NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date: October 2, 2019

Region: Fayetteville Regional Office
County: Sampson
NC Facility ID: 8200152
Inspector's Name: Gregory Reeves
Date of Last Inspection: 05/01/2019
Compliance Code: B / Violation - emissions

Facility Data

Applicant (Facility's Name): Enviva Pellets Sampson, LLC

Facility Address:
Enviva Pellets Sampson, LLC
5 Connector Road, US 117
Faison, NC 28341

SIC: 2499 / Wood Products, Nec
NAICS: 321999 / All Other Miscellaneous Wood Product Manufacturing

Facility Classification: Before: Title V **After:**
Fee Classification: Before: Title V **After:**

Permit Applicability (this application only)

SIP: 02D .0515, 02D .0516, 02D .0521, 02D .0530, 02D .0540, 02D .1112
NSPS: No
NESHAP: 112(g) Case-by-Case MACT
PSD: Yes
PSD Avoidance: No
NC Toxics: Yes
112(r): No
Other: N/A

Contact Data

Facility Contact	Authorized Contact	Technical Contact
William Simon EHS Manager (910) 375-6365 5 Connector Road, US 117 Faison, NC 28341	Steven Schaar Acting Plant Manager (757) 556-3454 5 Connector Road, US 117 Faison, NC 28341	Kai Simonsen Air Permit Engineer (919) 789-3628 4242 Six Forks Road, Suite 1050 Raleigh, NC 27609

Application Data

Application Number: 8200152.18A and 8200152.19A
Date Received: 03/19/2018 and 08/02/19
Application Type: Modification and State Renewal
Application Schedule: PSD/State Renewal

Existing Permit Data

Existing Permit Number: 10386/R03
Existing Permit Issue Date: 04/07/2017
Existing Permit Expiration Date: 10/31/2019

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2017	20.85	166.90	509.38	175.19	96.90	62.58	18.36 [Formaldehyde]
2016	4.73	38.01	73.26	39.81	18.63	9.10	4.46 [Methanol (methyl alcohol)]

Review Engineer: Betty Gatano

Review Engineer's Signature: BGatano **Date:** 10/2/2019

Comments / Recommendations:
Issue 10386/R04
Permit Issue Date: 10/2/2019
Permit Expiration Date: 09/30/2027

Table of Contents

1. Introduction

This document is intended to be a summary document of the Permitting Section's response to any public or EPA comments regarding the issuance of the Air Quality Permit. A more complete record of the full review by the North Carolina Division of Air Quality (NCDAQ) can be found in the Preliminary Determination in Attachment A, along with applications and other documentation and materials retained by the NCDAQ in the normal course of its review process.

1.1 Overview of Project

Enviva Pellets Sampson, LLC (referred to as Enviva or the Sampson Plant throughout this document) currently holds Air Permit No. 10386R03 with an expiration date of October 31, 2019 for a wood pellets manufacturing plant near Faison in Sampson County, North Carolina. The plant began operation on October 3, 2016 and is currently permitted to produce up to 537,625 oven-dried tons (ODT) per year of wood pellets utilizing up to 75% softwood on a 12-month rolling basis. The plant consists of a log chipper, green wood hammermills, bark hog, wood-fired rotary dryer, dry hammermills, pellet presses and coolers, product loadout operations, and other ancillary activities

This permit application is a Prevention of Significant Deterioration (PSD) permit modification for a proposed Softwood Expansion Project (SWEP). The SWEP is being implemented to meet new customer demands for increased softwood percentage and production rate and to incorporate emission reduction efforts to minimize emissions impacts associated with the project. The following summarizes the proposed physical changes and changes in the method of operation associated with the SWEP:

- Increase permitted production rate from 537,625 ODT per year to 657,000 ODT per year by upgrading pellet dies with a new prototype;
- Increase the amount of softwood processed from 75% to a maximum of 100%;
- Add a regenerative thermal oxidizer (RTO) (ID No. CD-RTO) following the current wet electrostatic precipitator (WESP) (ID No. CD-WESP) on the wood-fired direct heat drying system. The WESP and RTO will control volatile organic compound (VOC), hazardous air pollutants (HAP) and particulate matter (PM) emissions;
- Remove the green wood hammermill bin vents/baghouses and recirculate the exhaust directly to the WESP/RTO system (ID Nos. CD-WESP and CD-RTO) to reduce VOC, HAP and PM emissions;[1]
- Install a baghouse (ID No. CD-PSTB-BH) to control the pellet sampling transfer bin (ID No. ES-PSTB) PM emissions. The emission source is currently controlled via a bin vent filter (ID No. CD-DC-BV-3);
- Install the eighth dry hammermill (ID No. ES-HM-8) with associated product recovery cyclone and baghouse (ID No. CD-HM-BH8). This emission source is already permitted but not yet installed;
- Decrease the amount of wood assumed to bypass the dry hammermills (ID Nos. ES-HM-1 to through ES-HM-8) from 25% to 15%; and

[1] Permit application no. 8200152.18A proposed to recirculate the exhaust from the green wood hammermills to either the inlet of the dryer or directly to the WESP/RTO system (ID Nos. CD-WESP and CD-RTO) to reduce VOC, HAP and PM emissions. Enviva subsequently decided to choose the latter control configuration.

- Add dry shavings handling (ID No. IES-DRYSHAVE) and storage silo to allow the facility to process purchased shavings that will not require drying.

A complete overview of the SWEP project is provided in the Preliminary Determination contained in Attachment A to this document.

1.2 Application Chronology

The following application chronology lists some, but not all, of the significant events associated with this permitting action. The Application Chronology in the Preliminary Determination in Attachment A includes more details.

Date	Event
November 21, 2017	Pre-application meeting between NCDAQ and Enviva occurred.
March 19, 2018	PSD permit application received.
April 3, 2018	A letter was issued to Enviva indicating the application was deemed complete for PSD processing.
June 6, 2018	An addendum to the permit application was received via e-mail.
August 16, 2018	Nancy Jones issued a revised memorandum approving the air modeling. The air modeling was resubmitted on August 5, 2018 to ensure it corresponded with the modeling results contained in the permit addendum.
October 10, 2018	Draft permit and draft permit review forwarded to the NCDAQ staff for comments.
December 17, 2018	Draft of permit and draft permit review forwarded to the Permittee for comments.
February 7, 2017	Enviva submitted revised comments on the draft permit review. Enviva also submitted a letter dated February 7, 2019 discussing why reevaluation of the 112(g) Case-by-Case MACT for this facility was not applicable.
March 1, 2019	NCDAQ issued a letter to Enviva requiring a reconsideration of the 112(g) Case-by-Case MACT analysis on the pellet presses and coolers.
May 31, 2019	A settlement agreement resolving the dispute between Enviva and NCDAQ regarding the 112(g) Case-by-Case MACT analysis on the pellet presses and coolers was signed.
June 12, 2019	Draft Permit and Preliminary Determination forwarded to public notice.
July 1, 2019	Enviva submitted revised air dispersion modeling for the furnace bypass.
July 15, 2019	Public hearing on the Draft Permit and Preliminary Determination held at Chatham County Agriculture & Conference Center in Pittsboro, NC. Joe Foutz, Compliance Supervisor of the Mooresville Regional Office, served as the Hearing Officer.
July 19, 2019	Last day of public comment period for Draft Permit and Preliminary Determination.
July 25, 2019	Nancy Jones issued a memorandum approving the air modeling for the furnace bypass.

Date	Event
August 2, 2019	State renewal application (8200152.19A) received and consolidated into PSD application (8200152.18A) for processing. Enviva submitted this procedural State renewal in accordance with 15A NCAC 02Q .0304(d) and (f) to renew Permit No. 10386R03. No modifications were requested as part of this renewal application. This timely submittal, received 90 days prior to expiration in compliance with the permit, contained all required forms and appropriate signatures.
September 26, 2019	Hearing Officers Report signed
October 2, 2019	Final PSD Review was processed
October 2, 2019	Permit signed and issued.

The NC DAQ Permitting Section evaluated the application for compliance with PSD requirements and other NCDAQ air quality regulations. The findings were assembled in a Preliminary Determination provided in Attachment A of this document.

A notice of the opportunity for public comment concerning the Preliminary Determination appeared in The Sampson Independent of Clinton, North Carolina, and The Fayetteville Observer on June 12, 2019. The Public Notice was also posted on the Department of Environmental Quality website and e-mailed to all Interested Parties. The Public Notice stated that interested persons had from June 12, 2019 until July 19, 2019 in which to review the PSD application, Preliminary Determination and Draft Permit at specified locations and to submit written comments.

The NCDAQ Director has also determined a public hearing for this permit application was in the best interest of the public, and a public hearing for the Draft Permit was held at Sampson Community College in Clinton, North Carolina on July 15, 2019.

2. Revised BACT Analysis for VOC Emissions

During the public comment period, NCDAQ received comments on the Best Available Control Technology (BACT) analysis for VOC emissions associated with the SWEP. Specific concerns were raised regarding Enviva's assumptions used in its estimates of control costs and on the way regenerative catalytic oxidizers (RCOs) were considered in the BACT analysis. To address these concerns, NCDAQ requested Enviva to revise and resubmit its BACT analysis for the dry hammermills, the dry wood handling operations, and the pellet presses and coolers (PPCs). The revised BACT analysis was submitted on September 10, 2019 and is presented in this section.

The original BACT analysis submitted with permit application 8200152.18A for the following emissions sources has not changed. Please refer to the Preliminary Determination in Attachment A for the BACT analysis for the following emission sources:

- Dryer System (ID No. ES-DRYER) and Green Wood Hammermills (ID Nos. ES-GHM-1 to ES-GHM-3);
- Green Wood Storage Piles (ID Nos. IES-GWSP-1 to IES-GWSP-4) and Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 and IES-BFSP-2); and
- Log Chipping (ID No. IES-CHIP-1) and Bark Hog (ID No. IES-BARKHOG).

2.1 Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8)

2.1.1 Identify Control Technologies

Based on the review of RBLC, relevant literature, and industry knowledge, the following control technologies were considered in the BACT analysis for VOC emissions from Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8):

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

Thermal Oxidation

Thermal oxidation reduces VOC emissions by oxidizing VOC 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 RTOs. 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, with RTOs often having a thermal recovery efficiency of 95% to 99%. 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, RTOs are the only type of thermal oxidization considered in this BACT analysis.

An RTO uses high-density media such as a ceramic-packed bed still hot from a previous cycle to preheat an incoming VOC-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 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, unsafe operations such as fires, and/or significant operational and maintenance related difficulties. The existing WESP will serve as particulate control for the RTO.[2]

Catalytic Oxidation

Similar to an RTO, a regenerative catalytic oxidizer (RCO) and a thermal catalytic oxidizer (TCO) oxidize VOC to CO_2 and H_2O. However, RCO and TCO use catalyst to lower the activation energy

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

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 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. As with the RTO, particulate control must be placed upstream of the RCO to remove unwanted particulate matter, and the existing WESP will serve as particulate control. The risk of catalyst blinding/poisoning exists even with highly efficient particulate control, and catalyst life guarantees are relatively short. The VOC destruction efficiency for an RCO typically ranges from 90 to 99%.[5]

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

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. [3] Although some VOCs present in the dry hammermills (ID Nos. ES-HM-1 to ES-HM-8) exhaust stream are highly soluble in water, alpha/beta-pinene, which make up the predominate species emitted, are only slightly soluble in water. The reduced solubility results in a significantly reduced VOC control efficiency for wet scrubbers.

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%.[4] Specifically, VOCs 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

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[3] 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

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

has only been demonstrated on a single pilot scale installation that has a similar – but not exactly the same – exhaust stream profile as Enviva. Thermophilic microbes live and metabolize VOC at higher operating temperatures (~160 °F).

Carbon Adsorption

Carbon adsorption systems use an activated carbon bed to trap VOCs. As the exhaust gas stream passes through the activated carbon bed, VOC molecules are adsorbed onto the surface of the activated carbon, and clean exhaust gas is discharged to the atmosphere. A typical carbon adsorption system for continuous operation includes two activated carbon beds, such that one bed can be desorbing/idle while the other is adsorbing. When the activated carbon in one bed is spent and can no longer effectively adsorb VOC, the bed is taken off line for regeneration, and the VOC-containing gas stream is diverted to the fresh activated carbon bed. This switching allows for the source to operate continuously without shutting down. Regeneration of the sorbent can be achieved either via heating with steam or via vacuuming to remove VOC from the surface.

Depending on the application, carbon adsorption systems can typically achieve VOC control efficiencies of 95%.[5] Adsorption systems have been successfully used in industry types such as organic chemical processing, varnish manufacture, synthetic rubber manufacture, production of selected rubber products, pharmaceutical processing, graphic arts operations, food production, dry cleaning, synthetic fiber manufacture, pressure sensitive tape manufacturing, and other coating operations.

2.1.2 Eliminate Technically Infeasible Options

Wet Scrubbers

As discussed previously, wet scrubbers applied to exhaust gas streams such as those from dry hammermills have limited control efficiency given the insolubility of a large portion of the exhaust stream. The 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 components removed from the exhaust stream. Because of the expected low control efficiency for VOC emissions and additional environmental impacts, wet scrubbers are not considered technically feasible.

Bio-oxidation/Bio-filtration

Bio-oxidation/bio-filtration is effective in low temperature ranges, but at higher temperatures, cell components can begin to decompose and proteins within the cell's enzymes can become denatured and ineffective. Additionally, the primary constituents of the VOC in the exhaust stream are terpenes, which are highly viscous and would cause the bio-oxidation/bio-filtration system to foul. Furthermore, 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 the temperature limitations of this control technology, 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.

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[5] New Jersey DEP's State of the Art (SOTA) *Manual for Chemical and Pharmaceutical Processing and Manufacturing Industries* (July 1997). http://www.state.nj.us/dep/aqpp/downloads/sota/sota5.pdf

Carbon Adsorption

Carbon adsorption is not recommended for exhaust streams with relative humidity above 50% or temperatures above 150 °F. When the exhaust stream has a high relative humidity, the water molecules and VOCs in the exhaust stream compete for active adsorption site on the carbon, drastically reducing the efficiency and overall effectiveness of the adsorbent. Additionally, because heat is used to regenerate the carbon bed, the high exhaust stream temperatures would be in the range normally used to desorb VOCs from the carbon. Carbon adsorption is, therefore, determined to be technically infeasible for these sources.

2.1.3 Rank Remaining Control Technologies by Effectiveness

The remaining control technologies were ranked from the most stringent to the least stringent, as shown in the table below.

Control Technology	Approximate Control Efficiency (%)
RTO	95% to 99%
Catalytic Oxidizer	90% to 99%

2.1.4 Evaluate Technically Feasible Control Options

Enviva analyzed the costs associated with installation of an RTO and RCO on the dry hammermills. The dry hammermills are already equipped with baghouses to control PM emissions and thus, no additional control is required to reduce PM prior to oxidation in an RTO or RCO.

Assumptions Used in the Cost Analysis

To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO and RCO was selected at 95%, as a conservative estimate. Propane was assumed as the auxiliary fuel for the RTO and RCO, as natural gas infrastructure is not currently available to supply the facility. As such, the capital expenditure for both the RTO and RCO are underestimated as the capital cost does not include cost associated with propane receiving, storage, and vaporization. Other assumptions used in performing this analysis are included in the detailed revised cost calculations submitted on September 10, 2019 and provided in Attachment B to this document. All cost estimates were prepared using potential VOC emission rates for the dry hammermills under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling VOC emissions from the dry hammermills with an RTO and RCO are presented in the table below. The cost impacts were estimated using the Office of Air Quality Planning and Standards Control Cost Manual (CCM),[6] operating experience, and quotes from utilities and vendors.

[6] EPA's Control Cost Manual, 7th Addition, Section 3.2: VOC Destructive Controls, Chapter 2, Incinerators and Oxidizers, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

Add-On Control Technology	Emissions (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	168	95%	159.6	$2,934,883	$18,389
RCO	168	95%	159.6	$2,907,090	$18,215

Energy and Environmental Impacts

In addition to high cost effectiveness of these control devices, RTOs and RCOs also have associated negative energy and environmental impacts. The secondary environmental impacts are presented in the table below for the RTO and RCOs. In the case of oxidization, the combustion of propane would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG. Energy impacts associated with the operation of the control devices are also presented in the following table.

Control Technology	Emissions (tpy)						Energy (MW-h/yr)
	NOx	SO_2	PM	CO	VOC	GHG	
RTO	6.85	0.027	0.35	4.03	0.50	6,298	3,968
RCO	3.34	0.015	0.19	2.30	0.27	3,403	5,082

2.1.5 Select BACT for VOC Emissions

Enviva eliminated the RTO and RCO as BACT for VOC emissions from the dry hammermills after consideration of the economic, environmental, and energy impacts. Instead, Enviva proposes good operating procedures as BACT for VOC emissions from the dry hammermills. Enviva also proposes a VOC emission limit of 0.60 lb/ODT from the dry hammermills. The proposed BACT emission limit reflects an increase in the softwood throughput to 100% and the production rate requested with this permit modification for the SWEP. The emission limit also reflects new source test data acquired for similar Enviva facilities.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from the dry hammermills and the BACT emission limit is 0.60 lb of VOC /ODT from the dry hammermills.

2.2 Dried Wood Handling (ID No. ES-DWH)

2.2.1 Identify Control Technologies

The control technologies identified for control of VOC from dried wood handling and a description of each add-on control device considered in the BACT analysis for VOC emissions from dried wood handling is provided above in Section 2.1.1.

2.2.2 Eliminate Technically Infeasible Options

As described above in Section 2.1.2, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for dry wood handling operations.

2.2.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 2.1.3 for ranking of the RTO and RCO.

2.2.4 Evaluate Technically Feasible Control Options

Enviva analyzed the costs associated with installation of an RTO and RCO on dry wood handling. The dry wood handling operations are already equipped with baghouses to control PM emissions and thus, no additional control is required to reduce PM prior to oxidation in an RTO or RCO.

Assumptions Used in the Cost Analysis

To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO and RCO was selected at 95%, as a conservative estimate. Propane was assumed as the auxiliary fuel for the RTO and RCO, as natural gas infrastructure is not currently available to supply the facility. As such, the capital expenditure for both the RTO and RCO are underestimated as the capital cost does not include cost associated with propane receiving, storage, and vaporization. Other assumptions used in performing this analysis are included in the detailed revised cost calculations submitted on September 10, 2019 and provided in Attachment B to this document. All cost estimates were prepared using potential VOC emission rates for the dry wood handling operations under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling VOC emissions from dry wood handling with an RTO and RCO are presented in the table below. The cost impacts were estimated using the CCM,[7] operating experience, and quotes from utilities and vendors.

Add-On Control Technology	Emissions (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	41	95%	38.3	$598,594	$15,440
RCO	41	95%	38.3	$541,505	$13,968

Energy and Environmental Impacts

In addition to high cost effectiveness of these control devices, RTOs and RCOs also have associated negative energy and environmental impacts. The secondary environmental impacts are presented in the table below for the RTO and RCOs. In the case of oxidization, the combustion of propane would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG. Energy impacts associated with the operation of the control devices are also presented in the following table.

[7] EPA's Control Cost Manual, 7th Addition, Section 3.2: VOC Destructive Controls, Chapter 2, Incinerators and Oxidizers, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

Control Technology	Emissions (tpy)						Energy (MW-h/yr)
	NOx	SO_2	PM	CO	VOC	GHG	
RTO	1.15	0.004	0.06	0.68	0.08	1,030	649
RCO	0.65	0.002	0.03	0.40	0.04	557	786

2.2.5 Select BACT for VOC Emissions

Enviva eliminated the RTO and RCO as BACT for VOC emissions from dry wood handling after consideration of the economic, environmental, and energy impacts. Instead, Enviva proposes good operating procedures as BACT for VOC emissions from dry wood handling. Enviva also proposes a VOC emission limit of 0.12 lb/ODT from the dry wood handling operations. The proposed BACT emission limit was derived from NCASI's Wood Products Database (February 2013)[8] for dry wood handling operations at an oriented strand board mill.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from the dry wood handling operations and the BACT emission limit is 0.12 lb of VOC /ODT from the dry wood handling operations.

2.3 Pellet Presses and Coolers (ID Nos. ES-CLR-1 to ES-CLR-6)

2.3.1 Identify Control Technologies

The control technologies identified for control of VOC from the PPCs and a description of each add-on control device considered in the BACT analysis for VOC emissions from the PPCs is provided above in Section 2.1.1.

2.3.2 Eliminate Technically Infeasible Options

As described above in Section 2.1.2, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for the PPCs at Enviva.

2.3.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 2.1.3 for ranking of the RTO and RCO.

2.3.4 Evaluate Technically Feasible Control Options

Enviva analyzed the costs associated with installation of an RTO and RCO on the PPCs. The pellet coolers are currently equipped with cyclones for PM control. However, additional PM control is required to ensure proper operation of any RTO or RCO on the pellet coolers. Because additional PM control is required, the annualized cost of the PM control device (i.e., a baghouse) was included with the RTO and RCO costs in the BACT analysis.

<u>Assumptions Used in the Cost Analysis</u>
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO and RCO was

[8] National Council for Air and Stream Improvement (NCASI)

selected at 95%, as a conservative estimate. Propane was assumed as the auxiliary fuel for the RTO and RCO, as natural gas infrastructure is not currently available to supply the facility. As such, the capital expenditure for both the RTO and RCO are underestimated as the capital cost does not include cost associated with propane receiving, storage, and vaporization. Other assumptions used in performing this analysis are included in the detailed revised cost calculations submitted on September 10, 2019 and provided in Attachment B to this document. All cost estimates were prepared using potential VOC emission rates for the dry hammermills under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling VOC emissions from the PPCs with an RTO and RCO are presented in the table below. The cost impacts were estimated using the CCM,[9] operating experience, and quotes from utilities and vendors.

Add-On Control Technology	Emissions (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	168	95%	159.6	$2,934,883	$18,389
RCO	168	95%	159.6	$2,907,090	$18,215

Energy and Environmental Impacts

In addition to high cost effectiveness of these control devices, RTOs and RCOs also have associated negative energy and environmental impacts. The secondary environmental impacts are presented in the table below for the RTO and RCOs. In the case of oxidization, the combustion of propane would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG. Energy impacts associated with the operation of the control devices are also presented in the following table.

Control Technology	Emissions (tpy)						Energy (MW-h/yr)
	NOx	SO_2	PM	CO	VOC	GHG	
RTO	6.96	0.025	0.32	4.29	0.46	5,697	5,528
RCO	4.24	0.013	0.17	2.72	0.25	3,079	6,284

2.3.5 Select BACT for VOC Emissions

Enviva eliminated the RTO and RCO as BACT for VOC emissions from the PPCs after consideration of the economic, environmental, and energy impacts. Instead, Enviva proposes good operating procedures as BACT for VOC emissions from these emission sources. Enviva also proposes a VOC emission limit of 1.74 lb/ODT from the PPCs. The proposed BACT emission limit reflects an increase in the softwood throughput to 100% and the production rate requested with this permit modification for the SWEP. The emission limit also reflects new source test data acquired for similar Enviva facilities. Enviva will conduct testing of the PPCs to demonstrate compliance with the emission limit.

[9] EPA's Control Cost Manual, 7th Addition, Section 3.2: VOC Destructive Controls, Chapter 2, Incinerators and Oxidizers, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from the PPCs and the BACT emission limit is 1.74 lb of VOC /ODT from these emission sources, based on a 3-hour average.

2.4 Pellet Presses and Pellet Coolers (ID Nos. ES-CLR-1 to ES-CLR-6) and (Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8)

One commenter suggested that Enviva should have considered a single RTO or RCO to control combined emissions from the dry hammermills and PPCs in its BACT analysis. NCDAQ requested Enviva to consider this option, and it was included in the revised BACT analyses submitted on September 10, 2019.

2.4.1 Identify Control Technologies

The control technologies identified for control of VOC from the combined exhaust from the dry hammermills and PPCs (aka referred to as the combined exhaust streams) and a description of each add-on control device considered in the BACT analysis for VOC emissions from combined exhaust streams is provided above in Section 2.1.1.

2.4.2 Eliminate Technically Infeasible Options

As described above in Section 2.1.2, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for the combined exhaust streams.

2.4.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 2.1.3 for ranking of the RTO and RCO.

