 (ES-TK-1 and 2)	Not included in BACT analysis (not impacted by project and permit-exempt sources)	

Emissions Unit	Pollutants	Control Technology or Work Practice
Mobile Source Diesel Fuel Tank 3 (ES-TK-3)	Not included in BACT analysis (permit-exempt source)	

As described below, Enviva's proposed control options are generally consistent with, or more stringent than, those currently employed by the facility in existing emissions units. In instances where this is not the case or where no controls are proposed as BACT, Enviva is providing a case-by-case BACT analysis. VA DEQ does not have a formal process for performing a case-by-case state BACT analysis. However, VA DEQ's BACT definition is generally consistent with the definition of BACT under Federal PSD regulations and Enviva conducted its case-by-case BACT analyses consistent with EPA guidance for top-down BACT analyses.

The top-down BACT approach begins with consideration of the technology that would achieve the maximum degree of emissions limitations, i.e. the lowest emission rate that can be or has been applied to the specific source type under review or to other similar source types. The top-ranked technology may be eliminated based on costs, economics, environmental or energy impacts. If the top control option is eliminated, the BACT analysis then proceeds to the next most stringent technology and the analysis continues until a BACT conclusion is reached. In practice, each step may not apply to each BACT analysis, and the steps may be overlapping, combined or undertaken in a different order depending on the specific emissions units and considerations involved.

6.1 Existing Dryer (ES-DRYER-1) and Bypass Stacks Dryer Bypass Stacks (ES-DRYERBYP-1, ES-FURNACEBYP-1)

The existing Dryer at the Southampton plant is equipped with a WESP and SNCR system to reduce PM and NO_X emissions, which have been previously determined to meet or exceed Virginia BACT standards.[22] In addition, as part of this application, Enviva is proposing to install a new RTO (CD-RTO-1) for control of VOC and TAP emissions from the existing dryer. No add-on controls have been previously required as BACT for CO and SO_2. The combination of existing and proposed controls for the existing Dryer are expected to exceed Virginia BACT requirements.

As part of this application, Enviva is also proposing to include the Dryer and Furnace Bypass Stacks. Periods when the Bypass Stacks will be used are not predictable; therefore, controlling emissions from these stacks would require installing large air pollution control systems with inherent environmental impacts (e.g., emissions of products of combustion from oxidation, wastewater discharges from scrubbing) that would need to operate throughout the entire year but only be required during limited periods of time. Due to the intermittent and unpredictable nature of these operations, and their negligible annual emissions, controlling Dryer and Furnace Bypass emissions is not economically feasible or environmentally beneficial, and is not further addressed in this analysis.

[22] April 9, 2012 Air Quality Permit Application and August 22, 2014 State Major Air Permit Application – Revision 1

6.2 New Dryer (ES-DRYER-2) and Bypass Stacks (ES-DRYERBYP-2, ES-FURNACEBYP-2)

Enviva is proposing to install an additional dryer with a furnace rated at 180 MMBtu/hr, and associated bypass stacks. The proposed Dryer 2 will operate in the same manner as the existing dryer. With the exception of SNCR for NO_X, Enviva will install the same controls for Dryer 2 that are currently in place for the existing Dryer 1, and which have been previously determined to meet or exceed Virginia BACT requirements. A top-down BACT analysis for NO_X emissions from Dryer 2 is provided below. For the same reasons discussed in Section 6.1 above for Dryer 1, the bypass stacks are not addressed in this analysis.

6.2.1 BACT Review for NO_x Emissions from the New Dryer 2 (ES-DRYER-2)

6.2.1.1 Step 1 – Identify Control Technologies

NO_X emissions generated during normal operation of the dryer furnace can potentially be reduced by add-on control technologies. There are no known process design or operational changes that will result in lower NO_X emissions and still allow the Dryers to function as required. Based upon a search of EPA's RACT/BACT/LAER Clearinghouse (RBLC) results and commercially demonstrated technology, the following control technologies are considered in this evaluation:

- SNCR;
- SCR; and
- Good Combustion Practices.

The following provides additional information on each of the above control technologies and expected NO_x control efficiency.

Selective Non-Catalytic Reduction (SNCR)

SNCR describes a process by which NO_x is reduced to molecular nitrogen (N_2) and water (H_2O) by injecting an ammonia (NH_3) or urea ($CO(NH_2)_2$) spray into the post-combustion area of the unit. Typically, injection nozzles are located in the upper area of the furnace and convective passes. Once injected, the urea or ammonia decomposes into NO_3 or NH_2 free radicals, reacts with NO_x molecules, and reduces to nitrogen and water. The reactions are endothermic and use the heat of the burners as energy to drive the reduction reaction.

Both ammonia and urea have been successfully employed as reagents in SNCR systems and have certain advantages and disadvantages. Ammonia is less expensive than urea and results in substantially lower operating costs at comparable levels of effectiveness. Urea, however, is able to penetrate further into flue gas streams, making it more effective in larger scale burners and combustion units with high exhaust flow rates.

SNCR is considered a selective chemical process because, under a specific temperature range, the reduction reactions are favored over reactions with other flue gas components. Although other operating parameters such as residence time and oxygen availability can significantly affect performance, temperature remains one of the most prominent factors affecting SNCR performance.

The SNCR process requires the installation of reagent storage facilities, a system capable of metering and diluting the stock reagent into the appropriate solution, and an atomization/injection system at the appropriate locations in the combustion unit. The reagent solution is typically injected along the post-combustion section of the combustion

unit. Injection sites around the unit must be optimized for reagent effectiveness and must balance residence time with flue gas stream temperature.

For ammonia, the optimum reaction temperature range is approximately 880 to 1,100 degrees Celsius (1,615 to 2,000°F.) Below this range, the NH_3/ NO_X reaction will not occur. The unreacted NH_3 will either be emitted as NH_3 slip, or it will react with SO_3 to form ammonium salts. Above the optimal temperature range, the amount of NH_3 that oxidizes to NO_x increases and NO_x reduction performance deteriorates. Further, oxidation of unreacted ammonia into NO_X may also occur in downstream oxidation-based control devices, such as the proposed RTOs

Selective Catalytic Reduction (SCR)

Similar to SNCR, SCR is a post combustion NO_X control method which uses a catalyst bed to reduce the effective temperature in which the conversion of NO_X to molecular nitrogen and water (H_2O) occurs. Specifically, SCR involves the injection of ammonia (NH_3) into the flue gas stream upstream of a catalyst bed. On the catalyst surface, ammonia reacts with NOX contained within the air to form nitrogen gas (N_2) and H_2O.

The catalyst's active surface is usually either a noble metal (platinum), base metal (titanium or vanadium) or a zeolite-based material. Metal-based catalysts are usually applied as a coating over a metal or ceramic substrate. Zeolite catalysts are typically a homogenous material that forms both the active surface and the substrate. The geometric configuration of the catalyst body is designed for maximum surface area and minimum obstruction of the flue gas flow path in order to achieve maximum conversion efficiency and minimum back pressure. The most common configuration is a "honeycomb" design. In a typical ammonia injection system, ammonia is drawn from a storage tank, vaporized and injected upstream of the catalyst bed. Excess ammonia that is not reacted in the catalyst bed and emitted is referred to as ammonia slip. An important factor that affects the performance of an SCR is operating temperature. The temperature range for standard base metal catalyst is between 400-800°F.

The flue gas in wood-fired systems prior to final particulate matter controls contain alkali metals such as sodium, potassium and zinc and trace heavy metals that poison the SCR catalyst. Additionally, the high particulate loading associated with wood fired operations reduces the number of active catalyst sites available for the reaction to occur (i.e., blinding), reducing the NO_x removal efficiency and increasing ammonia slip. Further, the firing rate for the wood fired furnace changes frequently to accommodate the variable heat demand of each rotary dryer and the inconsistency in fuel. This makes it difficult to optimize the ammonia injection rate and, as a result, significant ammonia slip and/or higher NO_X emissions would occur. Additionally, the alkalinity of wood ash can contaminate the catalyst and significantly reduce NO_X removal efficiency. It is believed that there are no conventional SCR systems operating after wood-fired combustion systems in the United States.

6.2.1.2 Step 2 – Eliminate Technically Infeasible Options

Based on EPA's Air Pollution Control Technology Fact Sheet, SNCR can achieve NO_x reduction efficiencies of 30% to 50%[23]. As previously discussed, the SNCR process injects a reagent into the flue gas stream that reacts with NO_X to form N_2 and H_2O, and SNCR does not utilize a catalyst to promote the chemical reduction of NO_X. Because no catalyst is used, the SNCR

[23] Air Pollution Control Technology Fact Sheet, EPA-452/F-03-031

process requires extremely high flue gas temperatures (1,600 to 2,100°F) to increase the temperature window sufficiently to disassociate NO_X to N_2 and H_2O. The exhaust flue gas temperature of the Dryers is lower than the required temperatures as evidenced by site-specific data on the performance of the SNCR system for the existing dryer. The manufacturer of the existing system has confirmed that the temperature in the secondary combustion chamber is not sufficiently high to achieve full reduction of NO_X, and stack test data show that an SNCR NO_X reduction efficiency of 50% is not routinely achieved for the existing Dryer. In addition, given the proposed use of an RTO, any ammonia slip could result in increased NO_X emissions due to oxidation of ammonia in the RTO. Nevertheless, and despite poor control efficiencies observed for the SNCR on the existing Dryer, this technology cannot be eliminated due to technical infeasibility for the new Dryer.

With regards to SCR, there are substantial technical concerns about poisoning/blinding of catalysts utilized within an SCR system and our research indicates that there are no such systems operating on a source similar to a wood-fired dryer burner system anywhere in the world. Although SCR is included as a potential control technology in this BACT analysis, the use of such a system is not technically feasible for the wood fired furnace/dryer exhaust due to the following:

- High particulate loading in wood fired operations effectively blinds the catalyst by reducing the number of active catalyst sites available for the reaction to occur, reducing the NOx removal efficiency and increasing ammonia slip;
- The firing rate for the wood fired furnace changes frequently to accommodate the variable heat demand of each rotary dryer and the inconsistency in fuel. This makes it difficult to optimize the ammonia injection rates resulting in significant ammonia slip and potentially higher NOx emissions; and
- The alkalinity of wood ash can contaminate and/or poison the catalyst and significantly reduce NOx removal efficiency.

Therefore, the use of SCR for the wood fired furnace/dryers will not be considered for the remainder of this analysis.

6.2.1.3 Step 3 – Rank Remaining Control Technologies by Effectiveness

After eliminating SCR, SNCR and good combustion practices are the remaining control options, with SNCR expected to be more effective at controlling NO_X emissions compared to good combustion practices.

6.2.1.4 Step 4 – Evaluate Most Effective Control Options

As detailed Appendix C, Enviva is proposing to comply with a NO_X emissions limit of 20 lb/hr for the existing Dryer 1, which corresponds to 0.11 lb/MMBtu. The proposed new Dryer 2 is expected to emit NO_X at a rate of 14.3 lbs/hr, which is equivalent to 0.08 lb/MMBtu based on the new furnace's capacity of 180 MMBtu/hr. The Dryer 2 emissions rate is lower than the emissions rate for the existing Dryer 1 using SNCR. Therefore, the proposed Dryer 2 emissions limit exceeds the Virginia BACT requirements for these types of units.

6.2.1.5 Step 5 – Select BACT

As documented above, installation of NO_X controls on the new Dryer is not representative of Virginia BACT requirements. As such, Enviva proposes good combustion practices as BACT for NO_X with an emissions limit of 14.3 lb/hr on a 3-hour average basis.

6.3 RTO 1 (CD-RTO-1), RTO 2 (CD-RTO-2), and RCO 1 (CD-RCO-1)

As discussed above, with this application, Enviva is proposing to install two RTOs for control of VOC, HAP, and TAP emissions from the two Dryer lines and Green Hammermills, and one RCO/RTO for control of VOC, HAP, and TAP emissions from Dry Hammermills and Pellet Coolers. Each RTO will have four, 8-MMBtu/hr burners fired by propane or natural gas. The RCO/RTO will have two, 9.8-MMBtu/hr burners also fired by propane or natural gas. The burners will emit NO_X, CO, PM, SO_2, VOC, and TAP as a result of combustion of the propane or natural gas fuel and oxidation of organic materials in the exhaust streams controlled by the oxidizers. Each burner is estimated to emit less than 5 tons per year of CO and NO_X from fuel combustion and VOC oxidation, and less than 1 tpy each of PM, SO_2, VOC, and TAP. Given that the burners exhaust through the same stacks as the main process emissions, controlling emissions from the burners would require installation of additional, large air pollution control devices with their own added environmental impacts to control only a small amount of emissions. As such, controlling emissions from the RTO and RCO/RTO burners is not cost-effective or environmentally-beneficial, and use of propane/natural gas fuel along with good combustion practices is expected to exceed Virginia BACT requirements.

6.4 Pellet Cooler HP Fines Relay System (ES-PCHP) and Truck Loadout (ES-TL)

The Southampton plant includes a Pellet Cooler HP Fines Relay System and pellet Truck Loadout operations. The only pollutant of concern from these sources is PM. These emission units will be controlled by a new baghouse, consistent with other existing sources of PM emissions at the facility, which reduces PM emissions to an outlet grain loading of 0.004 grains per cubic foot (gr/cf). The baghouse are expected to exceed Virginia BACT requirements.

6.5 Additive Handling and Storage (ES-ADD)

Enviva is proposing to add a silo to store a dry powder additive that will be used in the pelletizing process. The primary pollutant of concern from Additive Handling and Storage will be PM. The facility is proposing to install a baghouse on the silo that will reduce PM emissions to an outlet grain loading of 0.004 gr/cf. The proposed baghouse is expected to exceed Virginia BACT for PM emissions from the additive silo.

6.6 Finished Product Handling (ES-FPH)

The wood pellet storage bins, used to store finished product before being sent offsite, are sources of PM emissions. PM emissions from the storage bins are currently controlled by a baghouse, which reduces PM exhaust to 0.004 gr/cf. Enviva is not proposing to change the control device for finished product handling which was previously determined to meet or exceed Virginia BACT standards.

6.7 Pellet Presses and Coolers (ES-PP and ES-CLR-1 - 6)

The Pellet Presses and Coolers are a source of PM, VOC, and TAP emissions. As part of the proposed project, Enviva is voluntarily proposing to install a new scrubber (CD-WS-2) for control of PM emissions from the Pellet Presses and Coolers. The exhaust from the scrubber will then be fed into the Dry Hammermills for control of VOC and TAP emissions by the proposed new control devices for those units (i.e., CD-WS-1 and CD-RCO-1). In the event that the Dry Hammermills are not in operation, the exhaust from the new Pellet Cooler scrubber (CD-WS-2) will be routed directly to the Dry Hammermill scrubber (CD-WS-1) and then the new RCO/RTO (CD-RCO-1). Installation of the proposed scrubbers and RCO/RTO is expected to exceed Virginia BACT for emissions from the pellet coolers.

6.8 Green Wood Hammermills (ES-GHM-1 - 5)

Enviva is proposing to install five (5) new Green Hammermills. The Green Hammermill exhaust will be routed to the existing Dryer 1 WESP (CD-WESP-1) for control of PM emissions. In addition, and as noted above, as part of the proposed project, Enviva is voluntarily proposing to install a new RTO (CD-RTO-1) on the existing Dryer line that will also control VOC and TAP emissions from the proposed Green Hammermills.

Installation of the new RTO in combination with the use of the existing WESP is expected to exceed Virginia BACT for PM, VOC, and TAP emissions from the Green Hammermills.

6.9 Dry Hammermills (ES-HM-1 thru -8)

The primary pollutants of concern from the Dry Hammermills are VOC, TAP, and PM. The Southampton plant currently operates baghouses to reduce PM emissions, which have been previously determined to meet or exceed Virginia BACT requirements.

Additionally, Enviva is voluntarily proposing to further control PM emissions by routing the baghouse exhaust to a new scrubber (CD-WS-1). The additional PM control will reduce the risk of catalyst blinding in the new RCO/RTO (CD-RCO-1), which will be used for voluntary control of VOC and TAP emissions from the Dry Hammermills as well as the Pellet Presses and Coolers.

Installation of the new PM, VOC, and TAP control devices in combination with the use of the existing PM controls is expected to exceed Virginia BACT for the Dry Hammermills.

6.10 Dry Wood Handling (ES-DWH)

There are several conveyor transfer points comprising the Dry Wood Handling emission source that are located between the Dryer and Dry Hammermills, which are sources of PM emissions. Additionally, the dried material may continue to emit VOC and TAP as it is transferred between the Dryer and Dry Hammermills due to the elevated temperature of the material. The majority of the dried wood material transfer systems are enclosed, which minimizes emissions of PM. In addition, Enviva will be voluntarily installing a new baghouse (CD-DWH-BF) to control PM emissions associated with Dried Wood Handling at the pre-screener inlet before the Dry Hammermills. The use of enclosures as well as a baghouse for one of the Dried Wood Handling emissions points is expected to exceed Virginia BACT requirements for PM. BACT for VOC and TAP emissions is addressed in detail in the following subsections.

6.10.1 VOC/TAP BACT for Dried Wood Handling Operations

6.10.1.1 Step 1- Identify Control Technologies

VOC and TAP emissions from the Dried Wood Handling operations can potentially be controlled by add-on control technologies. There are no know process changes that could be implemented that would reduce VOC or TAP emissions and still allow proper operation of Dried Wood Handling operations. Based upon a search of RBLC results and commercially demonstrated technology, the following add-on control technologies are considered in this evaluation:

- Thermal Oxidation – TO, Recuperative Unit, or RTO;
- Catalytic Oxidation - RCO and TCO;
- Wet Scrubber - Packed-Bed/Packed-Tower; and,
- Bio-oxidation/Bio-filtration.

Thermal Oxidation

Thermal oxidation reduces VOC and TAP emissions by oxidizing these organic pollutants to carbon dioxide (CO_2) and water vapor (H_2O) at a high temperature with a residency time between one-half second and one second. Thermal oxidizers can be designed as conventional thermal units, recuperative units, or RTO. A conventional thermal oxidizer does not have heat recovery capability. Therefore, the fuel costs are extremely high and not suitable for high volume flow applications. In a recuperative unit, the contaminated inlet air is preheated by the combustion exhaust gas stream through a heat exchanger. An RTO can achieve a heat recovery higher than a recuperative oxidizer. It is common now to design an RTO with a thermal recovery efficiency of 95% or greater. RTOs are commonly used to control VOC emissions in high-volume low concentration gas streams because of the significant savings in fuel costs while still achieving equal VOC emissions control efficiencies; therefore, for purposes of this BACT analysis only RTOs will be further discussed.

An RTO uses high-density media such as a ceramic-packed bed still hot from a previous cycle to preheat an incoming VOC/TAP-laden waste gas stream. The preheated, partially oxidized gases then enter a combustion chamber where they are heated by auxiliary fuel (propane or natural gas) combustion to a final oxidation temperature typically between 760-820 °C (1,400-1,500 °F) and maintained at this temperature to achieve maximum VOC/TAP destruction. The purified, hot gases exit this chamber and are directed to one or more different ceramic-packed beds cooled by an earlier cycle. Heat from the purified gases is absorbed by these beds before the gases are exhausted to the atmosphere. The reheated packed-bed then begins a new cycle by heating a new incoming waste gas stream.

Particulate control must be placed upstream of thermal oxidation controls to remove unwanted particulate matter that can cause plugging of heat exchange media or result in unsafe operations as a result of fires and significant operational and maintenance related difficulties. Typical VOC control efficiencies range from 95 to 99%.[24]

Catalytic Oxidation

Similar to an RTO, an RCO and a thermal catalytic oxidizer (TCO) oxidize VOC and TAP to CO_2 and H_2O. However, RCO and TCO use catalyst to lower the activation energy required for the oxidation so that the oxidation can be accomplished at a lower temperature than an RTO. As a result, the overall auxiliary fuel required is lower than that for an RTO. RCO technology is widely used in the reduction of VOC emissions. An RCO operates in the same fashion as an RTO, but it requires only moderate reheating to the operating range of the catalyst, approximately 450 °F. Similar to thermal oxidation units, particulate control must be placed upstream of an RCO. Even with highly efficient particulate control, there is the risk of catalyst blinding/poisoning and catalyst life guarantees are relatively short. The VOC and TAP destruction efficiency for an RCO typically ranges from 90 to 99%.[25]

Operating much in the same fashion as an RCO, a TCO passes heated gases through a catalyst without the regenerative properties attributed by the ceramic bed used to recapture

[24] EPA, *Air Pollution Control Technology Fact Sheet, Regenerative Incinerator*, EPA-452/F-03-021. https://www3.epa.gov/ttn/catc/dir1/fregen.pdf

[25] Ibid.

heat. Depending on design criteria, a TCO is expected to achieve a similar VOC and TAP emission destruction efficiency to that of an RTO.

Consistent with EPA's economic analyses it has been determined by Enviva that an RTO is a more cost effective control device than catalytic oxidation units (RCO and TCO) and has significantly less operational and maintenance issues while still achieving the same level of VOC control.[23,26] Specifically, as documented in EPA's Air Pollution Control Technology Fact Sheet the annualized costs for the installation of an RTO ranges from $8 to $33 per scfm while that of an RCO ranges from $11 to $42 per scfm. As such, the VOC/TAP BACT analyses in this document will only address the use of RTO controls.

Wet Scrubber

With packed-bed/packed-tower wet scrubbers (scrubbers), pollutants are removed by inertial or diffusional impaction, reaction with a sorbent or reagent slurry, or absorption into a liquid solvent. Removal efficiencies for gas absorbers vary for each pollutant-solvent system and with the type of absorber used. Most absorbers can achieve removal efficiencies in excess of 90%, and packed-tower absorbers may achieve efficiencies as great as 99% for some pollutant-solvent systems. [27] It should be noted that some VOCs present in the Dried Wood Handling exhaust streams are highly soluble in water; other VOCs, most notably alpha/beta-pinene which make up the predominate species, are only slightly soluble in water and thus, result in a significantly reduced VOC control efficiency.

Bio-oxidation/Bio-filtration

Bio-oxidation/Bio-filtration offers a cost-effective alternative to traditional thermal and catalytic oxidation systems in limited situations. In limited applications this air pollution control technology can provide a reduction in VOC emissions of 60 to 99.9%.[28] Specifically, VOC and TAP are oxidized using living micro-organisms on a media bed (sometimes referred to as a "bioreactor"). A fan is typically used to collect or draw contaminated air from a building or process. If the air is not properly conditioned (heat, humidity, solids), then pre-treatment is a necessary step to obtain optimum gas stream conditions before introducing it into the bioreactor. As the emissions flow through the bed media, the pollutants are absorbed by moisture on the bed media and come into contact with the microbes. Depending on the volume of air required to be treated, the footprint of a bio-oxidation/bio-filtration system can be excessive and take up significant acreage. The microbes consume and metabolize the excess organic pollutants, converting them into CO_2 and water, much like a traditional thermal and catalytic oxidation process.

"Mesophilic" microbes are typically used in these systems. Mesophilic microbes can survive and metabolize VOC materials at conditions up to 110 °F to 120 °F. One company is attempting to develop a commercial-scale technology that employs "thermophilic" microbes, but that technology has only been demonstrated on a single pilot scale installation that has a

[26] EPA, *Air Pollution Control Technology Fact Sheet, Packed-Bed/Packed-Tower Wet Scrubber*, EPA-452/F-03-015. https://www3.epa.gov/ttn/catc/dir1/fpack.pdf

[27] EPA, *Air Pollution Control Technology Fact Sheet, Packed-Bed/Packed-Tower Wet Scrubber*, EPA-452/F-03-015. https://www3.epa.gov/ttn/catc/dir1/fpack.pdf

[28] EPA, *Using Bioreactors to Control Air Pollution*, EPA-456/R-03-003. https://www3.epa.gov/ttncatc1/dir1/fbiorect.pdf

similar – but not exactly the same – exhaust stream profile as Enviva. Thermophilic microbes live and metabolize VOC/TAP at higher operating temperatures (~160 °F).

6.10.1.2 Step 2 – Eliminate Technically Infeasible Options

While there are a number of techniques that can be used to control VOC/TAP, the following technologies are not technically feasible for the Dried Wood Handling operations at the facility:

- Wet Scrubber; and
- Bio-oxidation/Bio-filtration

As discussed previously, wet scrubbers applied to exhaust gas streams such as those from the Dried Wood Handling operations have limited control efficiency given the insolubility of a large portion of the exhaust stream. It should also be noted that use of a scrubber would generate additional environmental impacts and would require onsite or offsite treatment of the scrubber blowdown water to remove/treat the soluble VOC/TAP components removed from the exhaust stream. Because of the expected low control efficiency and additional environmental impacts, wet scrubbers are not considered technically feasible.