2.4.4 Evaluate Technically Feasible Control Options

Enviva analyzed the costs associated with installation of an RTO and RCO on the combined exhaust streams. The pellet coolers are currently equipped with cyclones for PM control. However, additional PM control is required to ensure proper operation of any RTO or RCO on the exhaust of the pellet coolers. Because additional PM control is required, the annualized cost of the PM control device (i.e., a baghouse) was included with the RTO and RCO costs in the BACT analysis for the combined exhaust streams.

<u>Assumptions Used in the Cost Analysis</u>
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO and RCO was selected at 95%, as a conservative estimate. Propane was assumed as the auxiliary fuel for the RTO and RCO, as natural gas infrastructure is not currently available to supply the facility. As such, the capital expenditure for both the RTO and RCO are underestimated as the capital cost does not include cost associated with propane receiving, storage, and vaporization. Other assumptions used in performing this analysis are included in the detailed revised cost calculations submitted on September 10, 2019 and provided in Attachment B to this document. All cost estimates were prepared using potential VOC emission rates for the dry hammermills under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling VOC emissions from the combined exhaust streams with an RTO and RCO are presented in the table below. The cost impacts were estimated using CCM,[10] operating experience, and quotes from utilities and vendors.

Add-On Control Technology	Emissions (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	740	95%	703	$6,553,936	$9,294
RCO	740	95%	703	$5,869,334	$8,349
Notes: The costs include the cost of baghouses to control PM from the pellet coolers.					

Energy and Environmental Impacts

In addition to high cost effectiveness of these control devices, RTOs and RCOs also have associated negative energy and environmental impacts. The secondary environmental impacts are presented in the table below for the RTO and RCOs. In the case of oxidization, the combustion of propane would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG. Energy impacts associated with the operation of the control devices are also presented in the following table.

Control Technology	Emissions (tpy)						Energy (MW-h/yr)
	NOx	SO_2	PM	CO	VOC	GHG	
RTO	13.82	0.052	0.67	8.32	0.96	11,995	9,486
RCO	8.08	0.028	0.36	5.02	0.52	6,482	11,087
Notes: The energy usage includes energy associated with operation of baghouses on the pellet coolers.							

2.4.5 Select BACT for VOC Emissions

Enviva eliminated the RTO and RCO as BACT for VOC emissions from the combined exhaust from dry hammermills and PPCs after consideration of the economic, environmental, and energy impacts. Instead, BACT has been proposed for VOC emissions from each source individually as discussed above in Sections 2.3 and 2.4.

3. Air Quality Impacts for the Bypass Scenario

The air dispersion modeling submitted with the permit application on March 19, 2018 and application amendment on August 5, 2018 did not include the emissions from the furnace bypass scenarios. The NCDAQ requested Enviva to revise the air dispersion modeling to account for these scenarios. The revised air dispersion modeling was submitted on July 1, 2019. The bypass scenarios and the results of the revised air dispersion modeling are discussed in this section.

[10] EPA's Control Cost Manual, 7th Addition, Section 3.2: VOC Destructive Controls, Chapter 2, Incinerators and Oxidizers, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

3.1 Bypass Scenarios

Bypass stacks for the furnace and rotary dryer are used to exhaust hot gases for temperature control during startups, shutdowns, and malfunctions. The bypasses on the furnace and dryer are used differently as discussed below.

3.1.1 Furnace Bypass

The furnace bypass is operated under several scenarios. In a letter dated May 10, 2019, Enviva provided descriptions of the furnace bypass operation during the following scenarios:

- Cold Start-ups: The furnace bypass stack is 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 (up to approximately 15% of the maximum furnace heat input). The bypass stack is then closed, and the furnace is slowly brought up to a normal operating rate. The duration of a cold start-up is typically between 6 to 8 hours, with total start-up time not to exceed 12 hours for each cold start-up. There are generally two cold start-ups per year.

- 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 automatically switches to "idle mode" [defined as operation at up to a maximum heat input rate of 5 Million British thermal units per hour (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 is decreased, and all remaining fuel is moved through the system to prevent a fire during the shutdown period. The remaining fuel is combusted prior to opening the furnace bypass stack. Emissions during this time are minimal as the furnace and dryer are no longer operating.

The cold-start up, "idle mode," and planned shutdown scenarios for the furnace bypass were included in the revised air dispersion modeling. Because malfunctions experience unexpected emissions that are often difficult to quantify, they were not included in the revised air dispersion modeling for the bypass events.

3.1.2 Dryer Bypass

The dryer bypass is only operated under two conditions – malfunction and planned shutdown. In a letter dated May 10, 2019, Enviva provided the following descriptions of these two events:

- Malfunction: The dryer system can abort due to power failure, equipment failure, or furnace abort. If the RTO goes offline because of an interlock failure, the dryer immediately aborts. This can occur if the dryer temperature is out of range or due to equipment or power failure. Dryer abort is also triggered if a spark is detected.

- Planned Shutdown: During planned shutdowns, as the remaining fuel is combusted by the furnace, the operator reduces the chip input to the dryer. When only a small amount of chips remains, the dryer drum is emptied. The dryer bypass stack is then opened, and a purge air fan is used to ensure no explosive build-up occurs in the drum. Emissions during this time are minimal as the furnace and dryer are no longer operating.

Because malfunctions experience unexpected emissions that are often difficult to quantify, they were not included in the revised air dispersion modeling that included the bypass events. As noted above, emissions from the dryer bypass during shutdown are minimal because neither the furnace nor dryer are being operated and the dryer drum is empty. Thus, the dryer bypass was not included in the revised air dispersion modeling because of the minimal emissions.

3.3 Revised Air Dispersion Modeling for the Non-Regulated Pollutant Impact Analysis

The revised air dispersion modeling that included cold-start up, "idle mode," planned shutdown for the furnace bypass was received on July 1, 2019. Nancy Jones of the Air Quality Analysis Branch of the NC DAQ approved of the revised air dispersion modeling in a memo dated July 25, 2019. As discussed below, the revised air dispersion modeling (which included the furnace bypass scenarios) adequately demonstrated that emissions of total suspended particles (TSP) will not cause or contribute to an exceedance of the State Ambient Air Quality Standard (SAAQS). The revised air dispersion modeling also demonstrated compliance with NC Air Toxics for all toxic air pollutant (TAPs) modeled.

3.3.1 NC Air Toxics

An air toxics dispersion modeling analysis was conducted to evaluate ambient impacts of facility-wide TAPs. Emissions rates of TAPs were first compared with their associated TAP permitting emission rate (TPERs) in 15A NCAC 02Q .0711. Nine TAPs exceeded their TPER and were further evaluated in facility-wide modeling.

AERMOD (16216r) was run using surface data from Fayetteville and upper air data from Greensboro for 2016 processed with the adjust u* option. All toxics except acrolein were less than 50% of the AAL, so only acrolein was run using the five-year set from 2012-2016. Direction-specific building dimensions, determined using EPA's BPIP-Prime program (04274), were used as input to the model for building wake effect determination. EPA's AERMAP terrain processor was used to determine elevations. Receptors were spaced at 25 meters around the ambient boundary, at 100-meter intervals out to 800 meters, and at 500-meter intervals out to 10,000 meters from the facility.

Three scenarios were modeled (normal operation, furnace bypass – idle mode, and furnace bypass – cold start-up and planned shutdown) because different sources would be operating under each scenario. The maximum impact and associate scenario are provided in the table below. The air dispersion modeling adequately demonstrates compliance on a source-by-source basis for all TAPS modeled. Therefore, the proposed SWEP will not present an "an unacceptable risk to human health," and no modeled emission limits will be included in the permit.

Pollutant	Averaging Period	Scenario	Maximum Impact (μg/m³)	AAL (μg/m³)	% of AAL
Acrolein	1-hour	Normal and Furnace Idle	66.9	80	84 %
Arsenic	Annual	Furnace Cold Start-Up	0.00021	0.0021	1 %

Pollutant	Averaging Period	Scenario	Maximum Impact (µg/m³)	AAL (µg/m³)	% of AAL
Benzene	Annual	Normal	0.0053	0.12	5 %
Cadmium	Annual	Furnace Cold Start-Up	0.0000392	0.0055	1 %
Chlorine	1-hour	Furnace Cold Start-Up	0.17	900	<1 %
	24-hour	Furnace Cold Start-Up	0.065	37.5	<1 %
Formaldehyde	1-hour	Normal and Furnace Idle	42.4	150	28 %
Hydrogen Chloride	1-hour	Furnace Cold Start-Up	4.1	700	1 %
Manganese	24-hour	Furnace Cold Start-Up	0.13	31	<1 %
Phenol	1-hour	Normal and Furnace Idle	33.3	950	4 %

3.3.2 SAAQS

Enviva modeled facility-wide TSP project emissions including the bypass scenarios using AERMOD and the same model setup as the TAPs modeling analyses to show project impacts were below the 24-hour and annual SAAQS. The highest modeled concentration and associate scenario are provided in the table below and show the impacts are less than the SAAQS.

Averaging Period	Scenario	Modeled Concentration (µg/m³)	SAAQS (µg/m³)	Exceeds SAAQS?
24-Hour	Furnace Bypass – Idle	146	150	No
Annual	Furnace Bypass – Idle and Cold Start-Up	21.8	75	No

4. Public Comments and Hearing Officer's Report

The Public Notice stated that interested persons had from June 12, 2019 until July 19, 2019 in which to review the PSD application, Preliminary Determination and Draft Permit at specified locations and to submit written comments. All public comments received during this period were addressed in the Hearing Officer's Report dated September 26, 2019. Certain comments related to the BACT analysis, the Draft Permit, and the Preliminary Determination are addressed in this section.

4.1 Response to Comments from Enviva

Enviva submitted comments on the Draft Permit in a letter dated July 8, 2019. The comments were received within the Public Notice Comment period. NCDAQ's response to the facility's comments are provided in this section.

<u>Enviva Comment 1:</u>

1. For consistency with the recent permit issued for the Softwood Expansion Project at the Enviva Pellets Hamlet, LLC plant (10365R03), Enviva requests that Condition 2.2.A.1.d.iv be revised to read as follows:

*The Permittee shall establish the combustion chamber temperature of the regenerative thermal oxidizer **(ID No. CD-RTO)** during testing. The combustion chamber temperature shall be based upon the average temperature over the span of the test runs. Documentation for the combustion chamber temperature shall be submitted to the DAQ as part of the initial compliance test report.*

NCDAQ Response to Comment 1

According to discussions, e-mails, and other information provided by Enviva, the RTO (ID No. CD-RTO) on the dryer/green wood hammermills is comprised of two fireboxes, each containing two temperature probes. Enviva currently averages the temperature across all four temperature probes to arrive at the average temperature of the RTO. This approach does not ensure the RTO will meet the 95% destruction efficiency for VOC emissions referenced in the permit application.

Consider the example where one of the fireboxes is operating at much higher temperature than measured during performance testing, while the other firebox is operating at a much lower temperature. The VOCs may not be adequately controlled in the second firebox because of the low temperature. However, the average temperature across both fireboxes (i.e., across the four temperature probes) may be meeting the value measured during performance testing, even though VOCs are not being adequately controlled. To avoid this scenario, NCDAQ is requiring Enviva to measure the average temperature of EACH firebox. NCDAQ will not make the requested change.

Enviva Comment 2:

2. Enviva requests that the language shown in bold below be added to Condition 2.2.A.1.e.vi:

vi. The Permittee shall conduct periodic performance tests when the following conditions are met:

(A) The monthly average softwood content exceeds the average softwood percentage documented during prior performance testing by more than 10 percentage points, or

(B) The monthly production rate exceeds the average production rate documented during prior performance testing by more than 10 percentage points, or

(C) At a minimum testing shall be conducted annually, unless a longer duration is otherwise approved pursuant to Section 2.2.A.1.e.x. Annual performance tests shall be completed no later than 13 months after the previous performance test.

(D) If 90% of the maximum permitted throughput is achieved during a performance test, with a softwood percentage of 90%, subsequent periodic performance testing will be limited to VOC only.

NCDAQ Response to Comment 2:

The wood pellet industry is a relatively new industry and emission data is being developed. NCDAQ recommends continuing to test for pollutants other than VOC to better quantify the emission profile of this facility and industry. Section 2.2 A.1.e.x of the permit allows for Enviva to reduce the frequency of testing of a given pollutant once compliance has been demonstrated for three consecutive years, as shown below:

Section 2.2 A.1.e.x

x. The Permittee may request that the performance tests be conducted less often for a given pollutant if the performance tests for at least 3 consecutive years show compliance with the emission limit. If the request is granted, the Permittee shall conduct a performance test no more than 36 months after the previous performance test for the given pollutant.

Enviva can request to modify the testing frequency once compliance has been demonstrating, and thus, no change to the permit language is needed.

Enviva Comment 3:

3. Condition 2.2.A.1.m requires that a 3-hour rolling average be used to assess compliance with the RTO parametric monitoring requirements; however, other established Maximum Achievable Control Technology (MACT) standards require use of a 3-hour block average (e.g., 40 CFR 63 Subpart DDDD, National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products, Table 2). Enviva requests that this condition be revised to read as follows:

*To ensure compliance and effective operation of the regenerative thermal oxidizer, the Permittee shall maintain a 3-hour block average combustion chamber temperature for the RTO **(ID No. CD-RTO)** at or above the minimum average temperature established during the most recent performance test. The Permittee shall maintain records of the 3-hour block average combustion chamber temperatures used to demonstrate compliance with the established RTO minimum average combustion chamber temperature. The Permittee shall also perform inspections and maintenance on the RTO as specified above in Section 2.1 A.1.h.*

NCDAQ Response to Comment 3:

Although the calculation of 3-hour block averages is often "easier" to accommodate in data handling (in that there are eight distinct and eight unique time blocks in a 24-hour day starting from midnight), the selection of the 3-hour rolling average helps assure that compliance is being maintained "between" the time blocks for some emission or parametric value. For example, the selection of the thermal oxidizer minimum temperature being set to a 3-hour rolling value can assure that the average temperature is being maintained between the times when data is being accumulated to calculate the 3-hour block average. A dataset that shows compliance in all 3-hour rolling average values for a given temperature requirement will always demonstrate compliance with a comparable 3-hour block average value (for the same temperature). The converse is not always true (i.e., compliance with a 3-hour block average does not assure compliance with a 3-hour rolling average for the same numerical value). The 3-hour rolling average provides greater assurance of continuous compliance, particularly where the effects of short-term changes (in temperature) may have non-linear effects on emissions. Therefore, the NCDAQ will continue to use the rolling average in the permit.

4.2 Response to Public Comments

The Hearing Officer's Report, which was finalized on September 26, 2019, addresses comments received during the public comment period, including those regarding the BACT analysis, forestry management, Executive Order 80, Environmental Justice, among others. The Environmental

Integrity Project (EIP) and the Southern Environmental Law Center (SELC) submitted detailed comments on July 19, 2019, and many of these comments related specifically to the BACT analysis and other issues germane to the Draft Permit and Preliminary Determination. The NCDAQ has included responses to EIP/SELC comments specific to the BACT analysis, Draft Permit, and Preliminary Determinations as Attachment B to this document.

4.3 Recommendations from Hearing Officer

All public comments were addressed in the Hearing Officer's Report dated September 26, 2019. The following changes were made to the Draft Permit that went to public notice on June 12, 2019, as recommended by Joe Foutz, the Hearing Officer.

1. Case-by-Case MACT and BACT

   Report Recommendation (Page 10 of 41)
   It is recommended that a condition be added to the draft air permit requiring Enviva Sampson to include either a BACT analysis for the dry hammermills and the pellet presses and coolers or a request for PSD avoidance in its permit application for case-by-case MACT. The permit application will be due within six months of this permit issuance.

   Resolution
   The following was added to the permit under Section 2.2 A.1.f:

   f. Within six months of issuance of this permit (10386R04), the Permittee shall submit to the DAQ a permit application that includes one of the following:
      i. A BACT analysis for VOC emissions from the dry hammermills (ID Nos. ES-HM-1 to ES-HM-8) and the pellet presses and pellet coolers (ID No. ES-CLR-1 to ES-CLR-6), OR
      ii. A request for an avoidance condition for 15A NCAC 02D .0530, Prevention of Significant Deterioration, for VOC emissions.

2. Revised BACT Analysis

   Report Recommendation (Page 11 of 41)
   The final permit review for the PSD permit application should include the revised BACT analysis for VOC emission sources based on the September 10, 2019 submittal.

   Resolution
   The revised BACT analysis submitted on September 10, 2019 for the dry hammermill, dry wood handling operations, and the PPCs is provided above in Section 2.

3. Startup, Shutdown, and Malfunction (SSM)

   Report Recommendation (Page 25 of 41)
   It is recommended that the language noted above *[see Hearing Officer's Response to Comment (17) on Page 25 of 41 for text]* or similar requirements having the same intent be added to the permit in order to clarify BACT during SSM events.

Resolution

References to the BACT emissions limits not applying during periods of SSM were removed from the permit. The following was added to the permit under Sections 2.2 A.1.k, l, and m:

k. The furnace bypass **(ID No. ES-FBYPASS)** shall be limited to less than 50 hours per year for start-ups (for temperature control) and shutdowns. The furnace bypass shall be limited to a cold startup of 15% maximum heat input (or 37.6 million Btu per hour). The cold startup period of time begins when the wood-fired furnace is started up and lasts until the wood-fired furnace's refractory is heated to a temperature sufficient to sustain combustion operations at a minimal level or 8 hours, whichever is less.
l. The furnace bypass **(ID No. ES-FBYPASS)** in idle mode, defined as maximum heat input of 5 million Btu per hour, shall be limited to less than 500 hours per year.
m. At all times, including periods of startup, shutdown, and malfunction, the Permittee shall, to the extent practicable, maintain and operate all emission sources including associated control devices in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Administrator which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

4. Semiannual Reporting

Report Recommendation (Page 30 of 41)

Because Enviva does not hold a Title V permit, the reporting requirements pursuant to 40 CFR 70.6(a)(3)(iii)(A) are not applicable to the Enviva permit. However, semiannual reporting can be included if deemed necessary to ensure compliance pursuant to 15A NCAC 2D .0605(b). The Hearing Officer recommended adding semiannual reporting.

It is recommended that semiannual reporting requirements for monitoring activities be added to the permit.

Resolution

The following semiannual reporting language was added to the permit for regulations that require monitoring and recordkeeping activities to ensure compliance.

> The Permittee shall submit a summary report of the monitoring and recordkeeping activities given in Sections [list applicable Section numbers] above postmarked on or before January 30 of each calendar year for the preceding six-month period between July and December and July 30 of each calendar year for the preceding six-month period between January and June. All instances of deviations from the requirements of this permit must be clearly identified.

Note some regulations (e.g., 15A NCAC 02D .0516, Sulfur Dioxide Emissions from Combustion Sources, etc.) do not require any monitoring or recordkeeping activities to ensure compliance with the underlying rule. For such regulations, no reporting requirements were added to the permit.

5. Final Determination

Based on the application submitted and the review of this proposal, the NCDAQ developed the Preliminary Determination and Draft Permit and held a public hearing on the drafts. The comment period expired on July 19, 2019.

Numerous comments were submitted during the comment period and all comments were addressed in the Hearing Officer's Report dated September 26, 20119. NCDAQ modified the permit per the recommendations of the Hearing Officer.

NCDAQ recommends issuance of Permit No. 10386R04.

ATTACHMENT A

Preliminary Determination
June 12, 2019

DRAFT

NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date:

Region: Fayetteville Regional Office
County: Sampson
NC Facility ID: 8200152
Inspector's Name: Gregory Reeves
Date of Last Inspection: 03/29/2018
Compliance Code: B / Violation - emissions

Facility Data

Applicant (Facility's Name): Enviva Pellets Sampson, LLC

Facility Address:
Enviva Pellets Sampson, LLC
5 Connector Road, US 117
Faison, NC 28341

SIC: 2499 / Wood Products, Nec
NAICS: 321999 / All Other Miscellaneous Wood Product Manufacturing

Facility Classification: Before: Title V **After:** Title V
Fee Classification: Before: Title V **After:** Title V

Permit Applicability (this application only)

SIP: 02D .0515, 02D .0516, 02D .0521, 02D .0530, 02D .0540, 02D .1112
NSPS: No
NESHAP: 112(g) Case-by-Case MACT
PSD: Yes
PSD Avoidance: No
NC Toxics: Yes
112(r): No
Other: N/A

Contact Data

Facility Contact	Authorized Contact	Technical Contact
William Simon EHS Manager (910) 375-6365 5 Connector Road, US 117 Faison, NC 28341	Steven Schaar Plant Manager (757) 556-3454 5 Connector Road, US 117 Faison, NC 28341	Kai Simonsen Air Permit Engineer (919) 428-0289 4242 Six Forks Road, Suite 1050 Raleigh, NC 27609

Application Data

Application Number: 8200152.18A
Date Received: 03/19/2018
Application Type: Modification
Application Schedule: PSD

Existing Permit Data

Existing Permit Number: 10386/R03
Existing Permit Issue Date: 04/07/2017
Existing Permit Expiration Date: 10/31/2019

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2017	20.85	166.90	509.38	175.19	96.90	62.58	18.36 [Formaldehyde]
2016	4.73	38.01	73.26	39.81	18.63	9.10	4.46 [Methanol (methyl alcohol)]

Review Engineer: Betty Gatano

Review Engineer's Signature: **Date:**

Comments / Recommendations:
Issue 10386/R04
Permit Issue Date:
Permit Expiration Date:

Table of Contents

1.0 Introduction and Purpose of Application

1.1 Facility Description & Proposed Change

Enviva Pellets Sampson, LLC (referred to as Enviva or the Sampson Plant throughout this document) currently holds Air Permit No. 10386R03 with an expiration date of October 31, 2019 for a wood pellets manufacturing plant near Faison in Sampson County, North Carolina. The plant began operation on October 3, 2016 and is currently permitted to produce up to 537,625 oven-dried tons (ODT) per year of wood pellets utilizing up to 75% softwood on a 12-month rolling basis. The plant consists of a log chipper, green wood hammermills, bark hog, wood-fired rotary dryer, dry hammermills, pellet presses and coolers, product loadout operations, and other ancillary activities.

This permit application is a Prevention of Significant Deterioration (PSD) permit modification for a proposed Softwood Expansion Project (SWEP). The SWEP is being implemented to meet new customer demands for increased softwood percentage and production rate and to incorporate emission reduction efforts to minimize emissions impacts associated with the project. The following summarizes the proposed physical changes and changes in the method of operation associated with the SWEP:

- Increase permitted production rate from 537,625 ODT per year to 657,000 ODT per year by upgrading pellet dies with a new prototype;
- Increase the amount of softwood processed from 75% to a maximum of 100%;
- Add a regenerative thermal oxidizer (RTO) (ID No. CD-RTO) following the current wet electrostatic precipitator (WESP) (ID No. CD-WESP) on the wood-fired direct heat drying system. The WESP and RTO will control volatile organic compound (VOC), hazardous air pollutants (HAP) and particulate matter (PM) emissions;
- Remove the green wood hammermill bin vents/baghouses and recirculate the exhaust directly to the WESP/RTO system (ID Nos. CD-WESP and CD-RTO) to reduce VOC, HAP and PM emissions;[11]
- Install a baghouse (ID No. CD-PSTB-BH) to control the pellet sampling transfer bin (ID No. ES-PSTB) PM emissions. The emission source is currently controlled via a bin vent filter (ID No. CD-DC-BV-3);
- Install the eighth dry hammermill (ID No. ES-HM-8) with associated product recovery cyclone and baghouse (ID No. CD-HM-BH8). This emission source is already permitted but not yet installed;
- Decrease the amount of wood assumed to bypass the dry hammermills (ID Nos. ES-HM-1 to through ES-HM-8) from 25% to 15%; and
- Add dry shavings handling (ID No. IES-DRYSHAVE) and storage silo to allow the facility to process purchased shavings that will not require drying.

In addition to changes associated with SWEP, the permit application addresses the following:

- Update site emissions to reflect existing insignificant activities including:
    - Four green wood storage piles (ID Nos. IES-GWSP-1 through 4), which replace the currently permitted green wood storage pile 1 and 2 (ID Nos. IES-GWSP-1 and 2);

[11] Permit application no. 8200152.18A proposed to recirculate the exhaust from the green wood hammermills to either the inlet of the dryer or directly to the WESP/RTO system (ID Nos. CD-WESP and CD-RTO) to reduce VOC, HAP and PM emissions. Enviva subsequently decided to choose the latter control configuration.