The primary constituents of the VOC in the Dried Wood Handling exhaust stream are terpenes, which are highly viscous and would cause the bio-oxidation/bio-filtration system to foul. In addition, the expected footprint of a unit sized to handle the volume of gas needed for treatment would be extensive and impractical. Finally, the use of this technology has not been demonstrated in practice at a pellet manufacturing facility. Due to expected fouling, significant land requirements, and the undemonstrated nature of this technology at a pellet manufacturing facility, bio-oxidation/bio-filtration has been eliminated from further consideration in this BACT analysis.

6.10.1.3 Step 3 – Rank Remaining Control Technologies by Effectiveness

After eliminating wet scrubber and bio-oxidation/bio-filtration as a potential control option, Enviva has concluded that the following options remain technologically feasible:

- Thermal Oxidation – TO, Recuperative Unit, or RTO; and
- Catalytic Oxidation - RCO and TCO.

See Section 6.9.1.1 above for details on why a RTO is the only control considered out of the remaining technically feasible options.

6.10.1.4 Step 4 – Evaluate Most Effective Control Options (Impacts Analysis)

Enviva analysed the costs associated with installation of an RTO on the Dried Wood Handling operations. As noted above, particulate control must be placed upstream of thermal oxidation controls to remove unwanted particulate matter that can cause plugging of heat exchange media or result in unsafe operations as a result of fires and significant operational and maintenance related difficulties. Further, it is Enviva's experience that fire hazards are still potentially created when a baghouse is used as the upstream particulate matter control device. Therefore, a wet scrubber or WESP would be required instead.

An economic analysis was performed to estimate the cost effectiveness of an RTO in reducing VOC/TAP emissions from the Dried Wood Handling operation. The RTO capital expenditure was estimated to be $1,340,705 (including a wet scrubber) with annualized

operating costs of $1,009,588. The installation of the RTO would reduce VOC emissions by 47.3 tpy and TAP emissions by 1.1 tpy. As detailed in Appendix H, the cost of control would be $21,337 per ton of VOC emissions reduced (controlled) and $949,997 per ton of TAP. The high cost per ton is due to: (1) the relatively low emissions; (2) the relatively high initial capital and annual operating costs associated with the installation and operation of the RTO; and (3) the need to install a PM control device upstream of the RTO. This high cost of control associated with installing and operating a RTO to control emissions from the Dried Wood Handling operations is considered to be excessive and is therefore not considered to be representative of Virginia BACT on the basis of its high cost of control.

It should also be noted that the installation of an RTO would result in adverse impacts in the form of increased combustion pollutants and GHG emissions as result of the oxidation of fuel and VOC emissions from the Dried Wood Handling Operations

6.10.1.5 Step 5 – Select BACT

As documented above the cost to install additional controls on the Dried Wood Handling operations is not considered cost effective. Therefore, BACT for VOC/TAP emissions from the Dried Wood Handling Operations is considered good operating procedures consistent with previous permitting actions.

6.11 Pellet Mill Feed Silo (ES-PMFS)

The existing Pellet Mill Feed Silo at the Southampton plant is currently equipped with a baghouse to reduce PM. Enviva is not proposing to change the control device for the Pellet Mill Feed Silo, which has been previously determined to meet or exceed Virginia PM BACT standards.

6.12 Paved and Unpaved Roads

Fugitive PM emissions will occur as a result of trucks and employee vehicles traveling on Paved and Unpaved Roads on the Southampton plant property. The following sections document the BACT analysis for PM emissions from Paved and unpaved Roads.

6.12.1 Step 1 – Identify Control Technologies

As described above, PM emissions from Paved and Unpaved Roads are fugitive in nature. As such, no add-on control technologies are technically feasible for control of PM emissions. Therefore, work practices and pollution prevention are the only feasible means for minimizing PM emissions from Paved and Unpaved Roads. Based on a review of approved BACT from EPA's RBLC database, the following options have been identified as potential control options:

- Application of water or wet suppressants;
- Vehicle speed control/reduction;
- Good housekeeping and maintenance practices; and
- Vacuuming and/or sweeping of roadways.

6.12.2 Step 2 – Eliminate Technically Infeasible Options

All of the control options are considered technically feasible for minimizing PM emissions from Paved and Unpaved Roads.

6.12.3 Step 3 – Rank Remaining Control Technologies by Effectiveness

The control effectiveness for the work practices and pollution prevention options identified may vary depending on the frequency of application, treatment, and implementation. However, with proper implementation a combination of the above control options can achieve up to 90% control efficiency.

6.12.4 Step 4 – Evaluate Most Effective Control Options and Step 5 – Select BACT

As described above, the most effective control for minimizing PM emissions from Paved and Unpaved Roads is to employ good work practices. Thus, no one work practice is considered the most effective control. Therefore, Enviva proposes a combination of watering, vehicle speed control, and good housekeeping as BACT for PM emissions from Paved and Unpaved Roads, which will reduce emissions by an estimated 90%.

7. TOXICS MODELING ANALYSIS

As previously described in Section 5.5.5, Article 5 of 9VAC5-60 establishes Virginia's Emissions Standards for Toxic Pollutants from New and Modified Sources. The standards apply to sources with TAP emissions above Virginia's Toxic Air Pollutant Permitting Emission Rates unless specifically exempt from these requirements (e.g., sources subject to an emissions standard or other requirement under Article 2 of 9VAC5-60 or an emissions standard or other requirement established pursuant to §112 of the Clean Air Act).

In accordance with 9VAC5-60-320, sources subject to Virginia's TAP standards must employ BACT for TAP and must not "cause, or contribute to, any significant ambient air concentration that may cause, or contribute to, the endangerment of human health." The following sections outline the data sources and methodologies used in completing the TAP air quality analysis for the Southampton plant. Section 6.0 – BACT Analysis of this document addresses BACT requirements for TAP emissions.

7.1 State Requirements

Dispersion modeling was conducted for each TAP with post-project facility-wide potential emissions in excess of its respective VA DEQ exemption threshold. The analysis was conducted consistent with the following state and federal guidance documents:

- *Virginia Modeling Guideline for Air Quality Permits* (March 2015);
- EPA's Guideline on Air Quality Models 40 CFR 51, Appendix W (Revised, January 17, 2017), herein referred to as Appendix W;[29] and
- EPA's *AERMOD Implementation Guide* (Revised April 17, 2018).

7.2 Significant Ambient Air Concentrations

Enviva conducted air dispersion modeling for 28 TAP with emissions in excess of the VA DEQ exemption thresholds based on 9VAC5-60-300.C.1 to demonstrate compliance with the Significant Ambient Air Concentrations (SAAC) based on 9VAC5-60-330.[30] The SAAC serve to ensure that emissions from a facility do not adversely affect human health. A comparison of the Southampton plant facility-wide potential emissions to the exemption thresholds is provided in Table 7-1 below.

The maximum annual concentration across five years of meteorological data was compared to the annual SAAC and the highest-first-high (H1H) 1-hour concentration across the five years was compared to the 1-hour SAAC. Concentrations below the SAAC indicate that the Southampton plant will not cause an exceedance of the SAAC.

[29] Appendix W was revised on December 17, 2016 (Federal Register Vol. 82, No. 10); however, on January 26, 2017 the effective date of the final rule was delayed until March 21, 2017 (Federal Register Vol. 82, No. 16). On March 20, 2017 the effective date of the final rule was further delayed to May 22, 2017 (Federal Register Vol. 82, No. 52), upon which it became effective.

[30] Exemption thresholds and SAAC obtained from: https://www.deq.virginia.gov/Portals/0/DEQ/Air/Permitting/Toxics_Spreadsheet.xlsx

Table 7-1. Comparison to Toxic Air Pollutant Exemption Thresholds

Pollutant	Potential Emissions		Exemption Threshold		Modeling Required?
	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	
Acetaldehyde	25.0	5,893	8.91	26.1	**Yes**
Acrolein	17.9	5,578	0.023	0.033	**Yes**
Formaldehyde	22.8	6,368	0.083	0.17	**Yes**
Methanol	16.0	7,123	10.8	38.0	**Yes**
Phenol	8.60	2,701	1.25	2.76	**Yes**
Acetophenone	2.33E-06	3.79E-04	3.24	7.13	No
Antimony and compounds	5.90E-03	2.10	0.033	0.073	**Yes**
Arsenic	0.016	6.01	0.013	0.029	**Yes**
Benzene	0.11	905	2.11	4.64	**Yes**
Beryllium	8.22E-04	0.30	1.32E-04	2.90E-04	**Yes**
1,3-Butadiene	1.78E-04	0.09	1.45	3.19	No
Cadmium	3.16E-03	1.96	3.30E-03	7.25E-03	**Yes**
Carbon tetrachloride	0.033	5.33	2.05	4.50	**Yes**
Chlorine	0.85	2,491	0.10	0.22	**Yes**
Chlorobenzene	0.024	3.91	3.04	6.67	No
Chloroform	2.49E-04	2.18	3.23	7.11	No
Chromium VI	2.16E-04	1.89	3.30E-03	7.25E-03	**Yes**
Chromium	0.014	4.74	3.30E-03	7.25E-03	**Yes**
Cobalt compounds	4.85E-03	1.73	3.30E-03	7.25E-03	**Yes**
Dichlorobenzene	1.08E-04	0.95	21.8	65.4	No
Dichloroethane, 1,2-	0.021	3.43	2.64	5.80	No
Dichloropropane, 1,2-	0.024	3.91	16.8	50.3	No
Dinitrophenol, 2,4-	1.31E-04	0.021	6.60E-03	0.015	**Yes**
Di(2-ethylhexyl)phthalate	3.38E-05	5.33E-03	0.33	0.73	No
Ethyl benzene	0.023	3.67	17.9	62.9	No
Hexane	0.16	1,418	11.6	25.5	**Yes**
Hydrochloric acid	14.4	6,684	0.25	--	**Yes**
Lead	1.28E-03	11.2	9.90E-03	0.022	**Yes**
Manganese	1.19	426	0.33	0.73	**Yes**
Mercury	2.64E-03	1.14	6.60E-03	0.015	**Yes**
Methyl bromide	0.011	1.78	1.25	2.76	No
Methyl chloride	0.017	2.72	6.83	14.9	No
Methylene chloride	2.58E-03	22.6	11.5	25.2	No
Naphthalene	0.071	12.0	2.61	7.54	**Yes**
Nickel	0.025	10.4	6.60E-03	0.014	**Yes**
Nitrophenol, 4-	8.02E-05	0.013	0.066	0.15	No
Pentachlorophenol	3.72E-05	6.04E-03	0.033	0.073	No
Perchloroethylene	0.037	4.50	22.8	49.2	No
Phosphorus	0.028	7.19	6.60E-03	0.015	**Yes**
Polychlorinated biphenyls	5.95E-06	9.64E-04	6.60E-05	1.45E-04	**Yes**
Selenium compounds	2.09E-03	0.76	0.013	0.029	**Yes**
Styrene	0.017	148	14.1	30.9	**Yes**
Toluene	2.43E-03	5.94	18.7	54.7	No

Pollutant	Potential Emissions		Exemption Threshold		Modeling Required?
	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	
Trichloroethane, 1,1,1-	0.023	3.67	22.8	100	No
Trichloroethylene	0.022	3.40	22.8	39.0	No
Trichlorophenol, 2,4,6-	1.60E-05	2.60E-03	0.021	0.045	No
Vinyl chloride	0.013	2.13	0.86	1.89	**Yes**
Xylene	1.52E-03	2.59	21.5	62.9	No

7.3 Model Selection

Enviva utilized the latest version of the AERMOD model (Version 18081). AERMOD is the EPA-approved air dispersion model for near-field (within 50 km) modeling analyses. AERMOD was run using default regulatory options.

7.4 Receptor Grid and Elevation Data

A resolution of 25 meters was used for receptors along the ambient boundary and a nested Cartesian grid extending approximately 10 km from the center of the facility was modeled using the following resolutions, consistent with the *Virginia Modeling Guideline for Air Quality Permits*:

- 50 meter resolution extending approximately 1 km from the property boundary;
- 100 meter resolution between approximately 1 km and approximately 3 km from the property boundary; and
- 250 meter resolution between approximately 3 km and 10 km from the property boundary.

Modeled concentrations were reviewed to ensure that the maximum concentration was captured for all averaging periods within the 10 km grid.

Receptor elevations, in addition to source and building elevations, were determined using the AERMAP terrain pre-processor. Hill height parameters required by AERMOD are also calculated by AERMAP. Elevations were based on 1/3 arc-second National Elevation Dataset (NED) from the U.S. Geological Survey (USGS). AERMAP input and output files and a copy of the NED file are provided in Appendix E.

7.5 Meteorological Data

Enviva utilized AERMOD-ready meteorological data processed by VA DEQ for the Richmond International Airport National Weather Service (NWS) surface station (ID: 13740) and upper air data from the Sterling NWS Station (ID: 93734) for the period 2012-2016.[31] The selection of meteorological stations is consistent with previous modeling conducted for the Southampton plant in June 2012. The Richmond NWS station is located approximately 90 km north-northwest of the Southampton plant. Based on its proximity and similar topographic setting, the Richmond NWS station was previously determined to be the most representative source of surface meteorological data.

[31] Data provided via email to Aubrey Jones (Ramboll) by Robert Lute (DEQ) on August 30, 2018.

The meteorological data were processed by VA DEQ using version 18081 of AERMET with the ADJ U* option. The base elevation for the Richmond surface station was set to 50 m.[32] The meteorological data files are provided in Appendix E for reference.

7.6 Modeled Sources and Release Parameters

As previously described in Section 2, there are several different operating scenarios for the Southampton plant dryers and furnaces. Normal operation was modeled to assess compliance with the SAAC as it results in the maximum annual potential emissions. Use of the dryer and furnace bypass stacks occurs intermittently, and the frequency and duration are minimized to the extent possible, as previously described in Section 2.4.

Tables 7-2 and 7-3 present a summary of the modeled sources and associated release parameters. The emergency generator and fire water pump are subject to 40 CFR 63 Subpart ZZZZ and are therefore exempt from toxics permitting requirements per 9VAC5-60-300.C.3. These sources were excluded from the modeling analysis.

Modeled emission rates are consistent with the emission rates provided in the potential emissions calculations in Appendix C. A figure showing the modeled layout is provided in Appendix F.

7.6.1 Point Sources

Each modeled source with a defined stack was represented as a point source. The duct burner stacks will have rain caps and were modeled using the POINTCAP option in accordance with the *AERMOD Implementation Guide*.[33] Modeled stack parameters for point sources are summarized in Table 7-2 below.

Table 7-2. Summary of Modeled Point Source Parameters

Model ID	Source Type	UTM Easting[1] (m)	UTM Northing[1] (m)	Stack Height (m)	Exhaust Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
RTO1	POINT	323,736.57	4,057,818.75	28.66	352.59	7.58	3.05
RTO2	POINT	323,607.72	4,057,880.40	28.61	388.71	23.88	1.63
RCO	POINT	323,620.29	4,057,922.94	27.43	362.04	15.15	2.34
DWH	POINT	323,666.42	4,057,904.46	18.31	Ambient	5.63	0.40
PVAP	POINT	323,609.81	4,057,941.99	3.05	449.82	18.11	0.15
DB1	POINTCAP	323,714.75	4,057,863.57	3.05	449.82	18.11	0.15
DB2	POINTCAP	323,723.64	4,057,851.19	3.05	449.82	18.11	0.15
DB3	POINTCAP	323,626.96	4,057,838.01	3.05	449.82	18.11	0.15
DB4	POINTCAP	323,646.17	4,057,851.98	3.05	449.82	18.11	0.15
DB5	POINTCAP	323,630.93	4,057,996.92	3.05	449.82	18.11	0.15
DB6	POINTCAP	323,659.66	4,057,963.26	3.05	449.82	18.11	0.15
DB7	POINTCAP	323,682.84	4,057,915.16	3.05	449.82	18.11	0.15
DB8	POINTCAP	323,632.51	4,057,900.72	3.05	449.82	18.11	0.15

1. Coordinates reflect NAD83, UTM Zone 18.

[32] http://weather.rap.ucar.edu/surface/stations.txt

[33] EPA. *AERMOD Implementation Guide*. Revised April 17, 2018.

7.6.2 Volume Sources

Fugitive TAP emissions associated with the chipper and bark hog were modeled using volume sources. Initial lateral and vertical dimensions were determined in accordance with the AERMOD *User's Guide*.[34] Modeled volume source parameters are summarized in Table 7-3 below.

Table 7-3. Summary of Modeled Volume Source Parameters

Model ID	UTM Easting[1] (m)	UTM Northing[1] (m)	Release Height (m)	Initial Lateral Dimension (m)	Initial Vertical Dimension (m)
CHIP	323,871.15	4,057,867.97	10.97	2.84	3.40
BHOG	323,827.55	4,057,859.77	3.96	0.39	0.43

1. Coordinates reflect NAD83, UTM Zone 18.

7.7 GEP Stack Height Analysis

EPA has promulgated regulations that limit the maximum stack height that may be used in a modeling analysis to no more than Good Engineering Practice (GEP) stack height. The purpose of this requirement is to prevent the use of excessively tall stacks to reduce the modeled concentrations of a pollutant. GEP stack height is impacted by the heights of nearby structures. In general, the minimum value for GEP stack height is 65 meters. The stack heights for all sources at the Southampton plant are less than 65 meters and were thus modeled using actual stack heights.

7.8 Building Downwash

The AERMOD model incorporates Plume Rise Modeling Enhancements (PRIME) to account for downwash. The direction-specific building downwash dimensions used as inputs were determined by the latest version (04274) of the Building Profile Input Program, PRIME (BPIP PRIME). BPIP PRIME uses building downwash algorithms incorporated into AERMOD to account for the plume dispersion effects of the aerodynamic wakes and eddies produced by buildings and structures. On-site structures at the Southampton plant were evaluated for downwash effects on each modeled point source. BPIP input and output files are included in Appendix E.

7.9 Modeling Results

As shown in Table 7-4 below, modeled concentrations for each of the 28 TAP are below the respective SAAC. The Southampton plant will not cause an exceedance of the SAAC for any of the modeled TAP. AERMOD input and output files are provided in Appendix E.

[34] EPA. *User's Guide for the AMS/EPA Regulatory Model (AERMOD)*. EPA-454/B-18-001. April 2018.

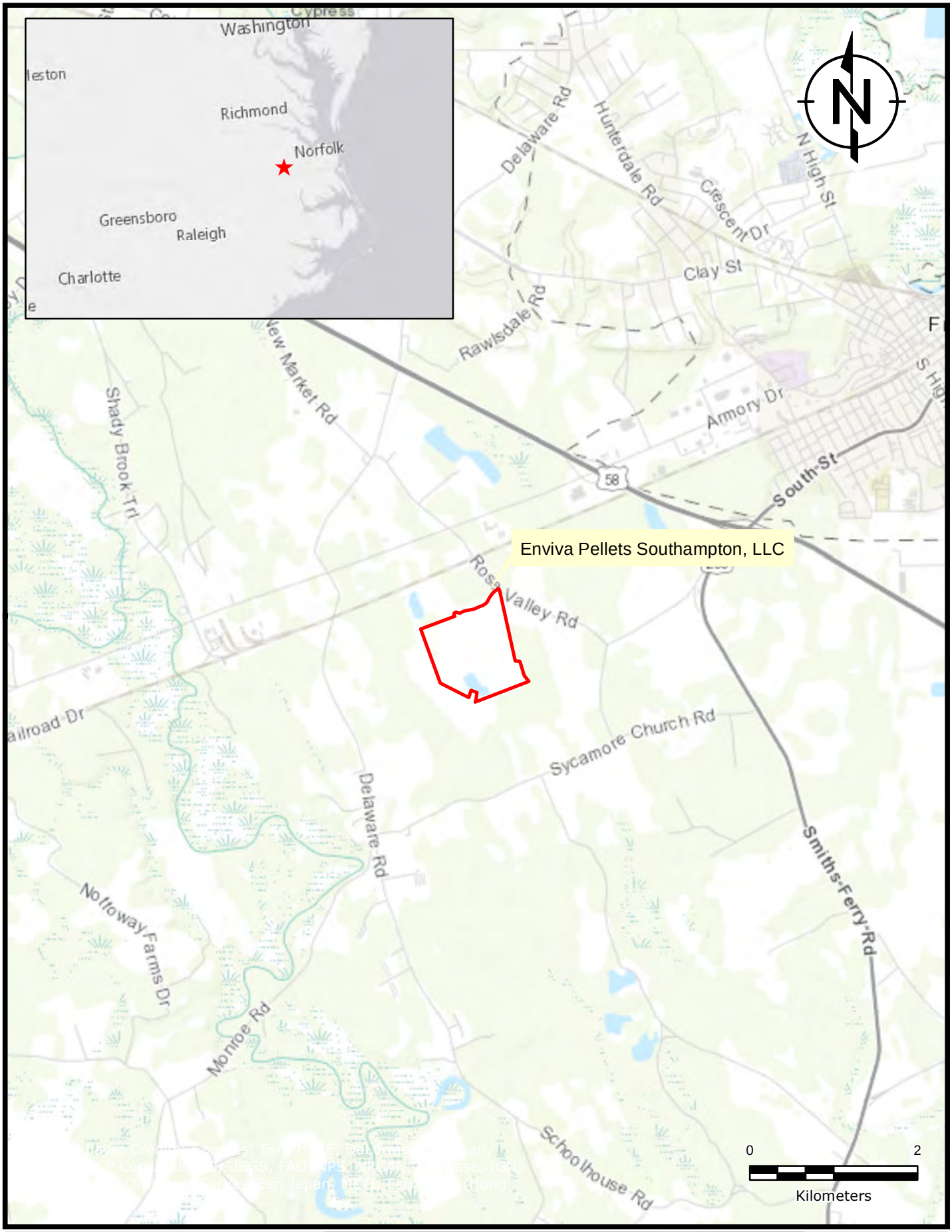
Table 7-4. Comparison of Maximum Modeled Concentrations to the SAAC

Pollutant	Averaging Period	UTM Easting[1] (m)	UTM Northing[1] (m)	Modeled Concentration (µg/m³)	SAAC (µg/m³)	Exceeds SAAC?
Acetaldehyde	1-Hour	323,711.50	4,057,534.70	0.72	6,750	No
	Annual	323,711.50	4,057,534.70	0.032	360	No
Acrolein[2]	1-Hour	323,907.60	4,057,480.10	0.61	17.25	No
	Annual	323,711.50	4,057,534.70	0.028	0.46	No
Antimony[2]	1-Hour	323,711.50	4,057,534.70	2.20E-04	25	No
	Annual	323,711.50	4,057,534.70	8.92E-06	1	No
Arsenic[2]	1-Hour	323,711.50	4,057,534.70	6.30E-04	10	No
	Annual	323,711.50	4,057,534.70	2.74E-05	0.40	No
Benzene	1-Hour	323,524.30	4,058,227.40	0.37	1,600	No
	Annual	323,625.50	4,058,276.90	0.014	64	No
Beryllium[2]	1-Hour	323,711.50	4,057,534.70	3.17E-05	0.10	No
	Annual	323,711.50	4,057,534.70	1.39E-06	0.004	No
Cadmium[2]	1-Hour	323,524.30	4,058,227.40	5.56E-04	2.5	No
	Annual	323,720.70	4,058,301.60	2.01E-05	0.10	No
Carbon tetrachloride[2]	1-Hour	323,711.50	4,057,534.70	4.32E-04	1,550	No
	Annual	323,711.50	4,057,534.70	1.75E-05	62	No
Chlorine	1-Hour	323,711.50	4,057,534.70	0.30	72.5	No
	Annual	323,711.50	4,057,534.70	0.012	3	No
Chromium[2]	1-Hour	323711.50	4,057,534.70	4.87E-04	25	No
	Annual	323711.50	4,057,534.70	1.98E-05	1	No
Chromium VI[2]	1-Hour	323,524.30	4,058,227.40	7.07E-04	2.5	No
	Annual	323,720.70	4,058,301.60	2.44E-05	0.10	No
Cobalt[2]	1-Hour	323,711.50	4,057,534.70	1.81E-04	2.5	No
	Annual	323,711.50	4,057,534.70	7.34E-06	0.10	No
Dinitrophenol, 2,4-[2]	1-Hour	323,711.50	4,057,534.70	1.73E-06	5	No
	Annual	323,724.40	4,057,522.25	7.00E-08	0.20	No
Formaldehyde	1-Hour	323,474.40	4,057,572.25	5.15	62.5	No
	Annual	323,740.80	4,058,303.90	0.13	2.4	No
Hexane	1-Hour	323,524.30	4,058,227.40	0.91	8,800	No
	Annual	323,720.70	4,058,301.60	0.028	352	No

Pollutant	Averaging Period	UTM Easting[1] (m)	UTM Northing[1] (m)	Modeled Concentration (µg/m³)	SAAC (µg/m³)	Exceeds SAAC?
Hydrochloric acid	1-Hour	323,711.50	4,057,534.70	0.73	188	No
Lead[2]	1-Hour	323,711.50	4,057,534.70	1.38E-03	7.5	No
	Annual	323,711.50	4,057,534.70	6.05E-05	0.30	No
Manganese	1-Hour	323,711.50	4,057,534.70	0.045	250	No
	Annual	323,711.50	4,057,534.70	0.0018	10	No
Mercury[2]	1-Hour	323,524.30	4,058,227.40	1.31E-04	0.50	No
	Annual	323,711.50	4,057,534.70	7.22E-06	0.02	No
Methanol	1-Hour	324,124.30	4,057,884.50	13.6	8,200	No
	Annual	323,720.70	4,058,301.60	0.40	524	No
Naphthalene[2]	1-Hour	323,711.50	4,057,534.70	9.88E-04	1,975	No
	Annual	323,711.50	4,057,534.70	4.55E-05	104	No
Nickel[2]	1-Hour	323,711.50	4,057,534.70	1.11E-03	5	No
	Annual	323,711.50	4,057,534.70	6.36E-05	0.20	No
Phenol	1-Hour	323,907.60	4,057,480.10	0.29	950	No
	Annual	323,711.50	4,057,534.70	0.014	38	No
Phosphorous[2]	1-Hour	323,711.50	4,057,534.70	7.51E-04	5	No
	Annual	323,711.50	4,057,534.70	3.05E-05	0.20	No
PCBs[2,3]	1-Hour	323,724.40	4,057,522.25	8.00E-08	0.05	No
	Annual	322,174.40	4,057,572.25	0.00E+00	0.002	No
Selenium compounds[2]	1-Hour	323,711.50	4,057,534.70	8.01E-05	10	No
	Annual	323,711.50	4,057,534.70	3.46E-06	0.40	No
Styrene	1-Hour	323,711.50	4,057,534.70	0.018	10,650	No
	Annual	323,710.50	4,057,531.10	7.40E-04	426	No
Vinyl chloride[2]	1-Hour	323,711.50	4,057,534.70	1.73E-04	650	No
	Annual	323,711.50	4,057,534.70	7.01E-06	26	No

1. Coordinates reflect NAD83, UTM Zone 18.
2. Concentrations in the AERMOD output files are in nanograms per cubic meter.
3. Modeled maximum annual concentration is less than a hundred thousandth of a nanogram per cubic meter.

APPENDIX A
AREA MAP AND FACILITY LAYOUT



RAMBOLL

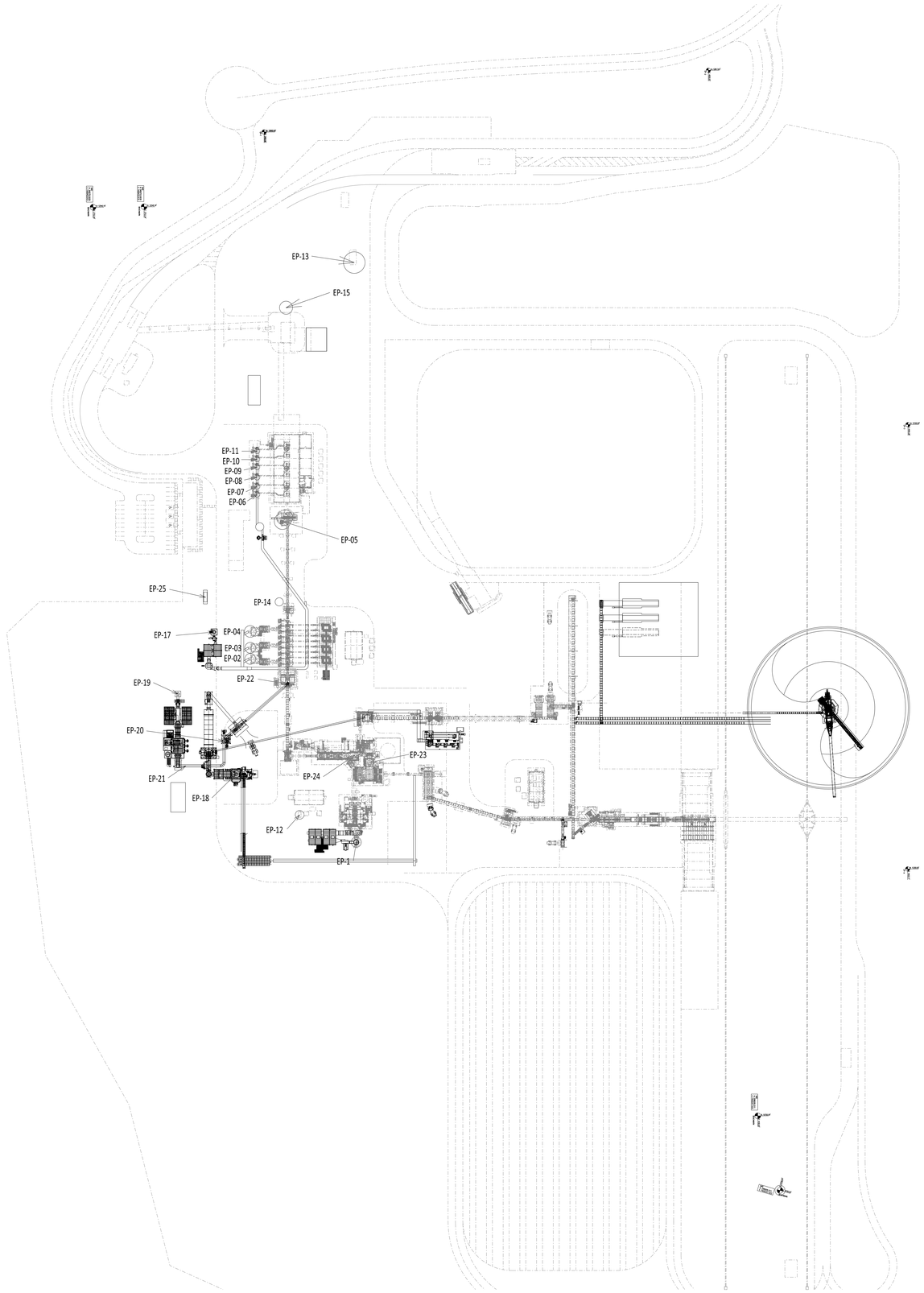
DRAFTED BY: ARJ

DATE: 9/11/2018

Site Location Map
Enviva Pellets Southampton, LLC
Franklin, Southampton County, Virginia

FIGURE
1

PROJECT: 1690009469



PNT. #	NAME	EASTING (FT)	NORTHING (FT)	ELEVATION (FT)
EP-01	UNIT 1 RTO STACK	11931209.07	3399639.59	122.53
EP-02	HAMMERMILL FILTER #1	11930898.36	3399935.14	76.99
EP-03	HAMMERMILL FILTER #2	11930892.03	3399956.64	76.99
EP-04	HAMMERMILL FILTER #3	11930882.68	3399988.45	76.99
EP-05	PELLET SILO BIN VENT	11930882.20	3400220.78	67.49
EP-06	PELLET COOLER #1 ASPIRATION STACK	11930817.87	3400258.32	67.49
EP-07	PELLET COOLER #2 ASPIRATION STACK	11930813.29	3400274.02	67.49
EP-08	PELLET COOLER #3 ASPIRATION STACK	11930807.84	3400292.05	67.49
EP-09	PELLET COOLER #4 ASPIRATION STACK	11930802.07	3400311.83	67.49
EP-10	PELLET COOLER #5 ASPIRATION STACK	11930797.57	3400327.25	67.49
EP-11	PELLET COOLER #6 ASPIRATION STACK	11930792.97	3400343.03	34.31
EP-12	EMERGENCY GENERATION	11931083.46	3399660.36	37.34
EP-13	DIESEL FIRE PUMP	11930874.04	3400764.65	146.25
EP-14	FINES DUST BIN VENT	11930922.01	3400062.43	104.00
EP-15	FINISHED GOODS DUST COLLECTION STACK	11930767.26	3400637.93	121.21
EP-17	PELLET MILL RCO	11930813.26	3399967.50	117.5
EP-18	UNIT 2 DRYER ABORT STACK A	11930936.65	3399703.67	104.00
EP-19	UNIT 2 RTO STACK	11930778.21	3399826.56	123.39
EP-20	UNIT 2 DRYER ABORT STACK B	11930894.98	3399760.61	34.5
EP-21	WESP DUCT HEATING OUTLET	11930838.28	3399692.48	146.25
EP-22	SCREENER BIN FILTER TIE-IN	11930985.87	3399908.09	79.5
EP-23	UNIT 1 FURNACE BYPASS	11931189.62	3399802.05	119.5
EP-24	UNIT 1 DRYER BYPASS	11931157.08	3399808.16	91.5
EP-25	PROPANE VAPORIZER	11930776.42	3400030.90	91.5

- PRELIMINARY -
NOT FOR CONSTRUCTION

REV	DESIGN BY	DRAWN BY	CHECKED BY	DATE
A	1st Int. Last Name	1st Int. Last Name	1st Int. Last Name	__date__

revision description

ENVIVA PELLETS LLC.

SOUTHAMPTON

Kiewit

KIEWIT ENGINEERING GROUP INC
9401 Renner Boulevard
Lenexa, Kansas 66219

EMISSIONS POINTS DRAWING

ENGINEER/DESIGN ORIGINATOR	1st Int. Last Name
LEAD ENG	1st Int. Last Name
ENG MGR	1st Int. Last Name
PROJ MGR	1st Int. Last Name

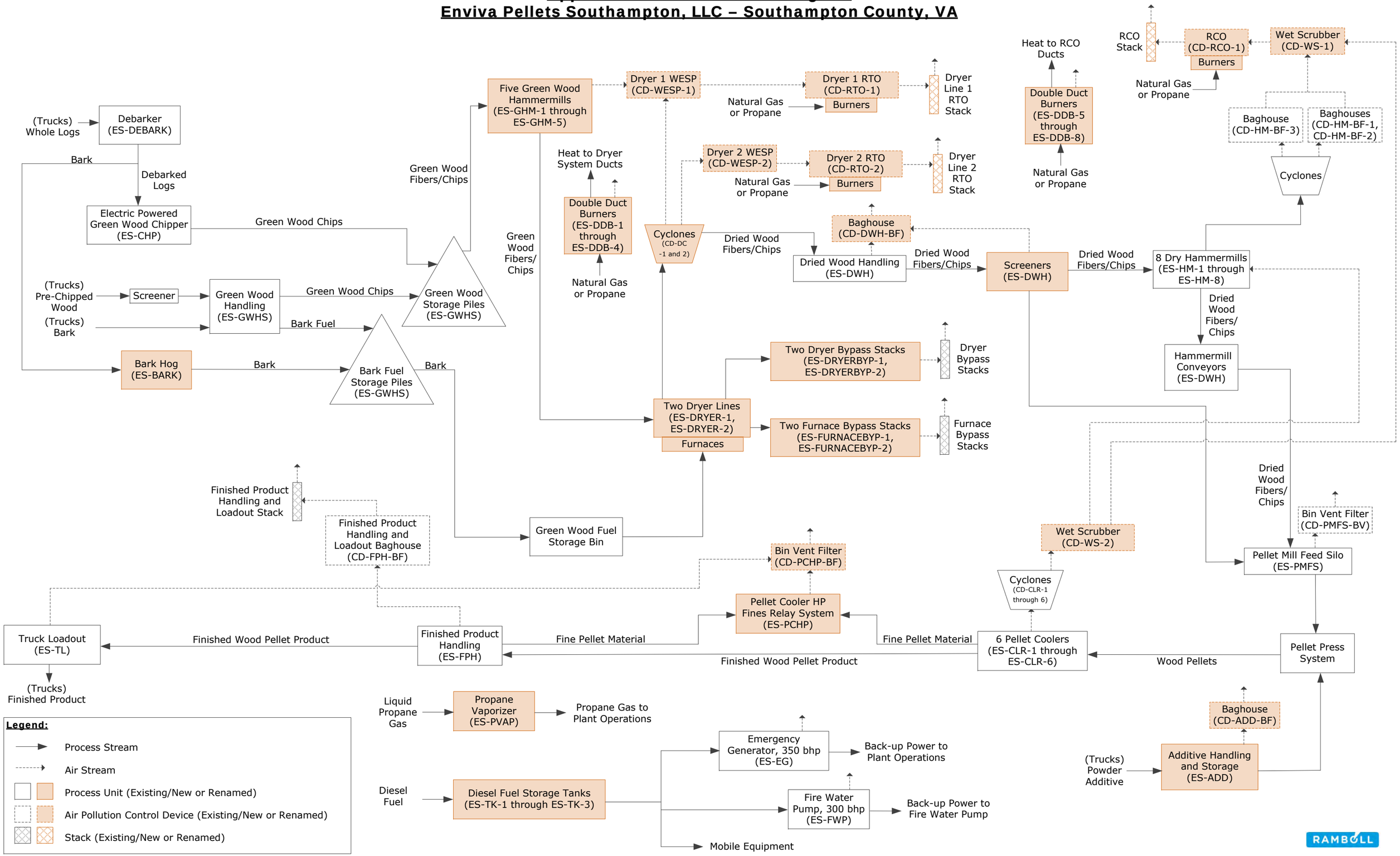
DRAWING NUMBER

20028969-SKM-081518-1

I:\Jobs\2018\2018 ENVIVA\2018 SOUTH HAMPTON MECS SKM-Sketches\20028969-SKM-081518-1.dgn 9/18/2018 4:16:56 PM Ron.Callahan
20028969-SKM-081518-1.dgn 9/18/2018 4:20:40 PM Ron.Callahan

APPENDIX B
PROCESS FLOW DIAGRAM

Appendix B - Process Flow Diagram
Enviva Pellets Southampton, LLC – Southampton County, VA



APPENDIX C
POTENTIAL EMISSIONS CALCULATIONS

TABLE C-1
FACILITY-WIDE CRITERIA & CO_2e POLLUTANT SUMMARY
ENVIVA PELLETS SOUTHAMPTON, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NOx (tpy)	TSP (tpy)	PM-10 (tpy)	PM-2.5 (tpy)	SO2 (tpy)	Total VOC (tpy)	CO_{2e} (tpy)
ES-DRYER-1	DRYER 1	CD-DC-1; CD-WESP-1; CD-RTO-1; SNCR	Multiclone; WESP; RTO; SNCR	78.32	55.31	33.29	33.29	33.29	19.20	12.89	180,892
ES-GHM-1 thru -5	Green Hammermills 1 thru 5										
ES-DRYERBYP-1	Dryer Bypass	--	--	0.54	0.66	1.52	1.52	1.52	0.11	0.35	918
ES-FURNACEBYP-1	Furnace Bypass	--	--	3.38	1.24	3.25	3.17	3.09	0.14	0.10	1,180
ES-DDB-1 & 2	Dryer Line 1 - Double Duct Burner	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219
ES-DRYER #2	ES - DRYER #2	CD-DC-2; CD-WESP-2; CD-RTO-2	Multiclone; WESP; RTO	78.13	62.55	33.29	33.29	33.29	19.71	12.89	184,717
ES-DRYERBYP-2	Dryer Bypass	--	--	0.54	0.66	1.56	1.56	1.56	0.11	0.35	943
ES-FURNACEBYP-2	Furnace Bypass	--	--	3.45	1.27	3.32	3.24	3.16	0.14	0.10	1,205
ES-DDB-3 & -4	Dryer Line 2 - Double Duct Burner	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219
ES-PVAP	Propane Vaporizer	--	--	0.36	0.62	0.03	0.03	0.03	0.003	0.05	610
ES-EG	Emergency Generator	--	--	0.50	0.58	0.03	0.03	0.03	0.001	0.002	100
ES-FWP	Fire Water Pump	--	--	0.43	0.49	0.02	0.02	0.02	0.001	0.001	85.9
ES-CLR1 thru -6	Pellet Presses and Coolers	CD-CLR-1 thru 6; CD-HM-CYC-1 thru 8; CD-HM-BF-1 thru 3; CD-WS-1; CD-WS-2; CD-RCO-1	Simple Cyclones; Wet Cyclonic Scrubber; High Efficiency Cyclones; Baghouses; Wet Scrubbers; RCO	8.30	9.88	59.45	30.98	2.23	0.05	41.23	14,021
ES-HM-1 thru -8	Dry Hammermills 1 thru 8										
ES-DDB-5 thru -8	RCO - Double Duct Burners	--	--	1.44	1.24	0.13	0.13	0.13	0.01	0.19	2,438
ES-DWH	Dry Wood Handling	CD-DWH-BF	Baghouse	--	--	0.23	0.23	0.23	--	48.53	--
ES-PCHP	Pellet Cooler HP Fines Relay System, including Pellet Screeners and Truck Loadout	CD-PCHP-BF	Baghouse	--	--	0.54	0.54	0.54	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BF	Bin Vent Filter	--	--	0.38	0.38	0.38	--	--	--
ES-FPH	Finished Product Handling	CD-FPH-BF	Baghouse	--	--	5.33	4.85	0.09	--	--	--
ES-ADD	Starch Additive Handling and Storage	CD-ADD-BF	Baghouse	--	--	3.21E-03	3.21E-03	3.21E-03	--	--	--
ES-GWHS	Green Wood Handling and Storage	--	--	--	--	29.27	14.61	2.19	--	11.79	--
ES-CHIP	Log Chipping	--	--	--	--	--	--	--	--	1.95	--
ES-DEBARK	Debarker	--	--	--	--	1.56	0.86	--	--	--	--
ES-BARK	Bark Hog	--	--	--	--	0.47	0.26	--	--	0.59	--
IES-BFB[1]	Bark Fuel Bin	--	--	--	--	--	--	--	--	--	--
ES-TK-1	Diesel Storage Tank for Emergency Generator	--	--	--	--	--	--	--	--	5.75E-04	--
ES-TK-2	Diesel Storage Tank for Fire Water Pump	--	--	--	--	--	--	--	--	1.60E-04	--
ES-TK-3	Mobile Fuel Diesel Storage Tank	--	--	--	--	--	--	--	--	3.33E-03	--
--	Haul Road Emissions	--	--	--	--	59.21	15.63	1.990	--	--	--
			Total Emissions:	**176.8**	**135.7**	**233.0**	**144.8**	**83.9**	**39.5**	**131.2**	**389,549**
			Total Excluding Fugitives[2]:	**176.8**	**135.7**	**144.5**	**114.5**	**79.7**	**39.5**	**119.4**	**389,549**
			PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**
			Major Source?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**--**

Notes:

1. Bark is transferred from the primary Bark Fuel Storage Pile by walking floor to covered conveyors which transfer the bark into the fully enclosed Bark Fuel Bin. There are no emissions expected from transfer of material into the bin.
2. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