  - Green wood handling (ID No. IES-GHW) material transfer points (i.e., transfer of chips from trucks); and
  - Bark fuel storage piles (ID No. IES-BFSP-1 and 2).
- Add additive handling and storage (ID No. ES-ADD);
- Incorporate a new baghouse (ID No. CD-HMC-BH) installed to control emissions from the dry hammermill conveying system (ID No. ES-HMC) previously approved by NCDAQ;
- Update to HAP emission factors to reflect new testing data from the Sampson plant and other similar Enviva facilities;
- Update the diesel-fired emergency generator (ID No. IES-EG) rating to the as-built rating of 689 brake horsepower (bhp) instead of the proposed 536 bhp unit referenced in the initial PSD application;
- Update bin vent filter (ID No. CD-BF) and bagfilter (ID No. CD-BF) descriptions, which have been changed to baghouses (ID No. CD-BHs) to more accurately reflect control equipment used at the Sampson plant; and
- Clarify the use of the cyclones on the dry hammermills (ID No. ES-HM-1 to 8) and dryer (ID No. ES-DRYER). These cyclones are not used as air pollution control devices but rather are used for product recovery and, therefore, will be removed from the control device description in Section 1 of the Sampson plant's permit.

The permit application is being submitted as a PSD modification. Per 15A NCAC 02D .0530(r), the permit application shall be processed in accordance with the public participation procedures and requirements of 40 CFR 51.166(q). The draft permit will be sent out for public comment for a period of 30 days (to the Region, the US Environmental Protection Agency (US EPA), local newspaper, applicant, affected states, local city/county executives, and FLM as necessary). The NCDAQ Director has also determined a public hearing for this permit application is in the best interest of the public, and a public hearing will be held for the draft permit.

1.2 Plant Location

Enviva is located at 5 Connector Road, US 117, Faison, North Carolina, which is in northeastern Sampson County. Sampson County has been classified as in attainment for all pollutants subject to a National Ambient Air Quality Standard (NAAQS).

1.3 Permitting History

Permit	Date	Description
10386R00	November 17, 2014	Air Permit No. 10386R00 was issued for a greenfield facility to manufacture wood pellets in Sampson County. The proposed plant was designed to produce up to 537,625 ODT of wood pellets per year utilizing up to 75% softwood on a 12-month rolling total basis. The facility is PSD major, with the incorporation of applicable BACT limits in the permit.
10386R01	January 6, 2015	Air Permit No. 10386R01 was issued as an administrative amendment to correct the Regional Supervisor/Office listed in General Condition 1 in the permit.

Permit	Date	Description
10386R02	January 27, 2016	Air Permit No. 10386R02 was issued as a "Part 1" of a two-step significant modification under 15A NCAC 02Q .0501(b)(2). The following changes were made under this permit: • Added a third green wood hammermill (ID No. ES-GHM-3) controlled by a bagfilter (ID No. CD-GHM-BF-3), • Added a pellet sampling transfer bin (ID No. ES-PSTB) controlled by a bin vent filter (ID No. CD-DC-BV-3), • Added pellet cooler recirculation (ID No. ES-PCR) controlled by a bin vent filter (ID No. CD-PCR-BV), • Modified the emergency engine (ID No. IES-EG) and fire water pump engine (ID No. IES-FWP) to 536 horsepower and 131 horsepower, respectively, • Increased throughput through the green wood hammermills, and • Updated prior air dispersion modeling analysis to reflect the updated design of the facility.
10386R03	April 7, 2017	Air Permit No. 10386R03 was issued as an administrative amendment to add General Condition 17, "General Emissions Testing and Reporting Requirement," to the permit. This condition was inadvertently left out in the previous revision.
--	September 29, 2017	Permit application no. 8200152.17B for an initial Title V permit was received. This permit application will be processed separately from the PSD permit application 8200152.18A.
10386R03	September 21, 2018	Special Order by Consent (SOC) 2018-003 became effective on September 21, 2018. The SOC addressed exceedance of the Best Available Control Technology (BACT) limit for VOCs from the dryer. Enviva intends to install an RTO on the dryer prior to permit issuance. The SOC provides activities and milestones Enviva must meet until the PSD permit is issued.
SOC 2018-003	December 14, 2018	Installation of the RTO was completed on December 14, 2018.

1.4 Application Chronology

Date	Event
November 21, 2017	Pre-application meeting between NCDAQ and Enviva occurred.
March 19, 2018	PSD permit application received.
March 23, 2018	A permit application acknowledgment letter was issued indicating the permit application was incomplete for processing because the required permit fee was not received in full.
April 3, 2018	The remainder of the permit fee was received, at which point the permit application was deemed administratively complete for processing.
April 3, 2018	A letter was issued to Enviva indicating the application was deemed complete for PSD processing. This does not preclude the NCDAQ from requesting additional information to process the Air Permit.
April 3, 2018	A copy of permit application and air modeling was forwarded to US EPA Region 4.

Date	Event
April 5, 2018	Kevin Godwin, Permitting Engineer, forwarded an e-mail to Michael Carbon, consultant for Enviva, requesting additional information on the PSD permit application.
April 19, 2018	Enviva submitted a letter response to the information request.
May 9, 2018	Tom Anderson of the Air Quality Analysis Branch (AQAB) of NCDAQ e-mailed personnel from US Forest Service, the Fish and Wildlife Services, and the National Park Service informing them of the project. No response from any of these agencies has been received to date.
June 6, 2018	An addendum to the permit application was received via e-mail.
July 6, 2018	NCDAQ issued an additional information request letter to Enviva regarding emission testing, BACT analysis, and air modeling.
July 23, 2018	Nancy Jones of the AQAB issued a memorandum approving the air modeling submitted in support of the permit application.
July 25, 2018	Enviva submitted a letter response to the information request dated July 6, 2018.
August 2, 2018	The permit application was reassigned to Betty Gatano.
August 16, 2018	Nancy Jones issued a revised memorandum approving the air modeling. The air modeling was resubmitted on August 5, 2018 to ensure it corresponded with the modeling results contained in the permit addendum.
August 22, 2018	Conference call with Enviva on questions regarding BACT analysis and emission references.
August 27, 2018	Betty Gatano e-mailed Mike Carbon and Aubrey Jones, consultants for Enviva, to discuss additional questions on emission calculations and the BACT analyses and emission calculations.
September 17, 2018	Betty Gatano, Mike Carbon and Aubrey Jones discussed the questions via conference call. After the call, some issues remained and Enviva's consultants indicated they would provide an e-mail to address outstanding issues.
October 5, 2018	Betty Gatano received response from Enviva's consultants.
October 10, 2018	Draft permit and permit review forwarded to the NCDAQ staff for comments.
October 15, 2018	FRO received a letter dated October 10, 2018 from Enviva notifying the region that Enviva planned to recirculate exhaust from green wood hammermills through the dryer and the WESP (ID Nos. CD-WESP) and the RTO (ID No. CD-RTO), which was under construction at the time. This configuration was proposed in the permit application (8200152.18A).
October 17, 2018	Comments received from Steve Hall, Chief of the Technical Services Section of the NCDAQ and Greg Reeves of the Fayetteville Regional Office.
October 24, 2018	Comments received from Mark Cuilla, Permitting Supervisor.
October 26, 2018	Betty Gatano e-mailed Michael Carbon questions based on comments received on the draft permit and permit review. Mr. Carbon responded via e-mail on October 30, 2018.
October 30, 2018	Comments received from Booker Pullen, Permitting Supervisor, and Heather Carter, Supervisor of the FRO.
November 5, 2018	Second draft forwarded for internal review.
November 29, 2018	Betty Gatano called Kai Simonsen of Enviva to discuss how emission testing at Enviva facilities were used to develop emission factors for the Sampson facility. Mr. Simonsen provided detailed information in an e-mail dated December 5, 2018.

Date	Event
December 2018	Comments on the draft permit were focused primarily on the testing conditions. NCDAQ staff meet internally several times to discuss and revise the PSD testing condition.
December 17, 2018	Draft of permit and permit review forwarded to the Permittee for comments.
January 4, 2019	Enviva submitted initial comments on the draft permit and permit review.
January 18, 2019	NCDAQ met with Enviva to discuss the draft Sampson permit.
February 2, 2017	Enviva submitted revised comments on the draft permit and permit review. Enviva also submitted a letter dated February 1, 2019 discussing why reevaluation of the 112(g) Case-by-Case MACT for this facility was not applicable.
March 1, 2019	NCDAQ issued a letter to Enviva requiring a reconsideration of the 112(g) Case-by-Case MACT analysis on the pellet coolers and presses.
March 21, 2019	Alan McConnell, attorney for Enviva, submitted a letter on behalf of Enviva in response to the 112(g) reconsideration letter.
May 1, 2019	NCDAQ staff conduct a site visit to the Sampson facility.
May 3, 2019	Betty Gatano discussed issues that arose from the site visit with Michael Carbon.
May 10, 2019	Michael Carbon submitted a letter addressing questions that arose from the May 1, 2019 site visit at Sampson.
May 17, 2019	Revised draft of permit and permit review forwarded to the Permittee for comments.
May 23, 2019	FRO received a letter dated May 23, 2019 from Enviva requesting approval to modify the controls for the green wood hammermills during the planned shut down in July 2019. Exhaust from the green wood hammermills will be recirculated directly into the new WESP/RTO control system (ID Nos. CD-WESP and CD-RTO).
May 31, 2019	Enviva submitted comments on the revised draft permit and permit review.
May 31, 2019	A settlement agreement resolving the dispute between Enviva and NCDAQ regarding the 112(g) Case-by-Case MACT analysis on the pellet coolers and presses was signed.

2.0 Modified Emission Sources and Emissions Estimates

All emission sources at Enviva will potentially be impacted by the SWEP, with the exception of the emergency generator, fire water pump, and associated diesel fuel storage tanks. Equipment, process changes, emissions associated with this PSD modification are discussed in this section. Figure 1 below provides a schematic of the wood pellets manufacturing process at Enviva after completion of the SWEP.

2.1 Emission Sources

Green Wood Handling and Storage

"Green" (i.e., wet) wood is delivered to the plant via trucks as either pre-chipped wood or bark or unchipped logs. Purchased chips and bark are unloaded from trucks into hoppers. From the hoppers the chips and bark are fed to conveyors (ID No. IES-GWH) that transfer the material to green wood storage piles (ID Nos. IES-GWSP-1 through 4) or to bark fuel storage piles (ID Nos. IES-BFSP-1 and 2), as appropriate. Conveyors transferring green wood chips are enclosed.

Purchased chips are screened and oversized chips undergo additional chipping as needed prior to transfer to the green wood storage piles.

Debarking, Chipping, Bark Hog, and Bark Fuel Storage Piles and Bin

Unchipped logs are first debarked by the electric-powered rotary drum debarker (ID No. IES-DEBARK-1) and then sent to the chipper (ID No. IES-CHIP-1), which chips the wood to specification for drying. Bark generated from the debarker is transferred via conveyor to the bark hog (ID No. IES-BARKHOG) for further processing.

Purchased bark and bark generated onsite are transferred to the bark fuel storage piles (ID Nos. IES-BFSP-1 and 2) via conveyor. The primary bark fuel storage pile (ID No. IES-BFSP-1) is located under a covered structure. The secondary bark fuel storage pile (ID No. IES-BFSP-2) serves as overflow storage as needed. Following storage in the bark fuel storage piles, the bark is transferred via a walking floor, to a covered conveyor, and finally to a fully enclosed bark fuel bin (ID No. IES-BFB) where the material is pushed into the dryer furnace.

Green Wood Hammermills

Chipped wood is further processed in the green wood hammermills (ID No. ES-GHM-1, ES-GHM-2, and ES-GHM-3) to reduce material to proper size. Emissions from the green wood hammermills are currently recirculated through the dryer and the new WESP/RTO control system (ID Nos. CD-WESP and CD-RTO). During the planned July 2019 shutdown, Enviva will recirculate the vent streams directly into the new WESP/RTO control system (ID Nos. CD-WESP and CD-RTO) to control PM, VOC, and HAP emissions.

Dryer

The wood-fired direct heat drying system (ID No. ES-DRYER) (aka "the dryer" throughout this document) consists of a furnace and single rotary dryer, which is used to reduce the moisture content of processed green wood chips to a desired level. The direct contact heat is provided to the system via a 250.4 million British thermal unit per hour (MMBtu/hr) total heat input furnace burner system. Fuel for the furnace consists of self-generated and purchased bark; purchased fuel chips (lower grade than chips that are used in the pelletizing process) and off-specification raw material chips; thermally/ mechanically processed intermediate off-specification raw material; and off-specification wood pellets.

Wood from the dryer is routed to four (4) identical product recovery cyclones operating in parallel, which capture dried wood for further processing. The current permit (Air Permit No. 10386R03) describes these cyclones as control devices, and these descriptions will be removed as part of this permit modification. Emissions from the dryer cyclones are combined into a common duct and routed to the existing WESP (ID No. CD-WESP) for PM and metallic HAP removal. As part of this project, a propane/natural gas-fired RTO (ID No. CD-RTO) will be added following the existing WESP to provide further control of PM, VOC, and HAP emissions.

The furnace and rotary dryer both have bypass stacks used to exhaust hot gases for temperature control during start-ups, shutdowns, and malfunctions. Specifically, the furnace bypass stack is used for cold startups, malfunctions, and planned shutdowns, while the dryer bypass is used during malfunction and planned shutdowns.

Use of the furnace bypass stack for cold start-ups and shutdowns will be limited to 50 hours per year. The furnace may also operate in "idle mode" with emissions routed to the furnace bypass stack. The purpose of operation in "idle mode" is to maintain the temperature of the fire brick lining the furnace 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. The furnace may 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.

Dried Wood Handling

Dried materials from the dryer product recovery cyclones are conveyed to screening operations to remove smaller wood particles. These smaller particles are diverted to the dry hammermill discharge conveyor, while oversized wood is sent to the dry hammermills (ID Nos. ES-HM-1 through 8) for further size reduction prior to pelletization. As part of the SWEP, Enviva is proposing to reduce the amount of material that will bypass the dry hammermills from 25% to 15%. Dust generated from transfer operations around the screening operation is diverted to the dry hammermill area filtration system (ID No. ES-HMA) controlled by a baghouse (ID No. CD-PCHP-BH).

Several other conveyor transfer points located between the dryer and dry hammermills comprise the emission source collectively called dry wood handling (ID No. ES-DWH). This handling system is completely enclosed with two (2) emission points that are controlled by individual baghouses (ID Nos. CD-DWH-BH-1 and 2).

As part of the SWEP, Enviva is proposing to use purchased dry shavings to produce wood pellets. Because the purchased shavings will not require drying, they will not produce any VOC and HAP emissions from the drying process. Purchased dry shavings will be unloaded from trucks into a hopper that feeds material via enclosed conveyors to a bucket elevator that ultimately fills a silo. Each of these material transfer points will be entirely enclosed except for truck unloading (ID No. IES-DRYSHAVE). From the silo, the dry shavings will then be transferred via an enclosed screw conveyor to the dry hammermills for additional processing.

Dry Hammermills

Prior to pelletization, dried wood is reduced to the appropriate size using seven (7) existing dry hammermills operating in parallel (ID Nos. ES-HM-1 through ES-HM-7). Each dry hammermill includes a product recovery cyclone for capturing hammered wood for further processing. The current permit (Air Permit No. 10386R03) describes these cyclones as control devices, and these descriptions will be removed as part of this permit modification. PM emissions from each existing dry hammermill are controlled via one of the seven (7) individual baghouses (ID Nos. CD-HM-BH-1 through 7). Enviva will install an eighth dry hammermill (ID No. ES-HM-8) with associated product recovery cyclone and baghouse (ID No. CD-HM-BH8) as part of the SWEP. The eighth dry hammermill and associated controls have already been permitted.

Pellet Mill Feed Silo

Sized wood from the dry hammermill product recovery cyclones is transported by a set of conveyors to the pellet mill feed silo (ID No. ES-PMFS) prior to pelletization. PM emissions from the pellet mill feed silo are controlled by a baghouse (ID No. CD-PMFS-BH).

The conveyors from the product recovery cyclones to the pellet mill feed silo are referred to as the dry hammermill conveyors (ID Nos. ES-HMC), and emissions from these conveyors are controlled by a baghouse (ID NO. CD-HMC-BH).

Hammermill Area

An induced draft fan is used to transfer dust generated from several enclosed transfer/handling sources around the dry hammermill area (ID No. ES-HMA) to the pellet cooler high-pressure fines relay system (ID No. ES-PCHP) controlled by a baghouse (ID No. CD-PCHP-BH). Sources controlled by this baghouse include, but are not limited to, the following:

- Dry hammermill infeed and distribution transfer;
- Dry hammermill cyclone and baghouse drop out;
- Pellet cooler transfer (PM emissions from pellet cooler cyclones large enough to drop out of entrainment) and pellet screening;
- Dry hammermill pre-screen feeder emissions;
- Pellet screen fines cyclone; and
- Pellet fines relay system emissions.

Additive Handling

A dry powder additive is used in the pellet production process to increase the durability of the final product. The powder is added to sized wood from the dry hammermills prior to transfer to the pellet presses. The dry powder contains no hazardous chemicals or VOC materials.

Bulk additive material will be delivered by truck and pneumatically unloaded into a storage silo (ID No. ES-ADD) equipped with a baghouse (ID No. CD-ADD-BH) 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 that transfers milled wood to the pellet presses.

Pellet Press System and Pellet Coolers

Sized wood from the dry hammermills and dry fines collected from the pellet cooler HP fines relay system are mechanically compacted through pellet presses. Enviva has twelve (12) pellet presses at the facility. Exhaust from the pellet press system and pellet press conveyors are vented through the cooler aspiration cyclones and then to the atmosphere. No resin or other chemical binding agents are needed for pelletization. As part of the SWEP, Enviva is proposing to increase the permitted production rate from 537,625 ODT per year to 657,000 ODT per year by upgrading the pellet dies with a new prototype.

Heat is generated by compressing the pellets, and formed pellets are discharged into one of six (6) pellet coolers (ID Nos. ES-PCLR-1 through ES-PCLR-6) (i.e., two presses per cooler). Cooling air is passed through the pellets. The pellets contain a small amount of wood fines that are entrained in the cooling air and are controlled using six (6) cyclones (ID Nos. CD-CLR-1 through CD-CLR-6) operating in parallel prior to discharge to the atmosphere. Exhaust from the coolers are recirculated through the pellet cooler low pressure (LP) fines relay system (ID No. ES-PCLP), which is controlled by a baghouse (ID No. CD-PCLP-BH) that collects the fines from the cyclones to be reused in the process.

Pelletized wood is transferred from the pellet coolers to the truck loadout operation via a conveyor. PM emissions from conveyor are controlled by a baghouse (ID No. CD-PSTB-BH) on the pellet sampling transfer bin (ID Nos. ES-PSTB).

Finished Product Handling and Loadout

Final product is conveyed to four (4) pellet loadout bins (ID Nos. ES-PB-1 through ES-PB-4) that feed the two (2) truck loadout stations (ID Nos. ES-PL-1 and ES-PL-2). At both truck loadout stations, pellets are gravity fed into trucks through a covered chute that automatically telescopes upward during the loadout process to maintain constant contact with the product while loading to prevent fugitive PM emissions. Atmospheric emissions from pellet loadout are minimal because dried wood fines have been removed in the pellet screener, and a slight negative pressure is maintained in the loadout building as a fire prevention measure to prevent any buildup of dust on surfaces within the building. Slight negative pressure is produced via an induced draft fan that exhausts to the finished product handling baghouse (ID No. CD-FPH-BH). This baghouse controls emissions from finished product handling, which encompasses the pellet loadout bins (ID Nos. ES-PB-1 through ES-PB-4) and truck loadout operations (ID Nos. ES-PL-1 and ES-PL-2). Trucks are covered immediately after loading.

Emergency Generator, Fire Water Pump, and Diesel Fuel Storage Tanks

The plant currently has a 689 bhp diesel-fired emergency generator (ID No. IES-EG) and a 131 bhp diesel-fired fire water pump engine (ID No. IES-FWP). Aside from maintenance and readiness testing, the generator and fire water pump engines are only used for emergency operations.

Diesel for the emergency generator is stored in a tank of up to 2,500 gallons capacity (ID No. IES-TK-1) and diesel for the fire water pump is stored in a storage tank of up to 1,000 gallons capacity (ID No. IES-TK-2). A third diesel storage tank (ID No. IES-TK-3) with a capacity of 2,500 gallons is also located on-site.

The emergency generator, the fire water pump, and associated diesel fuel tanks will not be affected by the SWEP.

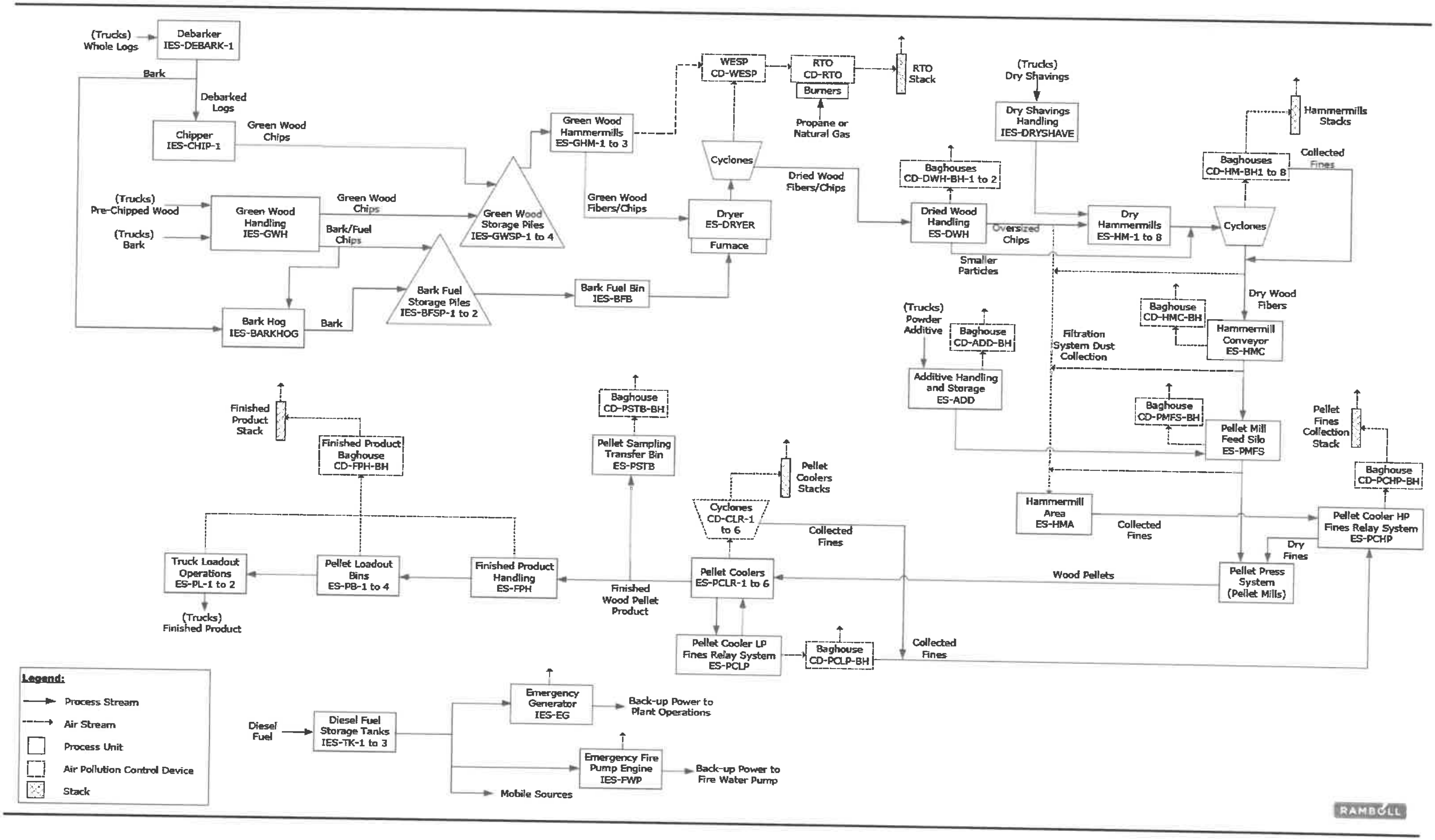

Figure 1. Process Flow Diagram of Pellet Manufacturing at Enviva

2.2 Emissions Associated with the Softwood Expansion Project

Emissions resulting from the proposed SWEP were reviewed to determine if the project is considered a major modification under PSD rules. All emission sources at Enviva are potentially impacted by the SWEP, with the exception of the emergency generator (ID No. IES-EG), the emergency fire water pump (ID No. IES-FWP), and the associated diesel fuel tanks. Emissions from these sources were excluded from review. Emissions from all other sources, as well as the proposed RTO (ID No. CD-RTO), were reviewed to determine PSD applicability.

Enviva assessed the applicability of PSD by performing a comparison test of baseline actual emissions (BAE) to potential emissions of the SWEP. Per 40 CFR 50.166(b)(7)(i), emission units that have existed for less than 2 years from the date of initial operation are, by definition, new emission units. Regulation 15A NCAC 02D .0530(b)(1)(B) specifies the following regarding BAE at new emission units:

> "For a new emission unit, the baseline actual emissions for purposes of determining the emissions increase that will result from the initial construction and operation of such unit shall equal zero and thereafter, for all other purposes, shall equal the unit's potential to emit."

Because Enviva began operation at the Sampson plant in October of 2016 and has been in operation for less than two years when this PSD permit application was submitted, the BAE for all project-impacted emission units are equal to the potential to emit, as originally permitted. The BAE for the SWEP are provided in Table 1 below.

Calculation of the potential emissions from the project are provided in Appendix C of the PSD permit application, and the SWEP emissions are summarized in Table 1 below. The increases in emissions associated with the SWEP were compared with the PSD significant emission rates (SER) for each PSD regulated pollutant to determine if the modification was major under PSD. As shown in the table, the emission increases exceed the SERs only for emissions of VOC and PM, and BACT analyses were conducted for these two pollutants.

Table 1. Emissions Associated with the SWEP

Pollutant	Baseline Actual Emissions (tpy)	Potential Project Emissions (tpy)	Emission Increase after Modification (tpy)	PSD Significant Threshold (tpy)	PSD Significant Modification? (Yes/No)
CO	230	219	-11	100	No
NO_X	219	219	-0.4	40	No
PM	169	239	70	25	**Yes**
PM_{10}	106	106	-0.1	15	No
$PM_{2.5}$	62	43	-20	10	No
SO_2	27.4	27.4	0	40	No
VOCs	627	840	214	40	**Yes**
CO_2e	229,828	256,230	26,402	75,000	No

Notes:

- Emissions include all emission sources except for emergency engines (ID Nos. IES-EG and IES-FWP) and associated diesel fuel tanks. These emission sources are not impacted by the SWEP.
- Baseline emissions are based on potential emissions as provided in previous Enviva Sampson PSD applications dated August 2014 and October 2015.

Table 1. Emissions Associated with the SWEP					
Pollutant	**Baseline Actual Emissions (tpy)**	**Potential Project Emissions (tpy)**	**Emission Increase after Modification (tpy)**	**PSD Significant Threshold (tpy)**	**PSD Significant Modification? (Yes/No)**

- Emissions for SWEP based on the following:
  - Emission factors developed, in part, from emission testing at other Enviva facilities.
  - Production rate of 657,000 ODT.
  - Maximum of 100% softwood processed.
  - Bypass of the dry hammermill estimated at 15%.
  - Control efficiency of the RTO estimated at 95% control of VOC.
- Detailed emission calculations are provided Appendix C of Air Permit Application No. 8200152.18A.
- CO_2 equivalent is defined as the sum of individual greenhouse gas pollutant emission times their global warming potential, converted to metric tons.

Table 2 below provides facility-wide emissions of criteria pollutants and greenhouse gases (GHGs) after the SWEP modification for all emission sources at Enviva, while Table 3 below provides facility-wide HAP emissions. As shown in Table 3, Enviva remains a major source of HAP emissions after the SWEP modification and installation of the RTO on the dryer and green wood hammermills, which will be rerouted to the WESP/RTO control system. Detailed emission calculations for each of these sources are provided in Appendix C of the permit application, and methodology for developing emission factors are discussed in Section 2.3 below.

Table 2. Facility-Wide Emissions after the SWEP Modification

Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NO_X (tpy)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)
IES-CHIP-1	Log Chipping	--	--	--	--	--	--	--	--	1.6	--
IES-BARKHOG	Bark Hog	--	--	--	--	0.24	0.13	0.13	--	0.30	--
ES-DRYER	250.4 MMBtu/hr wood-fired direct heat drying system	CD-WESP CD-RTO	WESP; RTO	219	219	33	33	33	27	51	256,230
ES-GHM-1 through 3	Three (3) Green Wood Hammermills	CD-WESP CD-RTO	WESP; RTO								
ES-HM-1 through 8	Eight (8) Dry Hammermills	CD-HM-BH1 through 8	Eight (8) baghouses	--	--	18	18	0.31	--	168	--
ES-HMC	Hammermill Conveying System	CD-HMC-BH	One (1) baghouse	--	--	0.23	0.23	0.23	--	--	--
ES-HMA	Hammermill Area	CD-PCLP-BH	One (1) baghouse	--	--	0.47	0.47	0.47	--	--	--
ES-PCLP	Pellet Cooler LP Fines Relay System										
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse	--	--	0.37	0.37	0.37	--	--	--
ES-CLR-1 through 6	Six (6) Pellet Coolers	CD-CLR-1 through 6	Six (6) simple cyclones (one on each cooler)	--	--	151	39	4.8	--	572	--
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--
ES-PSTB	Pellet Sampling Transfer Bin	CD-PSTB-BH	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse	--	--	1.3	1.2	0.02	--	--	--
ES-PB-1 through 4	Four (4) Pellet Loadout Bins										
ES-PL-1 and 2	Two (2) Pellet Mill Loadouts										
ES-DWH	Dried wood handling operations	CD-DWH-BH-1 through -2	Two (2) baghouses	--	--	0.30	0.30	0.30	--	41	--
ES-ADD	Additive Handling and Storage	CD-ADD-BH	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--
IES-GWH	Green wood handling operations	--	--	--	--	0.08	0.04	0.006	--	--	--
IES-TK-1	2,500 gal diesel storage tank	--	--	--	--	--	--	--	--	0.001	--
IES-TK-2	500 gal diesel storage tank	--	--	--	--	--	--	--	--	0.0002	--
IES-TK-3	3,000 gal diesel storage tank	--	--	--	--	--	--	--	--	0.002	--
IES-GWSP-1 through 4	Green wood storage piles	--	--	--	--	15	7.7	1.2	--	6.9	--
IES-BFSP-1 and 2	Bark fuel storage piles	--	--	--	--	0.64	0.32	0.05	--	0.29	--
IES-DRYSHAVE	Dry shavings material handling	--	--	--	--	0.05	0.03	0.004	--	--	--
IES-DEBARK-1	Debarker	--	--	--	--	1.1	0.62	0.62	--	--	--
IES-BFB[1]	Bark fuel bin	--	--	--	--	--	--	--	--	--	--
IES-EG	689 hp diesel-fired emergency generator	--	--	0.18	1.5	0.019	0.019	0.019	0.0019	0.02	195
IES-FWP	131 hp diesel-fired fire water pump	--	--	0.07	0.18	0.009	0.009	0.009	0.0005	0.01	50
--	Paved Roads	--	--	--	--	16	3.3	0.80	--	--	--
			Total Emissions:	**219**	**221**	**239**	**106**	**43**	**27**	**840**	**256,475**

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Table 3. Facility-Wide Emissions of HAPs after the SWEP Modification

Pollutant	RTO[1] (tpy)	ES-HM-1 through 8 (tpy)	ES-CLR-1 through 6 (tpy)	IES-EG (tpy)	IES-FWP (tpy)	ES-DWH (tpy)	IES-CHIP-1 (tpy)	IES-BARKHOG (tpy)	Total HAP (tpy)
Acetaldehyde	1.9	2.5	2.8	9.2E-04	1.8E-04	--	--	--	7.2
Acetophenone	1.8E-07	--	--	--	--	--	--	--	1.8E-07
Acrolein	1.1	3.0	17	1.1E-04	2.1E-05	--	--	--	21
Antimony & Compounds	6.3E-04	--	--	--	--	--	--	--	6.3E-04
Arsenic & Compounds	1.8E-03	--	--	--	--	--	--	--	1.8E-03
Benzo(a)pyrene	1.4E-04	--	--	2.3E-07	4.3E-08	--	--	--	1.4E-04
Benzene	0.33	--	--	1.1E-03	2.1E-04	--	--	--	0.33
Beryllium metal	8.9E-05	--	--	--	--	--	--	--	8.9E-05
Butadiene, 1,3-	--	--	--	4.7E-05	9.0E-06	--	--	--	5.6E-05
Cadmium Metal	4.8E-04	--	--	--	--	--	--	--	4.8E-04
Carbon tetrachloride	2.5E-03	--	--	--	--	--	--	--	2.5E-03
Chlorine	0.87	--	--	--	--	--	--	--	0.87
Chlorobenzene	1.8E-03	--	--	--	--	--	--	--	1.8E-03
Chloroform	1.5E-03	--	--	--	--	--	--	--	1.5E-03
Chromium VI	2.8E-04	--	--	--	--	--	--	--	2.8E-04
Chromium–Other compds	1.6E-03	--	--	--	--	--	--	--	1.6E-03
Cobalt compounds	5.3E-04	--	--	--	--	--	--	--	5.3E-04
Dichlorobenzene	1.6E-04	--	--	--	--	--	--	--	1.6E-04
Dichloroethane, 1,2-	1.6E-03	--	--	--	--	--	--	--	1.6E-03
Dichloropropane, 1,2-	1.8E-03	--	--	--	--	--	--	--	1.8E-03
Dinitrophenol, 2,4-	9.9E-06	--	--	--	--	--	--	--	9.9E-06
Di(2-ethylhexyl)phthalate	2.6E-06	--	--	--	--	--	--	--	2.6E-06
Ethyl benzene	1.7E-03	--	--	--	--	--	--	--	1.7E-03
Formaldehyde	1.2	2.2	10	1.4E-03	2.7E-04	0.28	--	--	14
Hexane	0.25	--	--	--	--	--	--	--	0.25
Hydrochloric acid	2.1	--	--	--	--	--	--	--	2.1
Lead and Lead Compounds	3.9E-03	--	--	--	--	--	--	--	3.9E-03
Manganese & Compounds	0.13	--	--	--	--	--	--	--	0.13
Mercury, vapor	3.1E-04	--	--	--	--	--	--	--	3.1E-04
Methanol	2.2	1.4	79	--	--	0.64	0.33	6.0E-02	83
Methyl bromide	8.2E-04	--	--	--	--	--	--	--	8.2E-04
Methyl chloride	1.3E-03	--	--	--	--	--	--	--	1.3E-03
Methylene chloride	1.6E-02	--	--	--	--	--	--	--	1.6E-02
Naphthalene	5.4E-03	--	--	1.0E-04	1.9E-05	--	--	--	5.5E-03
Nickel metal	2.9E-03	--	--	--	--	--	--	--	2.9E-03
Nitrophenol, 4-	6.0E-06	--	--	--	--	--	--	--	6.0E-06
Pentachlorophenol	5.6E-05	--	--	--	--	--	--	--	5.6E-05
Perchloroethylene	4.2E-02	--	--	--	--	--	--	--	4.2E-02
Phenol	1.3	1.1	8.3	--	--	--	--	--	11
Phosphorus Metal, Yellow or White	2.1E-03	--	--	--	--	--	--	--	2.1E-03
Polychlorinated Biphenyls	4.5E-07	--	--	--	--	--	--	--	4.5E-07
Propionaldehyde	0.48	5.3	3.5	--	--	--	--	--	9.3
Selenium Compounds	2.3E-04	--	--	--	--	--	--	--	2.3E-04
Styrene	0.10	--	--	--	--	--	--	--	0.10
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	4.7E-10	--	--	--	--	--	--	--	4.7E-10
Toluene	2.1E-03	--	--	4.9E-04	9.4E-05	--	--	--	2.7E-03
Total PAH (POM)	0.14	--	--	2.0E-04	3.9E-05	--	--	--	0.14
Trichloroethane, 1,1,1-	3.4E-02	--	--	--	--	--	--	--	3.4E-02
Trichloroethylene	1.6E-03	--	--	--	--	--	--	--	1.6E-03
Trichlorophenol, 2,4,6-	1.2E-06	--	--	--	--	--	--	--	1.2E-06
Vinyl Chloride	9.9E-04	--	--	--	--	--	--	--	9.9E-04
Xylene	1.4E-03	--	--	3.4E-04	6.5E-05	--	--	--	1.8E-03
Total HAP Emissions[2] (tpy)	**12**	**16**	**120**	**4.7E-03**	**8.9E-04**	**0.92**	**0.33**	**6.0E-02**	**149**
Maximum Individual HAP (tpy)	**Methanol**	**Propionaldehyde**	**Methanol**	**Formaldehyde**	**Formaldehyde**	**Methanol**	**Methanol**	**Methanol**	**Methanol**
Maximum Individual HAP Emissions (tpy)	**2.2**	**5.3**	**79**	**1.4E-03**	**2.7E-04**	**0.64**	**0.33**	**6.0E-02**	**83**

2.3 Methodology for Determining Emission Factors

As noted in Appendix C of the PSD permit application, many emission factors used in calculating emissions for the SWEP were based on emission testing at other Enviva facilities. The Permittee provided the following description of the methodology used in selecting appropriate emission factors for the Sampson facility.

Methodology for Deriving VOC Emission Factors

Step One: Review all available stack testing data across Enviva plants and determine which data are representative based on the specific source/equipment configuration for which emissions need to be quantified.

Step Two: Use lab/AP-42 derived VOC multipliers to convert each selected stack testing result to the desired pine percentage. More detail on VOC multipliers is provided below.

VOC Derived Multiplier

Laboratory tests were conducted using hardwood and softwood samples taken at various Enviva plants to evaluate VOC emissions as a function of pine percentage. Linear regression was performed on two laboratory datasets and the resulting equations were used to derive multipliers which can be used to extrapolate VOC emissions at varying pine percentage. Additionally, VOC softwood ratios were developed using US EPA's AP-42 Chapter 10.6.2 Particleboard Manufacturing VOC emission factors for rotary dryers processing 100% hardwood and 100% softwood. These laboratory derived multipliers as well as AP-42 multipliers were applied to the Enviva stack testing data to obtain VOC emission factors at 100% pine for the Sampson permit application.

Step Three: Review the adjusted stack testing data and based on engineering judgement, select the most appropriate emission factor. Depending on the size of the dataset and quality of the data available, the selected value may be either the maximum emission factor or the 95% upper confidence interval.

Step Four: Add safety factor to the emission factor based on engineering judgement.

Methodology for Deriving HAP Emission Factors

Step One: Review all available stack testing data across Enviva plants and determine which data are representative based on the specific source/equipment configuration for which emissions need to be quantified.

Step Two: Review the selected subset of stack testing data and based on engineering judgement select the most appropriate emission factor. Depending on the size and quality of the data available, the selected value may be either the maximum emission factor or the 95% upper confidence interval.

Step Three: Add safety factor to the emission factor based on engineering judgement.

The PSD permit will require extensive testing to verify the assumed emission factors and to ensure compliance with BACT and other emission limits.

3.0 Project Regulatory Review

The emission sources associated with the SWEP are subject to the following regulations. The SWEP affects all sources at the facility with the exception of the emergency generator, the fire pump, and the associated diesel fuel tanks.

3.1 Project Regulatory Review

- 15A NCAC 02D .0515, Particulates from Miscellaneous Industrial Processes – Numerous emission sources at Enviva are subject to 02D .0515. Allowable emissions of PM are calculated from the following equations:

  $E = 4.10 \times P^{0.67}$ for units with process weight rate less than 30 tons per hour
  or
  $E=55.0(P)^{0.11} - 40$ for units with process weight rates greater than 30 tons per hour

  where:
  E = allowable emission rate in pounds per hour calculated to three significant figures
  P = process weight rate in tons per hour

  According to the PSD application, the highest amount of PM is emitted from the proposed dryer and green wood hammermill system and the pellet presses and coolers. Compliance with 02D .0515 from these sources is discussed below.

  Throughput of the dryer and green wood hammermills is being increased under this permit application to 657,000 ODT/yr, with a short-term maximum hourly throughput of 120 ODT/hr. The allowable emission rate with the short-term maximum hourly throughput is calculated to be 53 lb/hr. The PM emission rate at the outlet of the RTO as reported in the permit application is 7.6 lb/hr, per vendor guarantee. Compliance is anticipated for the dryer system and green wood hammermills, and testing will be required in the revised permit to verify compliance.

  The short-term maximum hourly throughput through the pellet presses and coolers is also 120 ODT/hr, which results in an allowable emission rate of 53 lb/hr. Potential PM emissions from this emission source is estimated at a total of 34.4 lb/hr (151 tons per year (tpy)) (or 5.7 lb/hr per cyclone). Compliance is anticipated for the presses and coolers, and testing will be required in the revised permit to verify compliance.

  In addition to testing, Enviva ensures compliance with 02D .0515 with the effective operation of the control devices (i.e., cyclones, baghouses, WESP, and RTO, as appropriate). Enviva also conducts visual inspections of baghouses and cyclones monthly and conducts internal inspections of the baghouses annually. To ensure compliance and effective operation of the WESP, Enviva monitors and records the secondary voltage and minimum current through each grid of the precipitator daily. Enviva will also be required to conduct inspection and maintenance of the WESP and the RTO in accordance with the manufacturers' recommendations. Compliance is anticipated.

- 15A NCAC 02D .0516, Sulfur Dioxide Emissions from Combustion Sources – The wood-fired direct heat drying system (ID No. ES-DRYER) is subject to this rule and is limited to a sulfur dioxide emission rate of no more than 2.3 pounds sulfur dioxide (SO_2) per million Btu heat input. No monitoring, recordkeeping, or reporting is required when firing wood in the dryer system because of the low sulfur content of the fuel. Wood is inherently low enough in sulfur that continued compliance is anticipated.

- 15A NCAC 02D .0530, Prevention of Significant Deterioration – Enviva is a major source under PSD and previously triggered a facility-wide BACT analyses when the greenfield facility was permitted. BACT analyses were previously conducted for emissions of nitrogen oxides (NOx), VOC, PM/PM10/PM2.5, carbon monoxide (CO), and GHGs. The BACT emission limits for VOC and PM are being revised under this permit application, as discussed in detail in Section 4.0 below. The revised BACT permit condition is provided in Attachment 1. The BACT emission limits and controls for the other pollutants will remain the same, and continued compliance is anticipated.

- 15A NCAC 02D .0540, Particulates from Fugitive Dust Emissions – This condition is applicable facility-wide and is state-enforceable only. No changes are required for this permit modification, and continued compliance is anticipated.

- 15A NCAC 02D .1112, 112(g) Case-by-Case Maximum Achievable Control Technology – Enviva is a major source of HAPs and is subject to a Case-by-Case MACT determination under 112(g) of the Clean Air Act. More discussion on 112(g) Case-by-Case MACT for Enviva is provided below in Section 3.2.

3.2 112(g) Case-by-Case MACT Determination

Potential HAP emissions from Enviva exceed the major source threshold (i.e. 10 tons per year any single HAP or 25 tons per year combined HAP). Section 112(g) of the Clean Air Act requires any new or reconstructed stationary source that is not a regulated "source category" for which a NESHAP has been established to control emissions to the levels that reflect "maximum achievable control technology (MACT)." Because wood pellet manufacturing plants are not a regulated source category and emissions from the Sampson facility exceed the major source threshold, Enviva triggered a 112(g) analysis and underwent a Case-by-Case MACT determination as part of the initial PSD construction permitting process.

The discussion of the original 112(g) Case-by-Case MACT determination is provided in the permit review for Air Permit No. 10286R00, issued on November 17, 2014.[12] At that time, Enviva asserted its "drying and high-moisture pelletization process reduces uncontrolled emissions to levels significantly below that of its competitors that have installed RTO controls. These differences justify the classification of Enviva's process drying and pelletization process as a separate subcategory, not dependent upon use of RTO control technology to reduce VOC/HAP emissions." The NCDAQ concurred and concluded 112(g) Case-by-Case MACT was use of a low HAP emitting design for the dryer (ID No. ES-DRYER) without the addition of add-on controls and the Sampson plant was not subject to numeric HAP emission limits under Section 112(g).[13]

The 112(g) Case by Case MACT regulations as specified in 40 CFR 63.41 defines construction of a major source "as the fabrication, erection, or installation of a **new greenfield site** emitting greater

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[12] Kevin Godwin (11/17/2014).

[13] Application No. 8200152.14B, received 09/03/2014.

than the HAP major source thresholds, or of a new process or production unit at an existing site, provided the new process or production unit in and of itself emits above the HAP major source thresholds" [emphasis added]. The rule further defines process or production unit as "any collection of structures and/or equipment that processes, assembles, applies, or otherwise uses material inputs to produce or store an intermediate or final product."

Since Enviva has already begun operating the Sampson plant under the currently effective PSD permit, the proposed project does not constitute construction of a greenfield site as defined in 40 CFR 63.41. Furthermore, the proposed changes to the plant design do not constitute reconstruction of a major source. Per 40 CFR 63.41, reconstruction is defined as the replacement of components at an existing process or production unit such that the fixed capital cost of the new components exceeds 50% of that which would be required to construct a comparable new process or production unit. The "process or production unit" at the Sampson plant is the collection of all equipment used to manufacture the wood pellet product. The fixed capital costs associated with the proposed project are significantly less than 50% of the fixed capital costs that would be required to construct a comparable new wood pellet manufacturing facility. As such, the SWEP also does not constitute reconstruction of the process or production unit.

Based on this review, the proposed SWEP does not trigger a requirement to perform a new case-by-case MACT evaluation under Section 112(g), as the project does not constitute construction of a major source or reconstruction of the process or production unit. As part of the proposed project, Enviva is requesting an increase in the maximum amount of softwood that can be used from 75% up to a maximum of 100%. However, Enviva is also proposing to install an RTO to follow the WESP on the dryer exhaust which will significantly reduce emissions of VOC and organic HAP. In addition, the exhaust stream from the green wood hammermills (ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3) will be routed to the WESP/RTO system (ID Nos. CD-WESP/CD-RTO), which will control VOC and organic HAP emissions from the green wood hammermills. With the installation of the RTO, Enviva will surpass the level of control required under the original case-by-case MACT determination for the Sampson plant, and Enviva believes the intent of the original case-by-case MACT determination continues to be satisfied after completion of the proposed SWEP. The NCDAQ agrees, and case-by-case MACT remains the use of a low HAP emitting design for the dryer (ID No. ES-DRYER) without the addition of add-on controls and with no numeric HAP emission limits under Section 112(g).

Other HAP sources subject to 112(g) Case-by-Case MACT include the dry hammermills, the hammermill area, and the pellet presses and pellet coolers. According to the initial permit application (8200152.14B), no pellet presses (aka referred to as pellet mills) were using HAP control technologies on these emission sources at that time, and Air Permit No. 10386R00 was issued to Enviva on November 17, 2014, with the 112(g) Case-by-Case MACT for these sources of HAPs as no additional control.

NCDAQ subsequently discovered Georgia Biomass located in Waycross, Georgia and Florida Green Circle (now Enviva Pellets Cottondale, LLC) located in Jackson County, Florida both were controlling VOC emissions from the pellet presses at the time the initial permit application was submitted. Pursuant to 40 CFR 63.43(d)(1), MACT emission limitations or MACT requirements must not be less stringent than the emission control which is achieved in practice by the best controlled similar source. Because Enviva's determination did not consider controls on pellet presses and coolers at these other wood pellet manufacturing facilities, NCDAQ determined Enviva's 112(g)

Case-by-Case MACT determination for these emission sources did not meet requirements specified in 40 CFR 63.43(d)(1).