TABLE C-2
FACILITYWIDE HAP EMISSIONS SUMMARY
ENVIVA PELLETS SOUTHAMPTON, LLC

Description	HAP	VA TAP	CD-RTO-1 (tpy)	Dryer 1 Bypass (tpy)	Furnace 1 Bypass (tpy)	ES-DDB-1 & -2 (tpy)	CD-RTO-2 (tpy)	Dryer 2 Bypass (tpy)	Furnace 2 Bypass (tpy)	ES-DDB-3 & -4 (tpy)	ES-PVAP (tpy)	CD-RCO-1 (tpy)	ES-DDB-5 thru -8 (tpy)	ES-DWH (tpy)	ES-EG (tpy)	ES-FWP (tpy)	ES-BARK (tpy)	ES-CHIP (tpy)	Total (tpy)	Major Source?
Acetaldehyde	Y	Y	9.04E-01	2.98E-01	4.67E-03	1.31E-07	8.22E-01	2.98E-01	4.77E-03	1.31E-07	-	6.13E-01	2.61E-07	-	4.70E-04	4.03E-04	-	-	2.95E+00	No
Acrolein	Y	Y	6.89E-01	1.95E-01	2.25E-02	1.55E-07	5.37E-01	1.95E-01	2.30E-02	1.55E-07	-	1.13E+00	3.09E-07	-	5.67E-05	4.86E-05	-	-	2.79E+00	No
Formaldehyde	Y	Y	9.58E-01	2.54E-01	2.48E-02	1.31E-02	9.11E-01	2.54E-01	2.53E-02	1.31E-02	6.57E-03	3.68E-01	2.63E-02	3.28E-01	7.23E-04	6.20E-04	-	-	3.18E+00	No
Methanol	Y	Y	8.76E-01	1.86E-01	-	-	5.12E-01	1.86E-01	-	-	-	5.32E-01	-	7.62E-01	-	-	1.17E-01	3.91E-01	3.56E+00	No
Phenol	Y	Y	3.26E-01	1.02E-01	2.87E-04	-	2.81E-01	1.02E-01	2.93E-04	-	-	5.39E-01	-	-	-	-	-	-	1.35E+00	No
Propionaldehyde	Y	Y	2.00E-01	6.82E-02	3.44E-04	-	1.88E-01	6.82E-02	3.51E-04	-	-	4.91E-01	-	-	-	-	-	-	1.02E+00	No
Acetophenone	Y	Y	6.14E-08	1.40E-08	1.80E-08	-	6.31E-08	1.44E-08	1.84E-08	-	-	-	-	-	-	-	-	-	1.89E-07	No
Ammonia	N	N	4.40E-01	-	-	2.75E-02	4.40E-01	-	-	2.75E-02	-	2.69E-01	5.50E-02	-	-	-	-	-	1.26E+00	No
Antimony and compounds	Y	Y	4.40E-04	3.46E-05	4.45E-05	-	4.52E-04	3.56E-05	4.54E-05	-	-	-	-	-	-	-	-	-	1.05E-03	No
Arsenic	Y	Y	1.25E-03	9.64E-05	1.24E-04	1.72E-06	1.29E-03	9.90E-05	1.27E-04	1.72E-06	-	1.68E-05	3.44E-06	-	-	-	-	-	3.01E-03	No
Benzene	Y	Y	1.80E-01	-	-	6.22E-03	1.82E-01	-	-	6.22E-03	3.11E-03	6.10E-02	1.24E-02	-	5.71E-04	4.90E-04	-	-	4.53E-01	No
Benzo(a)pyrene	Y	N	5.01E-05	1.14E-05	1.46E-05	1.03E-08	5.14E-05	1.17E-05	1.50E-05	1.03E-08	-	1.01E-07	2.06E-08	-	1.15E-07	9.87E-08	-	-	1.55E-04	No
Beryllium	Y	Y	6.29E-05	4.82E-06	6.20E-06	1.03E-07	6.45E-05	4.95E-06	6.33E-06	1.03E-07	-	1.01E-06	2.06E-07	-	-	-	-	-	1.51E-04	No
1,3-Butadiene	Y	Y	-	-	-	-	-	-	-	-	-	-	-	-	2.39E-05	2.05E-05	-	-	4.45E-05	No
Cadmium	Y	Y	3.80E-04	1.80E-05	2.31E-05	9.45E-06	3.86E-04	1.85E-05	2.36E-05	9.45E-06	-	9.26E-05	1.89E-05	-	-	-	-	-	9.80E-04	No
Carbon tetrachloride	Y	Y	8.64E-04	1.97E-04	2.53E-04	-	8.87E-04	2.03E-04	2.59E-04	-	-	-	-	-	-	-	-	-	2.66E-03	No
Chlorine	Y	Y	6.07E-01	3.46E-03	4.45E-03	-	6.23E-01	3.56E-03	4.54E-03	-	-	-	-	-	-	-	-	-	1.25E+00	No
Chlorobenzene	Y	Y	6.33E-04	1.45E-04	1.86E-04	-	6.50E-04	1.49E-04	1.90E-04	-	-	-	-	-	-	-	-	-	1.95E-03	No
Chloroform	Y	Y	5.37E-04	-	-	-	5.52E-04	-	-	-	-	-	-	-	-	-	-	-	1.09E-03	No
Chromium VI	Y	Y	3.88E-04	-	-	1.20E-05	3.93E-04	-	-	1.20E-05	-	1.18E-04	2.40E-05	-	-	-	-	-	9.47E-04	No
Chromium−Other compounds	Y	Y	9.74E-04	7.67E-05	1.18E-04	-	1.00E-03	7.88E-05	1.21E-04	-	-	-	-	-	-	-	-	-	2.37E-03	No
Cobalt compounds	Y	Y	3.62E-04	2.85E-05	3.66E-05	-	3.72E-04	2.93E-05	3.74E-05	-	-	-	-	-	-	-	-	-	8.65E-04	No
Dichlorobenzene	Y	Y	1.65E-04	-	-	1.03E-05	1.65E-04	-	-	1.03E-05	-	1.01E-04	2.06E-05	-	-	-	-	-	4.73E-04	No
Dichloroethane, 1,2-	Y	Y	5.57E-04	1.27E-04	1.63E-04	-	5.72E-04	1.31E-04	1.67E-04	-	-	-	-	-	-	-	-	-	1.72E-03	No
Dichloropropane, 1,2-	Y	Y	6.33E-04	1.45E-04	1.86E-04	-	6.50E-04	1.49E-04	1.90E-04	-	-	-	-	-	-	-	-	-	1.95E-03	No
Dinitrophenol, 2,4-	Y	Y	3.46E-06	7.89E-07	1.01E-06	-	3.55E-06	8.10E-07	1.04E-06	-	-	-	-	-	-	-	-	-	1.07E-05	No
Di(2-ethylhexyl)phthalate	Y	Y	9.02E-07	2.06E-07	2.06E-07	-	9.26E-07	2.12E-07	2.12E-07	-	-	-	-	-	-	-	-	-	2.66E-06	No
Ethyl benzene	Y	Y	5.95E-04	1.36E-04	1.75E-04	-	6.11E-04	1.40E-04	1.78E-04	-	-	-	-	-	-	-	-	-	1.83E-03	No
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	N	3.44E-10	-	-	-	3.53E-10	-	-	-	-	-	-	-	-	-	-	-	6.96E-10	No
Hexane	Y	Y	2.48E-01	-	-	1.55E-02	2.48E-01	-	-	1.55E-02	-	1.51E-01	3.09E-02	-	-	-	-	-	7.09E-01	No
Indeno(1,2,3-cd)pyrene	Y	N	2.48E-07	-	-	1.55E-08	2.48E-07	-	-	1.55E-08	-	1.51E-07	3.09E-08	-	-	-	-	-	7.09E-07	No
Hydrochloric acid	Y	Y	1.46E+00	8.33E-02	1.07E-01	-	1.50E+00	8.55E-02	1.09E-01	-	-	-	-	-	-	-	-	-	3.34E+00	No
Lead	Y	Y	2.74E-03	-	-	4.29E-06	2.81E-03	-	-	4.29E-06	-	4.21E-05	8.59E-06	-	-	-	-	-	5.61E-03	No
Manganese	Y	Y	8.91E-02	7.01E-03	9.01E-03	3.26E-06	9.15E-02	7.20E-03	9.20E-03	3.26E-06	-	3.20E-05	6.53E-06	-	-	-	-	-	2.13E-01	No
Mercury	Y	Y	2.31E-04	1.53E-05	1.97E-05	2.23E-06	2.36E-04	1.58E-05	2.01E-05	2.23E-06	-	2.19E-05	4.47E-06	-	-	-	-	-	5.68E-04	No
Methyl bromide	Y	Y	2.88E-04	6.57E-05	8.45E-05	-	2.96E-04	6.75E-05	8.63E-05	-	-	-	-	-	-	-	-	-	8.88E-04	No
Methyl chloride	Y	Y	4.41E-04	1.01E-04	1.30E-04	-	4.53E-04	1.04E-04	1.32E-04	-	-	-	-	-	-	-	-	-	1.36E-03	No
3-Methylchloranthrene	Y	N	2.48E-07	-	-	1.55E-08	2.48E-07	-	-	1.55E-08	-	1.51E-07	3.09E-08	-	-	-	-	-	7.09E-07	No
Methylene chloride	Y	Y	5.57E-03	-	-	-	5.72E-03	-	-	-	-	-	-	-	-	-	-	-	1.13E-02	No
Naphthalene	Y	Y	1.95E-03	4.25E-04	5.46E-04	5.24E-06	2.00E-03	4.37E-04	5.58E-04	5.24E-06	-	5.13E-05	1.05E-05	-	-	-	-	-	5.99E-03	No
Nickel	Y	Y	2.13E-03	1.45E-04	1.86E-04	1.80E-05	2.18E-03	1.49E-04	1.90E-04	1.80E-05	-	1.77E-04	3.61E-05	-	-	-	-	-	5.22E-03	No
Nitrophenol, 4-	Y	Y	2.11E-06	4.82E-07	6.20E-07	-	2.17E-06	4.95E-07	6.33E-07	-	-	-	-	-	-	-	-	-	6.51E-06	No
Pentachlorophenol	Y	Y	9.79E-07	2.24E-07	2.87E-07	-	1.01E-06	2.30E-07	2.93E-07	-	-	-	-	-	-	-	-	-	3.02E-06	No
Perchloroethylene	Y	Y	7.29E-04	1.67E-04	2.14E-04	-	7.49E-04	1.71E-04	2.19E-04	-	-	-	-	-	-	-	-	-	2.25E-03	No
Phosphorus metal, yellow or white	Y	Y	1.50E-03	1.18E-04	1.52E-04	-	1.54E-03	1.22E-04	1.55E-04	-	-	-	-	-	-	-	-	-	3.59E-03	No
Polychlorinated biphenyls	Y	Y	1.56E-07	3.57E-08	4.59E-08	-	1.61E-07	3.67E-08	4.69E-08	-	-	-	-	-	-	-	-	-	4.82E-07	No
Polycyclic Organic Matter	Y	Y	8.01E-03	5.48E-04	7.04E-04	3.50E-04	8.08E-03	5.63E-04	7.19E-04	3.50E-04	1.75E-04	3.43E-03	7.01E-04	-	1.03E-04	8.82E-05	-	-	2.38E-02	No
Selenium compounds	Y	Y	1.59E-04	1.23E-05	1.58E-05	2.06E-07	1.63E-04	1.26E-05	1.61E-05	2.06E-07	-	2.02E-06	4.12E-07	-	-	-	-	-	3.82E-04	No
Styrene	Y	Y	3.65E-02	-	-	-	3.74E-02	-	-	-	-	-	-	-	-	-	-	-	7.39E-02	No
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	1.65E-10	3.77E-11	4.84E-11	-	1.70E-10	3.87E-11	4.95E-11	-	-	-	-	-	-	-	-	-	5.09E-10	No
Toluene	Y	Y	1.04E-03	-	-	2.92E-05	1.06E-03	-	-	2.92E-05	-	2.86E-04	5.84E-05	-	2.51E-04	2.15E-04	-	-	2.97E-03	No
Trichloroethane, 1,1,1-	Y	Y	5.95E-04	1.36E-04	1.75E-04	-	6.11E-04	1.40E-04	1.78E-04	-	-	-	-	-	-	-	-	-	1.83E-03	No
Trichloroethylene	Y	Y	5.76E-04	1.31E-04	1.31E-04	-	5.91E-04	1.35E-04	1.35E-04	-	-	-	-	-	-	-	-	-	1.70E-03	No
Trichlorofluoromethane	N	N	7.87E-04	-	-	-	8.08E-04	-	-	-	-	-	-	-	-	-	-	-	1.60E-03	No
Trichlorophenol, 2,4,6-	Y	Y	4.22E-07	9.64E-08	1.24E-07	-	4.34E-07	9.90E-08	1.27E-07	-		-	-	-	-	-	-	-	1.30E-06	No
Vinyl chloride	Y	Y	3.46E-04	7.89E-05	1.01E-04	-	3.55E-04	8.10E-05	1.04E-04	-	-	-	-	-	-	-	-	-	1.07E-03	No
Xylene	Y	Y	4.80E-04	-	-	-	4.93E-04	-	-	-	-	-	-	-	1.75E-04	1.50E-04	-	-	1.30E-03	No
TOTAL HAP			**6.61**	**1.20**	**0.18**	**0.04**	**5.97**	**1.20**	**0.18**	**0.04**	**0.01**	**3.89**	**0.07**	**1.09**	**0.002**	**0.002**	**0.117**	**0.39**	**20.97**	No
TOTAL TAP			6.61	1.20	0.18	0.04	5.97	1.20	0.18	0.04	0.01	3.89	0.07	1.09	0.00	0.00	0.12	0.39	20.97	

TABLE C-3
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - CRITERIA POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput of Dryer	**390,628**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	ODT/hr
Burner Heat Input	175.3	MMBtu/hr
Percent Hardwood	20.0%	
Percent Softwood	80.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,535,628**	**MMBtu/yr**
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/hr**
Number of Duct Burners	**2**	
Duct Burner Rating	**1**	**MMBtu/hr**
RTO Control Efficiency	**97.50%**	

RTO and Dryer Criteria Pollutant Calculations:

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Uncontrolled Emissions		Controlled Emissions[1]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 2	--	--	28.33	78.1
NO_X	0.282	lb/ODT	Southampton July 2015 VOC Compliance Stack Testing	--	--	19.97	55.1
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 3	--	--	7.60	33.3
SO_2	0.025	lb/MMBtu	AP-42, Section 1.6[4]	--	--	4.38	19.2
Total VOC (as propane)	2.64	lb/ODT	Note 5	186.99	515.6	4.67	12.9

Note:

[1] Exhaust from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3) are routed to a WESP and then RTO for control of VOC, HAP, and particulates.

[2] CO emissions based on data from similar Enviva facilities and information from NCASI database.

[3] Particulate emission factor is based on data from similar Enviva facilities

[4] No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based upon the heat input of the dryer burners using an emission factor for wood combustion from AP-42, Section 1.6.

[5] VOC emission factor based on source test data for similar pellet manufacturing facilities and represents uncontrolled emissions.

TABLE C-4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
GREEN HAMMERMILL - VOC, HAP AND TAP EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Max Hourly Throughput[1]	150 ODT/hr
Annual Throughput	781,255 ODT/yr
Hours of Operation	8,760 hr/yr
RTO Control Efficiency	97.50%

Potential VOC Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[2]	Potential Emissions	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	8.4E-03	0.032	0.082
Acrolein	107-02-8	Y	Y	1.6E-02	0.059	0.15
Formaldehyde	50-00-0	Y	Y	4.8E-03	0.018	0.047
Methanol	67-56-1	Y	Y	3.7E-02	0.14	0.36
Phenol	108-95-2	Y	Y	4.6E-03	0.017	0.045
Propionaldehyde	123-38-6	Y	Y	1.2E-03	0.0045	0.012
				Total HAP Emissions	**0.27**	**0.70**
Total VOC (as propane)	--	N/A	Y	0.32	1.21	3.15

Notes:
1. The max hourly throughput is based on the currently permitted max hourly throughput for the 2 existing green hammermills ratioed up to reflect 3 additional hammermills (i.e. 119.4 tph * 5/2).
2. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	0.018	MMBtu/lb
Uncontrolled VOC emissions	126	tons/yr
Heat input of uncontrolled VOC emissions	4,666	MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu[1]	0.04	0.19
NO_x	9.8E-02	lb/MMBtu[1]	0.05	0.23

Notes:
1. CO and NO_x emission factors are from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RTO - Regenerative Thermal Oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput of Dryer	**390,628**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	ODT/hr
Burner Heat Input (HHV)	175.3	MMBtu/hr
Percent Hardwood	20.0%	
Percent Softwood	80.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,535,628**	**MMBtu/yr**
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/hr**
Number of Duct Burners	**2**	
Duct Burner Rating	**1**	**MMBtu/hr**
RTO Control Efficiency	**97.50%**	

Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Dryer Burner - Biomass Source							
Acetaldehyde	Y	Y	1.7E-01	lb/ODT	1	0.30	0.82
Acrolein	Y	Y	1.1E-01	lb/ODT	1	0.19	0.54
Formaldehyde	Y	Y	1.4E-01	lb/ODT	1	0.25	0.70
Methanol	Y	Y	1.0E-01	lb/ODT	1	0.19	0.51
Phenol	Y	Y	5.8E-02	lb/ODT	1	0.10	0.28
Propionaldehyde	Y	Y	3.9E-02	lb/ODT	1	0.07	0.19
Acetophenone	Y	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.1E-08
Antimony and compounds	Y	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.4E-04
Arsenic	Y	N	2.2E-05	lb/MMBtu	2,4	2.8E-04	1.2E-03
Benzene	Y	Y	4.2E-03	lb/MMBtu	2,3	1.8E-02	8.1E-02
Benzo(a)pyrene	Y	Y	2.6E-06	lb/MMBtu	2,3	1.1E-05	5.0E-05
Beryllium	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.1E-05
Cadmium	Y	N	4.1E-06	lb/MMBtu	2,4	5.2E-05	2.3E-04
Carbon tetrachloride	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.6E-04
Chlorine	Y	N	7.9E-04	lb/MMBtu	2,9	1.4E-01	6.1E-01
Chlorobenzene	Y	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Chloroform	Y	Y	2.8E-05	lb/MMBtu	2,3	1.2E-04	5.4E-04
Chromium VI	-[5]	N	3.5E-06	lb/MMBtu	2,4,5	4.4E-05	1.9E-04
Chromium–Other compounds	Y	N	1.8E-05	lb/MMBtu	2,4	2.2E-04	9.7E-04
Cobalt compounds	Y	N	6.5E-06	lb/MMBtu	2,4	8.3E-05	3.6E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.6E-04
Dichloropropane, 1,2-	Y	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Dinitrophenol, 2,4-	Y	Y	1.8E-07	lb/MMBtu	2,3	7.9E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.0E-07
Ethyl benzene	Y	Y	3.1E-05	lb/MMBtu	2,3	1.4E-04	6.0E-04
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	1.8E-11	lb/MMBtu	2,3	7.8E-11	3.4E-10
Hydrochloric acid	Y	N	1.9E-02	lb/MMBtu	2,6	3.3E-01	1.5E+00
Lead	Y	N	4.8E-05	lb/MMBtu	2,4	6.1E-04	2.7E-03
Manganese	Y	N	1.6E-03	lb/MMBtu	2,4	2.0E-02	8.9E-02
Mercury	Y	N	3.5E-06	lb/MMBtu	2,4	4.4E-05	1.9E-04
Methyl bromide	Y	Y	1.5E-05	lb/MMBtu	2,3	6.6E-05	2.9E-04
Methyl chloride	Y	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.4E-04
Methyl ethyl ketone	N	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.0E-04
Methylene chloride	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.6E-03
Naphthalene	Y	Y	9.7E-05	lb/MMBtu	2,3	4.3E-04	1.9E-03
Nickel	Y	N	3.3E-05	lb/MMBtu	2,4	4.2E-04	1.8E-03
Nitrophenol, 4-	Y	Y	1.1E-07	lb/MMBtu	2,3	4.8E-07	2.1E-06
Pentachlorophenol	Y	N	5.1E-08	lb/MMBtu	2	2.2E-07	9.8E-07

TABLE C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Perchloroethylene	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.3E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	lb/MMBtu	2,4	3.4E-04	1.5E-03
Polychlorinated biphenyls	Y	Y	8.2E-09	lb/MMBtu	2,3	3.6E-08	1.6E-07
Polycyclic Organic Matter	Y	N	1.3E-04	lb/MMBtu	2	5.5E-04	2.4E-03
Selenium compounds	Y	N	2.8E-06	lb/MMBtu	2,4	3.6E-05	1.6E-04
Styrene	Y	Y	1.9E-03	lb/MMBtu	2,3	8.3E-03	3.6E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	lb/MMBtu	2,3	3.8E-11	1.7E-10
Toluene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichloroethane, 1,1,1-	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.0E-04
Trichloroethylene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichlorofluoromethane	N	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	7.9E-04
Trichlorophenol, 2,4,6-	Y	Y	2.2E-08	lb/MMBtu	2,3	9.6E-08	4.2E-07
Vinyl chloride	Y	Y	1.8E-05	lb/MMBtu	2,3	7.9E-05	3.5E-04
Xylene	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.8E-04
Total HAP Emissions (related to biomass)						**1.6**	**5.3**
Pollutant	**HAP**	**VOC**	**Emission Factor**	**Units**	**Footnote**	**Potential Emissions**	
						Max (lb/hr)	**Annual (tpy)**
RTO & Duct Burners - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	7	5.7E-07	2.5E-06
Ammonia	N	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	4,7	6.3E-06	2.8E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	4,7	3.8E-07	1.7E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	4,7	3.5E-05	1.5E-04
Chromium VI	Y	N	1.4E-03	lb/MMscf	4,7	4.4E-05	1.9E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Cobalt	Y	N	8.4E-05	lb/MMscf	4,7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.7E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.9E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	1.8	lb/MMscf	7	5.7E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	4,7	1.6E-05	6.9E-05
Manganese	Y	N	3.8E-04	lb/MMscf	4,7	1.2E-05	5.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	4,7	8.2E-06	3.6E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	4,7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	4,7	7.6E-07	3.3E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas/propane)						**0.129**	**0.565**

TABLE C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. The control efficiency of 97.5% for the RTO is applied to all VOC hazardous and toxic pollutants.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants from the dryer and duct burners. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
5. Chromium VI is a subset of chromium compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.
6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
8. The RTO burners can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.
9. It was assumed that chlorine is not oxidized in the RTO.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less thar
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 m
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE C-6
DRYER 1 BYPASS - POTENTIAL EMISSIONS [1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput	70.83 ODT/hr
Hourly Heat Input Capacity (HHV)	175.3 MMBtu/hr
Annual Heat Input Capacity	8,765 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.38	0.110
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	2.98	0.075
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	57.8	1.45
Total $PM/PM_{10}/PM_{2.5}$			60.8	1.52

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line. As the feed to the dryer is typically stopped during shutdown and malfunction events, the hourly throughput is equal to the annual average of the dryer feed rate.
2. CO, NO_X, and VOC emission rates based on data from a comparable Enviva facility.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.

TABLE C-6
DRYER 1 BYPASS - POTENTIAL EMISSIONS [1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	0.168	lb/ODT	2	11.9	0.30
Acrolein	0.110	lb/ODT	2	7.79	0.195
Formaldehyde	0.144	lb/ODT	2	10.16	0.25
Methanol	0.10	lb/ODT	2	7.43	0.19
Phenol	0.058	lb/ODT	2	4.08	0.10
Propionaldehyde	0.039	lb/ODT	2	2.73	0.068
Acetophenone	3.2E-09	lb/MMBtu	3	5.61E-07	1.40E-08
Antimony and compounds	7.9E-06	lb/MMBtu	3	1.38E-03	3.46E-05
Arsenic	2.2E-05	lb/MMBtu	3	3.86E-03	9.64E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	3	4.56E-04	1.14E-05
Beryllium	1.1E-06	lb/MMBtu	3	1.93E-04	4.82E-06
Cadmium	4.1E-06	lb/MMBtu	3	7.19E-04	1.80E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	3	7.89E-03	1.97E-04
Chlorine	7.9E-04	lb/MMBtu	3	1.38E-01	3.46E-03
Chlorobenzene	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Chromium–Other compounds	1.8E-05	lb/MMBtu	3	3.07E-03	7.67E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3	1.14E-03	2.85E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	3	3.16E-05	7.89E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	3	8.24E-06	2.06E-07
Ethyl benzene	3.1E-05	lb/MMBtu	3	5.43E-03	1.36E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	3	5.08E-03	1.27E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	3	3.33E+00	8.33E-02
Lead	4.8E-05	lb/MMBtu	3	8.41E-03	2.10E-04
Manganese	1.6E-03	lb/MMBtu	3	2.80E-01	7.01E-03
Mercury	3.5E-06	lb/MMBtu	3	6.14E-04	1.53E-05
Methyl bromide	1.5E-05	lb/MMBtu	3	2.63E-03	6.57E-05
Methyl chloride	2.3E-05	lb/MMBtu	3	4.03E-03	1.01E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	3	5.43E-03	1.36E-04
Naphthalene	9.7E-05	lb/MMBtu	3	1.70E-02	4.25E-04
Nickel	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	3	1.93E-05	4.82E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	3	8.94E-06	2.24E-07
Perchloroethylene	3.8E-05	lb/MMBtu	3	6.66E-03	1.67E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	3	4.73E-03	1.18E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	3	1.43E-06	3.57E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	3	2.19E-02	5.48E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Selenium compounds	2.8E-06	lb/MMBtu	3	4.91E-04	1.23E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	3	1.51E-09	3.77E-11
Trichloroethylene	3.0E-05	lb/MMBtu	3	5.26E-03	1.31E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	3	3.86E-06	9.64E-08
Vinyl chloride	1.8E-05	lb/MMBtu	3	3.16E-03	7.89E-05
			Total HAP Emissions	**48.0**	**1.200**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from Cottondale and other similar Enviva plants.
3. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-7
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity (HHV)	175.3 MMBtu/hr
Annual Heat Input Capacity	8,765 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	105.2	2.63
NO_X	0.22	lb/MMBtu[2]	38.57	0.96
SO_2	0.025	lb/MMBtu[2]	4.38	0.110
VOC	0.017	lb/MMBtu[2]	2.98	0.075
Total $PM/PM_{10}/PM_{2.5}$	0.58	lb/MMBtu[2]	101.1	2.53

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, SO_2, PM, and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

TABLE C-7
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	1.45E-01	3.64E-03
Acrolein	4.00E-03	lb/MMBtu	1	7.01E-01	1.75E-02
Formaldehyde	4.40E-03	lb/MMBtu	1	7.71E-01	1.93E-02
Phenol	5.10E-05	lb/MMBtu	1	8.94E-03	2.24E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.07E-02	2.67E-04
Acetophenone	3.2E-09	lb/MMBtu	1	5.61E-07	1.40E-08
Antimony and compounds	7.9E-06	lb/MMBtu	1	1.38E-03	3.46E-05
Arsenic	2.2E-05	lb/MMBtu	1	3.86E-03	9.64E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	4.56E-04	1.14E-05
Beryllium	1.1E-06	lb/MMBtu	1	1.93E-04	4.82E-06
Cadmium	4.1E-06	lb/MMBtu	1	7.19E-04	1.80E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	7.89E-03	1.97E-04
Chlorine	7.9E-04	lb/MMBtu	1	1.38E-01	3.46E-03
Chlorobenzene	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	3.68E-03	9.20E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.14E-03	2.85E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	3.16E-05	7.89E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	8.24E-06	2.06E-07
Ethyl benzene	3.1E-05	lb/MMBtu	1	5.43E-03	1.36E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	5.08E-03	1.27E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	1	3.33E+00	8.33E-02
Lead	4.8E-05	lb/MMBtu	1	8.41E-03	2.10E-04
Manganese	1.6E-03	lb/MMBtu	1	2.80E-01	7.01E-03
Mercury	3.5E-06	lb/MMBtu	1	6.14E-04	1.53E-05
Methyl bromide	1.5E-05	lb/MMBtu	1	2.63E-03	6.57E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	4.03E-03	1.01E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	5.43E-03	1.36E-04
Naphthalene	9.7E-05	lb/MMBtu	1	1.70E-02	4.25E-04
Nickel	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	1.93E-05	4.82E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	8.94E-06	2.24E-07
Perchloroethylene	3.8E-05	lb/MMBtu	1	6.66E-03	1.67E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	4.73E-03	1.18E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	1.43E-06	3.57E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	2.19E-02	5.48E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Selenium compounds	2.8E-06	lb/MMBtu	1	4.91E-04	1.23E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	1.51E-09	3.77E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	5.26E-03	1.31E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	3.86E-06	9.64E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	3.16E-03	7.89E-05
Total HAP Emissions (Biomass Combustion)				**5.51**	**0.14**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-8
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_X	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.58	lb/MMBtu[2]	2.89	0.72
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56

Notes:

1. As part of this submittal Enviva is requesting a limit of 500 hours per year of "idle mode" for each furnace.
2. CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

TABLE C-8
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	7.63E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	4.00E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	9.88E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.75E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	3.25E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.38E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	5.13E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	5.63E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	9.88E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.63E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	2.25E-07
Bis(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.88E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.63E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.38E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	6.00E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	2.00E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	4.38E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.88E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.21E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.38E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	6.38E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	1.02E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	1.08E-11
Trichloroethene	3.0E-05	lb/MMBtu	1	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.75E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.039**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-9
Doube Duct Burner (ES-DDB-1 & -2) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Duct Burner Inputs

Duct Burner Rating	**1**	**MMBtu/hr**
Number of Duct Burners	**2**	
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant Emissions:

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	Note 1	0.16	0.72
NO_X	50.0	lb/MMscf	Note 2	0.10	0.43
SO_2	0.60	lb/MMscf	Note 1	0.0012	0.005
VOC	5.50	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	Note 1	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.065

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[3]	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	Note 3	0.16	0.72
NO_X	6.50	lb/Mgal	Note 4	0.14	0.62
SO_2	0.054	lb/Mgal	Note 3,5	0.001	0.005
VOC	1.00	lb/Mgal	Note 3	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	Note 3	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	Note 3	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.067

Note:

1. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
2. Emission factors for NO_X assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
3. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08. Propane heating value of 91.5 MMBtu/Mgal assumed per AP-42.
4. AP-42 Section 1.5 does not include an emission factor for low NO_X burners. Per AP-42 Section 1.4, low NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_X emission factors in AP-42 Section 1.4.
5. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Potential HAP and TAP Emissions

TABLE C-9
Doube Duct Burner (ES-DDB-1 & -2) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Duct Burners - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	1	3.1E-08	1.4E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	1	3.0E-08	1.3E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	1	3.5E-08	1.5E-07
Ammonia	N	N	3.2	lb/MMscf	1	6.3E-03	2.7E-02
Anthracene	Y	Y	2.4E-06	lb/MMscf	1	4.7E-09	2.1E-08
Arsenic	Y	N	2.0E-04	lb/MMscf	1	3.9E-07	1.7E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzene	Y	Y	7.1E-04	lb/MMBtu	2	1.4E-03	6.2E-03
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	1	2.4E-08	1.0E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	1	2.2E-06	9.4E-06
Chromium VI	Y	N	1.4E-03	lb/MMscf	1	2.7E-06	1.2E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Cobalt	Y	N	8.4E-05	lb/MMscf	1	1.6E-07	7.2E-07
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	1	2.4E-06	1.0E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	1	5.9E-09	2.6E-08
Fluorene	Y	Y	2.8E-06	lb/MMscf	1	5.5E-09	2.4E-08
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	2	3.0E-03	1.3E-02
Hexane	Y	Y	1.8	lb/MMscf	1	3.5E-03	1.5E-02
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Lead	Y	N	5.0E-04	lb/MMscf	1	9.8E-07	4.3E-06
Manganese	Y	N	3.8E-04	lb/MMscf	1	7.5E-07	3.3E-06
Mercury	Y	N	2.6E-04	lb/MMscf	1	5.1E-07	2.2E-06
Naphthalene	Y	Y	6.1E-04	lb/MMscf	1	1.2E-06	5.2E-06
Nickel	Y	N	2.1E-03	lb/MMscf	1	4.1E-06	1.8E-05
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	8.0E-05	3.5E-04
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	1	3.3E-08	1.5E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	1	9.8E-09	4.3E-08
Selenium compounds	Y	N	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
Toluene	Y	Y	3.4E-03	lb/MMscf	1	6.7E-06	2.9E-05
Total HAP Emissions (related to natural gas/propane)						**0.008**	**0.035**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
2. The duct burners can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE C-10
POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 -CRITERIA POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput of Dryer	**390,628**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	ODT/hr
Burner Heat Input (HHV)	180.0	MMBtu/hr
Percent Hardwood	20.0%	
Percent Softwood	80.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,576,800**	**MMBtu/yr**
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/yr**
Number of Duct Burners	**2**	
Duct Burner Rating	**1**	**MMBtu/hr**
RTO Control Efficiency	**97.50%**	

RTO and Dryer Criteria Pollutant Calculations:

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Uncontrolled Emissions		Controlled Emissions[1]	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 2	--	--	28.33	78.1
NO_X	14.28	lb/hr	Note 2	--	--	14.28	62.5
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 3	--	--	7.60	33.3
SO_2	0.025	lb/MMBtu	AP-42, Section 1.6[4]	--	--	4.50	19.7
Total VOC (as propane)	2.64	lb/ODT	Note 5	186.99	515.6	4.67	12.9

Note:
[1] Exhaust from the dryer (ES-DRYER-2) is routed to a WESP and then RTO for control of VOC, HAP, and particulates.
[2] CO emissions based on data from similar Enviva facilities and information from NCASI database.
NOx emissions based on stack test results from similar facility plus 20% contingency.
[3] Particulate emission factor is based on data from similar Enviva facilities
[4] No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based upon the heat input of the dryer burners using an emission factor for wood combustion from AP-42, Section 1.6.
[5] VOC emission factor based on source test data for similar pellet manufacturing facilities and represents uncontrolled emissions.