NCDAQ issued a letter dated March 1, 2019 requiring Enviva to undergo a revised 112(g) Case-by-Case MACT determination for the pellet coolers and presses and to submit an amended permit application for the revised determination in accordance with 40 CFR 63.43(e). Enviva responded in a letter dated March 21, 2019. In accordance with the settlement agreement dated May 31, 2019, resolving the dispute between Enviva and NCDAQ, Enviva must complete the following:

- Within six months of issuance of this permit (10386R04), Enviva shall submit to NCDAQ an application requesting authorization for installation of an RCO/RTO to control VOC and HAP emissions from the pellet presses and pellet coolers (ID Nos. ES-CLR-1 through ES-CLR-6)

- Installation and startup of the control on the pellet presses and coolers shall be completed by no later than June 1, 2021, provided that, if a permit authorizing the same is not issued until after June 1, 2020, installation and startup of the control device shall be completed within twelve months of permit issuance. Initial compliance for the RCO/RTO shall be demonstrated in accordance with the future issued permit.

- Within six months of issuance of this permit (10386R04), Enviva shall submit to NCDAQ an application requesting authorization for either (i) the installation of an RCO/RTO to control VOC and HAP emissions from the dry hammermills (ID Nos. ES-HM-1 through ES-HM-8), or (ii) an engineering solution that will result in an equivalent or greater reduction in VOC and HAP emissions from the dry hammermills.

- Installation and startup of the control device or engineering solution for the dry hammermills shall be completed by no later than June 1, 2021, provided that, if a permit authorizing the same is not issued until after June 1, 2020, installation and startup of the control device shall be completed within twelve months of permit issuance. Initial compliance for the RCO/RTO or engineering solution shall be demonstrated in accordance with the future issued permit.

3.3 Special Order by Consent

On August 15, 2018, Enviva entered into a Special Order by Consent (SOC) with the NCDAQ to address an exceedance of the BACT emission limit for VOC from the dryer (ID No. ES-DRYER). The SOC became effective on September 21, 2018.

During stack testing conducted on March 29, 2018, the three-run average of VOC emissions from the dryer was 1.21 pounds per ODT. This value exceeded the BACT emission limit of 1.07 pounds of VOC per ODT (i.e., the existing BACT emission limit). The NCDAQ issued a Notice of Violation/Notice of Recommendation for Enforcement on June 14, 2018 for this violation.

To reduce emissions and achieve compliance with the existing BACT emission limit, Enviva completed construction of the RTO used to control emissions from the dryer (ID No. ES-DRYER) and green wood hammermills (ID Nos. ES-GHM-1 through 3) on December 14, 2018, prior to issuance of a PSD permit for the RTO. Enviva acknowledges construction of the RTO prior to permit issuance constitutes a violation of 15A NCAC 02D .0530, Prevention of Significant Deterioration.

The SOC specifies milestones and timelines the Permittee must follow until the issuance of the PSD permit, including, but not limited to, the following:

- The Permittee must complete the RTO by January 25, 2019, which is 120 days of commencing construction of the RTO. Construction was completed on December 14, 2018.
- The Permittee must begin continuous operations of the RTO on the dryer by March 26, 2019, which is 180 days after commencement of construction of the RTO. Continuous operation began on December 14, 2018.
- The Permittee must submit an emission testing protocol at least 45 days prior to VOC emissions compliance test on the RTO). Test protocol was submitted on December 21, 2018.
- The Permittee must perform emission testing to demonstrate a VOC emission rate of 0.15 lb/ODT at the RTO outlet. Emission testing was conducted on February 7, 2019.
- The Permittee must submit a written report of the test results to the NCDAQ, within 30 days of completion of the test. The test report was submitted on March 6, 2019.
- The Permittee cannot process more than 50% softwood monthly during the duration of the SOC.

The SOC will expire upon the issuance of this air permit containing revised BACT limits or on December 31, 2019, whichever is sooner.

4.0 Prevention of Significant Deterioration

The basic goal of the PSD regulations is to ensure the air quality in clean (i.e. attainment) areas does not significantly deteriorate while maintaining a margin for future industrial growth. The PSD regulations focus on industrial facilities, both new and modified, that create large increases in the emission of certain pollutants. The US EPA promulgated final regulations governing the PSD in the Federal Register published August 7, 1980. Effective March 25, 1982, the NCDAQ received full authority from the US EPA to implement PSD regulations in the state. North Carolina has incorporated US EPA's PSD regulations (40 CFR 51.166) into its air pollution control regulations in 15A NCAC 02D .0530 and 02D .0531.

4.1 PSD Applicability

Under PSD requirements all major new or modified stationary sources of air pollutants regulated and listed in this section of the Clean Air Act must be reviewed and approved prior to construction by the permitting authority. A major stationary source is defined as any one of 28 named source categories that has the potential to emit 100 tons per year of any regulated pollutant or any other stationary source that has the potential to emit 250 tons per year of any PSD regulated pollutant.

Enviva is an existing major stationary source under PSD because it has the potential to emit VOCs in excess of 250 tons per year. This modification is a major modification under PSD because emissions of VOC and PM exceed their SER, as noted previously.

The elements of a PSD review are as follows:

1) A BACT Determination as determined by the permitting agency on a case-by-case basis in accordance with 40 CFR 51.166(j),

2) An Air Quality Impacts Analysis including Class I and Class II analyses, and
3) An Additional Impacts Analysis including effects on soils and vegetation and impacts on local visibility in accordance with 40 CFR 51.166(o).

4.2 BACT Analysis

Under PSD regulations, the basic control technology requirement is the evaluation and application of BACT. BACT is defined as follows [40 CFR 51.155 (b)(12)]:

> *An emissions limitation...based on the maximum degree of reduction for each pollutant... which would be emitted from any proposed major stationary source or major modification which the reviewing authority, on a case-by-case basis, taking into account energy, environment, and economic impacts and other costs, determines is achievable... for control of such a pollutant.*

As evidenced by the statutory definition of BACT, this technology determination must include a consideration of numerous factors. The structural and procedural framework upon which a decision should be made is not prescribed by Congress under the Act. This void in procedure has been filled by several guidance documents issued by the US EPA. The only final guidance available is the October 1980 "Prevention of Significant Deterioration – Workshop Manual." As the US EPA states on page II-B-1, "A BACT determination is dependent on the specific nature of the factors for that **particular case**. The depth of a BACT analysis should be based on the quantity and type of pollutants emitted and the **degree of expected air quality impacts**." (emphasis added). The US EPA has issued additional DRAFT guidance suggesting the use of what they refer to as a "top-down" BACT determination method. While the US EPA Environmental Appeals Board recognizes the top-down approach for delegated state agencies,[14] this procedure has never undergone rulemaking and as such, the process is not binding on fully approved states, including North Carolina.[15] The Division prefers to follow closely the statutory language when making a BACT determination and therefore bases the determination on an evaluation of the statutory factors contained in the definition of BACT in the Clean Air Act. As stated in the legislative history and in US EPA's final October 1980 PSD Workshop Manual, each case is different, and the State must decide how to weigh each of the various BACT factors. North Carolina is concerned that the application of US EPA's DRAFT suggesting a top-down process will result in decisions that are inconsistent with the Congressional intent of PSD and BACT. The following are passages from the legislative history of the Clean Air Act and provide valuable insight for state agencies when making BACT decisions.

> The decision regarding the actual implementation of best available technology is a key one, and the committee places this responsibility with the State, to be determined on a case-by-case judgment. It is recognized that the phrase has broad flexibility in how it should and can be interpreted, depending on site.
>
> In making this key decision on the technology to be used, the State is to take into account energy, environmental, and economic impacts and other costs of the application of best available control technology. The weight to be assigned to such factors is to be determined by the State. Such a flexible approach allows the adoption

[14] See, https://yosemite.epa.gov/oa/EAB_Web_Docket.nsf/PSD+Permit+Appeals+(CAA)?OpenView for various PSD appeals board decisions including standard for review.

[15] North Carolina has full authority to implement the PSD program, 40 CFR Sec. 52.1770

of improvements in technology to become widespread far more rapidly than would occur with a uniform Federal standard. The only Federal guidelines are the US EPA new source performance and hazardous emissions standards, which represent a floor for the State's decision.

This directive enables the State to consider the size of the plant, the increment of air quality which will be absorbed by any particular major emitting facility, and such other considerations as anticipated and desired economic growth for the area. This allows the States and local communities to judge how much of the defined increment of significant deterioration will be devoted to any major emitting facility. If, under the design which a major facility proposes, the percentage of increment would effectively prevent growth after the proposed major facility was completed, the State or local community could refuse to permit construction or limit its size. This is strictly a State and local decision; this legislation provides the parameters for that decision.

One of the cornerstones of a policy to keep clean areas clean is to require that new sources use the best available technology available to clean up pollution. One objection which has been raised to requiring the use of the best available pollution control technology is that a technology demonstrated to be applicable in one area of the country may not be applicable at a new facility in another area because of the differences in feedstock material, plant configuration, or other reasons. **For this and other reasons the Committee voted to permit emission limits based on the best available technology on a case-by-case judgment at the State level**. [emphasis added]. This flexibility should allow for such differences to be accommodated and still maximize the use of improved technology.

Legislative History of the Clean Air Act Amendments of 1977.

The BACT analyses provided by Enviva for the proposed project were conducted consistent with the above definition as well as US EPA's five step "top-down" BACT process. The "top down" methodology results in the selection of the most stringent control technology in consideration of the technical feasibility and the energy, environmental, and economic impacts. Control options are first identified for each pollutant subject to BACT and evaluated for their technical feasibility. Options found to be technically feasible are ranked in order of their effectiveness and then further evaluated for their energy, economic, and environmental impacts. In the event that the most stringent control identified is selected, no further analysis of impacts is performed. If the most stringent control is ruled out based upon economic, energy, or environmental impacts, the next most stringent technology is similarly evaluated until BACT is determined.

After establishing the baseline emissions levels required to meet any applicable NSPS, NESHAPs, or SIP limitations, the "top-down" procedure followed for each pollutant subject to BACT is outlined as follows:

- Step 1: Identify all available control options - from review of US EPA RACT/BACT/LAER Clearinghouse (RBLC), agency permits for similar sources, literature review and contacts with air pollution control system vendors.

- Step 2: Eliminate technically infeasible options - evaluation of each identified control to rule out those technologies that are not technically feasible (i.e., not available and applicable per US EPA guidance).
- Step 3: Rank remaining control technologies - "Top-down" analysis, involving ranking of control technology effectiveness.
- Step 4: Evaluate most effective controls and document results – Economic, energy, and environmental impact analyses are conducted if the "top" or most stringent control technology is not selected to determine if an option can be ruled out based on unreasonable economic, energy or environmental impacts.
- Step 5: Select the BACT – the highest-ranked option that cannot be eliminated is selected, which includes development of an achievable emission limitation based on that technology.

4.3. References Used to Identify Control Technologies

The references and methodologies discussed in this section were used to identify control technologies considered in the BACT analyses found in Sections 4.4 and 4.5.

- RACT/BACT/LAER Clearinghouse (RBLC) database located on EPA's Technology Transfer Network in the EPA electronic bulletin board system, as well as other agency on-line BACT listings. Specifically, the Permittee performed searches of the RBLC database using the following categories:
  - Wood lumber kilns (RBLC Code 30.800); and
  - Other wood products industry sources (RBLC Code 30.999).

- EPA Air Pollution Control Technology Fact Sheets and other EPA guidance and technical reports, which were relied upon as a reference for the likely achievable range of control for control equipment and/or for guidance regarding the BACT process;

- Vendor data; and,

- Professional knowledge and experience.

4.4. BACT Review for VOC Emission Sources

A BACT analysis is required for each new or modified emission source of VOC associated with the SWEP. The following are VOC emission sources evaluated for BACT as part of this PSD permit modification, and each emission source and its selected BACT are discussed in this section:

- Dryer System (ID No. ES-DRYER) and Green Wood Hammermills (ID Nos. ES-GHM-1 to ES-GHM-3);
- Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8);
- Dried Wood Handling (ID No. ES-HMC);
- Pellet Presses and Coolers (ID Nos. ES-CLR-1 to ES-CLR-6);
- Green Wood Storage Piles (ID Nos. IES-GWSP-1 to IES-GWSP-4) and Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 and IES-BFSP-2); and
- Log Chipping (ID No. IES-CHIP-1) and Bark Hog (ID No. IES-BARKHOG).

A description of each of these emission sources is provided above in Section 2.1.

4.4.1 Dryer (ID No. ES-DRYER) and Green Wood Hammermills (ID Nos. ES-GHM-1 to ES-GHM-3)

4.4.1.1 Identify Control Technologies

Based on the review of RBLC, relevant literature, and industry knowledge, the following control technologies were considered in the BACT analysis for VOC emissions from the dryer and green wood hammermills:

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

Thermal Oxidation

Thermal oxidation reduces VOC emissions by oxidizing VOC 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 RTOs. 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, with RTOs often having a thermal recovery efficiency of 95% to 99%. 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, RTOs are the only type of thermal oxidization considered in this BACT analysis.

An RTO uses high-density media such as a ceramic-packed bed still hot from a previous cycle to preheat an incoming VOC-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 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, unsafe operations such as fires, and/or significant operational and maintenance related difficulties. The existing WESP will serve as particulate control for the RTO. [16]

Catalytic Oxidation

Similar to an RTO, a regenerative catalytic oxidizer (RCO) and a thermal catalytic oxidizer (TCO) oxidize VOC to CO_2 and H_2O. However, RCO and TCO use catalyst to lower the activation energy

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

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 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. As with the RTO, particulate control must be placed upstream of the RCO to remove unwanted particulate matter, and the existing WESP will serve as particulate control. The risk of catalyst blinding/poisoning exists even with highly efficient particulate control, and catalyst life guarantees are relatively short. The VOC destruction efficiency for an RCO typically ranges from 90 to 99%.[5]

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

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.[17] Although some VOCs present in the dryer and green wood hammermill exhaust stream are highly soluble in water, alpha/beta-pinene, which make up the predominate species emitted, are only slightly soluble in water. The reduced solubility results in a significantly reduced VOC control efficiency for wet scrubbers.

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%.[18] Specifically, VOCs 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

[17] 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

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

has only been demonstrated on a single pilot scale installation that has a similar – but not exactly the same – exhaust stream profile as Enviva. Thermophilic microbes live and metabolize VOC at higher operating temperatures (~160 °F).

Carbon Adsorption
Carbon adsorption systems use an activated carbon bed to trap VOCs. As the exhaust gas stream passes through the activated carbon bed, VOC molecules are adsorbed onto the surface of the activated carbon, and clean exhaust gas is discharged to the atmosphere. A typical carbon adsorption system for continuous operation includes two activated carbon beds, such that one bed can be desorbing/idle while the other is adsorbing. When the activated carbon in one bed is spent and can no longer effectively adsorb VOC, the bed is taken off line for regeneration, and the VOC-containing gas stream is diverted to the fresh activated carbon bed. This switching allows for the source to operate continuously without shutting down. Regeneration of the sorbent can be achieved either via heating with steam or via vacuuming to remove VOC from the surface.

Depending on the application, carbon adsorption systems can typically achieve VOC control efficiencies of 95%.[19] Adsorption systems have been successfully used in industry types such as organic chemical processing, varnish manufacture, synthetic rubber manufacture, production of selected rubber products, pharmaceutical processing, graphic arts operations, food production, dry cleaning, synthetic fiber manufacture, pressure sensitive tape manufacturing, and other coating operations.

4.4.1.2 Eliminate Technically Infeasible Options

Wet Scrubbers
As discussed previously, wet scrubbers applied to exhaust gas streams such as those from dryer and green wood hammermills have limited control efficiency given the insolubility of a large portion of the exhaust stream. The 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 components removed from the exhaust stream. Because of the expected low control efficiency and additional environmental impacts, wet scrubbers are not considered technically feasible.

Bio-oxidation/Bio-filtration
Bio-oxidation/bio-filtration is effective in low temperature ranges, but at higher temperatures, cell components can begin to decompose and proteins within the cell's enzymes can become denatured and ineffective. The temperature of the exhaust steam from the dryer and green wood hammermills is expected to be 172 °F, which exceeds the typical operating temperatures of a bio-oxidation/bio-filtration system. Additionally, the primary constituents of the VOC in the exhaust stream are terpenes, which are highly viscous and would cause the bio-oxidation/bio-filtration system to foul. Furthermore, 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 the temperature limitations of this control technology, 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.

[19] New Jersey DEP's State of the Art (SOTA) *Manual for Chemical and Pharmaceutical Processing and Manufacturing Industries* (July 1997). http://www.state.nj.us/dep/aqpp/downloads/sota/sota5.pdf

Carbon Adsorption

Both the high temperature and high relative humidity of the combined exhaust stream for the dryer and green wood hammermills would limit the effectiveness of carbon adsorption as a VOC control technology for these sources. Carbon adsorption is not recommended for exhaust streams with relative humidity above 50% or temperatures above 150 °F. When the exhaust stream has a high relative humidity, the water molecules and VOCs in the exhaust stream compete for active adsorption site on the carbon, drastically reducing the efficiency and overall effectiveness of the adsorbent. Additionally, because heat is used to regenerate the carbon bed, the high exhaust stream temperatures would be in the range normally used to desorb VOCs from the carbon. Carbon adsorption is, therefore, determined to be technically infeasible for these sources.

4.4.1.3 Rank Remaining Control Technologies by Effectiveness

The remaining control technologies were ranked from the most stringent to the least stringent, as shown in the table below.

Control Technology	Approximate Control Efficiency (%)
RTO	95% to 99%
Catalytic Oxidizer	90% to 99%

4.4.1.4 Evaluate Technically Feasible Control Options

Enviva proposes to install an RTO to reduce VOC emissions from the dryer and green wood hammermills. Because the Permittee has selected the top-option for BACT, detailed economic, energy, and environmental information on the lower efficient option (i.e., the catalytic oxidizer) is not required.

4.4.1.5 Select BACT for VOC Emissions

An RTO is the selected BACT for the dryer and green wood hammermills. Enviva proposes a maximum emission rate of 0.15 lb /ODT as the BACT limit for VOC control of the dryer and green wood hammermills. The emission limit reflects new source test data acquired for similar Enviva facilities. Enviva will conduct testing to demonstrate compliance with the emission limit and to establish an operating temperature range for the RTO. The Permittee will also conduct associated monitoring, recordkeeping, and reporting to demonstrate compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined an RTO is BACT for VOC emissions from the dryer and green wood hammermills and the BACT emission limit is 0.15 lb of VOC /ODT from the dryer and green wood hammermills.

4.4.2 Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8)

4.4.2.1 Identify Control Technologies

The control technologies identified for control of VOC from the dry hammermills and a description of each add-on control device considered in the BACT analysis for VOC emissions from the dry hammermills is provided above in Section 4.4.1.1.

4.4.2.2 Eliminate Technically Infeasible Options

As described above in Section 4.4.1.2, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for the dry hammermills.

4.4.2.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.4.1.3 for ranking of the RTO and RCO.

4.4.2.4 Evaluate Technically Feasible Control Options

A BACT analysis, consistent with the Clean Air Act, was performed on the add-on control technologies that were shown to be technically feasible. Based on a review of literature and discussions with vendors, Enviva determined 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. An overview of annualized costs and cost effectiveness as documented in EPA's Air Pollution Control Technology Fact Sheet[20] is provided below:

Control Technology	Annualized Cost	Cost Effectiveness
RTO	$12 - $50 per scfm	$149 to $25,000 per ton
Catalytic Oxidizer	$16 to $63 scfm	$185 to $31,000 per ton
Notes: Cost ranges as expressed in 2018 dollars using Consumer Price Index Price Inflation calculator at https://www.bls.gov/data/inflation_calculator.htm.		

Because the same level of control is achieved at lower costs with the RTO, the evaluation of technically feasible options will only address the RTO.

<u>Assumptions Used in the BACT analysis</u>
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO ranges from 95 to 99%, with 95% selected as a conservative estimate. Other assumptions used in performing this analysis are included in the detailed cost calculations presented in Appendix F of the permit application. All cost estimates were prepared using potential VOC emission rates for the dry hammermills under the SWEP. Annual operational hours were assumed to be 8,760 per year.

<u>Cost Effectiveness</u>
The cost impacts of controlling VOC emissions from the dry hammermills with an RTO are presented in the table below. The cost impacts were estimated using the Office of Air Quality Planning and Standards Control Cost Manual (CCM),[21] operating experience, EPA Technology Fact

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

[21] <u>Office of Air Quality Planning and Standards Cost Control Manual</u>. Fourth Edition. EPA-450/3-90-006. Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, North Carolina. January 1990.

Sheet for RTOs, quotes for utilities, and vendor quotes for the RTO. All costs were updated to 2017 dollars using Consumer Price Index (CPI) Price Inflation calculator.[22]

Add-On Control Technology	Emissions (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	168	95%	159	$3,313,346	$20,818

Energy and Environmental Impacts

In addition to high cost effectiveness of this control device, the RTO also has associated negative energy and environmental impacts. The secondary environmental impacts are presented in the table below for the RTO. In the case of thermal oxidization, the combustion of natural gas would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG.

Control Technology	Emissions (tpy)					
	NOx	SO_2	PM	CO	VOC	GHG
RTO	3.96	0.016	0.21	2.31	0.30	3,819

Notes:

- Emissions based on an RTO with a heat input of 6.25 MMBtu/hr and operating at 8,760 hours per year.
- Burners on the RTO will combust either natural gas or propane. Potential emissions equal to the maximum emissions between natural gas and propane on a pollutant-by-pollutant basis.
- Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98 and AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
- Includes emissions of CO and NO_X generated during combustion of the VOC waste stream.

In addition to increased emissions, the RTO also requires an additional 5,028 Mw-hr/year consumption of electricity to operate.

4.4.2.5 Select BACT for VOC Emissions

The installation of add-on controls for VOC emissions from dry hammermills is not considered cost effective. Therefore, Enviva proposes good operating procedures as BACT for VOC emissions from the dry hammermills. Enviva also proposes a VOC emission limit of 0.60 lb/ODT from the dry hammermills. The proposed BACT emission limit reflects an increase in the softwood throughput to 100% and the production rate requested with this permit modification for the SWEP. The emission limit also reflects new source test data acquired for similar Enviva facilities.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from the dry hammermills and the BACT emission limit is 0.60 lb of VOC /ODT from the dry hammermills.

[22] Consumer Price Index Calculator developed by the US Department of Labor Bureau of Labor Statistics.

4.4.3 Dried Wood Handling (ID No. ES-DWH)

4.4.3.1 Identify Control Technologies

The control technologies identified for control of VOC from dried wood handling and a description of each add-on control device considered in the BACT analysis for VOC emissions from dried wood handling is provided above in Section 4.4.1.1.

4.4.3.2 Eliminate Technically Infeasible Options

As described above in Section 4.4.1.2, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for dry wood handling operations.

4.4.3.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.4.1.3 for ranking of the RTO and RCO.

4.4.3.4 Evaluate Technically Feasible Control Options

As noted in Section 4.4.2.4 above, the evaluation of technically feasible options will only address RTO controls because the same level of control is achieved at lower costs with the RTO.

Assumptions Used in the BACT analysis
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO ranges from 95 to 99%, with 95% selected as a conservative estimate. Other assumptions used in performing this analysis are included in the detailed cost calculations presented in Appendix F of the permit application. All cost estimates were prepared using potential VOC emission rates for dry wood handling under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness
The cost impacts of controlling VOC emissions from dry wood handling with an RTO are presented in the table below. The cost impacts were estimated using the CCM, operating experience, EPA Technology Fact Sheet for RTOs, quotes for utilities, and vendor quotes for the RTO. All costs were updated to 2017 dollars using CPI calculator.

Add-On Control Technology	Emissions from DWH (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
RTO	40.8	95%	38.8	$566,776	$14,619

Energy and Environmental Impacts
In addition to high cost effectiveness of this control device, the RTO also has associated negative energy and environmental impacts. The energy and secondary environmental impacts are presented in the table below for the RTO. In the case of thermal oxidization, the combustion of natural gas

would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG.

Control Technology	Emissions (tpy)					
	NOx	SO_2	PM	CO	VOC	GHG
RTO	2.87	0.012	0.15	1.69	0.22	2,751

Notes:

- Emissions based on an RTO with a heat input at 4.6 MMBtu/hr and operating at 8,000 hours per year.
- Burners on the RTO will combust either natural gas or propane. Potential emissions equal to the maximum emissions between natural gas and propane on a pollutant-by-pollutant basis.
- Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98 and AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
- Includes emissions of CO and NOx generated during combustion of the VOC waste stream.

In addition to increased emissions, the RTO also requires an additional 593 Mw/year consumption of electricity to operate.