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput of Dryer	**390,628**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	ODT/hr
Burner Heat Input (HHV)	180.0	MMBtu/hr
Percent Hardwood	20.0%	
Percent Softwood	80.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	**1,576,800**	**MMBtu/yr**
Number of RTO Burners	**4**	
RTO Burner Rating	**8**	**MMBtu/hr**
Number of Duct Burners	**2**	
Duct Burner Rating	**1**	**MMBtu/hr**
RTO Control Efficiency	**97.50%**	

Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Dryer Burner - Biomass Source							
Acetaldehyde	Y	Y	1.7E-01	lb/ODT	1	0.30	0.82
Acrolein	Y	Y	1.1E-01	lb/ODT	1	0.19	0.54
Formaldehyde	Y	Y	1.4E-01	lb/ODT	1	0.25	0.70
Methanol	Y	Y	1.0E-01	lb/ODT	1	0.19	0.51
Phenol	Y	Y	5.8E-02	lb/ODT	1	0.10	0.28
Propionaldehyde	Y	Y	3.9E-02	lb/ODT	1	0.07	0.19
Acetophenone	Y	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.3E-08
Antimony and compounds	Y	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.5E-04
Arsenic	Y	N	2.2E-05	lb/MMBtu	2,4	2.9E-04	1.3E-03
Benzene	Y	Y	4.2E-03	lb/MMBtu	2,3	1.9E-02	8.3E-02
Benzo(a)pyrene	Y	Y	2.6E-06	lb/MMBtu	2,3	1.2E-05	5.1E-05
Beryllium	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.3E-05
Cadmium	Y	N	4.1E-06	lb/MMBtu	2,4	5.4E-05	2.3E-04
Carbon tetrachloride	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.9E-04
Chlorine	Y	N	7.9E-04	lb/MMBtu	2	1.4E-01	6.2E-01
Chlorobenzene	Y	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Chloroform	Y	Y	2.8E-05	lb/MMBtu	2,3	1.3E-04	5.5E-04
Chromium VI	-[5]	N	3.5E-06	lb/MMBtu	2,4,5	4.6E-05	2.0E-04
Chromium–Other compounds	Y	N	1.8E-05	lb/MMBtu	2,4	2.3E-04	1.0E-03
Cobalt compounds	Y	N	6.5E-06	lb/MMBtu	2,4	8.5E-05	3.7E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.7E-04
Dichloropropane, 1,2-	Y	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Dinitrophenol, 2,4-	Y	Y	1.8E-07	lb/MMBtu	2,3	8.1E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.3E-07
Ethyl benzene	Y	Y	3.1E-05	lb/MMBtu	2,3	1.4E-04	6.1E-04
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	1.8E-11	lb/MMBtu	2,3	8.1E-11	3.5E-10
Hydrochloric acid	Y	N	1.9E-02	lb/MMBtu	2,6	3.4E-01	1.5E+00
Lead	Y	N	4.8E-05	lb/MMBtu	2,4	6.3E-04	2.7E-03
Manganese	Y	N	1.6E-03	lb/MMBtu	2,4	2.1E-02	9.1E-02
Mercury	Y	N	3.5E-06	lb/MMBtu	2,4	4.6E-05	2.0E-04
Methyl bromide	Y	Y	1.5E-05	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methyl chloride	Y	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.5E-04
Methyl ethyl ketone	N	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.1E-04
Methylene chloride	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.7E-03
Naphthalene	Y	Y	9.7E-05	lb/MMBtu	2,3	4.4E-04	1.9E-03
Nickel	Y	N	3.3E-05	lb/MMBtu	2,4	4.3E-04	1.9E-03
Nitrophenol, 4-	Y	Y	1.1E-07	lb/MMBtu	2,3	5.0E-07	2.2E-06
Pentachlorophenol	Y	N	5.1E-08	lb/MMBtu	2	2.3E-07	1.0E-06

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Perchloroethylene	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.5E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	lb/MMBtu	2,4	3.5E-04	1.5E-03
Polychlorinated biphenyls	Y	Y	8.2E-09	lb/MMBtu	2,3	3.7E-08	1.6E-07
Polycyclic Organic Matter	Y	N	1.3E-04	lb/MMBtu	2	5.6E-04	2.5E-03
Selenium compounds	Y	N	2.8E-06	lb/MMBtu	2,4	3.7E-05	1.6E-04
Styrene	Y	Y	1.9E-03	lb/MMBtu	2,3	8.6E-03	3.7E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	lb/MMBtu	2,3	3.9E-11	1.7E-10
Toluene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichloroethane, 1,1,1-	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.1E-04
Trichloroethylene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichlorofluoromethane	N	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	8.1E-04
Trichlorophenol, 2,4,6-	Y	Y	2.2E-08	lb/MMBtu	2,3	9.9E-08	4.3E-07
Vinyl chloride	Y	Y	1.8E-05	lb/MMBtu	2,3	8.1E-05	3.5E-04
Xylene	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.9E-04
Total HAP Emissions (related to biomass)						**1.6**	**5.402**
Pollutant	**HAP**	**VOC**	**Emission Factor**	**Units**	**Footnote**	**Potential Emissions**	
						Max (lb/hr)	**Annual (tpy)**
RTO & Duct Burners - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	7	5.7E-07	2.5E-06
Ammonia	N	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	4,7	6.3E-06	2.8E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	4,7	3.8E-07	1.7E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	4,7	3.5E-05	1.5E-04
Chromium VI	Y	N	1.4E-03	lb/MMscf	4,7	4.4E-05	1.9E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Cobalt	Y	N	8.4E-05	lb/MMscf	4,7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.7E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.7E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.9E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	1.8	lb/MMscf	7	5.7E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	7	5.7E-08	2.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	4,7	1.6E-05	6.9E-05
Manganese	Y	N	3.8E-04	lb/MMscf	4,7	1.2E-05	5.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	4,7	8.2E-06	3.6E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	4,7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	4,7	7.6E-07	3.3E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas/propane)						**0.129**	**0.565**

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. The control efficiency of 97.5% for the RTO is applied to all VOC hazardous and toxic pollutants.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants from the dryer and duct burners. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
5. Chromium VI is a subset of chromium compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.
6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
8. The RTO burners can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.
9. It was assumed that chlorine is not oxidized in the RTO.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - PM with an aerodynamic diameter <= 10 microns
$PM_{2.5}$ - PM with an aerodynamic diameter <= 2.5 microns
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE C-12
POTENTIAL EMISSIONS - DRYER 2 BYPASS[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput	70.83	ODT/hr
Hourly Heat Input Capacity (HHV)	180.00	MMBtu/hr
Annual Heat Input Capacity	9,000	MMBtu/yr
Hours of Operation[1]	50	hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.50	0.113
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	3.06	0.077
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	59.4	1.49
Total $PM/PM_{10}/PM_{2.5}$			62.5	1.56

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, and VOC emission rates based on data from a comparable Enviva facility.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.

TABLE C-12
POTENTIAL EMISSIONS - DRYER 2 BYPASS[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	0.168	lb/ODT	2	11.9	0.30
Acrolein	0.110	lb/ODT	2	7.8	0.195
Formaldehyde	0.144	lb/ODT	2	10.2	0.25
Methanol	0.10	lb/ODT	2	7.4	0.19
Phenol	0.058	lb/ODT	2	4.1	0.10
Propionaldehyde	0.039	lb/ODT	2	2.7	0.068
Acetophenone	3.2E-09	lb/MMBtu	3	5.76E-07	1.44E-08
Antimony and compounds	7.9E-06	lb/MMBtu	3	1.42E-03	3.56E-05
Arsenic	2.2E-05	lb/MMBtu	3	3.96E-03	9.90E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	3	4.68E-04	1.17E-05
Beryllium	1.1E-06	lb/MMBtu	3	1.98E-04	4.95E-06
Cadmium	4.1E-06	lb/MMBtu	3	7.38E-04	1.85E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	3	8.10E-03	2.03E-04
Chlorine	7.9E-04	lb/MMBtu	3	1.42E-01	3.56E-03
Chlorobenzene	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Chromium–Other compounds	1.8E-05	lb/MMBtu	3	3.15E-03	7.88E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3	1.17E-03	2.93E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	3	3.24E-05	8.10E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	3	8.46E-06	2.12E-07
Ethyl benzene	3.1E-05	lb/MMBtu	3	5.58E-03	1.40E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	3	5.22E-03	1.31E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	3	3.42E+00	8.55E-02
Lead	4.8E-05	lb/MMBtu	3	8.64E-03	2.16E-04
Manganese	1.6E-03	lb/MMBtu	3	2.88E-01	7.20E-03
Mercury	3.5E-06	lb/MMBtu	3	6.30E-04	1.58E-05
Methyl bromide	1.5E-05	lb/MMBtu	3	2.70E-03	6.75E-05
Methyl chloride	2.3E-05	lb/MMBtu	3	4.14E-03	1.04E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	3	5.58E-03	1.40E-04
Naphthalene	9.7E-05	lb/MMBtu	3	1.75E-02	4.37E-04
Nickel	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	3	1.98E-05	4.95E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	3	9.18E-06	2.30E-07
Perchloroethylene	3.8E-05	lb/MMBtu	3	6.84E-03	1.71E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	3	4.86E-03	1.22E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	3	1.47E-06	3.67E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	3	2.25E-02	5.63E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Selenium compounds	2.8E-06	lb/MMBtu	3	5.04E-04	1.26E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	3	1.55E-09	3.87E-11
Trichloroethylene	3.0E-05	lb/MMBtu	3	5.40E-03	1.35E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	3	3.96E-06	9.90E-08
Vinyl chloride	1.8E-05	lb/MMBtu	3	3.24E-03	8.10E-05
			Total HAP Emissions	**48.1**	**1.20**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from Cottondale and other similar Enviva plants.
3. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-13
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity (HHV)	180.00 MMBtu/hr
Annual Heat Input Capacity	9,000 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	108.0	2.70
NO_X	0.22	lb/MMBtu[2]	39.60	0.99
SO_2	0.025	lb/MMBtu[2]	4.50	0.113
VOC	0.017	lb/MMBtu[2]	3.06	0.077
Total $PM/PM_{10}/PM_{2.5}$	0.58	lb/MMBtu[2]	103.9	2.60

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, SO_2, PM, and VOC emission rates based on AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

TABLE C-13
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	1.49E-01	3.74E-03
Acrolein	4.00E-03	lb/MMBtu	1	7.20E-01	1.80E-02
Formaldehyde	4.40E-03	lb/MMBtu	1	7.92E-01	1.98E-02
Phenol	5.10E-05	lb/MMBtu	1	9.18E-03	2.30E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.10E-02	2.75E-04
Acetophenone	3.2E-09	lb/MMBtu	1	5.76E-07	1.44E-08
Antimony and compounds	7.9E-06	lb/MMBtu	1	1.42E-03	3.56E-05
Arsenic	2.2E-05	lb/MMBtu	1	3.96E-03	9.90E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	4.68E-04	1.17E-05
Beryllium	1.1E-06	lb/MMBtu	1	1.98E-04	4.95E-06
Cadmium	4.1E-06	lb/MMBtu	1	7.38E-04	1.85E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	8.10E-03	2.03E-04
Chlorine	7.9E-04	lb/MMBtu	1	1.42E-01	3.56E-03
Chlorobenzene	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	3.78E-03	9.45E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.17E-03	2.93E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	3.24E-05	8.10E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	8.46E-06	2.12E-07
Ethyl benzene	3.1E-05	lb/MMBtu	1	5.58E-03	1.40E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	5.22E-03	1.31E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	1	3.42E+00	8.55E-02
Lead	4.8E-05	lb/MMBtu	1	8.64E-03	2.16E-04
Manganese	1.6E-03	lb/MMBtu	1	2.88E-01	7.20E-03
Mercury	3.5E-06	lb/MMBtu	1	6.30E-04	1.58E-05
Methyl bromide	1.5E-05	lb/MMBtu	1	2.70E-03	6.75E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	4.14E-03	1.04E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	5.58E-03	1.40E-04
Naphthalene	9.7E-05	lb/MMBtu	1	1.75E-02	4.37E-04
Nickel	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	1.98E-05	4.95E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	9.18E-06	2.30E-07
Perchloroethylene	3.8E-05	lb/MMBtu	1	6.84E-03	1.71E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	4.86E-03	1.22E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	1.47E-06	3.67E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	2.25E-02	5.63E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Selenium compounds	2.8E-06	lb/MMBtu	1	5.04E-04	1.26E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	1.55E-09	3.87E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	5.40E-03	1.35E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	3.96E-06	9.90E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	3.24E-03	8.10E-05
Total HAP Emissions (Biomass Combustion)				**5.66**	**0.14**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-14
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_X	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.58	lb/MMBtu[2]	2.89	0.72
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56

Notes:

1. As part of this submittal Enviva is requesting a limit of 500 hours per year of "idle mode" for each furnace.
2. CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensible factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

TABLE C-14
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	7.63E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	4.00E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	9.88E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.75E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	3.25E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.38E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	5.13E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	5.63E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	9.88E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.63E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	2.25E-07
Bis(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.88E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.63E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.38E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	6.00E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	2.00E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	4.38E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.88E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.21E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.38E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	6.38E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	1.02E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	1.08E-11
Trichloroethene	3.0E-05	lb/MMBtu	1	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.75E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.039**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

TABLE C-15
Doube Duct Burner (ES-DDB-3 & -4) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Duct Burner Inputs

Duct Burner Rating	**1**	**MMBtu/hr**
Number of Duct Burners	**2**	
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant Emissions:

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	Note 1	0.16	0.72
NO_X	50.0	lb/MMscf	Note 2	0.10	0.43
SO_2	0.60	lb/MMscf	Note 1	0.0012	0.005
VOC	5.50	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	Note 1	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.065

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[3]	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	Note 3	0.16	0.72
NO_X	6.50	lb/Mgal	Note 4	0.14	0.62
SO_2	0.054	lb/Mgal	Note 3,5	0.001	0.005
VOC	1.00	lb/Mgal	Note 3	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	Note 3	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	Note 3	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.067

Note:

1. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
2. Emission factors for NO_X assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
3. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08. Propane heating value of 91.5 MMBtu/Mgal assumed per AP-42.
4. AP-42 Section 1.5 does not include an emission factor for low NO_X burners. Per AP-42 Section 1.4, low NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_X emission factors in AP-42 Section 1.4.
5. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Potential HAP and TAP Emissions

TABLE C-15
Doube Duct Burner (ES-DDB-3 & -4) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Duct Burners - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	1	3.1E-08	1.4E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	1	3.0E-08	1.3E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	1	3.5E-08	1.5E-07
Ammonia	N	N	3.2	lb/MMscf	1	6.3E-03	2.7E-02
Anthracene	Y	Y	2.4E-06	lb/MMscf	1	4.7E-09	2.1E-08
Arsenic	Y	N	2.0E-04	lb/MMscf	1	3.9E-07	1.7E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzene	Y	Y	7.1E-04	lb/MMBtu	2	1.4E-03	6.2E-03
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	1	2.4E-08	1.0E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	1	2.2E-06	9.4E-06
Chromium VI	Y	N	1.4E-03	lb/MMscf	1	2.7E-06	1.2E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Cobalt	Y	N	8.4E-05	lb/MMscf	1	1.6E-07	7.2E-07
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	1	2.4E-06	1.0E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	1	5.9E-09	2.6E-08
Fluorene	Y	Y	2.8E-06	lb/MMscf	1	5.5E-09	2.4E-08
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	2	3.0E-03	1.3E-02
Hexane	Y	Y	1.8	lb/MMscf	1	3.5E-03	1.5E-02
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Lead	Y	N	5.0E-04	lb/MMscf	1	9.8E-07	4.3E-06
Manganese	Y	N	3.8E-04	lb/MMscf	1	7.5E-07	3.3E-06
Mercury	Y	N	2.6E-04	lb/MMscf	1	5.1E-07	2.2E-06
Naphthalene	Y	Y	6.1E-04	lb/MMscf	1	1.2E-06	5.2E-06
Nickel	Y	N	2.1E-03	lb/MMscf	1	4.1E-06	1.8E-05
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	8.0E-05	3.5E-04
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	1	3.3E-08	1.5E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	1	9.8E-09	4.3E-08
Selenium compounds	Y	N	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
Toluene	Y	Y	3.4E-03	lb/MMscf	1	6.7E-06	2.9E-05
Total HAP Emissions (related to natural gas/propane)						**0.008**	**0.035**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
2. The duct burners can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE C-16
PROPANE VAPORIZER POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Heat Content[1]	91.5	MMBtu/10^3 gal propane
Hours of Operation	8,760	hr/yr
Vaporizer Heat Input[2]	1.00	MMBtu/hr

Notes:
1. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08, Table 1.5-1, footnote a.
2. Heat input based on information provided by Enviva in August 2018.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor [1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	7.5	lb/10^3 gal	0.08	0.36
NO_X	13.0	lb/10^3 gal	0.14	0.62
SO_2[2]	0.054	lb/10^3 gal	0.001	0.003
TOC	1.0	lb/10^3 gal	0.01	0.05
$PM/PM_{10}/PM_{2.5}$[3]	0.70	lb/10^3 gal	0.01	0.03

Notes:
1. Emission factors obtained from AP 42 1.5, Liquefied Petroleum Gas Production, 07/08, Table 1.5-1.
2. AP 42 1.5, Liquefied Petroleum Gas Production, 10/96, Table 1.5-1 provides an SO_2 emission factor of 0.10S, where S equals the sulfur content of the fuel. The national sulfur fuel content for LPG of 0.54 grains/100 ft^3 as assigned by EPA was used (Source: A National Methodology and Emission Inventory for Residential Fuel Combustion).
3. All particulate matter was conservatively assumed to be less than 2.5 microns in size.

Potential HAP Emissions

Pollutant	CAS No.	Emission Factor[1]	Potential Emissions	
		(lb/MMBtu)	Max (lb/hr)	Annual (tpy)
Benzene	71-43-2	7.1E-04	7.10E-04	3.11E-03
Formaldehyde	50-00-0	1.5E-03	1.50E-03	6.57E-03
PAHs		4.0E-05	4.00E-05	1.75E-04
		Total HAP Emissions	**2.25E-03**	**9.86E-03**

Notes:
1. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
gal - gallon
HAP - hazardous air pollutant
hp - horsepower
hr - hour
kg - kilogram
kW - kilowatt
lb - pound
MW - megawatt
MMBtu - Million British thermal units
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
AP-42 Chapter 3.3, Stationary Internal Combustion Engines, 10/96.

TABLE C-17
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RCO STACK
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput	781,255 ODT/yr
Hourly Throughput	144 ODT/hr
Hours of Operation	8,760 hr/yr
Number of Burners	2 burners
RCO/RTO Burner Rating	9.8 MMBtu/hr
RCO/RTO Control Efficiency	95%

Pellet Cooler and Pellet Mill Potential Process VOC and HAP Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[1]	Emissions at RCO Outlet[2]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.025	0.181	0.49
Acrolein	107-02-8	Y	Y	0.050	0.36	0.97
Formaldehyde	50-00-0	Y	Y	0.006	0.04	0.12
Methanol	67-56-1	Y	Y	0.021	0.15	0.41
Phenol	108-95-2	Y	Y	0.025	0.18	0.49
Propionaldehyde	123-38-6	Y	Y	0.015	0.105	0.29
				Total HAP Emissions	**1.02**	**2.78**
Total VOC (as propane)	--	--	Y	1.41	10.17	27.60

Notes:

1. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
2. A 95.0% control efficiency for the RCO is applied to VOC and organic HAP emissions.
Emissions from the pellet mills and pellet coolers will be controlled by an RCO that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions when operating in thermal mode.