4.4.3.5 Select BACT for VOC Emissions

The installation of add-on controls for VOC emissions from dry wood handling is not considered cost effective. Therefore, Enviva proposes good operating procedures as BACT for VOC emissions from dry wood handling. Enviva also proposes a VOC emission limit of 0.12 lb/ODT from the dry wood handling operations. The proposed BACT emission limit was derived from NCASI's Wood Products Database (February 2013)[23] for dry wood handling operations at an oriented strand board mill.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from the dry wood handling operations and the BACT emission limit is 0.12 lb of VOC /ODT from the dry wood handling operations.

4.4.4 Pellet Presses and Pellet Coolers (ID Nos. ES-CLR-1 to ES-CLR-6)

4.4.4.1 Identify Control Technologies

The control technologies identified for control of VOC from presses and coolers and a description of each add-on control device considered in the BACT analysis for VOC emissions from the presses and coolers is provided above in Section 4.4.1.1.

4.4.4.2 Eliminate Technically Infeasible Options

As described above in Section 4.4.2.1, wet scrubbers, bio-oxidation/bio-filtration, and carbon adsorption are not considered feasible control options for the wood pellet presses and coolers.

4.4.4.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.4.1.3 for ranking of the RTO and RCO.

[23] **National Council for Air and Stream Improvement (NCASI)**

4.4.4.4 Evaluate Technically Feasible Control Options

As noted in Section 4.4.2.4 above, the evaluation of technically feasible options will only address RTO controls because the same level of control is achieved at lower costs with the RTO.

Assumptions Used in the BACT analysis

To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The destruction efficiency of the RTO ranges from 95 to 99%, with 95% selected as a conservative estimate. Because PM emissions from the press and coolers are controlled only by cyclones, the cost of the RTO includes the cost of the baghouse, which is required to reduce PM emissions to an appropriate level prior to the RTO.

Other assumptions used in performing this analysis are included in the detailed cost calculations presented in Appendix F of the permit application. All cost estimates were prepared using potential VOC emission rates for the presses and coolers under the SWEP. Annual operational hours were assumed to be 8,760 per year.

Cost Effectiveness

The cost impacts of controlling VOC emissions from the presses and coolers with an RTO are presented in the table below. The cost impacts were estimated using the CCM, operating experience, EPA Technology Fact Sheet for RTOs, quotes for utilities, and vendor quotes for the RTO. All costs were updated to 2017 dollars using CPI calculator.

Add-On Control Technology	VOC Emissions from Presses and Coolers (tons/yr)	VOC Emissions Reduction (%)	VOC Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
Baghouse/RTO	572	95%	544	$3,800,354	$6,991

Energy and Environmental Impacts

In addition to high cost effectiveness of this control device, the RTO also has associated negative energy and environmental impacts. The energy and secondary environmental impacts are presented in the table below for the RTO. In the case of thermal oxidization, the combustion of natural gas would result in an increase of combustion pollutants, specifically, NO_x, SO_2, PM, CO, VOCs, and GHG.

Control Technology	Emissions (tpy)					
	NOx	SO_2	PM	CO	VOC	GHG
RTO	10.0	0.041	0.54	5.83	0.77	9,783

Notes:

- Emissions based on an RTO with a heat input of 16.25 MMBtu/hr and operating at 8,760 hours per year.
- Burners on the RTO will combust either natural gas or propane. Potential emissions equal to the maximum emissions between natural gas and propane on a pollutant-by-pollutant basis.
- Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98 and AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
- Includes emissions of CO and NOx generated during combustion of the VOC waste stream.

In addition to increased emissions, the RTO also requires an additional 5,589 Mw-hr/year consumption of electricity to operate.

4.4.4.5 Select BACT for VOC Emissions

The installation of add-on controls for VOC emissions from presses and coolers is not considered cost effective. Therefore, Enviva proposes good operating procedures as BACT for VOC emissions from these emission sources. Enviva also proposes a VOC emission limit of 1.74 lb/ODT from the presses and coolers. The proposed BACT emission limit reflects an increase in the softwood throughput to 100% and the production rate requested with this permit modification for the SWEP. The emission limit also reflects new source test data acquired for similar Enviva facilities. Enviva will conduct testing of the pellet presses and coolers to demonstrate compliance with the emission limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined good operating procedures is BACT for VOC emissions from presses and coolers and the BACT emission limit is 1.74 lb of VOC /ODT from these emission sources, based on a 3-hour average.

4.4.5 Green Wood Storage Piles (ID Nos. IES-GWSP-1 to IES-GWSP-4) and Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 and IES-BFSP-2)

4.4.5.1 Identify Control Technologies

The VOC emissions from the storage piles are fugitive. Because of the size of the piles, covering or enclosing the piles to capture VOC emissions is not feasible. Further, no work practice or operational measures are known that will reduce emissions of VOC from these source types, while allowing for proper function and operation.

4.4.5.2 Select BACT for VOC Emissions

Because no feasible control options exist to capture, control, or minimize the VOC emissions, Enviva proposes no control or work practices as BACT for VOC emissions from these emission sources. The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is no control or work practice standards for green wood and bark fuel storage piles.

4.4.6 Log Chipping (ID No. IES-CHIP-1) and Bark Hog (ID No. IES-BARKHOG)

4.4.6.1 Identify Control Technologies

The VOC emissions from the log chipper and bark hog are fugitive, which makes capturing and controlling emissions from these sources infeasible. Further, no work practice standards or operational measures are known that would reduce VOC emissions from these emission sources.

4.4.6.2 Select BACT for VOC Emissions

Because no feasible control options exist to capture, control, or minimize the VOC emissions, Enviva proposes no control or work practices as BACT for fugitive VOC emissions from these emission sources. The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is no control or work practice standards for log chipping and the bark hog.

4.5. BACT Review for PM Emission Sources

A BACT analysis is required for each new or modified emission source of PM associated with the SWEP. The following are PM emission sources evaluated for BACT as part of this PSD permit modification, and each emission source and its selected BACT are discussed in this section:

- Dryer System (ID No. ES-DRYER) and Green Wood Hammermills (ID Nos. ES-GHM-1 to ES-GHM-3);
- Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8);
- Dried Wood Handling (ID No. ES-HMC);
- Pellet Presses and Coolers (ID Nos. ES-CLR-1 to ES-CLR-6);
- Hammermill Conveying System (ID No. ES-HMC);
- Pellet Cooler LP Fines Relay System (ID No. ES-PCLP);
- Pellet Sampling Transfer Bin (ID No. ES-PSTB);
- Hammermill Area and Pellet Cooler HP Fines Relay System (ID Nos. ES-HMA and ES-PCHP);
- Pellet Mill Feed Silo (ID No. ES-PMFS);
- Finished Product Handling / Pellet Loadout Bins, and Pellet Mill Loadouts (ID Nos. ES-FPH, ES-PB-1 to 4, and ES-PL-1 and 2);
- Green Wood Handling (ID No. ES-GWH);
- Green Wood Storage Piles (ID Nos. IES-GWSP-1 to IES-GWSP-4) and Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 and IES-BFSP-2);
- Bark Fuel Bin (ID No. IES-BFB);
- Dry Shaving Material Handling (ID No. IES-DRYSHAVE);
- Debarker (ID No. IES-DEBARK);
- Bark Hog (ID No. IES-BARKHOG); and
- Paved Roads (--).

Log Chipping (ID No. IES-CHIP-1) occurs inside a building, and no PM10 or PM2.5 emissions are anticipated from this source.[24] Therefore, PM emissions from log chipping are considered negligible and are not quantified. A BACT analysis for PM emissions from log chipping was not conducted.

4.5.1 Dryer (ID No. ES-DRYER) and Green Wood Hammermills (ID Nos. ES-GHM-1 through ES-GHM-3)

4.5.1.1 Identify Control Technologies

Based on the review of RBLC, relevant literature, and industry knowledge, the following control technologies were considered in the BACT analysis for PM emissions from the dryer and green wood hammermills:

- Cyclone;
- Baghouse;
- Scrubber;
- Electrostatic Precipitator (ESP); and

[24] Emission factors for PM10 and PM2.5 for chipping and shaving from NCDAQ's "Woodworking Emissions Calculator Revision C July 2007."

- WESP.

Cyclone
Cyclones are frequently used for product recovery or emissions control of dry dusts and powders, and as primary collectors on high dust loading operations. Entrained particulate matter is removed in a cyclone through centrifugal and inertial forces. Thus, particulate-laden gas is forced to change direction and fall out of the gas stream where it accumulates and slides down the cyclone walls into a receiving vessel. The control efficiency range for conventional single cyclones is estimated to be 70 to 90% for PM.[25]

Baghouse
A fabric filtration device (baghouse) consists of several filtering elements (bags) along with a bag cleaning system contained in a main shell structure incorporating dust hoppers. Baghouses use fabric bags as filters to collect particulate matter. The particulate-laden gas enters a fabric filter compartment and passes through a layer of particulate and filter bags. The collected particulate forms a cake on the bag, which enhances the bag's filtering efficiency. However, excessive caking will increase the pressure drop across the fabric filter and reduce its efficiency. A phenomenon known as "blinding" occurs when cake builds up to the point that air can no longer pass through the baghouse during normal operation or the baghouse becomes clogged with wet and/or resinous compounds.

The particulate removal efficiency of baghouses depends on a variety of particle and operational characteristics. Particle characteristics that affect the collection efficiency include particle size distribution, particle cohesion characteristics, and particle electrical resistivity. Operational parameters that affect baghouse collection efficiency include air-to-cloth ratio, operating pressure loss, cleaning sequence, interval between cleanings, cleaning method, and cleaning intensity. In addition, the particle collection efficiency and size distribution can be affected by certain fabric properties (e.g., structure of fabric, fiber composition, and bag properties). Typical baghouse control efficiencies range between 99 and 99.9% for PM with a typical exhaust grain loading of 1 to 100 gr/scf.[26]

Wet Scrubber
As discussed above, wet scrubbers remove pollutants by inertial or diffusional impaction, reaction with a sorbent or reagent slurry, or absorption into a liquid solvent. In addition to VOCs, scrubbers can be used to control PM emissions; however, they are limited to applications in which dust loading is low. Collection efficiencies for PM removal range from 50 to 95%, depending on the application.[27]

Electrostatic Precipitator
ESPs remove particles from a gas stream using electrical forces. Discharge electrodes apply a negative charge to particles passing through a strong electrical field. These charged particles then migrate to a collecting electrode having an opposite, or positive, charge. Collected particles are

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[25] EPA, *Air Pollution Control Technology Fact Sheet, Cyclones,* EPA-452/F-03-005. https://www3.epa.gov/ttn/catc/dir1/fcyclon.pdf

[26] EPA, *Air Pollution Control Technology Fact Sheet, Fabric Filter – Pulse-Jet Cleaned Type (also referred to as Baghouses),* EPA-452/F-03-025. https://www3.epa.gov/ttn/catc/dir1/ff-pulse.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

removed from the collecting electrodes by periodic mechanical rapping. Typical PM control efficiencies for PM range between 99 and 99.9%.[28]

Wet Electrostatic Precipitator

Similar to ESPs, WESPs remove particles from a gas stream using electrical forces. Discharge electrodes apply a negative charge to particles passing through a strong electrical field. These charged particles then migrate to a collecting electrode having an opposite, or positive, charge. Unlike ESPs, collected particles in a WESP are removed from the collecting electrodes by washing utilizing a mild hydroxide solution to prevent build-up of resinous materials present in the dryer exhaust. WESPs, rather than ESPs, are used in the forest products industries for control of emissions from similar sources because ESPs cannot reliably operate due to resin build-up on collection electrodes. Typical PM control efficiencies for PM range between 99 and 99.9%.[29]

4.5.1.2 Eliminate Technically Infeasible Options

All PM control devices listed above in Section 4.5.1.1., with the exception of ESPs, are considered technically feasible. ESPs are not typically used in the forest products industries for control of emissions because ESPs cannot reliably operate due to resin build-up on collection electrodes.

4.5.1.3 Rank Remaining Control Technologies by Effectiveness

All technically feasible control technologies were ranked from the most stringent to the least stringent, as shown in the table below.

Control Technology	Approximate Control Efficiency (%)
WESP	99% to 99.9%
Baghouse	99% to 99.9%
Scrubber	50% to 95%
Cyclone	70% to 90%

4.5.1.4 Evaluate Technically Feasible Control Options

A WESP is currently installed on the dryer for PM control, and Enviva is proposing this control option as BACT for PM from the dryer and green wood hammermills. Because the Permittee has selected the top-option for BACT, detailed economic, energy, and environmental information on the lower efficient options is not required.

4.5.1.5 Select BACT for PM Emissions

A WESP (which is existing at the facility) is the selected BACT for PM controls for the dryer and green wood hammermills. Enviva proposes a maximum emission rate of 0.105 lb /ODT as the BACT limit for PM control of the dryer and green wood hammermills. The Permittee will conduct

[28] EPA, *Air Pollution Control Technology Fact Sheet, Dry Electrostatic Precipitator (ESP) – Wire-Plate Type,* EPA-452/F-03-028. https://www3.epa.gov/ttn/catc/dir1/fdespwpl.pdf

[29] EPA, *Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator (ESP) – Wire Plate Type,* EPA-452/F-03-030. https://www3.epa.gov/ttn/catc/dir1/fwespwpl.pdf

monitoring of the WESP and associated recordkeeping and reporting to demonstrate compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined a WESP is BACT for PM control for the dryer and green wood hammermills and the BACT emission limit is 0.105 lb of PM /ODT from the dryer and green wood hammermills.

4.5.2 Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8)

4.5.2.1 Identify Control Technologies

The control technologies identified for control of PM from the dry hammermills and a description of each add-on control device considered in the BACT analysis for PM emissions from the dry hammermills is provided above in Section 4.5.1.1.

4.5.2.2 Eliminate Technically Infeasible Options

All PM control devices listed above in Section 4.5.1.1., with the exception of ESPs, are considered technically feasible. ESPs are not typically used in the forest products industries for control of emissions because ESPs cannot reliably operate due to resin build-up on collection electrodes.

4.5.2.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.5.1.3 for ranking of control devices for PM control.

4.5.2.4 Evaluate Technically Feasible Control Options

Particulate matter emissions generated by the dry hammermills are currently controlled by individual baghouses, and Enviva is proposing this control option as BACT for PM from the dry hammermills. The control efficiency for the WESP and baghouse are similar, with both devices achieving upwards of 99.9% PM removal efficiency. Because the Permittee has selected the top-option for BACT, detailed economic, energy, and environmental information on the lower efficient options is not required.

4.5.2.5 Select BACT for PM Emissions

Baghouses, which are currently installed on the dry hammermills, are the selected BACT for PM controls for the dry hammermills. Enviva proposes a maximum emission rate of 0.004 gr/scf as the BACT limit for PM control of the dry hammermills. The Permittee will also conduct monitoring, recordkeeping, and reporting to ensure compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined baghouses are BACT for PM control for the dry hammermills and the BACT emission limit for PM is 0.004 gr/scf for the dry hammermills.

4.5.3 Dried Wood Handling (ID No. ES-DWH)

4.5.3.1 Identify Control Technologies

The control technologies identified for control of PM from dried wood handling and a description of each add-on control device considered in the BACT analysis for PM emissions from dried wood handling is provided above in Section 4.5.1.1.

4.5.3.2 Eliminate Technically Infeasible Options

All PM control devices listed above in Section 4.5.1.1., with the exception of ESPs, are considered technically feasible. ESPs are not typically used in the forest products industries for control of emissions because ESPs cannot reliably operate due to resin build-up on collection electrodes.

4.5.3.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.5.1.3 for ranking of control devices for PM control.

4.5.3.4 Evaluate Technically Feasible Control Options

Particulate matter emissions from dry wood handling are currently controlled by individual baghouses, and Enviva is proposing this control option as BACT for PM from the dry wood handling operations. The control efficiency for the WESP and baghouse are similar, with both devices achieving upwards of 99.9% PM removal efficiency. Because the Permittee has selected the top-option for BACT, detailed economic, energy, and environmental information on the lower efficient options is not required.

4.5.3.5 Select BACT for PM Emissions

Baghouses, which are currently installed on the dry wood handling operations, are the selected BACT for PM controls for this emission source. Enviva proposes a maximum emission rate of 0.004 gr/scf as the BACT limit for PM. The Permittee will also conduct monitoring of the baghouses, recordkeeping, and reporting to ensure compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined baghouses are BACT for PM control for dry wood handling operations and the BACT emission limit for PM is 0.004 gr/scf for the dry wood handling operations.

4.5.4 Pellet Presses and Pellet Coolers (ID Nos. ES-CLR-1 to ES-CLR-6)

4.5.4.1 Identify Control Technologies

The control technologies identified for control of PM from pellet presses and pellet coolers and a description of each add-on control device considered in the BACT analysis for PM emissions from the pellet presses and pellet coolers is provided above in Section 4.5.1.1.

4.5.4.2 Eliminate Technically Infeasible Options

All PM control devices listed above in Section 4.5.1.1., with the exception of ESPs, are considered technically feasible. ESPs are not typically used in the forest products industries for control of emissions because ESPs cannot reliably operate due to resin build-up on collection electrodes.

4.5.4.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.5.1.3 for ranking of control devices for PM control.

4.5.4.4 Evaluate Technically Feasible Control Options

A BACT analysis, consistent with the Clean Air Act, was performed on the add-on control technologies that were shown to be technically feasible. Based on a review of literature and discussions with vendors, Enviva determined that the baghouse is a more cost-effective control device than WESP and has essentially the same control efficiency. The wet scrubber is also less cost-effective than the baghouse. An overview of annualized costs and cost effectiveness as documented in EPA's Air Pollution Control Technology Fact Sheets is provided below:[30]

- A scrubber would achieve a lower PM control efficiency than a baghouse (typically in the range of 50-95%, depending on the application) and would have a higher annualized cost ($17 to $78 per scfm) compared to a baghouse ($6 to $39 per scfm).
- While a WESP would achieve a comparable PM removal efficiency to that of a baghouse, the annualized costs associated with a WESP would be higher ($9 to $47 per scfm for a WESP vs. $6 to $39 per scfm for a baghouse).

Because the same level of control is achieved at lower costs with the baghouse, other technically feasible options will not be address in the BACT analysis.

<u>Assumptions Used in the BACT analysis</u>
To perform the BACT analysis, it was necessary to make engineering judgments concerning the control efficiency of various add-on controls. The removal efficiency of a baghouse ranges from 99% to 99.9% and 99% was selected as a conservative estimate.

Other assumptions used in performing this analysis are included in the detailed cost calculations presented in Appendix F of the permit application. All cost estimates were prepared using potential PM emission rates for the coolers and presses under the SWEP. Annual operational hours were assumed to be 8,760 per year.

<u>Cost Effectiveness</u>
The cost impacts of controlling PM emissions from the coolers and presses with baghouses are presented in the table below. The cost impacts were estimated using the Office of Air Quality CCM operating experience, EPA Technology Fact Sheet for baghouses, quotes for utilities, and vendor quotes for the baghouse. All costs were updated to 2017 dollars using CPI inflation calculator.

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[30] EPA, *Air Pollution Control Technology Fact Sheet, Fabric Filter – Pulse-Jet Cleaned Type (also referred to as Baghouses)*, EPA-452/F-03-025. https://www3.epa.gov/ttn/catc/dir1/ff-pulse.pdf
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
EPA, *Air Pollution Control Technology Fact Sheet, Wet Electrostatic Precipitator (ESP) – Wire Plate Type*, EPA-452/F-03-030. https://www3.epa.gov/ttn/catc/dir1/fwespwpl.pdf

Add-On Control Technology	PM Emissions from Presses and Coolers (tons/yr)	PM Emissions Reduction (%)	PM Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
Baghouse	151	99%	149.5	$1,465,025	$9,807

Energy and Environmental Impacts
In addition to high cost effectiveness of this control device, baghouse also has associated negative energy and environmental impacts. The baghouse is anticipated to result in an additional 2,111 Mw-h/yr consumption of electricity. The installation of baghouses would also result in adverse impacts in the form of solid waste generated from the disposal of baghouse filter media.

4.5.4.5 Select BACT for PM Emissions

The installation of baghouses for control of PM emissions from the presses and coolers is not considered cost effective. Therefore, cyclones, which are currently used, are selected BACT for the presses and coolers. Enviva proposes a maximum emission rate of 0.04 gr/scf as the BACT limit for PM control of these emission sources. The Permittee will also conduct monitoring of the cyclones and associated recordkeeping and reporting to ensure compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined cyclones are BACT for PM control for the presses and coolers and the BACT emission limit for PM is 0.04 gr/scf for the presses and coolers.

4.5.6 Other PM Emission Sources Currently Controlled with Baghouses

This section discusses BACT for several similar PM emission sources at Enviva. These emission sources are all point sources and are currently controlled by baghouses. The BACT analyses for the following emission sources are discussed in this section:

- Hammermill Conveying System (ID No. ES-HMC);
- Pellet Cooler LP Fines System (ID No. ES-PCLP);
- Pellet Sampling Transfer Bin (ID No. ES-PSTB);
- Hammermill Area and Pellet Cooler HP Fines Relay System (ID Nos. ES-HMA and ES-PCHP);
- Pellet Mill Feed Silo (ID No. ES-PMFS); and
- Finished Product Handling / Pellet Loadout Bins, and Pellet Mill Loadouts (ID Nos. ES-FPH, ES-PB-1 to 4, and ES-PL-1 and 2).

4.5.6.1 Identify Control Technologies

The control technologies identified for control of PM emissions from the emission sources noted above and a description of each add-on control device is provided above in Section 4.5.1.1

4.5.6.2 Eliminate Technically Infeasible Options

All PM control devices listed above in Section 4.5.1.1., with the exception of ESPs, are considered technically feasible. ESPs are not typically used in the forest products industries for control of emissions because ESPs cannot reliably operate due to resin build-up on collection electrodes.

4.5.6.3 Rank Remaining Control Technologies by Effectiveness

Please refer to Section 4.5.1.3 for ranking of control devices for PM control.

4.5.6.4 Evaluate Technically Feasible Control Options

Particulate matter emissions from all these emission sources are currently controlled by associated baghouses. The control efficiency for the WESP and baghouse are similar, with both devices achieving upwards of 99.9% PM removal efficiency. Because the Permittee has selected the top-option for BACT, detailed economic, energy, and environmental information on the lower efficient options is not required.

4.5.6.5 Select BACT for PM Emissions

Baghouses, which are currently installed on these emission sources, are the selected BACT for PM controls. Enviva proposes a maximum emission rate of 0.004 gr/scf as the BACT limit for PM control for these sources controlled via a baghouse. The Permittee will also conduct monitoring, recordkeeping, and reporting to ensure compliance with the BACT limit.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined baghouses are BACT for PM control for the above noted sources and the BACT emission limit for PM is 0.004 gr/scf for these sources.

4.5.7 Green Wood Handling (ID No. IES-GWH)

Fugitive PM emissions result from unloading purchased chips and bark from trucks and hoppers and transferring these materials to the storage piles via conveyors.

4.5.7.1 Identify Control Technologies

Control technologies for the handling of the green wood handling include the following:

- Windscreen barriers
- Reduced drop heights from transfer points
- Use of water spray or wet suppression.

4.5.7.2 Eliminate Technically Infeasible Options

All the identified control options are technically feasible. However, use of water sprays or chemical suppressants would result in notable increases in emissions of criteria pollutants from the dryer due to combustion of additional fuel to remove the added moisture. Therefore, use of water spray or wet suppressants is not considered further.

4.5.7.3 Rank Remaining Control Technologies by Effectiveness

The remaining control options – windscreen barriers and reduced drop heights – have varying degrees of effectiveness depending on additional factors such as wind speed and direction. Therefore, both remaining options are equal in terms of effectiveness.

4.5.7.4 Evaluate Technically Feasible Control Options

Due to the inherently low emissions generated by the green wood handling (0.08 tpy PM), even a modestly low-cost windscreen would be considered cost prohibitive and would not result in a significant reduction in PM emissions. Reducing of drop heights is not possible for the unloading of trucks and reduction of emissions from varying the drop height from the conveyors to the storage piles would result in minimal emission reductions.

4.5.7.5 Select BACT for PM Emissions

Because of the low emissions associated with this source, controls are cost prohibitive or not effective. Therefore, Enviva proposes no control or work practices for BACT for PM emissions from the green wood handling. The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is no control or work practice standards for green wood handling.