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02 MMBtu/lb
Uncontrolled VOC emissions	552 tons/yr
Heat input of uncontrolled VOC emissions	20,417 MMBtu/yr

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.19	0.84
NO_X	9.8E-02	lb/MMBtu	0.23	1.00

Natural Gas Combustion Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	1.6	7.1
NO_X	9.8E-02	lb/MMBtu	1.9	8.4
SO_2	5.9E-04	lb/MMBtu	1.2E-02	5.0E-02
VOC	5.4E-03	lb/MMBtu	0.11	0.46
Total PM	7.5E-03	lb/MMBtu	0.15	0.64
Total PM_{10}	7.5E-03	lb/MMBtu	0.15	0.64
Total $PM_{2.5}$	7.5E-03	lb/MMBtu	0.15	0.64

TABLE C-17
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RCO STACK
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[2]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	1.61	7.04
NO_X	6.50	lb/Mgal	1.39	6.10
SO_2	0.054	lb/Mgal	0.01	0.05
VOC	1.00	lb/Mgal	0.21	0.94
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.11	0.47
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.04	0.19
Total $PM/PM_{10}/PM_{2.5}$			0.15	0.66

Natural Gas and Propane Combustion Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	3	3.1E-07	1.3E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	3	2.9E-07	1.3E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	3	3.5E-07	1.5E-06
Ammonia	N	N	3.2	lb/MMscf	3	0.06	0.27
Anthracene	Y	Y	2.4E-06	lb/MMscf	3	4.6E-08	2.0E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	3	3.8E-06	1.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	4	1.4E-02	6.1E-02
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	3	2.3E-07	1.0E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	3	2.1E-05	9.3E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	3	2.7E-05	1.2E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Cobalt	Y	N	8.4E-05	lb/MMscf	3	1.6E-06	7.1E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	3	2.3E-05	1.0E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	3	5.8E-08	2.5E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	3	5.4E-08	2.4E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	4	2.9E-02	1.3E-01
Hexane	Y	Y	1.8	lb/MMscf	3	3.5E-02	0.15
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	3	9.6E-06	4.2E-05
Manganese	Y	N	3.8E-04	lb/MMscf	3	7.3E-06	3.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	3	5.0E-06	2.2E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	3	1.2E-05	5.1E-05
Nickel	Y	N	2.1E-03	lb/MMscf	3	4.0E-05	1.8E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	5	7.8E-04	3.4E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	3	3.3E-07	1.4E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	3	9.6E-08	4.2E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	3	6.5E-05	2.9E-04
Total HAP Emissions (natural gas/propane combustion)						**0.079**	**0.35**

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
3. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
3. The RCO burner can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE C-18
POTENTIAL DRY HAMMERMILL EMISSIONS AT OUTLET OF RCO STACK
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Total Plant Throughput	781,255	ODT/yr
% of Total Throughput to the Hammermills	85%	
Hours of Operation	8760	hr/yr

Hammermills Annual Throughput	664,067	ODT/yr
Hammermills Hourly Throughput	144	ODT/hr
Control Efficiency[1]	95.0%	

Potential VOC and HAP Emissions

Pollutant	CAS No.	HAP	VOC	Emission Factor[2] (lb/ODT)	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.0073	0.05	0.12
Acrolein	107-02-8	Y	Y	0.0092	0.07	0.15
Formaldehyde	50-00-0	Y	Y	0.0071	0.05	0.12
Methanol	67-56-1	Y	Y	0.0071	0.05	0.12
Phenol	108-95-2	Y	Y	0.0028	0.02	0.05
Propionaldehyde	123-38-6	Y	Y	0.0124	0.09	0.21
				Total HAP Emissions	**0.33**	**0.76**
Total VOC (as propane)	--		Y	0.765	5.51	12.70

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02	MMBtu/lb
Uncontrolled VOC emissions	254	tons/yr
Heat input of uncontrolled VOC emissions	9,396	MMBtu/yr

Pollutant	Emission Factor[3]	Units	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.09	0.39
NO_X	9.8E-02	lb/MMBtu	0.11	0.46

Notes:

1. Emissions from the dry hammermills are controlled by the RCO with estimated control efficiency of 95.0%.
2. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
3. CO and NO_x emission factors are from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE C-19
DOUBLE DUCT BURNERS (ES-DDB-5 and -8) POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Duct Burner Inputs

Duct Burner Rating	**1 MMBtu/hr**
Number of Duct Burners	**4**
Annual Operation	8,760 hr/yr

Potential Criteria Pollutant Emissions:

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	Note 1	0.33	1.44
NO_X	50.0	lb/MMscf	Note 2	0.20	0.86
SO_2	0.60	lb/MMscf	Note 1	0.0024	0.010
VOC	5.50	lb/MMscf	Note 1	0.02	0.09
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	Note 1	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	Note 1	0.007	0.03
Total $PM/PM_{10}/PM_{2.5}$				0.030	0.131

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[3]	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	Note 3	0.33	1.44
NO_X	6.50	lb/Mgal	Note 4	0.28	1.24
SO_2	0.054	lb/Mgal	Note 3,5	0.002	0.010
VOC	1.00	lb/Mgal	Note 3	0.04	0.19
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	Note 3	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	Note 3	0.009	0.04
Total $PM/PM_{10}/PM_{2.5}$				0.031	0.134

Note:

1. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
2. Emission factors for NO_X assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
3. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08. Propane heating value of 91.5 MMBtu/Mgal assumed per AP-42.
4. AP-42 Section 1.5 does not include an emission factor for low NO_X burners. Per AP-42 Section 1.4, low NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low NO_X emission factors in AP-42 Section 1.4.
5. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Potential HAP and TAP Emissions

TABLE C-19
DOUBLE DUCT BURNERS (ES-DDB-5 and -8) POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Duct Burners - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	1	9.4E-08	4.1E-07
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	1	6.3E-08	2.7E-07
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	1	6.0E-08	2.6E-07
Acrolein	Y	Y	1.8E-05	lb/MMscf	1	7.1E-08	3.1E-07
Ammonia	N	N	3.2	lb/MMscf	1	1.3E-02	5.5E-02
Anthracene	Y	Y	2.4E-06	lb/MMscf	1	9.4E-09	4.1E-08
Arsenic	Y	N	2.0E-04	lb/MMscf	1	7.8E-07	3.4E-06
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Benzene	Y	Y	7.1E-04	lb/MMBtu	2	2.8E-03	1.2E-02
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	1	4.7E-09	2.1E-08
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	1	4.7E-09	2.1E-08
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Beryllium	Y	N	1.2E-05	lb/MMscf	1	4.7E-08	2.1E-07
Cadmium	Y	N	1.1E-03	lb/MMscf	1	4.3E-06	1.9E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	1	5.5E-06	2.4E-05
Chrysene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Cobalt	Y	N	8.4E-05	lb/MMscf	1	3.3E-07	1.4E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	1	4.7E-09	2.1E-08
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	1	4.7E-06	2.1E-05
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	1	1.2E-08	5.2E-08
Fluorene	Y	Y	2.8E-06	lb/MMscf	1	1.1E-08	4.8E-08
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	2	6.0E-03	2.6E-02
Hexane	Y	Y	1.8	lb/MMscf	1	7.1E-03	3.1E-02
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	1	7.1E-09	3.1E-08
Lead	Y	N	5.0E-04	lb/MMscf	1	2.0E-06	8.6E-06
Manganese	Y	N	3.8E-04	lb/MMscf	1	1.5E-06	6.5E-06
Mercury	Y	N	2.6E-04	lb/MMscf	1	1.0E-06	4.5E-06
Naphthalene	Y	Y	6.1E-04	lb/MMscf	1	2.4E-06	1.0E-05
Nickel	Y	N	2.1E-03	lb/MMscf	1	8.2E-06	3.6E-05
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	1.6E-04	7.0E-04
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	1	6.7E-08	2.9E-07
Pyrene	Y	Y	5.0E-06	lb/MMscf	1	2.0E-08	8.6E-08
Selenium compounds	Y	N	2.4E-05	lb/MMscf	1	9.4E-08	4.1E-07
Toluene	Y	Y	3.4E-03	lb/MMscf	1	1.3E-05	5.8E-05
Total HAP Emissions (related to natural gas/propane)						**0.016**	**0.071**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
2. The duct burners can fire either natural gas or propane; Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_X - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

TABLE C-20
DRIED WOOD HANDLING POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput[1]	142 ODT/hr
Annual Throughput[1]	781,255 ODT/yr

Potential VOC and HAP Pollutant Emissions

Pollutant	Emission Factor (lb/ODT)	Potential Emissions	
		Max (lb/hr)	Annual (tpy)
Formaldehyde	8.4E-04	0.119	0.33
Methanol	2.0E-03	0.28	0.76
Total HAP Emissions		**0.40**	**1.09**
VOC as carbon[2]	0.10	14.3	39.5
VOC as propane[3]	0.12	17.6	48.53

Notes:

1. Hourly and annual throughputs assumed to be the same as dry hammermill throughput.

2. Emission factors derived from NCASI's Wood Products Database (February 2013) for dry wood handling operations at an OSB mill, mean emission factors. The emission factors were converted from lb/MSF (3/8") to lb/ODT using the typical density and moisture content of an OSB panel.

3. VOC as propane = (1.22 x VOC as carbon) + formaldehyde.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE C-21
DEBARKER POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput	781,255	tons/year (dry wood)[1]
Short-term Throughput	210.0	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions	
			Max (lb/hr)	Annual (tpy)
PM[2]	2.00E-02	lb/ton	**0.84**	**1.56**
PM_{10}[2]	1.10E-02	lb/ton	**0.46**	**0.86**

[1] The annual throughput used for the debarker is assumed to equal the annual throughput of the dryers.
The short-term throughput is based upon the maximum capacity of the debarker.

[2] Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking)*. All PM is assumed to be larger than 2.5 microns. PM emissions are assumed to be controlled due to the use of water spray and the debarker being partially enclosed (assumed 90% control).

TABLE C-22
BARK HOG POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput of Bark Hog	234,377	tons/year (dry wood)[1]
Short-term Throughput of Bark Hog	31.50	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions	
			Max (lb/hr)	Annual (tpy)
THC as Carbon[2]	0.0041	lb/ODT	0.13	0.48
VOC as propane[3]	0.0050	lb/ODT	0.16	0.59
PM[4]	0.02	lb/ton	0.13	0.47
PM_{10}[4]	0.011	lb/ton	0.07	0.26
Methanol[2]	0.0010	lb/ODT	0.03	0.12

Notes:

[1] The annual throughput used for the bark hog is 30% of the annual throughput of the facility. The short-term throughput is 15% of maximum hourly capacity of the debarker.

[2] Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.

[3] Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.

[4] Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking)*. All PM is assumed to be larger than 2.5 microns. PM emissions are assumed to be controlled due to the bark hog being partially enclosed (assumed 90% control).

TABLE C-23
ELECTRIC POWERED CHIPPER EMISSIONS
ENVIVA PELLET SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput of Chipper	781,255	tons/year (dry wood)[1]
Short Term Throughput	119.4	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions	
			Max (lb/hr)	Annual (tpy)
THC as Carbon[2]	4.10E-03	lb/ODT	0.49	1.60
VOC as propane[3]	5.00E-03	lb/ODT	**0.60**	**1.95**
Methanol[2]	1.00E-03	lb/ODT	**0.12**	**0.39**

[1] The annual throughput used for the chipper is assumed to be the same as the throughput for the bark hog; while the short-term throughput is based upon the maximum capacity of the chippers.
[2] Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.
[3] Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.

TABLE C-24
SUMMARY OF POTENTIAL EMISSIONS FROM BAGHOUSES AND CYCLONES
ENVIVA PELLETS SOUTHAMPTON, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate[1]	Pollutant Loading[2]	Annual Operation	Particulate Speciation		Potential Emissions					
									PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	(hours)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
ES-HM-1 thru 3	Dry Hammermills 1 thru 3	CD-HM-BF-1	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-HM-4 thru 6	Dry Hammermills 4 thru 6	CD-HM-BF-2	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-HM-7 and 8	Dry Hammermills 7 thru 8	CD-HM-BF-3	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-PCHP	Pellet Cooler HP Fines Relay System, including Pellet Screeners and Truck Loadout	CD-PCHP-BF	One (1) baghouse[5]	3,600	0.004	8760	100%	100%	0.123	0.54	0.123	0.54	0.123	0.54
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BF	Bin Vent Filter[5]	2,500	0.004	8760	100%	100%	0.086	0.38	0.086	0.38	0.09	0.38
ES-CLR-1	Pellet Cooler	CD-CLR-1	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-2	Pellet Cooler	CD-CLR-2	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-3	Pellet Cooler	CD-CLR-3	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-4	Pellet Cooler	CD-CLR-4	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-5	Pellet Cooler	CD-CLR-5	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-6	Pellet Cooler	CD-CLR-6	One (1) existing Cyclone and one (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-DWH	Dried Wood Handling	CD-DWH-BF	One (1) baghouse[5]	1,500	0.004	8760	100%	100%	0.05	0.23	0.05	0.23	0.05	0.23
ES-FPH	Finished Product Handling	CD-FPH-BF	One (1) baghouse[4,7]	35,500	0.004	8760	91.0%	1.7%	1.22	5.33	1.11	4.85	0.02	0.09
ES-ADD	Starch Additive Handling and Storage	CD-ADD-BF	One (1) baghouse[5]	1,600	0.004	117	100%	100%	0.05	0.003	0.05	0.003	0.05	0.003

Notes:

1. Filter, Vent, and Cyclone inlet flow rate (cfm) provided by design engineering firm (Mid-South Engineering Co.). The exit flowrate was conservatively assumed to be the same as the inlet flowrate.
2. Pollutant loading provided by Enviva. For Pellet Coolers, pollutant loading based on data from other Enviva facilities reflecting addition of a wet scrubber.
3. No speciation data is available for PM_{10}. Therefore, it is conservatively assumed to be equal to total PM.
4. Dry Hammermills and finished product handling $PM_{2.5}$ speciation based on April 2014 Enviva Southampton $PM_{2.5}$ speciation tests.
5. No speciation data is available for $PM_{10}/PM_{2.5}$. Therefore, it is conservatively assumed to be equal to total PM.
6. Pellet cooler $PM_{10}/PM_{2.5}$ speciation based on data for similar Enviva facility.
7. Finished product handling PM_{10} speciation based on AP-42 factors for wet wood combustion (Section 1.6) controlled by a mechanical separator. Since the particle size of particulate matter from a pellet cooler is anticipated to be larger than flyash, this factor is believed to be a conservative indicator of speciation.

Abbreviations:

cf - cubic feet
cfm - cubic feet per minute
ES - Emission Sources
IES - Insignificant Emission Source
gr - grain
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year

TABLE C-25
GREEN WOOD HANDLING
ENVIVA PELLETS SOUTHAMPTON, LLC

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[2]	PM Emission Factor[3]	PM_{10} Emission Factor[3]	$PM_{2.5}$ Emission Factor[3]	Potential Throughput		Potential PM Emissions		Potential PM_{10} Emissions[4]		Potential $PM_{2.5}$ Emissions[4]	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
ES-GWHS	Material feed conveyance system to dryer burner fuel storage bin	4	48%	3.74E-05	1.77E-05	2.68E-06	30	252,692	4.5E-03	1.9E-02	5.3E-04	2.2E-03	8.0E-05	3.4E-04
	Material feed conveyance system to raw wood chip storage pile	1	48%	3.74E-05	1.77E-05	2.68E-06	400	1,502,414	1.5E-02	2.8E-02	1.8E-03	3.3E-03	2.7E-04	5.0E-04
	Material feed conveyance system to dryer burner	0	45%	4.09E-05	1.93E-05	2.93E-06	30	545,455	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Material feed conveyance system to rotary drum wood dryer	0	48%	3.74E-05	1.77E-05	2.68E-06	300	1,652,655	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Material feed conveyance system to fuel storage piles	3	45%	4.09E-05	1.93E-05	2.93E-06	30	238,909	3.7E-03	1.5E-02	4.4E-04	1.7E-03	6.6E-05	2.6E-04
								Total Emissions:	**2.3E-02**	**6.2E-02**	**2.7E-03**	**7.3E-03**	**4.1E-04**	**1.1E-03**

Notes:

1. These green wood handling emissions are representative of the fugitive emissions at the site.
2. Moisture content provided by Enviva on 8/2318.
3. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 1, (11/06).

where:
E = emission factor (lb/ton)
k = particle size multiplier (dimensionless) for PM 0.74
k = particle size multiplier (dimensionless) for PM_{10} 0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.053
U = mean wind speed (mph) 6.3

4. PM10 control efficiency of 74.7% applied for three-sided enclosed structure with 50% porosity per Sierra Research "Final BACM Technological and Economic Feasibility Analysis" , report prepared for the San Joaquin Valley Unified Air Pollution Control District (3/03). The control efficiency is assumed equivalent for PM10 and PM2.5 emissions.

Abbreviations:

hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year

TABLE C-26
STORAGE PILE WIND EROSION
ENVIVA PELLETS SOUTHAMPTON, LLC

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width/ Diameter	Pile Length	Pile Height	Outer Surface Area of Pile[3]	Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions		Potential VOC Emissions as propane[4]	
		(lb/day/acre)	(lb/hr/ft^2)	(lb/day/acre)	(lb/hr/ft^2)	(ft)	(ft)	(ft)	(ft^2)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-GWHS	Green Wood Storage Pile No. 1	10.9	1.0E-05	3.6	3.4E-06	155	--	72	30,907	0.32	1.4	0.16	0.7	0.024	0.11	0.13	0.6
	Green Wood Storage Pile No. 2	10.9	1.0E-05	3.6	3.4E-06	500	600	25	426,000	4.44	19.4	2.22	9.7	0.333	1.46	1.79	7.8
	Fuel Storage Pile No. 1	10.9	1.0E-05	3.6	3.4E-06	150	700	25	177,000	1.84	8.07	0.921	4.04	1.4E-01	0.605	0.744	3.26
	Fuel Storage Pile No. 2	10.9	1.0E-05	3.6	3.4E-06	50	--	25	3,332	0.035	0.152	0.017	0.076	2.6E-03	1.1E-02	0.014	0.061
	Fuel Storage Pile No. 3	10.9	1.0E-05	3.6	3.4E-06	50	--	25	3,332	0.035	0.152	0.017	0.076	2.6E-03	1.1E-02	0.014	0.061
									Total Emissions:	**6.7**	**29**	**3.3**	**14.6**	**0.50**	**2.2**	**2.7**	**11.8**

Notes:

1. TSP emission factor based on U.S. EPA Control of Open Fugitive Dust Sources. Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988, Page 4-17.

$$E = 1.7\left(\frac{s}{1.5}\right)\left(\frac{(365-p)}{235}\right)\left(\frac{f}{15}\right)(\text{lb/day/acre})$$

where:	s, silt content of wood chips (%):	8.4	s - silt content (%) for lumber sawmills (mean) from AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Table 13.2.2-1
	p, number of days with rainfall greater than 0.01 inch:	120	Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Southampton, VA).
	f (time that wind exceeds 5.36 m/s - 12 mph) (%):	16.5	Based on meteorological data averaged for 2012-2016 for Richmond, VA National Weather Service (NWS) Station
	PM_{10}/TSP ratio:	50%	PM_{10} is assumed to equal 50% of TSP based on U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
	$PM_{2.5}$/TSP ratio:	7.5%	$PM_{2.5}$ is assumed to equal 7.5 % of TSP U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

2. Emission factors obtained from NCASI document provided by the South Carolina Department of Health and Environmental Control (DHEC) for the calculation of fugitive VOC emissions from Douglas Fir wood storage piles. Emission factors ranged from 1.6 to 3.6 lb C/acre-day. Enviva chose to employ the maximum emission factor for purposes of conservatism.
3. The surface area for rectangular piles is calculated as [2*H*L+2*W*H+L*W] + 20% to consider the sloping pile edges. Pile dimensions were provided by Enviva.
The surface area for circular piles is calculated as $[\Pi*R*(R^2+H^2)^{0.5}]$ + 20% to consider the sloping pile edges. Diameter and height were provided by Enviva.
4. Emissions are calculated in tons of carbon per year by the following formula:
tons C/year = 5 acres * 365 days * 1.6 lb C/acre-day / 2000 lb/ton
Emission factor converted from as carbon to as propane by multiplying by 1.22.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
ft^2 - square feet
lb - pound
mph - miles per hour
NC - North Carolina
NCASI - National Council for Air and Stream Improvement, Inc.
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
TSP - total suspended particulate
yr - year
VOC - volatile organic compound

TABLE C-27
EMERGENCY GENERATOR AND FIRE PUMP
ENVIVA PELLETS SOUTHAMPTON, LLC

Emergency Generator Emissions (ES-EG)

Equipment and Fuel Characteristics

Engine Output	0.26	MW
Engine Power	350	hp (brake)
Hours of Operation	500	hr/yr[1]
Heating Value of Diesel	19,300	Btu/lb
Power Conversion	7,000	Btu/hp-hr

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
TSP	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
PM_{10}	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
$PM_{2.5}$	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
NO_x	PSD	8.82E-03	lb/kW-hr (5)	2.30	5.75E-01
SO_2	PSD	15	ppmw (3)	3.81E-03	9.52E-04
CO	PSD	7.72E-03	lb/kW-hr (2)	2.01	5.03E-01
VOC (NMHC)	PSD	2.51E-03	lb/MMBtu (4)	6.15E-03	1.54E-03
Hazardous Air Pollutant Emissions					
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	1.88E-03	4.70E-04
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	2.27E-04	5.67E-05
Benzene	HAP	6.53E-06	lb/hp-hr (4)	2.29E-03	5.71E-04
Benzo(a)pyrene[6]	HAP	1.32E-09	lb/hp-hr (4)	4.61E-07	1.15E-07
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	9.58E-05	2.39E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	2.89E-03	7.23E-04
Total PAH (POM)	HAP	1.18E-06	lb/hp-hr (4)	4.12E-04	1.03E-04
Toluene	HAP	2.86E-06	lb/hp-hr (4)	1.00E-03	2.51E-04
Xylenes	HAP	2.00E-06	lb/hp-hr (4)	6.98E-04	1.75E-04
Highest HAP (Formaldehyde)		8.26E-06	lb/hp-hr (4)	2.89E-03	7.23E-04
Total HAPs				9.49E-03	2.37E-03

Note:

1 NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown). The PTE for the emergency generator is based on 500 hr/yr, though, because the regs allow non-emergency operation and EPA guidance is 500 hr/yr for emergency generators.

2 Emissions factors from NSPS Subpart IIII (or 40 CFR 89.112 where applicable) in compliance with post-2009 construction.

3 Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.

4 Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.

5 Emission factor for NOx is listed as NOx and NMHC (Non-Methane Hydrocarbons or VOC) in Table 4 of NSPS Subpart IIII. Conservatively assumed entire limit attributable to NOx.

6 Benzo(a)pyrene is included as a HAP in Total PAH.

TABLE C-27
EMERGENCY GENERATOR AND FIRE PUMP
ENVIVA PELLETS SOUTHAMPTON, LLC

Firewater Pump Emissions (ES-FWP)

Equipment and Fuel Characteristics

Engine Output	0.22	MW
Engine Power	300	hp
Hours of Operation	500	hr/yr[1]
Heating Value of Diesel	19,300	Btu/lb
Power Conversion	7,000	Btu/hp-hr

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
TSP	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
PM_{10}	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
$PM_{2.5}$	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
NO_x	PSD	8.82E-03	lb/kW-hr (5)	1.97	4.93E-01
SO_2	PSD	15	ppmw (3)	3.26E-03	8.16E-04
CO	PSD	7.72E-03	lb/kW-hr (2)	1.73	4.32E-01
VOC (NMHC)	PSD	2.51E-03	lb/MMBtu (4)	5.27E-03	1.32E-03
Hazardous Air Pollutant Emissions					
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	1.61E-03	4.03E-04
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	1.94E-04	4.86E-05
Benzene	HAP	6.53E-06	lb/hp-hr (4)	1.96E-03	4.90E-04
Benzo(a)pyrene[6]	HAP	1.32E-09	lb/hp-hr (4)	3.95E-07	9.87E-08
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	8.21E-05	2.05E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	2.48E-03	6.20E-04
Total PAH (POM)	HAP	1.18E-06	lb/hp-hr (4)	3.53E-04	8.82E-05
Toluene	HAP	2.86E-06	lb/hp-hr (4)	8.59E-04	2.15E-04
Xylenes	HAP	2.00E-06	lb/hp-hr (4)	5.99E-04	1.50E-04
Highest HAP (Formaldehyde)		8.26E-06	lb/hp-hr (4)	2.48E-03	6.20E-04
Total HAPs				8.13E-03	2.03E-03

Note:

1 NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown). The PTE for the emergency generator is based on 500 hr/yr, though, because the regs allow non-emergency operation and EPA guidance is 500 hr/yr for emergency generators.

2 Emissions factors from NSPS Subpart IIII (or 40 CFR 89.112 where applicable) in compliance with post-2009 construction.

3 Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.

4 Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.

5 Emission factor for NOx is listed as NOx and NMHC (Non-Methane Hydrocarbons or VOC) in Table 4 of NSPS Subpart IIII. Conservatively assumed entire limit attributable to NOx.

6 Benzo(a)pyrene is included as a HAP in Total PAH.

TABLE C-28
Diesel Storage Tanks
IES-TK-1 through 3
Enviva Pellets Southampton, LLC

Source ID	Description	Design Volume[1]	Working Volume[2]	Tank Dimensions[5]		Orientation	Throughput[3]	Turnovers	VOC Emissions[4]	
				Diameter	Height / Length					
		(gal)	(gal)	(ft)	(ft)		(gal / yr)		(lb / hr)	(tpy)
IES-TK-1	Emergency Generator Fuel Storage Tank[2]	2,500	1,250	6.0	12	Horizontal	8,813	7.1	1.3E-04	5.8E-04
IES-TK-2	Fire Pump Fuel Storage Tank[2]	500	250	3.0	10.0	Horizontal	7,554	30.2	3.7E-05	1.6E-04
IES-TK-3	Mobile Fuel Diesel Storage Tank	5,000	2,500	6.0	23.7	Horizontal	200,000	80.0	7.6E-04	3.3E-03
								Total Emissions:	**9.3E-04**	**4.1E-03**

Notes:

1. Conservative design specifications.
2. Working volume conservatively assumed to be 50% of tank design volume because tanks will not be full at all times.
3. Throughput for IES-TK-1 and IES-TK-2 based on fuel consumption provided by Enviva and 500 hours of operation per year. Throughput for IES-TK-3 provided by Enviva.
4. Emissions calculated using EPA TANKS 4.0 software. A minimum tank length for the TANKS program of 5 feet was used to estimate the emissions for IES-TK-2.
5. IES-TK-3 length was estimated based on the capacity of the tank and the diameter.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
gal - gallon
lb - pound
yr - year
VOC - volatile organic compound

TABLE C-29
POTENTIAL FUGITIVE PM EMISSIONS FROM UNPAVED ROADS
ENVIVA PELLETS SOUTHAMPTON, LLC

Source Data

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Log Delivery to Crane Storage Area	8,200	85	133	365	40,400	85,400	31.5	48,375
Log Delivery to Log Storage Area	8,200	85	133	365	40,400	85,400	31.5	48,375
Chip Delivery	2,800	121	64	365	41,000	91,000	33.0	23,432
							31.8	**120,181**

Notes:

1. Distance traveled per round trip and annual average daily trip counts were provided by Enviva

Emission Calculations Unpaved Road:

Pollutant	Emeperical Constant (k)[1]	Silt Content (S)[2]	Particle Constant a[1]	Particle Constant b[1]	Emission Factor[3]	Potential Emissions[4]
	(lb/VMT)	(%)	(-)	(-)	(lb/VMT)	(tpy)
PM	4.9	8.4	0.7	0.45	7.41	44.52
PM_{10}	1.5	8.4	0.9	0.45	2.11	12.69
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.21	1.27

Notes:

1. Constants (k, a, & b) based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-2 for Industrial Roads, November 2006
2. Silt loading factor based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-1, Lumber Sawmills, November 2006
3. Emission factors calculated based on Equation 1a from AP-42 Section 13.2.2 - Unpaved Roads, 11/06.