4.5.8 Green Wood Storage Piles (ID Nos. IES-GWSP-1 to IES-GWSP-4) and Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 and IES-BFSP-2)

PM emissions from the storage piles are fugitive and occur due to wind erosion.

4.5.8.1 Identify Control Technologies

Control technologies for the storage piles include the following:

- Windscreen barriers
- Use of water spray or wet suppression.

4.5.8.2 Eliminate Technically Infeasible Options

Both the identified control options are technically feasible. However, use of water sprays or chemical suppressants would result in notable increases in emissions of criteria pollutants from the dryer due to combustion of additional fuel to remove the added moisture. Therefore, use of water spray or wet suppressants is not considered further.

4.5.8.3 Rank Remaining Control Technologies by Effectiveness

The only remaining control options is windscreen barriers.

4.5.8.4 Evaluate Technically Feasible Control Options

Due to the inherently low emissions generated by the green wood storage piles (15.9 tpy PM) and bark storage piles (0.64 tpy PM), even a modestly low-cost windscreen would be considered cost prohibitive and would not result in a significant reduction in PM emissions. Enviva provided cost estimates for a windscreen on the green wood storage piles on the to demonstrate the cost effectiveness of this control option. As shown in the table below, windscreen on the green wood storage piles is not cost-effective.

Control Technology	Emissions (tons/yr)	Emissions Reduction (%)	Emissions Reduction (tpy)	Annual Operating Cost ($/yr)	Cost - Effectiveness ($/Ton)
IES-GWSP-1 through 4	15.9	71%	11.3	$410,720	$36,346
Notes: The annual operating cost includes maintenance for the windscreen and indirect annual costs, the largest of which is capital recovery.					

4.5.8.5 Select BACT for PM Emissions

Because of the low emissions associated with this source, controls are cost prohibitive or not effective. Therefore, Enviva proposes no control or work practices for BACT for PM emissions from the storage piles. The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is no control or work practice standards for the storage piles.

4.5.9 Bark Fuel Bin (ID No. IES-BFB), Dry Shaving Material Handling (ID No. IES-DRYSHAVE), Debarker (ID No. IES-DEBARK), and Bark Hog (ID No. IES-BARKHOG)

This section discusses BACT for several similar PM emission sources at Enviva. PM emissions from these sources are insignificant (< 5 tpy per 15A NCAC 02Q .0503(8)) and are fugitive in nature. Because of the fugitive nature of these sources, no add-on controls are feasible. The only identified control technology /work practice standard for these emission sources is the use of water spray or wet suppression.

4.5.9.2 Eliminate Technically Infeasible Options

The use of water sprays or chemical suppressants would result in notable increases in emissions of criteria pollutants from the dryer due to combustion of additional fuel to remove the added moisture. Therefore, use of water spray or wet suppressants is not considered further.

4.5.9.3 Rank Remaining Control Technologies by Effectiveness

No control options or work practice standards are identified as technically feasible for these emission sources.

4.5.9.4 Evaluate Technically Feasible Control Options

No control options or work practice standards are identified for these emission sources.

4.5.9.5 Select BACT for PM Emissions

Because of the inherently low PM emissions from these sources and the lack of control options or work practices standards. Enviva proposes no control or work practices for BACT for PM emissions from these sources. The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is no control or work practice standards for these emission sources.

4.5.10 Paved Roads (--)

The PM emissions from the paved roads are fugitive, which makes add-on controls from this emission source infeasible. Work practices and pollution prevention are the only feasible means to minimize PM emissions from the paved roads. Based on the review of the RBLC, the following work practices options are considered under the BACT analyses:

- Application of water or wet suppressants;
- Control of vehicle speed
- Good housekeeping and maintenance practices, and
- Vacuuming or sweeping the roadways.

4.5.10.2 Eliminate Technically Infeasible Options

All the control options are considered technically feasible for minimizing PM emissions from paved roads.

4.5.10.3 Rank Remaining Control Technologies by Effectiveness

The control effectiveness for the work practices and pollution prevention options identified 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.

4.5.10.4 Evaluate Technically Feasible Control Options

As described above, the most effective control for minimizing PM emissions from paved roads is to implement a combination of work practices. Thus, no one work practice is considered the most effective control.

4.5.10.5 Select BACT for PM Emissions

The most effective control for the paved roads is a combination of work practices. Enviva proposes watering of paved roads, vehicle speed control, and good housekeeping as BACT for PM for paved roadways, which will reduce emissions by an estimated 90%.

The NCDAQ concurs with the Permittee's proposal. The NCDAQ has determined BACT is watering of paved roads, vehicle speed control, and good housekeeping as BACT for PM for paved roads.

4.6 Proposed BACT

Based on the BACT analyses for the PSD project discussed in Sections 4.4 and 4.5 above, the NCDAQ has determined the technology and limitations presented in the following table are BACT for these sources. The BACT permit condition for these emission sources is provided in Attachment 1 to this permit review.

Table 4. Summary of BACT Determinations for the Sampson Plant

Emission Source	Pollutant	Control Technology or Work Practice	Proposed Emission Limit	Averaging Period
Dryer System (ID No. ES-DRYER) / Green Wood Hammermills (ID Nos. ES-GHM-1 to 3)	VOC	RTO	0.15 lb /ODT	3-hour
	PM	WESP	0.105 lb/ODT (filterable only)	3-hour
Dry Hammermills (ID Nos. ES-HM-1 to ES-HM-8)	VOC	Good Operating Procedures	0.60 lb/ODT	3-hour
	PM	Baghouses	0.004 gr/scf	3-hour
Hammermill Conveying System (ID No. ES-HMC)	PM	Baghouse	0.004 gr/scf	3-hour
Dried Wood Handling (ID No. ES-DWH)	VOC	Good Operating Procedures	0.12 lb/ODT	3-hour
	PM	Baghouses	0.004 gr/scf	3-hour
Pellet Presses and Coolers (ID No. ES-CLR-1 to 6)	VOC	Good Operating Procedures	1.74 lb/ODT	3-hour
	PM	Cyclones - Proper Design and Good Operating Procedures	0.04 gr/scf	3-hour
Pellet Cooler LP Fines Relay System (ID No. ES-PCLP)	PM	Baghouse	0.004 gr/scf	3-hour
Pellet Sampling Transfer Bin (ID No. ES-PSTB)	PM	Baghouse	0.004 gr/scf	3-hour
Hammermill Area/Pellet Cooler HP Fines Relay System (ID No. ES-HMA and ES-PCHP)	PM	Baghouse	0.004 gr/scf	3-hour
Pellet Mill Feed Silo (ID No. ES-PMFS)				
Finished Product Handling/Pellet Loadout Bins/Pellet Mill Loadouts (ID Nos. ES-FPH, ES-PB-1 to 4/ ES-PL-1 and 2)				
Paved Roads --	PM	Combination of watering of paved roads, vehicle speed control, and good housekeeping	Not Applicable	
Green Wood Handling (ID No. IES-GWH)	PM	None	Not Applicable	
Green Wood Storage Piles (ID Nos. IES-GWSP-1 to 4)	VOC			
	PM			
Bark Fuel Storage Piles (ID Nos. IES-BFSP-1 to 2)	VOC			
	PM			
Bark Fuel Bin (ID No. IES-BFB)	PM			
Dry Shavings Material	PM			

Table 4. Summary of BACT Determinations for the Sampson Plant				
Emission Source	**Pollutant**	**Control Technology or Work Practice**	**Proposed Emission Limit**	**Averaging Period**
Handling (ID No. IES-DRYSHAVE)				
Debarker (ID No. IES-DEBARK-1)	PM			
Log Chipping (ID No. IES-CHIP-1)	VOC			
Bark Hog (ID No. IES-BARKHOG)	VOC			
	PM			

5.0 PSD Air Quality Impact Analysis

The PSD impact analyses described in this section were conducted in accordance with current PSD directives and modeling guidance. References are made to the US EPA, Draft October 1990, New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting, which will herein be referred to as the NSR Workshop Manual. [31]

5.1 Class II Area Significant Impact Air Quality Modeling Analysis

Two pollutants (PM and VOC) exceeded the PSD SER, as shown previously in Table 1, and thus, these pollutants require a PSD analysis. A significant impact analysis was conducted only for ozone precursors (i.e., NOx and VOC) because project emission increases were below SERs for the other PSD pollutants with Class II Area Significant Impact Levels (SIL).

5.1.1 Class II Area Tier 1 Screening Analysis for Ozone Precursors

A Tier 1 screening analysis was conducted to evaluate project precursor emissions impacts on secondary formation of ozone in Class II areas. The screening analysis was based on methodologies taken from EPA's draft *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program.* MERPs are defined as the screening emission level (tpy) above which project precursor emissions would conservatively be expected to have a significant impact on secondary PM2.5 or ozone formation. A MERP value is developed for each precursor pollutant from photochemical modeling validated by EPA and a "critical air quality threshold." The MERPs guidance relies on EPA's 2016 draft SILs for PM2.5 and ozone as the critical air quality threshold to develop conservative MERPs values. As such, NOx and VOC project emissions were assessed by separately derived ozone MERPs values. The project impacts on secondary ozone were determined by summing the VOC project emissions as a percentage of the VOC MERP with the NOx project emissions as a percentage of the NOx MERP. A value less than 100% indicates the combined impacts of VOC and NOx will not exceed the critical air quality threshold. As shown in Table 5, project impacts on 8-hour ozone were below the 100% threshold demonstrating that the project will not cause or contribute to a violation of the NAAQS for ozone.

Table 5. Results of Tier I Screening Analysis for Ozone Precursors

Precursor	MERP (tpy)	Emission Increase (tpy)	Percentage of MERP
NOx	170	0	0 %
VOC	1,159	214	18 %
		Total	18 %

5.2 Class II Area Full Impact Air Quality Modeling Analysis

Class II Area NAAQS and PSD Increment full impact analyses were not required because project emission increases were below SERs for PSD pollutants with established NAAQS and Class II Area PSD Increments.

[31] US EPA. *NSR Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting* (Draft October 1990). Retrieved from https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf

5.3 Non-Regulated Pollutant Impact Analysis

5.3.1 NC Air Toxics

All emission sources at Enviva that emit toxic air pollutants (TAPs) are considered by DAQ to be affected sources pursuant to 40 CFR Part 63 because they are subject to either a 112(g) Case-by-Case MACT or a MACT standard under 40 CFR Part 63. Such emission sources are exempt from NC Air Toxics in accordance with 15A NCAC 02Q .0702(a)(27)(b). For this permit application, Enviva (rather than the NCDAQ) has elected to demonstrate that increased TAP emissions associated with the SWEP would not present "an unacceptable risk to human health," in accordance with G.S. 143-215. 107(b) as codified on May 1, 2014.

An air toxics dispersion modeling analysis was conducted to evaluate ambient impacts of facility-wide TAPs. Emissions rates of TAPs were first compared with their associated TAP permitting emission rate (TPERs) in 15A NCAC 02Q .0711. Nine TAPs exceeded their TPER and were further evaluated in facility-wide modeling.

AERMOD (16216r) was run using surface data from Fayetteville and upper air data from Greensboro for 2016 processed with the adjust u* option. All toxics except acrolein were less than 50% of the AAL, so only acrolein was run using the five-year set from 2012-2016. Direction-specific building dimensions, determined using EPA's BPIP-Prime program (04274), were used as input to the model for building wake effect determination. EPA's AERMAP terrain processor was used to determine elevations. Receptors were spaced at 25 meters around the ambient boundary, at 100-meter intervals out to 800 meters, and at 500-meter intervals out to 10,000 meters from the facility.

The results of the modeling are provided in the table below. The modeling adequately demonstrates compliance on a source-by-source basis for all TAPS modeled. Therefore, the proposed SWEP will not present an "an unacceptable risk to human health," and no modeled emission limits will be included in the permit.

Table 6. Results of Air Toxics Maximum Impacts Modeling

Pollutant	Averaging Period	Maximum Impact ($\mu g/m^3$)	AAL ($\mu g/m^3$)	% of AAL
Acrolein	1-hour	66.9	80	84
Arsenic	Annual	1E-5	0.0021	<1
Benzene	Annual	5.3E-3	0.12	5
Cadmium	Annual	2.11E-6	0.0055	<1
Chlorine	1-hour	0.14	900	<1
	24-hour	0.046	37.5	<1
Formaldehyde	1-hour	42.4	150	28
Hydrogen Chloride	1-hour	0.33	700	<1
Manganese	24-hour	6.8E-3	31	<1
Phenol	1-hour	33.3	950	4

Notes:
Emissions factors for certain TAPs (including acrolein, formaldehyde, and phenol) are in lb/ODT. Emissions were calculated for these TAPs using the maximum short-term throughput for a worst-case emission estimate.

The air dispersion modeling above did not account for the scenario of the furnace or dryer during bypass mode. The worst-case TAP concentration was for acrolein, with a maximum modeled concentration that was 83.7% of the 1-hour AAL. The maximum potential hourly emissions of acrolein from the furnace bypass stack are approximately 39% of the potential acrolein emissions from the dryer line RTO stack during normal operation. Given the relative magnitude of the furnace bypass emissions and the fact that emissions will not be exiting the RTO stack and the furnace bypass stack simultaneously, the NCDAQ does not anticipate the bypass scenario will impact the overall modeling results. However, the NCDAQ has requested Enviva to conduct revised air modeling to include the bypass scenarios.

5.3.2 SAAQS

Emissions of PM from the SWEP were estimated above the SER of 25 tpy as specified under 40 CFR 51.166(b)(23), as shown previously in Table 1. While the total suspended particulate (TSP) NAAQS was revised in 1987 to narrow focus and regulation to PM10, North Carolina State Ambient Air Quality Standards (SAAQS) currently still require evaluation of both PM10 and TSP separately in accordance with 15A NCAC 02D .0403. As such, Enviva modeled facility-wide TSP project emissions using AERMOD and the same model setup as the TAPs modeling analyses to show project impacts were below the 24-hour and annual SAAQS as shown in Table 7.

Table 7. Results of TSP SAAQS Modeling

Averaging Period	Modeled Concentration (µg/m^3)	SAAQS (µg/m^3)	Exceeds SAAQS?
24-Hour	145	150	No
Annual	20.9	75	No

The air dispersion modeling did not account for the scenario of the furnace or dryer during bypass mode. The 24-hour average TSP emission rate for the furnace bypass stack is slightly less than the modeled TSP emission rate for the RTO stack during normal operations (7.22 lb/hr vs. 7.60 lb/hr, respectively). Given the relative magnitude of the furnace bypass emissions, it is anticipated that modeled concentrations for the furnace bypass scenario would be approximately the same as the modeled concentrations for normal operation. As noted above, the NCDAQ has requested Enviva to conduct revised air modeling to include the bypass scenarios.

5.4 Additional Impact Analysis

Additional impact analyses were conducted for ozone, growth, soils and vegetation, and visibility impairment.

5.4.1 Growth Impacts

The Enviva Sampson plant is an existing facility and no permanent jobs will be added due to the proposed project. Therefore, this project is not expected to cause a significant increase in growth in the area.

5.4.2 Soils and Vegetation

The impact on soils and vegetation was conservatively estimated by comparing the first high modeled 24-hour TSP concentration to the 24-hour secondary NAAQS for PM_{10}. As shown in Table 8, the Enviva project is not expected to cause any detrimental impacts to soil or vegetation in the area.

Table 8. Soils and Vegetation Impact Analysis			
Averaging Period	Modeled TSP Concentration (µg/m³)	Secondary PM_{10} NAAQS (µg/m³)	Exceeds Secondary NAAQS?
24-hour	145	150	No

5.4.3 Class II Visibility Impairment Analysis

A Class II visibility impairment analysis was not conducted because there are not any visibility sensitive areas within the Class II Significant Impact Area.

5.5 Class I Area - Additional Requirements

Three Federal Class I Areas are located within 300 km of the Enviva project – Swanquarter NWR, James River Face Wilderness, and Cape Romain National Wildlife Refuge. The Federal Land Manager for each of those areas was contacted and none of them required any analysis. Thus, no analysis was conducted.

5.5.1 Class I Area Significant Impact Level Analysis

A Class I Area significant impact screening analysis was not required because project emission increases were below SERs for PSD pollutants with established Class I PSD Increments.

5.5.2 Class I Increment/Air Quality Related Values (AQRV) Regional Haze Impact and Deposition Analyses

The project does not include significant emissions of pollutants with established Class I Area Increments or Deposition Analysis Thresholds. The project also does not include significant emissions of visibility-impairing pollutants such as NO_X, SO_2, PM2.5, and PM10. Therefore, analysis of project impacts on Class I Area Air Quality Related Values (AQRVs) was not required.

5.6 PSD Air Quality Modeling Result Summary

Based on the PSD air quality ambient impact analysis performed, the proposed Enviva Pellets Sampson, LLC modification will not cause or contribute to any violation of the Class II NAAQS, PSD increments, Class I increments, or any FLM AQRVs.

6.0 Other Issues

6.1 Compliance

NCDAQ has reviewed the compliance status of Enviva. Greg Reeves of FRO conducted the most recent compliance inspection at the facility on March 29, 2018. The Permittee appeared to be operating in compliance during the inspection, with the exception of emission exceedances as addressed in the SOC.

The Permittee has had the following compliance issues within the past five years:

- On February 3, 2017, Enviva was issued a Notice of Violation (NOV) for recordkeeping violations observed during an inspection on January 26, 2017
- On November 3, 2017, Enviva was issued a Notice of Violation/Notice of Recommendation for Enforcement (NOV/NRE) for exceeding the BACT emission limit for CO. During stack testing conducted April 18-19, 2017, the lowest three consecutive-run average of CO emissions was 0.224 pounds per million Btu, which exceeded the BACT limit of 0.21 pounds per million Btu.
- On March 5, 2018, Enviva was assessed a civil penalty in the amount of $5,333, including investigation costs, for the CO emission exceedance. The civil penalty was paid in full on March 26, 2018.
- On June 5, 2018, Enviva was issued a NOV/NRE for exceeding the BACT emission limit for VOC. During stack testing conducted March 29, 2018, the three-run average VOC emissions was 1.21 pounds per ODT, which exceeded the BACT emission limit of 1.07 pounds per ODT.
- On September 21, 2018, the NCDAQ and Enviva finalized an SOC addressing the exceedance of the BACT emission limit for VOC. The SOC will expire upon the issuance of the air permit containing revised BACT limits or on December 31, 2019, whichever is sooner.

6.2 Zoning Requirements

A local zoning consistency determination is required. A copy of the zoning consistency determination dated March 19, 2018 from the Clinton-Sampson Planning Department was received on March 22, 2018.

6.3 Professional Engineer's Seal

A Professional Engineer's seal was included with the application. Russell Kemp of RESU Engineers, P.C, is a Professional Engineer currently registered in the State of North Carolina. Mr. Kemp sealed the application for the portions containing the engineering plans, calculations, and all supporting documentation.

6.4 Application Fee

An application fee in the amount of $14,762.00 was received. The amount of $14,359.00 was received with the PSD permit application on March 19, 2018, and the remaining $403.00 was received on April 3, 2018.

6.5 Public Participation Requirements

In accordance with 40 CFR 51.166(q), public participation, the reviewing authority (NCDAQ) shall meet the following:

1) Make a preliminary determination whether construction should be approved, approved with conditions, or disapproved.

   This document satisfies this requirement providing a preliminary determination that construction should be approved consistent with the permit conditions described herein.

2) Make available in at least one location in each region in which the proposed source would be constructed a copy of all materials the applicant submitted, a copy of the preliminary determination, and a copy or summary of other materials, if any, considered in making the preliminary determination.

   This preliminary determination, application, and draft permit will be made available in the Fayetteville Regional Office and in the Raleigh Central Office, with the addresses provided below.

   Fayetteville Regional Office
Systel Building
225 Green Street, Suite 714
Fayetteville, NC 28301

   Raleigh Central Office
217 West Jones Street
Raleigh, NC 27603

   In addition, the preliminary determination and draft permit will be made available on the NCDAQ public notice webpage.

3) Notify the public, by advertisement in a newspaper of general circulation in each region in which the proposed source would be constructed, of the application, the preliminary determination, the degree of increment consumption that is expected from the source or modification, and of the opportunity for comment at a public hearing as well as written public comment.

   The NCDAQ prepared a public notice (See Attachment 2) that will be published in a newspaper of general circulation in the region.

4) Send a copy of the notice of public comment to the applicant, the Administrator and to officials and agencies having cognizance over the location where the proposed construction would occur as follows: Any other State or local air pollution control agencies, the chief executives of the city and county where the source would be located; any comprehensive regional land use planning agency, and any State, Federal Land Manager, or Indian Governing body whose lands may be affected by emissions from the source or modification.

   The NCDAQ will send the public notice (See Attachment 2) to the Sampson County manager at 406 County Complex Rd., Bldg C, Suite 110, Clinton, NC 28328.

5) Provide opportunity for a public hearing for interested persons to appear and submit written or oral comments on the air quality impact of the source, alternatives to it, the control technology required, and other appropriate considerations.

   The NCDAQ public notice (See Attachment 2) provides contact information to allow interested persons to submit comments and/or request a public hearing.

7.0 Conclusion

Based on the application submitted and the review of this proposal, the NCDAQ is making a preliminary determination that the project can be approved and a revised permit issued. After consideration of all comments, a final determination will be made.

Attachment 1
Permit Condition for BACT for the SWEP at Enviva Pellets Sampson, LLC

1. **15A NCAC 02D .0530: PREVENTION OF SIGNIFICANT DETERIORATION**

   a. The Permittee shall comply with all applicable provisions, including the notification, testing, reporting, recordkeeping, and monitoring requirements in accordance with 15A NCAC 02D .0530, "Prevention of Significant Deterioration of Air Quality" as promulgated in 40 CFR 51.166.

   a. The following emission limits shall not be exceeded except during periods of start-up, shut-down, or malfunction:

Emission Source	Pollutant	Control Technology or Work Practice	BACT Emission Limit	Averaging Period
Wood-fired Direct Heat Drying System **(ID No. ES-DRYER)**	NOx	Good Combustion Practices	0.20 lb/MMBtu	3-hour
	CO	Process Design	0.21 lb/MMBtu	3-hour
	GHG	Good Operating Practices	230,000 tpy (CO_2e)	Annual
Wood-fired Direct Heat Drying System **(ID No. ES-DRYER)** Green Wood Hammermills **(ID Nos. ES-GHM-1 to 3)**	VOC**	RTO	0.15 lb /ODT	3-hour
	PM/PM10/2.5	WESP	0.105 lb/ODT (filterable only)	3-hour
Dry Hammermills **(ID Nos. ES-HM-1 to ES-HM-8)**	VOC**	Good Operating Procedures	0.60 lb/ODT	3-hour
	PM	Baghouse	0.004 gr/scf	3-hour
	PM10		0.004 gr/scf (filterable only)	3-hour
	PM2.5		0.000014 gr/scf (filterable only)	3-hour
Hammermill Conveying System **(ID No. ES-HMC)**	PM	Baghouse	0.004 gr/scf	3-hour
Dried Wood Handling **(ID No. ES-DWH)**	VOC**	Good Operating Procedures	0.12 lb/ODT	3-hour
	PM	Baghouses	0.004 gr/scf	3-hour
Pellet Presses and Coolers **(ID No. ES-CLR-1 to 6)**	VOC**	Good Operating Procedures	1.74 lb/ODT	3-hour
	PM	Cyclones - Proper Design and Good Operating Procedures	0.04 gr/scf	3-hour
	PM10		0.0057 gr/scf (filterable only)	3-hour
	PM2.5		0.0007 gr/scf (filterable only)	3-hour
Pellet cooler LP Fines Relay System **(ID No. ES-PCLP)**	PM2.5/PM10/PM	Baghouse	0.004 gr/scf	3-hour
Pellet Sampling Transfer Bin **(ID No. ES-PSTB)**	PM2.5/PM10/PM	Baghouse	0.004 gr/scf	3-hour
Hammermill Area/Pellet cooler HP Fines Relay System **(ID No. ES-HMA and ES-PCHP)**	PM2.5/PM10/PM	Baghouse	0.004 gr/scf	3-hour

Emission Source	Pollutant	Control Technology or Work Practice	BACT Emission Limit	Averaging Period
Pellet Mill Feed Silo **(ID No. ES-PMFS)**	PM2.5/PM10/PM	Baghouse	0.004 gr/scf	3-hour
Finished Product Handling/Pellet Loadout Bins/Pellet Mill Loadouts **(ID Nos. ES-FPH, ES-PB-1 to 4/ ES-PL-1 and 2)**	PM	Baghouse	0.004 gr/scf	3-hour
	PM10	Baghouse	0.004 gr/scf	3-hour
	PM2.5	Baghouse	0.000014 gr/scf	3-hour
Paved Roads --	PM/PM10/PM2.5	Combination of watering of paved roads, vehicle speed control, and good housekeeping	Not Applicable	
Green Wood Handling **(ID No. IES-GWH)**	PM/PM10/PM2.5	None	Not Applicable	
Green Wood Storage Piles **(ID Nos. IES-GWSP-1 to 4)**	VOC			
	PM/PM10/PM2.5			
Bark Fuel Storage Piles **(ID Nos. IES-BFSP-1 to 2)**	VOC			
	PM/PM10/PM2.5			
Bark Fuel Bin **(ID No. IES-BFB)**	PM/PM10/PM2.5			
Dry Shavings Material Handling **(ID No. IES-DRYSHAVE)**	PM			
Debarker **(ID No. IES-DEBARK-1)**	PM/PM10/PM2.5			
Log Chipping **(ID No. IES-CHIP-1)**	VOC			
Bark Hog **(ID No. IES-BARKHOG)**	VOC			
	PM			
Diesel storage tanks	VOC	Good operation practices	Not Applicable	

* BACT emission limits shall apply at all times except the following: Emissions resulting from start-up, shutdown or malfunction above those given in this table are permitted provided that optimal operational practices are adhered to and periods of excess emissions are minimized.