Particulate Emission Factor: $E_{ext} = k\,(s/12)^a \times (W/3)^b * (365-P/365)$

k = particle size multiplier for particle size range and units of interest
E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
P=number of days with at least 0.01 in of precipitation during the averaging period =
= 120 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Southampton, VA).

4. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

TABLE C-30
Potential Fugitive PM Emissions from Paved Roads
Enviva Pellets Southampton, LLC

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[2] (lb/VMT)	PM_{10} Emission Factor[2] (lb/VMT)	$PM_{2.5}$ Emission Factor[2] (lb/VMT)	Potential PM Emissions[3] (lb/day)	Potential PM Emissions[3] (tpy)	Potential PM_{10} Emissions[3] (lb/day)	Potential PM_{10} Emissions[3] (tpy)	Potential $PM_{2.5}$ Emissions[3] (lb/day)	Potential $PM_{2.5}$ Emissions[3] (tpy)
Bark Delivery - Dumper	4,800	11	10	365	41,000	81,000	30.5	3,658	2.2	0.45	0.11	2	0.4	0.4	0.1	0.1	0.02
Bark Delivery - Self Unload	4,800	11	10	365	41,000	81,000	30.5	3,658	2.2	0.45	0.11	2	0.4	0.4	0.1	0.1	0.02
Log Delivery to Crane Storage Area	3,800	85	61	365	40,400	85,400	31.5	22,417	2.3	0.46	0.11	14	2.6	2.8	0.5	0.7	0.13
Log Delivery to Log Storage Area	3,800	85	61	365	40,400	85,400	31.5	22,417	2.3	0.46	0.11	14	2.6	2.8	0.5	0.7	0.13
Purchased Chip Delivery	3,800	121	87	365	41,000	91,000	33.0	31,801	2.4	0.48	0.12	21	3.9	4.2	0.8	1.0	0.19
Additive Delivery	4,800	0.26	0.23	365	41,000	91,000	33.0	86	2.4	0.48	0.12	0.06	0.01	0.01	0.002	0.003	0.001
Pellet Truck to Pellet Loadout Area (Normal Operations)	6,000	92	104	365	41,000	91,000	33.0	37,959	2.4	0.48	0.12	25	4.6	5.0	0.9	1.2	0.23
Contractor Vehicle	5,600	18	19	365	4,000	4,000	2.0	6,894	0.1	0.03	0.01	0.26	0.05	0.05	0.01	0.01	0.002
Employee Car Parking	5,600	68	73	365	4,000	4,000	2.0	26,515	0.14	0.028	0.01	1.01	0.18	0.20	0.04	0.05	0.009
											Total Emissions:	**80.5**	**14.7**	**16.1**	**2.9**	**4.0**	**0.72**

Notes:

1. Distance traveled per round trip and annual average daily trip counts were provided by Enviva.
2. Emission factors calculated based on Equation 2 from AP-42 Section 13.2.1 - Paved Roads, 01/11.
   where:

E = emission factor (lb/ton)		
k = particle size multiplier (dimensionless) for PM	0.011	
k = particle size multiplier (dimensionless) for PM_{10}	0.0022	
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.00054	
sL - mean road surface silt loading from AP-42 Table 13.2.1-3 for quarries (g/m^2)	8.2	
P - No. days with rainfall greater than 0.01 inch	120	Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Southampton, VA).

3. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities followed by sweeping. Per Table 5 in Chapter 4 of the Air Pollution Engineering Manual, Air and Waste Management Association, page 141. Control efficiency (%) = 96-0.263*V, where V is the number of vehicle passes since application of water.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

TABLE C-31
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET SOUTHAMPTON, LLC

Operating Data:

Dryer-1 Heat Input	175.3	MMBtu/hr
Annual Heat Input	1,540,294	MMBtu/yr
Duct Burner 1 Heat Input	1	MMBtu/hr
Number of Burners	2	
Operating Schedule	8,760	hrs/yr
Dryer 1 Bypass Heat Input	175	MMBtu/hr
Operating Schedule	50	hrs/yr
Dryer-2 Heat Input	180.0	MMBtu/hr
Annual Heat Input	1,576,800	MMBtu/yr
Duct Burner 2 Heat Input	1	MMBtu/hr
Number of Burners	2	
Operating Schedule	8,760	hrs/yr
Dryer 2 Bypass Heat Input	180	MMBtu/hr
Operating Schedule	50	hrs/yr
RTO-1 Heat Input	32.0	MMBtu/hr
Operating Schedule	8,760	hrs/yr
Furnace 1 Bypass Heat Input	175	MMBtu/hr
Operating Schedule	50	hrs/yr
Furnace 1 Idle Heat Input	5	MMBtu/hr
Operating Schedule	500	hrs/yr
RTO-2 Heat Input	32.0	MMBtu/hr
Operating Schedule	8,760	hrs/yr
Furnace 2 Bypass Heat Input	180	MMBtu/hr
Operating Schedule	50	hrs/yr
Furnace 2 Idle Heat Input	5	MMBtu/hr
Operating Schedule	500	hrs/yr
RCO-1 Heat Input	201,508.5	MMBtu/yr
Operating Schedule	8,760	hrs/yr
Duct Burners 3 and 4 Heat Input	1	MMBtu/hr
Number of Burners	4	
Operating Schedule	8,760	hrs/yr
Propane Vaporizer Heat Input	1	MMBtu/hr
Operating Schedule	8,760	hrs/yr
Emergency Generator Output	350	bhp
Operating Schedule	500	hrs/yr
Power Conversion	7,000	Btu/hr/hp
Energy Input	2.450	MMBtu/hr
Fire Water Pump Output	300	bhp
Operating Schedule	500	hrs/yr
Power Conversion	7,000	Btu/hr/hp
Energy Input	2.100	MMBtu/hr

TABLE C-31
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET SOUTHAMPTON, LLC

Emission Unit ID	Fuel Type	Emission Factors from Table C-1 (kg/MMBtu)[1, 2]			Tier 1 Emissions (short tons)[2]			
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total CO_2e
ES-DRYER-1	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	159,259.79	306	1,821	161,387
ES-DDB-1	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 1 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
ES-DRYER-2	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	163,034.40	313	1,865	165,212
ES-DDB-2	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
ES-RTO-1	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 1 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
Furnace 1 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	258.49	0.50	2.96	262
ES-RTO-2	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
Furnace 2 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	258.49	0.50	2.96	262
ES-RCO-1	Propane	62.87	7.50E-02	1.79E-01	13964.86	16.66	39.72	14,021
ES-DDB-3 and -4	Propane	62.87	7.50E-02	1.79E-01	2428.33	2.90	6.91	2,438
ES-PVAP	Propane	62.87	7.50E-02	1.79E-01	607.08	0.72	1.73	610
ES-eg	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	100	1.01E-01	2.41E-01	100
ES-FWP	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	86	8.68E-02	2.07E-01	86

[1] Emission factors from Table C-1 and C-2 of GHG Reporting Rule. Emission factors for methane and N_2O already multiplied by their respective GWPs of 25 and 298.

[2] As per VADEQ guidance, VADEQ has adopted the GHG Biomass Deferral Rule which excludes CO_2 emissions from biomass combustion.

APPENDIX D
PERMIT APPLICATION FORMS

PERMIT FORMS
PURSUANT TO
REGULATIONS FOR THE CONTROL AND ABATEMENT OF AIR POLLUTION

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR PERMITS
FORM 7 APPLICATION

NEW SOURCE REVIEW PERMITS
and STATE OPERATING PERMITS54

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY – 2018 AIR PERMIT APPLICATION FEES

Air permit applications are subject to a fee. The fee does not apply to administrative amendments or true minor sources. Applications will be considered incomplete if the proper fee is not paid and will not be processed until full payment is received. Air permit application fees are not refundable.

Fees are adjusted January 1 of each calendar year. THIS FORM IS VALID JANUARY 1, 2018 TO DECEMBER 31, 2018.

Send this form and a check (or money order) payable to "Treasurer of Virginia" to:

Department of Environmental Quality
Receipts Control
P.O. Box 1104
Richmond, VA 23218

Send a copy of this form with the permit application to:
The DEQ Regional Office

Please retain a copy for your records. Any questions should be directed to the DEQ regional office to which the application will be submitted. **Unsure of your fee? Contact the Regional Air Permit Manager.**

COMPANY NAME:	**Enviva Pellets Southampton, LLC**	**FIN:**	**36-1666410**
COMPANY REPRESENTATIVE:	**Joe Harrell**	**REG. NO.**	**61653**
MAILING ADDRESS:	**26570 Rose Valley Road Franklin, Virginia 23851**		
BUSINESS PHONE:	**252-209-6032, ext. 2202**	**FAX:**	**301-657-5567**
FACILITY NAME:	**Enviva Pellets Southampton, LLC**		
PHYSICAL LOCATION:	**26570 Rose Valley Road Franklin, Virginia 23851**		

PERMIT ACTIVITY	APPLICATION FEE AMOUNT	CHECK ONE
Sources subject to Title V permitting requirements:		
• Major NSR permit (Articles 7, 8, 9)	$63,000	
• Major NSR permit amendment (Articles 7, 8, 9)*	$10,000	
• State major permit (Article 6)	$25,000	X
• Title V permit (Articles 1, 3)	$35,000	
• Title V permit renewal (Articles 1, 3)	$15,000	
• Title V permit modification (Articles 1, 3)	$4,000	
• Minor NSR permit (Article 6)	$5,000	
• Minor NSR amendment (Article 6)*	$2,500	
• State operating permit (Article 5)	$10,000	
• State operating permit amendment (Article 5)*	$4,000	
Sources subject to Synthetic Minor permitting requirements:		
• Minor NSR permit (Article 6)	$3,000	
• Minor NSR amendment (Article 6)*	$1,000	
• State operating permit (Article 5)	$5,000	
• State operating permit amendment (Article 5)*	$2,500	
***FEES DO NOT APPLY TO ADMINISTRATIVE AMENDMENTS AIR PERMIT APPLICATION FEES ARE NOT REFUNDABLE**		

DEQ OFFICE TO WHICH PERMIT APPLICATION WILL BE SUBMITTED (check one)

☐ SWRO/Abingdon ☐ NRO/Woodbridge ☐ PRO/Richmond

☐ VRO/Harrisonburg ☐ BRRO/Roanoke ☒ TRO/Virginia Beach

FOR DEQ USE ONLY
Date: _____
DC #: _____
Reg. No.: _____

AIR PERMIT APPLICATION
CHECK ALL PAGES ATTACHED AND LIST ALL ATTACHED DOCUMENTS

___ Local Government Certification Form, Page 3
X Application Fee Form, Pages 4-6
X Document Certification Form, Page 7
X General Information, Pages 8-9
X Fuel Burning Equipment, Page 10
X Stationary Internal Combustion Engines, Page 11
___ Incinerators, Page 12
X Processing, Page 13
___ Inks, Coatings, Stains, and Adhesives, Page 14
X VOC/Petroleum Storage Tanks, Pages 15-16
___ Loading Rack and Oil-Water Separators, Page 17
___ Fumigation Operations, Page 18
X Air Pollution Control and Monitoring Equipment, Page 19
X Air Pollution Control/Supplemental Information, Page 20
X Stack Parameters and Fuel Data, Page 21
X Proposed Permit Limits for Criteria Pollutants, Page 22
X Proposed Permit Limits for Toxic Pollutants/HAPs, Page 23
___ Proposed Permit Limits for Other Reg. Pollutants, Page 24
___ Proposed Permit Limits for GHGs on Mass Basis, Page 25
___ Proposed Permit Limits for GHGs on CO_2e Basis, Page 26
___ BAE for Criteria Pollutants, Page 27
___ BAE for GHGs on Mass Basis, Page 28
___ BAE for GHGs on CO_2e Basis, Page 29
X Operating Periods, Page 30

___ ATTACHED DOCUMENTS:
X Map of Site Location
X Facility Site Plan
X Process Flow Diagram/Schematic
___ MSDS or CPDS Sheets
X Estimated Emission Calculations
___ Stack Tests
X Air Modeling Data
___ Confidential Information (see Instructions)
X BACT Analysis

Check added form sheets above; also indicate the number of copies of each form in blank provided.

DOCUMENT CERTIFICATION FORM

I certify under penalty of law that this document and all attachments [as noted above] were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering and evaluating the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I certify that I understand that the existence of a permit under [Article 6 of the Regulations] does not shield the source from potential enforcement of any regulation of the board governing the major NSR program and does not relieve the source of the responsibility to comply with any applicable provision of the major NSR regulations.

SIGNATURE: _____ **DATE:** 9-24-18

NAME: **Royal Smith** **REGISTRATION NO:** **61653**

TITLE: **Vice President, Operations** **COMPANY:** **Enviva Pellets Southampton, LLC**

PHONE: **240-482-3770** **ADDRESS:** **7200 Wisconsin Avenue, Suite 1000**

EMAIL: **Royal.Smith@envivabiomass.com** **Bethesda, MD 20814**

References: Virginia Regulations for the Control and Abatement of Air Pollution (Regulations), 9 VAC 5-20-230B and 9 VAC 5-80-1140E.

GENERAL INFORMATION

Person Completing Form: **Michael Carbon, Ramboll**	Date: **9/2018**	Registration Number: **61653**
Company and Division Name: **Enviva Pellets Southampton, LLC**		FIN: **36-1666410**
Mailing Address: **7200 Wisconsin Ave Suite 1000, Bethesda, MD 20814**		
Exact Source Location – Include Name of City (County) and Full Street Address or Directions: **26570 Rose Valley Road** **Franklin, Virginia 23851 Southampton County**		
Telephone Number: **757-304-5222**	No. of Employees: **65**	Property Area at Site: **142.5 Acres**
Person to Contact on Air Pollution Matters – Name and Title: **Joe Harrell** **Corporate EHS Manager**	Phone Number: **252-370-3181** Fax: **252-364-3428** **Email:** **Joe.Harrell@envivabiomass.com**	
Latitude and Longitude Coordinates **OR** UTM Coordinates of Facility: **36.655923, -76.969594**		

Reason(s) for Submission (Check all that apply):

☐ State Operating Permit

This permit is applied for pursuant to provisions of the Virginia Administrative Code, 9 VAC 5 Chapter 80, Article 5 (SOP)

☐ New Source

☒ Modification of a Source

☐ Relocation of a Source

This permit is applied for pursuant to the following provisions of the Virginia Administrative Code:

- ☒ 9 VAC 5 Chapter 80, Article 6 (Minor Sources)
- ☐ 9 VAC 5 Chapter 80, Article 8 (PSD Major Sources)
- ☐ 9 VAC 5 Chapter 80, Article 9 (Non-Attainment Major Sources)

☐ Amendment to a Permit Dated: _____ Permit Type: ☐ SOP (Art. 5) ☐ NSR (Art. 6, 8, 9)

Amendment Type:

- ☐ Administrative Amendment
- ☐ Minor Amendment
- ☐ Significant Amendment

This amendment is requested pursuant to the provisions of:

- ☐ 9 VAC 5-80-970 (Art. 5 Adm.)
- ☐ 9 VAC 5-80-980 (Art. 5 Minor)
- ☐ 9 VAC 5-80-990 (Art. 5 Sig.)
- ☐ 9 VAC 5-80-1935 (Art. 8 Adm.)
- ☐ 9 VAC 5-80-1945 (Art. 8 Minor)
- ☐ 9 VAC 5-80-1955 (Art. 8 Sig.)
- ☐ 9 VAC 5-80-1270 (Art. 6 Adm.)
- ☐ 9 VAC 5-80-1280 (Art. 6 Minor)
- ☐ 9 VAC 5-80-1290 (Art. 6 Sig.)
- ☐ 9 VAC 5-80-2210 (Art. 9 Adm.)
- ☐ 9 VAC 5-80-2220 (Art. 9 Minor)
- ☐ 9 VAC 5-80-2230 (Art. 9 Sig.)

☐ Other (specify): _____

Explanation of Permit Request (attach documents if needed):

The facility is proposing to increase production at the facility by installing additional equipment and modifying existing sources at the facility. Please see Section 1 of the application narrative for a complete list of proposed changes and additions to the facility.

GENERAL INFORMATION (CONTINUED)

For Portable Plants:

Is this facility designed to be portable? ☐ Yes ☒ No

- If yes, is this facility already permitted as a portable plant? ☐ Yes ☐ No Permit Date: _____

If not permitted, is this an application to be permitted as a portable plant? ☐ Yes ☐ No

If permitted as a portable facility, is this a notification of relocation? ☐ Yes ☐ No

- Describe the new location or address (include a site map): _____

- Will the portable facility be co-located with another source? ☐ Yes ☐ No Reg. No. _____
- Will the portable facility be modified or reconstructed as a result of the relocation? ☐ Yes ☐ No
- Will there be any new emissions other than those associated with the relocation? ☐ Yes ☐ No
- Is the facility suitable for the area to which it will be located? (attach documentation) ☐ Yes ☐ No

Describe the products manufactured and/or services performed at this facility:

Wood pellet manufacturing facility

List the Standard Industrial Classification (SIC) Code(s) for the facility:

2	4	9	9																

List the North American Industry Classification System (NAICS) Code(s) for the facility:

3	2	1	9	9	9														

List all the facilities in Virginia under common ownership or control by the owner of this facility:

Port of Chesapeake, VA (Registration No. 60345)

Milestones: This section is to be completed if the permit application includes a new emissions unit or modification to existing operations.

Milestones*:	**Starting Date:**	**Estimated Completion Date:**
New Equipment Installation	**See Appendix G of the application package for discussion of the proposed project schedule**	
Modification of Existing Process or Equipment		
Start-up Dates		

*For new or modified installations to be constructed in phased schedule, give construction/installation starting and completion date for each phase.

FUEL BURNING EQUIPMENT: (Boilers, Turbines, Kilns, and Other External Combustion Units)

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Unit Ref. No.	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Input Heat Capacity For Each Fuel (Million Btu/hr)	Type of Fuel	Type of Equip. (use Code A)	Usage (use Code B)	Requested Throughput* (hrs/yr OR fuel/yr)	Federal Regulations that Apply

ES-PVAP	**LP Vaporizer for RTOs, RCO, and double duct burners**			**1**	**Propane**	**15. propane vaporizer**	**4**	**8760 hr/yr**	

X Estimated Emission Calculations Attached (include references of emission factors) and/or Stack Test Results if Available

Code A – Equipment		**Code B - Usage**
BOILER TYPE: 1. Pulverized Coal - Wet Bottom 2. Pulverized Coal - Dry Bottom 3. Pulverized Coal - Cyclone Furnace 4. Circulating Fluidized Bed 5. Spreader Stoke 6. Chain or Travelling Grate Stoker 7. Underfeed Stoker 8. Hand Fired Coal 9. Oil, Tangentially Fired 10. Oil, Horizontally Fired (except rotary cup)	11. Gas, Tangentially Fired 12. Gas, Horizontally Fired 13. Wood with Flyash Reinjection 14. Wood without Flyash Reinjection 15. Other (specify) _____ OTHER COMBUSTION UNITS: 16. Oven / Kiln 17. Rotary Kiln 18. Process Furnace 19. Other (specify) _____	1. Steam Production 2. Drying / Curing 3. Space Heating 4. Process Heat 5. Food Processing 6. Electrical Generation 7. Mechanical Work 8. Other (specify) _____

***Pick only one option for a requested throughput.**

NOTE: Dryers, kilns, and furnaces also have to fill out Page 13.

STATIONARY INTERNAL COMBUSTION ENGINES:

Company Name: Enviva Pellets Southampton, LLC	Date:	Registration Number: 61653

Unit Ref. No.	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Output Brake Horsepower (bhp)	Output Electrical Power (kW)	Type of Fuel	Usage* (use Code C)	Requested Throughput** (hrs/yr OR fuel/yr)	Federal Regulations that Apply
The facility maintains two internal combustion engines, which are not impacted by the proposed changes described in this application.									

☐ Estimated Emission Calculations Attached (include references of emission factors and manufacturer specifications per engine) and/or Stack Test Results if Available.

Code C – Usage

1. Emergency Generator
2. Participates in Emergency Load Response Program
3. Non-Emergency Generator
4. Participates in Demand Response Program(s)
5. Other (specify) _____

***Can pick more than one option**
(i.e. 1 and 2 **OR** 3 and 4)

****Pick only one option for a requested throughput.**

PROCESSING, MANUFACTURING, SURFACE COATING AND DEGREASING OPERATIONS:

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Unit Ref. No.	Process or Operation Name	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Capacity (_____/hr)*	Requested Throughput*			Federal Regulations that Apply
						(_____/hr)	(_____/day)	(_____/yr)	
ES-DRYER-1	Single pass rotary drum direct-heated wood dryer	Dryer		2013	175.3 MMBtu/hr	70.83 ODT/hr		390,628 ODT/yr	N/A
ES-DRYERBYP-1	Dryer bypass operating mode for dryer 1	Dryer			175.3 MMBtu/hr	70.83 ODT/hr		50 hr/yr	N/A
ES-FURNACEBYP-1	Furnace bypass operating mode for dryer 1	Dryer			175.3 MMBtu/hr			50 hr/yr	N/A
ES-FURNACEBYP-1	Furnace bypass idle mode for dryer 1	Dryer			5 MMBtu/hr			500 hr/yr	N/A
ES-CHIP	Log chipping using an electric-powered chipper	Chipper		2013	119.4 ton/hr	119.4 ODT/hr		781,255 ODT/yr	N/A
ES- HM-1 - 8	Eight hammermills operating in parallel	Dry Hammermills		2013	144 ODT/hr	144 ODT/hr		664,067 ODT/yr	N/A
ES-CLR-1 thru 6	Wood Pellet Presses/Coolers	Pellet Press/Coolers		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES- PMFS	Pellet Mill Feed Silo	Silo		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES-FPH	Finished Product Handling	Bins		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES-DEBARK	De- barking operations for wood logs using an electric- powered debarker	--		2013	210 ton/hr	210 ton/hr		781,255 ODT/yr	N/A

Unit Ref. No.	Process or Operation Name	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Capacity (_____/hr)*	Requested Throughput*			Federal Regulations that Apply
						(_____/hr)	(_____/day)	(_____/yr)	
ES-BARK	Log processing operations using bark hog	--		2013	31.5 ODT/hr	31.5 ODT/hr		234,377 ODT/yr	N/A
ES- DWH	Dried Wood Handling Equipment	--			142 ODT/hr	142 ODT/hr		781,255 ODT/yr	N/A
ES-GHWS	Green Wood Handling	--			400 ODT/hr[1]	400[2] ODT/hr		781,255 ODT/yr	N/A
ES-PCHP	Pellet Cooler HP Fines Relay System	--						8,760 hrs/yr	N/A
ES-TL	Truck Loadout	--			142 ODT/hr	142 ODT/hr		781,255 ODT/yr	N/A
ES-DRYER-2	Single pass rotary drum direct-heated wood dryer	Dryer		TBD	180 MMBtu/hr	70.83 ODT/hr		390,628 ODT/hr	N/A
ES-DRYERBYP-2	Dryer bypass operating mode for dryer 2	Dryer			180 MMBtu/hr	70.83 ODT/hr		50 hr/yr	N/A
ES-FURNACEBYP-2	Furnace bypass operating mode for dryer 2	Dryer			180 MMBtu/hr			50 hr/yr	N/A
ES-FURNACEBYP-2	Furnace bypass idle mode for dryer 2	Dryer			5 MMBtu/hr			500 hr/yr	N/A
ES-GHM-1 thru 5	Wood chip resizing using five (5) electric-powered Green hammermills	Green Hammermill	TBD	TBD	150 ODT/hr	150 ODT/hr		781,255 ODT/yr	N/A
ES-ADD	Additive Handling and Storage	Silo	TBD	TBD	22.5 ton/hr	22.5 ton/hr		2,344 ton/yr	N/A

[X] Estimated Emission Calculations Attached (include references of emission factors) and/or Stack Test Results if Available

*** Specify units for each operation in tons, pounds, gallons, etc., as applicable. <u>For coating operations</u>, the maximum rated capacity is the spray gun capacity.**

[1] Represents highest throughput associated with ES-GHWS for material conveyance to raw wood chip storage pile.
[2] See footnote 1.

VOLATILE ORGANIC COMPOUND (VOC)/PETROLEUM LIQUID STORAGE TANKS:

Company Name:	Enviva Pellets Southampton, LLC	Date:	September 2018	Registration Number:	61653

Unit Ref. No.	Tank Type (use Code H)	Source of Tank Contents (use Code I)	Date of Manuf.	Date of Const.	Material Stored - Name and CAS # (include Reid Vapor Pressure for Gasoline)	Max. True Vapor Pressure (psia)	Density* (lbs/gal)	Max. Average Storage Temp. (°F)	Tank Diameter (feet)	Tank Capacity (gal)	Requested Throughput (gal/yr)	Federal Regulations that Apply
ES-TK-3	1a	3			Diesel	~0.009	~6.9	64.41	6.0	5,000	200,000	None – Also exempt from state permitting requirements
The facility maintains two additional diesel fuel storage tanks, which are not impacted by the proposed changes.												

[X] Estimated Emission Calculations Attached (include TANKS Program printouts)

Code H – Tank Type		Code I – Source of Tank Contents
1. Fixed Roof a. Vertical Tank b. Horizontal Tank 2. Floating Roof a. Internal (welded deck) b. Internal (bolted deck) – Specify Panel or Sheet c. External (welded deck) d. External (riveted deck)	3. Variable Vapor Space 4. Pressure Tank (over 15 psig) 5. Underground Splash Loading 6. Underground Submerged Loading 7. Underground Submerged Loading, Balanced 8. Other:_____	1. Pipeline 2. Rail Car 3. Tank Truck 4. Ship or Barge 5. Process

*** Specify the ASTM temperature standard at which the density was measured.**

VOLATILE ORGANIC COMPOUND (VOC)/PETROLEUM LIQUID STORAGE TANKS (CONTINUED):

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Unit Ref. No.	Tank Color		Fixed Roof Only					Floating Roof Only				
	Shell	Roof	Internal Tank Height or Length (feet)	Max. Hourly Filling (gallons)	External Fixed Roof			Seal Type (use Code J)	Max. Hourly Withdrawal (gallons)	Internal Floating Roof		
					Type of Roof (cone or dome)	Cone height (ft) and slope (ft/ft)	Dome height (ft) and radius (ft)			Self Supporting?	If no, No. of Columns	If no, Column Diameter (ft)
ES-TK-3			23.67	2500				N/A	N/A	N/A	N/A	N/A

Code J – Seal Type (Pontoon External Only)	(Double Deck External Only)	(Internal Only)
1. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 2. Liquid Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary 3. Vapor Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary	4. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 5. Liquid Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary 6. Vapor Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary	7. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 8. Liquid Mounted a. Primary only b. Rim mounted secondary 9. Vapor Mounted a. Primary only b. Rim mounted secondary

AIR POLLUTION CONTROL AND MONITORING EQUIPMENT:
TABLE BELOW ADDRESSES NEW CONTROL DEVICES INCLUDED WITH THE PROPOSED CHANGES; EXISTING CONTROL DEVICES ARE NOT BEING MODIFIED

Company Name:	Enviva Pellets Southampton, LLC	Date:	September 2018	Registration Number:	61653

Unit Ref. No.	Vent/ Stack No.	Device Ref. No.	Pollutant/Parameter	Air Pollution Control Equipment			Monitoring Instrumentation
				Manufacturer and Model No.	Type (use Code N)	Percent Efficiency (%)	Specify Type, Measured Pollutant, and Recorder Used
ES-DRYER-1, ES-GHM-1 - 5	EP-1	CD-RTO-1	VOC, HAP/TAP	TBD	15	97.5%	Temperature, Data Acquisition System
ES-PCHP, ES-TL	EP-14	CD-PCHP-BF	Particulate	TBD	9a	>90%	Pressure drop
ES-DRYER-2	EP-19	CD-WESP-2	PM Metal HAP	TBD	10	>90%	Power Consumption (kW), Data Acquisition System
		CD-DC-2			3		
		CD-RTO-2	HAP, VOC	TBD	15	97.5%	Temperature, Data Acquisition System
ES-DWH	EP-22	CD-DWH-BF	Particulate	TBD	9a	>90%	Pressure drop
ES-HM-1 – 8, ES-HMA, ES-PP, ES-CLR-1 – 6	EP-17	CD-WS-1	PM Metal HAP	TBD	21[3]	>90%	Water flow rate
		CD-RCO-1	VOC, HAP	TBD	21[4]	96%	Temperature, Data Acquisition System

[3] Wet scrubber
[4] Regenerative Catalytic Oxidizer

ES-PP, ES-CLR-1 – 6	**EP-17**	**CD-WS-2**	**PM** **Metal HAP**	**TBD**	**21**[5]	**>90%**	**Water flow rate**
ES-ADD	**EP-26**	**CD-ADD-BF**	**Particulate**	**TBD**	**9a**	**>90%**	**Pressure drop**

☐ Manufacturer Specifications Included

Code N – Type of Air Pollution Control Equipment		
1. Settling Chamber 2. Cyclone 3. Multicyclone 4. Cyclone scrubber 5. Orifice scrubber 6. Mechanical scrubber 7. Venturi scrubber a. Fixed throat b. Variable throat 8. Mist eliminator 9. Filter a. Baghouse b. Other:_____ 10. Electrostatic Precipitator	a. Hot side b. Cold side c. High voltage d. Low voltage e. Single stage f. Two stage g. Other:_____ 11. Catalytic Afterburner 12. Direct Flame Afterburner 13. Diesel Oxidation Catalyst (DOC) 14. Thermal Oxidizer 15. Regenerative Thermal Oxidizer (RTO) 16. Selective Catalytic Reduction (SCR) 17. Selective Non-Catalytic Reduction (SNCR)	18. Absorber a. Packed tower b. Spray tower c. Tray tower d. Venturi e. Other:_____ 19. Adsorber a. Activated carbon b. Molecular sieve c. Activated alumina d. Silica gel e. Other:_____ 20. Condenser (specify) 21. Other:_____

[5] Wet scrubber (type TBD)

AIR POLLUTION CONTROL EQUIPMENT - SUPPLEMENTAL INFORMATION:
TABLE BELOW ADDRESSES NEW CONTROL DEVICES INCLUDED WITH THE PROPOSED CHANGES; EXISTING CONTROL DEVICES ARE NOT BEING MODIFIED

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Device Ref. No.	Type (use Code N)	Liquid Flow Rate (gpm) (4, 5, 6, 7, 17 ,19)	Liquid Medium (4, 5, 6, 7, 17, 19)	Cleaning Method (9, 10, 17, 18)	Number of Fields (10)	Number of Sections (9, 10)	Air to Cloth Ratio (fpm) (9)	Filter Material (9)	Inlet Temp. (°F)	Regeneration Method & Cycle Time (sec) (18)	Chamber Temp. (°F) (11, 12, 14, 15)	Retention Time (sec) (11, 12, 14, 15)	Pressure Drop (inch H_2O) (3, 4, 5, 6, 7, 9, 17)
CD-RTO-1	15								TBD		TBD	TBD	
CD-WESP-2	10			TBD	TBD	TBD			TBD				
CD-DC-2	3								TBD				TBD
CD-RTO-2	15								TBD		TBD	TBD	
CD-WS-1	21[6]	TBD	Water						TBD				
CD-RCO-1	21[7]								TBD				
CD-WS-2	21[8]	TBD	Water						TBD				
CD-ADD-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD
CD-PCHP-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD
CD-DWH-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD

NOTE: **Numbers listed in parenthesis in the columns above represent the Control Equipment in Code N below.**

[6] Wet scrubber.
[7] Regenerative Catalytic Oxidizer that can also operate in Regenerative Thermal Oxidizer mode.
[8] Wet scrubber.

Code N – Type of Air Pollution Control Equipment		
1. Settling Chamber 2. Cyclone 3. Multicyclone 4. Cyclone scrubber 5. Orifice scrubber 6. Mechanical scrubber 7. Venturi scrubber a. Fixed throat b. Variable throat 8. Mist eliminator 9. Filter a. Baghouse b. Other:_____ 10. Electrostatic Precipitator	a. Hot side b. Cold side c. High voltage d. Low voltage e. Single stage f. Two stage g. Other:_____ 11. Catalytic Afterburner 12. Direct Flame Afterburner 13. Diesel Oxidation Catalyst (DOC) 14. Thermal Oxidizer 15. Regenerative Thermal Oxidizer (RTO) 16. Selective Catalytic Reduction (SCR) 17. Selective Non-Catalytic Reduction (SNCR)	18. Absorber a. Packed tower b. Spray tower c. Tray tower d. Venturi e. Other:_____ 19. Adsorber a. Activated carbon b. Molecular sieve c. Activated alumina d. Silica gel e. Other:_____ 20. Condenser (specify) 21. Other:_____

TABLE BELOW ADDRESSES NEW OR MODIFIED STACKS; EXISTING STACKS NOT LISTED BELOW ARE NOT PROPOSED TO BE MODIFIED

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Unit Ref. No.	Vent/ Stack No.	Vent/Stack or Exhaust Data						Fuel(s) Data				
		Vent/ Stack Config (use Code O)	Vent/Stack Height (feet)	Exit Diameter (feet)	Exit Gas Velocity (ft/sec)	Exit Gas Flow Rate (acfm)	Exit Gas Temp. (°F)	Type of Fuel	Heating Value* (Btu/____)	Max. Rated Burned/hr (specify units)	Max. Sulfur %	Max. Ash %
ES-DRYER-1	EP-1	5	94	10.0	25	117,345	175	Bark/Wood		175.3 MMBtu/hr		
ES-GHM-1 - 5								None				
ES-PCHP	EP-14	TBD	TBD	TBD	TBD	TBD	TBD	None				
ES-TL								None				
ES-DRYER-2	EP-19	5	94	5.3	78	104,999	240	Bark/Wood		180 MMBtu/hr		
ES-DRYERBYP-1	EP-23	5	94	5.0	85	100,000	230	See above		See above		
ES-FURNACEBYP-1	EP-24	5	75	4.3	6	5,000	1,700	See above		See above		
ES-DRYERBYP-2	EP-20	5	118	5.0	85	100,000	230	See above		See above		
ES-FURNACEBYP-2	EP-18	5	75	4.3	6	5,000	1,700	See above		See above		
ES-DWH	EP-22	5	60	1.3	18	1,500	Ambient	None				

ES-PP	**EP-17**	**5**	**90**	**7.7**	**50**	**137,644**	**192**	**None**				
ES-CLR-1 - 6								**None**				
ES-HM-1 - 8								**None**				
ES-HMA								**None**				
ES-ADD	**EP-26**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**None**				
ES-PVAP	**EP-25**	**5**	**10**	**0.5**	**59**	**700**	**350**	**Propane**		**1 MMBtu/hr**		
ES-DDB-1	**EP-27**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-2	**EP-28**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-3	**EP-29**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-4	**EP-30**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-5	**EP-31**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-6	**EP-32**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-7	**EP-33**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		
ES-DDB-8	**EP-34**	**6**	**10**	**0.5**	**59**	**700**	**350**	**Natural gas/ propane**		**1 MMBtu/hr**		

Code O – Vent/Stack Configuration

1. Stack discharging downward, or nearly download
2. Equivalent stack representing a combination of multiple actual stacks
3. Gooseneck stack
4. Stack discharging in a horizontal direction
5. Stack with an unobstructed opening discharge in a vertical direction
6. Vertical stack with a weather cap or similar obstruction in exhaust system

*** Specify units for each heating value in Btus per unit of fuel.**

PROPOSED PERMIT LIMITS FOR CRITERIA POLLUTANTS:

Company Name:	Enviva Pellets Southampton, LLC	Date:	September 2018	Registration Number:	61653

Unit Ref. No.	Proposed Permit Limits for Criteria Pollutants															
	PM [a] (Particulate Matter)		PM-10 [a,b] (10 µM or smaller particulate matter)		PM 2.5 [a,b] (2.5 µM or smaller particulate matter)		SO_2 (Sulfur Dioxide)		NO_X (Nitrogen Oxides)		CO (Carbon Monoxide)		VOC [a] (Volatile Organic Compounds)		Pb (Lead)	
	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
Refer to Appendix C of this submittal for detailed emissions calculations.																
TOTAL:																

[X] Estimated Emission Calculations Attached (totals and per Unit Ref. No.)

[a] PM, PM-10, PM 2.5, and VOC should also be split up by component and reported under the Proposed Permit Limits for Toxic Pollutants/HAPs.

[b] PM-10 and PM 2.5 includes filterable and condensable.

PROPOSED PERMIT LIMITS FOR TOXIC POLLUTANTS/HAPS:

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

Unit Ref. No.	Proposed Permit Limits for Toxic/HAP Pollutants*															
	HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:		HAP Name: CAS #:	
	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
Refer to Appendix C of this submittal for detailed emissions calculations.																
TOTAL:																

[X] Estimated Emission Calculations Attached (totals and per Unit Ref. No.)

*** Specify the name of the toxic pollutant/HAP for each Unit Ref. No. along with the respective CAS Number**. Toxic

OPERATING PERIODS:

Company Name: Enviva Pellets Southampton, LLC	Date: September 2018	Registration Number: 61653

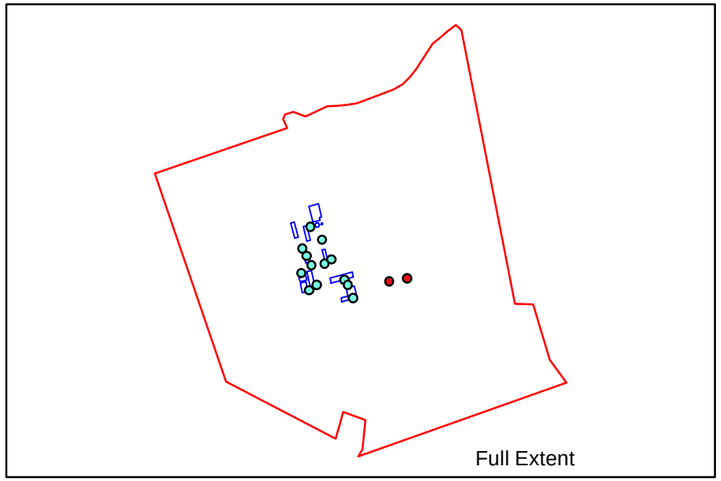
Unit Ref. No.	Percent Annual Use/Throughput by Season				Normal Process/Equipment Operating Schedule			Maximum Process/Equipment Operating Schedule		
	December / February	March / May	June / August	September / November	Hours per Day	Days per Week	Weeks per Year	Hours per Day	Days per Week	Weeks per Year
ALL	25	25	25	25	24	7	52	24	7	52

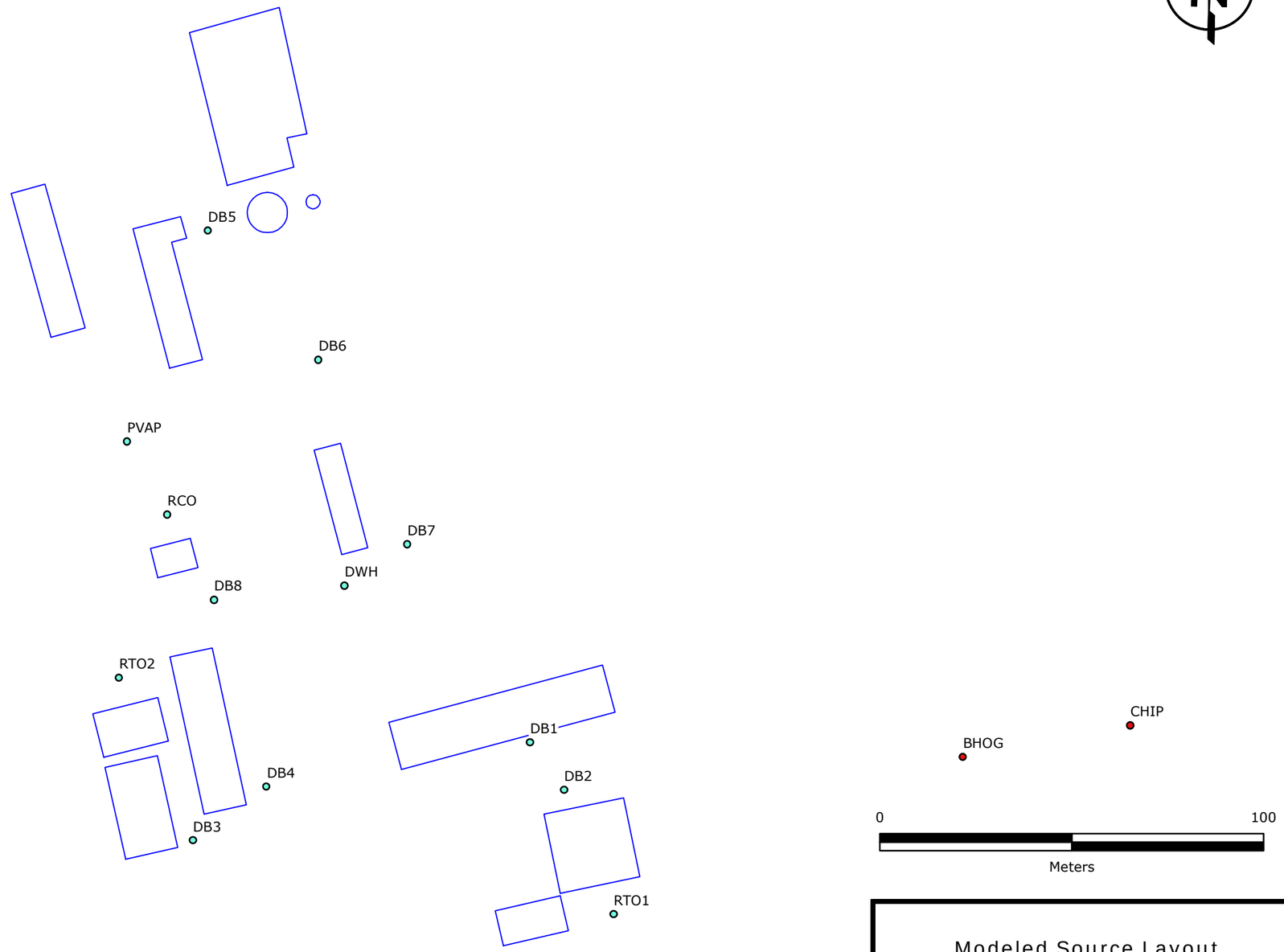
Maximum Facility Operating Schedule		
Hours per Day	Days per Week	Weeks per Year
24	7	52

APPENDIX E
SUPPORTING DOCUMENTATION FOR TAP MODELING ANALYSIS

Appendix E – Supporting Documentation for TAP Modeling Analysis is located on a USB drive provided with this application.

APPENDIX F
MODELED SOURCE LAYOUT





Legend

- Point Source
- Volume Source
- Property Boundary
- Downwash Structure

Modeled Source Layout

Enviva Pellets Southampton, LLC
Southampton County, VA

RAMBOLL

FIGURE
1

DRAFTED BY: ARJ | DATE: 9/27/2018 | PROJECT: 1690009469

APPENDIX G
CONSTRUCTION AND TESTING SCHEDULE

Table G-1. Proposed Construction and Testing Schedule[1]

Key Project Milestones (No Later Than)	RTO on Existing Dryer	RCO on PM / DHM	New GHM Island and Ducting of Emissions	New Dryer and Controls, and Stacker / Reclaimer
Commence Foundations	1/1/2019	3/1/2019	5/1/2019	8/1/2019
Commence M&E Install	7/31/2019	8/31/2019	9/30/2019	8/30/2019
Emissions Testing	6/28/2020	6/28/2020	6/28/2020	12/27/2020

Notes:

[1] – *Milestones to be achieved by the dates provided in the table above or 30 days after all necessary government approvals are obtained, whichever is later.*

Abbreviations:

DHM = Dry Hammermills
GHM = Green Hammermills
M&E = Mechanical and Electrical systems
PM = Pellet Mills (Pellet Presses and Pellet Coolers)
RTO = Regenerative Thermal Oxidizer
RCO = Regenerative Catalytic Oxidizer

APPENDIX H
CONTROL COST ANALYSIS FOR ES-DWH

ENVIVA PELLETS SOUTHAMPTON, LLC
VOC Controls: Average Cost Effectiveness ($/ton) Summary

Summary of Average Cost Effectiveness ($/ton)

Emissions Unit	Control Option	Pollutant	Uncontrolled PTE Emissions (TPY)	Control Efficiency (%)	Controlled Emission Rate (ton/yr)	Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
Dried Wood Handling (ES-DWH)	RTO[1]	VOC	49	97.5%	1.2	47.3	$1,009,588	$21,337
		TAP	1.09		0.03	1.1		$949,977

1. VOC control efficiency assumes same efficiency as RTOs proposed for the Softwood Expansion Project.

RTO Cost Calculations
Dried Wood Handling VOC Emissions
Dried Wood Handling (ES-DWH)
Enviva Pellets Southampton, LLC
Southampton County, Virginia

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	546,000	Equation 2.33 from EPA
Instrumentation	$	54,600	10% of incinerator and auxiliary equipment costs
Sales tax	$	16,380	3% of incinerator and auxiliary equipment costs
Freight	$	27,300	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**644,280**	
Direct installation costs			
Foundations and supports	$	51,542	8% of total purchased equipment costs
Handling and erection	$	90,199	14% of total purchased equipment costs
Electrical	$	25,771	4% of total purchased equipment costs
Piping	$	12,886	2% of total purchased equipment costs
Insulation for ductwork	$	6,443	1% of total purchased equipment costs
Painting	$	6,443	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**193,284**	
Total Direct Costs	**$**	**837,564**	
Indirect installation costs			
Engineering	$	64,428	10% of total direct costs
Construction and field expenses	$	32,214	5% of total direct costs
Contractor fees	$	64,428	10% of total direct costs
Start-up	$	12,886	2% of total direct costs
Performance test	$	6,443	1% of total direct costs
Total Indirect Installation Costs	**$**	**180,398**	
Contingency at 10%	$	101,796.24	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**1,119,759**	
Annual Operating Cost			
Direct Annual Costs			
Operating Labor			
Operator		$13,350	Based on $26.70/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Supervisor		$2,003	15% Operator
Maintenance			
Labor		$13,625	Based on $27.25/hr (2015), 0.5 hr/shift, 8 hr/shift, and 8,000 hr/yr.
Materials		$13,625	100% Maintenance Labor
Utilities			
Natural Gas	$	307,280	Assumes 8000 hr/yr at $0.00384/scf
Electricity	$	40,844	Assumes 8000 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead		$25,562	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges		$22,395	2% TCI
Property Taxes		$11,198	1% TCI
Insurance		$11,198	1% TCI
Capital Recovery		$105,697	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**566,776**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Based on similar Enviva facilities, controlling the combined Dried Wood Handling operations exhaust points would require an approximately 20,000-cfm system.

Packed Bed Scrubber Cost Effectiveness Calculations
Dried Wood Handling (ES-DWH)
Enviva Pellets Southampton, LLC
Southampton County, Virginia

Dried Wood Handling Process Data

Exhaust Gas Temperature	67.7	°F
Total Exhaust Gas Flow Rate	20,000	acfm
	20,086	scfm

Cost Analysis Supporting Information for Packed Bed Scrubber

Scrubber Capital Cost[1]	11	$/scfm (2002 $)
Scrubber Annual O&M Cost[1]	15	$/scfm (2002 $)
Scrubber Equipment Life[2]	15	years
Intrest Rate[2]	7	%
Capital Recovery Cost[3]	0.1098	
CPI for 2002[4]	179.9	
CPI for 2017[4]	244.7	
Price Index[5]	1.4	
Direct Annual Cost[6]	409,815	$
Indirect Annual Cost[7]	32,997	$
Total Annual Cost[8]	442,812	$

Notes:

1. USEPA Air Pollution Control Technology Fact Sheet: Packed-Bed/Packed-Tower Wet Scrubber (EPA-452/F-03-015). https://www3.epa.gov/ttn/catc/dir1/fpack.pdf
2. Equipment life and interest rate for a scrubber based on the example in Section 1.5.2 of the USEPA OAQPS *EPA Air Pollution Cost Control Manual*, Section 5.2, Chapter 1 - Wet Scrubbers for Acid Gas (December 1995).
3. Calculated based on Equation 2.8a of the USEPA OAQPS *EPA Air Pollution Cost Control Manual*, Section 1, Chapter 2 - Cost Estimation: Concepts and Methodology (November 2017).
4. CPI values obtained from the Federal Reserve Bank of Minneapolis: https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-and-inflation-rates-1913
5. Calculated based on Equation 2.5 of the USEPA OAQPS *EPA Air Pollution Cost Control Manual*, Section 1, Chapter 2 - Cost Estimation: Concepts and Methodology (November 2017).
6. Direct Annual Cost = Scrubber Annual O&M Cost ($/scfm) × Total Exhaust Gas Flow Rate (scfm) × Price Index
7. Indirect Annual Cost = Scrubber Capital Cost ($/scfm) × Total Exhaust Gas Flow Rate (scfm) × Capital Recovery Cost × Price Index
8. Total Annual Cost = Direct Annual Cost + Indirect Annual Cost