** The VOC limit is expressed as alpha pinene basis per the procedures in EPA OTM 26.

<u>**Notifications**</u> [15A NCAC 02Q .0308(a)]

b. The completion of the Softwood Expansion Project (SWEP) is defined as the replacement of pellet presses that allow throughput of up to 657,000 ODT/year on an annual basis and the rerouting of the exhaust from the green wood hammermills **(ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3)** to the wet electrostatic precipitator **(ID No. CD-WESP)** and the regenerative thermal oxidizer **(ID No. CD-RTO)**. The Permittee shall notify the DAQ of the actual completion date of the SWEP postmarked within 15 days after such date.

<u>**Testing**</u> [15A NCAC 02Q .0308(a)]

d. <u>Initial Performance Tests</u> – Under the provisions of North Carolina General Statute 143-215.108, the Permittee shall demonstrate compliance with the BACT emission limits in Section 2.2 A.1.b above by conducting an initial performance test on the wood-fired direct heat drying system **(ID No. ES-DRYER)**, the green wood hammermills **(ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3)**, the dry hammermills **(ID Nos. ES-HM-1 through ES-HM-8)**, the dry wood handling operations **(ID Nos. ES-DWH)**, and the pellet presses and coolers **(ID Nos. ES-CLR-1 through ES-CLR-6)**. Initial testing shall be conducted in accordance with the following:

i. The pollutants and emission sources to be tested during the initial performance test are listed in the following table:

Emission Sources	Pollutant
Dryer system/green wood hammermills controlled via WESP and RTO	VOC
	PM/PM10/PM2.5
	NOx
	CO
One pellet cooler cyclone	VOC
	PM/PM10/PM2.5
One dry hammermill baghouse	VOC
	PM/PM10/PM2.5
Dry wood handling operations	VOC

ii. The Permittee shall conduct initial compliance testing in accordance with a testing protocol approved by the DAQ.

iii. The Permittee shall submit a protocol to DAQ at least 45 days prior to initial compliance testing and shall submit a notification of initial compliance testing at least 15 days in advance of the testing.

iv. The RTO **(ID No. CD-RTO)** is comprised of two fireboxes, each containing two temperature probes. During the initial compliance test, the Permittee shall establish the minimum average firebox temperature for each of the two fireboxes comprising the regenerative thermal oxidizer **(ID No. CD-RTO)**, for a total of two average temperatures per regenerative thermal oxidizer. "Average firebox temperature" means the average temperature of the two temperature probes in each firebox. The minimum average firebox temperature for each firebox shall be based upon the average temperature of the two temperature probes over the span of the test runs. Documentation for the minimum average firebox temperature for each firebox shall be submitted to the DAQ as part of the initial compliance test report.

v. Initial compliance testing shall be completed as follows:

(A) The Permittee shall be responsible for ensuring, within practicable limits, that the equipment or processes being tested are operated at or near the maximum normal production rate but at a rate not to exceed 71.71 ODT/hr (not to exceed 537,625 ODT/year on an annual basis).

(B) Testing shall be conducted at the maximum normal operating softwood percentage, not to exceed 80% softwood.

(C) Testing shall be completed and results submitted to the DAQ within 90 days of permit issuance, unless an alternate date is approved in advance by DAQ.

vi. Additional initial compliance testing upon completion of the SWEP shall be completed as follows:

(A) The Permittee shall be responsible for ensuring, within practicable limits, that the equipment or processes being tested are operated at or near the maximum normal production rate but at a rate not to exceed 120 ODT/hr (not to exceed 657,000 ODT/year on an annual basis).

(B) Testing shall be conducted at the maximum normal operating softwood percentage, not to exceed 80% softwood.

(C) Testing shall be completed and results submitted to the DAQ within 120 days completion of the construction of the SWEP, unless an alternate date is approved in advance by DAQ,

e. <u>Periodic Performance Tests</u> – Under the provisions of North Carolina General Statute 143-215.108, the Permittee shall demonstrate compliance with the BACT emission limits in Section 2.2 A.1.b above by conducting periodic performance tests on the wood-fired direct heat drying system **(ID No. ES-DRYER)**, the green wood hammermills **(ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3)**, the dry hammermills **(ID Nos. ES-HM-1 through ES-HM-8)**, and the pellet presses and coolers **(ID Nos. ES-CLR-1 through ES-CLR-6)**. Periodic testing shall be conducted in accordance with the following:

i. The pollutants and emission sources to be tested during the periodic performance tests are listed in the following table:

Emission Sources	Pollutant
Dryer system/green wood hammermills controlled via WESP and RTO	VOC
	PM/PM10/PM2.5
	NOx
	CO
One pellet cooler cyclone	VOC
	PM/PM10/PM2.5
One dry hammermill baghouse	VOC
	PM/PM10/PM2.5

ii. The Permittee shall conduct periodic compliance testing in accordance with a testing protocol approved by the DAQ.

iii. The Permittee shall submit a protocol to DAQ at least 45 days prior to periodic compliance testing and shall submit a notification of periodic compliance testing at least 15 days in advance of the testing.

iv. The Permittee shall be responsible for ensuring, within practicable limits, that the equipment or processes being tested are operated at or near the maximum normal production rate.

v. To the extent possible, testing shall be conducted at the maximum normal operating softwood percentage.

vi. The Permittee shall conduct periodic performance tests when the following conditions are met:

(A) The monthly average softwood content exceeds the average softwood percentage documented during prior performance testing by more than 10 percentage points, or

(B) The monthly production rate exceeds the average production rate documented during prior performance testing by more than 10 percentage points, or

(C) At a minimum testing shall be conducted annually, unless a longer duration is otherwise approved pursuant to Section 2.2.A.1.e.x. Annual performance tests shall be completed no later than 13 months after the previous performance test.

vii. The Permittee shall notify the DAQ within 15 days when the conditions specified in Section 2.2 A.1.e.vi (A) or (B) are met.

viii. The Permittee shall conduct the periodic performance test and submit a written report of the test results to the DAQ within 90 days from the date the monthly softwood content or overall production rate increased as described in Section 2.2 A.1.e.vi (A) and (B) above, unless an alternate date is approved in advance by DAQ,

ix. When periodic performance testing has occurred at 90 percent softwood AND at 90 percent of the maximum permitted throughput, subsequent periodic performance testing shall occur on an annual basis and shall be completed no later than 13 months after the previous performance test, unless a longer duration is otherwise approved pursuant to Section 2.2.A.1.e.x.

x. The Permittee may request that the performance tests be conducted less often for a given pollutant if the performance tests for at least 3 consecutive years show compliance with the emission limit. If the request is granted, the Permittee shall conduct a performance test no more than 36 months after the previous performance test for the given pollutant.

xi. If a performance test shows noncompliance with an emission limit for a given pollutant, the Permittee shall return to conducting annual performance tests (no later than 13 months after the previous performance test) for that pollutant.

xii. Except as specified in Section 2.2 A.1.e.viii above, the Permittee shall submit a written report of results for any periodic performance test to the DAQ, not later than 30 days after sample collection, in accordance with 15A NCAC 02D .2602(h).

xiii. The Permittee may re-establish any parametric operating value during periodic testing. Compliance with previously approved parametric operating values is not required during periodic required testing or other tests undertaken to re-establish parametric operating values by the Permittee. If the new parametric operating values re-established during periodic testing are more stringent, the Permittee shall submit a request to revise the value(s) in the permit at the same time the test report required pursuant to General Condition 17 is submitted. The permit revision will be processed pursuant to 15A NCAC 02Q .0514. If, during performance testing, the new parametric operating values are less stringent, the Permittee may request to revise the value(s) in the permit pursuant to 15A NCAC 02Q .0515.

xiv. The Permittee shall comply with applicable emission standards at all times, except as allowed by Section 2.2 A.1.b, including during periods of testing.

Monitoring/Recordkeeping [15ANCAC 02Q .0308(a)]

g. Regardless of the actual completion date of the SWEP, the Permittee shall complete the rerouting of the exhaust from green wood hammermills **(ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3)** to the wet electrostatic precipitator **(ID No. CD-WESP)** and the regenerative thermal oxidizer **(ID No. CD-RTO)** within twelve (12) months of permit issuance.

h. The Permittee shall not increase production beyond 537,625 oven-dried tons (ODT) of pellets per consecutive 12-month period (the permitted maximum production rate in Air Permit No. 10386R03) until exhaust from the green wood hammermills **(ID Nos. ES-GHM-1, ES-GHM-2, and ES-GHM-3)** has been rerouted to the wet electrostatic precipitator **(ID No. CD-WESP)** and the regenerative thermal oxidizer **(ID No. CD-RTO)**.

i. Upon completion of the SWEP, the Permittee shall not process more than 657,000 ODT of pellets per consecutive 12-month period. The process rate shall be recorded monthly in a logbook (written or electronic format) kept on-site and made available to an authorized representative upon request.

j. Upon completion of the SWEP, the Permittee shall not process more than 558,450 ODT of pellets per consecutive 12-month period (85% of the permitted maximum production rate of 657,000 ODT per consecutive 12-month period) from the eight dry hammermills **(ID Nos. ES-HM-1 through ES-HM-8)**. The dry hammermill process rate shall be recorded monthly in a logbook (written or electronic format) kept on-site and made available to an authorized representative upon request.

k. The Permittee shall record the hardwood/softwood mix monthly in a logbook (written or electronic format) kept on-site and made available to an authorized representative upon request.

l. The Permittee shall calculate the total emissions of NOx, filterable PM, CO, and VOC monthly and shall record the emissions monthly in a logbook (written or electronic format) kept on-site and made available to DAQ personnel upon request.

m. For the wood-fired direct heat drying system **(ID No. ES-DRYER)**, GHG (CO_2e) emissions shall be calculated monthly and compliance demonstrated using the applicable Part 98 emission factors. Compliance shall be documented on a 12-month rolling basis.

n. To ensure compliance and effective operation of the RTO **(ID No. CD-RTO)**, the Permittee shall maintain a 3-hour rolling average firebox temperature for each of the two fireboxes comprising the RTO at or above the minimum average temperatures established during the most recent performance testing. The Permittee shall maintain records of the 3-hour rolling average temperatures for each firebox. The Permittee shall also perform inspections and maintenance on the RTO as specified above in Section 2.1 A.1.h.

o. To ensure compliance and effective operation of the wet electrostatic precipitator **(ID No. CD-WESP)**, the Permittee shall perform inspections and maintenance as specified above in Section 2.1 A.1.h. The Permittee shall also maintain the minimum secondary voltage and minimum current of the wet electrostatic precipitator as specified above in Section 2.1 A.1.g.

p. To ensure compliance and effective operation of the baghouses and cyclones, the Permittee shall perform inspections and maintenance as specified above in Section 2.1 A.1.e.

q. Monitoring and recordkeeping are not required for the following emission sources:
   i. Paved roads;
   ii. VOC emissions from storage tanks; and
   iii. Emission sources with no BACT emission limits or work practice standards.

Reporting [15A NCAC 02Q .0308(a)]

r. The Permittee shall submit the results of any maintenance performed on the wet electrostatic precipitator, regenerative thermal oxidizer, cyclones, and/or baghouses within 30 days of a written request by the DAQ.

Attachment 2
Public Notice for Enviva Pellets Sampson, LLC

NOTICE FOR PUBLIC MEETING AND HEARING

PRELIMINARY DETERMINATION REGARDING APPROVAL OF AN AIR PERMIT APPLICATION SUBMITTED UNDER THE "REGULATIONS FOR THE PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY" FOR ENVIVA PELLETS SAMPSON, LLC

Enviva Pellets Sampson, LLC has applied to the North Carolina Department of Environmental Quality, Division of Air Quality for the installation of Best Available Control Technology on emission sources and an increase of production to 657,000 ODT per year associated with a Softwood Expansion Project at its wood pellet manufacturing facility located at:

5 Connector Road, US 117
Faison, NC 28341
Sampson County

The proposed project is subject to review and processing under North Carolina Administrative Code (NCAC), Title 15A, Subchapter 02D.0530, "Prevention of Significant Deterioration." The proposed project is defined as a "major modification" for the discharge of significant quantities of particulate matter and volatile organic compounds.

Enviva Pellets Sampson, LLC's application has been reviewed by the Division of Air Quality, Raleigh Central Office to determine compliance with the requirements of the North Carolina Environment Management Commission air pollution regulations. The results of that review led to the preliminary determination that the proposed project could be approved and the Division of Air Quality permit could be issued, if certain permit conditions are met.

This notice serves as a Notice of Public Meeting and Hearing and Opportunity for Public Comment for this proposal. The Public meeting and hearing will be held at the Sampson Community College, Activity Center, 1801 Sunset Ave., Clinton, NC 28328 on July 15, 2019 beginning at 6:30 p.m. (meeting) and 7:00 p.m. (hearing).

A copy of all data and the application submitted by Enviva Pellets Sampson, LLC and other material used by the Division of Air Quality in making this preliminary determination are available for public inspection during normal business hours at the following locations:

NC DEQ
Division of Air Quality
Air Permits Section
217 West Jones Street, Suite 4000
Raleigh, NC 27603

or

Fayetteville Regional Office
Systel Building
225 Green Street, Suite 714
Fayetteville, NC 28301-5094

Information on the proposed permit, the permit application, and staff review is posted in the DAQ website and is also available by writing or calling:

Betty Gatano, P.E.
NC DEQ
Division of Air Quality
1641 Mail Service Center
Raleigh, North Carolina 27699 1641
Telephone: 919 707 8736

Interested persons are invited to review these materials and submit written comments to Betty Gatano at the above address or to present oral or written comments at the Public Hearing. Persons wishing to present oral comments at the hearing should prepare their presentation to be three minutes or less. The public comment period begins on June 12, 2019 and will run through July 19, 2019.

Written comments may also be submitted during the public comment period via email at the following address:

DAQ.publiccomments@ncdenr.gov
Please type "Enviva Sampson.18A" in the subject line.

After weighing all relevant comments received by July 19 2019, and other available information on the project, the Division of Air Quality will act on the Enviva Pellets Sampson, LLC PSD application.

William D. Willets, P.E., Chief, Permitting Section
Division of Air Quality, NCDEQ

ATTACHEMNT B

NCDAQ Response to EIP/SELC Comments on BACT Analysis

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The Environmental Integrity Project (EIP) and the Southern Environmental Law Center (SELC) submitted detailed comments on July 19, 2019. Comments related specifically to the BACT analysis and other issues germane to the Draft Permit and Preliminary Determination are presented in this Attachment. The Hearing Officer's Report dated September 26, 2019 addresses all comments in the EIP/SELC letter, in addition to all other comments received during the public comment period from June 12, 2019 to July 19, 2019.

I. The Draft Permit's VOC BACT Determinations are Deeply Flawed and Establish an Unacceptable Precedent.

A. Post-Dryer VOC Controls are Now Industry Standard and Constitute BACT.

DAQ disagrees that an "industry standard" defines BACT. BACT requires a case-by case, state-by-state analysis defined by economic, environmental, and energy factors. While control technology in place in other parts of the country at other facilities can provide valuable input for a state's permitting decision, it cannot substitute for the case-by-case analysis required by the Clean Air Act. Indeed, it is well established that in the context of the case-by-case analysis required under BACT, there is no guarantee that a new facility in one area will have the same emissions or the same control technology requirements as the same type of facility in another area.1

B. Enviva's BACT Determination is Also Contrary to Recent BACT Determinations for Similar Pellet Mills

DAQ disagrees its BACT determination for Enviva Sampson is "contrary" to recent BACT determinations for similar pellet mills. A BACT determination is a case-by-case, state-by-state analysis and is specific to a given facility. Control devices determined to be BACT for one facility or multiple facilities are not by default deemed BACT at other similar facilities. Equipment and labor costs, fuel availability (e.g., natural gas vs. propane), waste disposal options, and other factors vary across the country and may result in a control option being deemed not cost effective in one area while being considered cost effective in others.

Further, while the three facilities with recent BACT decisions cited in the EIP/SELC letter were not specifically identified in Enviva Sampson's BACT analysis, the controls used by these facilities – regenerative thermal oxidizers (RTOs) and regenerative catalytic oxidizers (RCOs) – were included. DAQ ultimately eliminated these control devices as BACT for the dry hammermills, pellet coolers and presses (PPCs), and dry wood handling at Enviva Sampson due to economic, environmental, and energy impacts as discussed.

1. Texas BACT Determination for German Pellets.

EIP/SELC letter refers to a BACT determination made by the Texas Commission for Environmental Quality (TCEQ) regarding German Pellets. Texas applies a different methodology for determining BACT than North Carolina. TCEQ has developed a three-tiered approach to evaluate BACT proposals in NSR air permit applications. A BACT

1 See EPA, Guidance for Determining BACT Under PSD (1974), available at https://www.epa.gov/sites/production/files/2015-07/documents/bactupsd.pdf

evaluation begins at the Tier I and progresses in sequence to the Tier II and Tier III only if necessary. [2] The TCEQ determined a Tier I BACT was applicable for German Pellets, which means the technical practicability and economic reasonableness of RCOs/RTOs at reducing VOC have been demonstrated for the industry.

The three-tiered approach to BACT analysis differs from EPA's "top-down" process. The "top down" methodology results in the selection of the most stringent control technology in consideration of the technical feasibility and the economic, environmental, and energy impacts. Control options are first identified for each pollutant subject to BACT and evaluated for their technical feasibility. Options found to be technically feasible are ranked in order of their control efficiency and then further evaluated for their economic, environmental, and energy impacts. In the event the most stringent control identified is selected, no further analysis of impacts is performed. If the most stringent control is ruled out based upon economic, environmental, or energy impacts, the next most stringent technology is similarly evaluated until BACT is determined.

EPA's "top down" approach does not establish controls that are deemed technical practicable and economic reasonable across an industry (i.e., the Tier 1 approach). Rather, controls are evaluated for each specific facility based on technical feasibility, control efficiency, and economic, environmental, and energy impacts.

EPA has approved the North Carolina State Implementation Plan, making DAQ the permitting authority for New Source Review permitting program in the State. DAQ's evaluation of BACT at Enviva Sampson is consistent with methodology used by the Division and is in line with a "top-down" BACT process.

2 Louisiana BACT Determination for Drax Morehouse

The EIP/SELC letter refers to a BACT determination made in connection with the Drax Morehouse wood pellets facility in Louisiana. As discussed above, a BACT analysis is a site-specific, case-by-case, state-by-state evaluation. Controls that may be cost effective in one part of the country (Louisiana) may not be cost effective elsewhere (North Carolina). One example of regional differences in the BACT analyses at Drax and Enviva Sampson is in the cost of natural gas, which is much lower in Louisiana than in North Carolina. The cost of natural gas was $3.96/1,000 scf in Louisiana in December 2018 compared to $6.57/1,000 scf in North Carolina (165% higher cost) during that same time period. Further, natural gas is not currently available at the Enviva Sampson site, and the cost of the more expensive propane was used in control cost estimates at Enviva Sampson. Because of the regional cost differences among other factors (e.g., softwood percentage, throughput, etc.), any conclusions drawn from the Drax Morehouse BACT determination are not appropriate for the situation at Enviva Sampson.

3. Florida BACT Determination for Enviva Cottondale

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2 Air Pollution Control How to Conduct a Pollution Control Evaluation, TCEQ, retrieved from https://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/airpoll_guidance.pdf

The EIP/SELC letter refers to a BACT determination made in connection with the Enviva Cottondale facility in Florida. Florida's cost estimates for VOC controls on the pellet coolers stacks were reduced because the state excluded the cost of the particulate matter (PM) control device. In its request letter for additional information from the Cottondale facility, Florida's Department of Environmental Protection stated, "[s]ince a particulate matter control device is already proposed in the application as BACT for PM, the Department determines that the cost of the PM control device should be considered a "sunk cost" in determining the costs of a VOC control. It is a fundamental principle of engineering economics that sunk costs are not be considered in the analysis of future costs of a project. For this reason, it is improper to lump the cost of the PM control device in with the cost of the RTO in the decision to install, or not install, an RTO."[3]

Because DAQ determined existing cyclones, are BACT for PM for the PPCs, the cost of the baghouse or other PM controls post the cyclones is not a "sunk cost" and should be included in the cost of the RTO on the PPCs at Enviva Sampson (See Item I.D.6 below). Thus, any conclusions drawn from Florida's determination are not appropriate for the situation at Enviva Sampson. See responses for items I.D.6 and II below for more discussion of PM controls on the PPCs.

Florida ultimately decided an RTO was not BACT for the pellet coolers. Florida's technical evaluation for the PSD permit for the Cottondale facility cites economic, environmental, and energy impacts of the RTO as justification for not selecting this control technology as BACT. The technical evaluation states, "[Florida] finds that these additional environmental impacts associated with an RTO, coupled with a control cost effectiveness [$4,090 per ton of VOC removed] at the upper end of the range that could potentially be considered acceptable, make an RTO an inappropriate choice for BACT for the pellet coolers.... Additionally, the Department notes that in a forested rural area with high biogenic VOC emissions and low NO_X emissions, ozone production is NO_X limited. VOC emissions should have little impact on ambient ozone concentrations in this area."4

C. Reliance on a Cost-Per-Ton Economic Analysis to Reject Controls that are Widely Used in the Wood Pellet Industry is Arbitrary and Capricious and Contrary to the Clean Air Act.

DAQ disagrees with EIP/SELC's contention that use of a cost-per-ton economic analysis is arbitrary and capricious and contrary to the Clean Air Act.

As discussed above, BACT requires a case-by-case analysis that takes into consideration economic, environmental, and energy impacts. Therefore, as discussed above, proper application of BACT does not always result in the same control technology being applied in all areas of the country at facilities in the same industry. Nothing about DAQ's process in determining BACT was arbitrary or capricious. Rather, DAQ's process is consistent with applicable statutes and regulations.

D. Even Accepting the Cost-Per-Ton Methodology as Valid, Enviva has Improperly Inflated Control Costs for the Pellet Coolers and Dry Hammermills.

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3 Attachment L to EIP's comments, Letter from the Florida Department of Environmental Protection to Enviva Cottondale LLC, September 17, 2108.

4 Attachment JJ to EIP's comments, Technical Evaluation and Preliminary Determination, February 8, 2019.

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NCDAQ Response to EIP Comments on BACT Analysis

1. The Economic Analysis Improperly Fails to Account for the Sunk Costs of Controls Already Required Under MACT.

As noted in the EIP/SELC letter, the permit requires Enviva to, within six months of issuance of the permit, submit an application for installation of controls on pellet coolers, pellet presses, and dry hammermills. This requirement stems from actions taken by DAQ to ensure proper control of HAP emissions pursuant to Section 112(g) of the Clean Air Act. On March 1, 2019, DAQ sent a letter to Enviva Sampson notifying the Permittee of DAQ's determination that the case-by-case MACT determination submitted in connection with Enviva's 2014 Air Quality Permit application No. 8200152.14B was not conducted in accordance with 40 CFR 63.43(d). The letter stated that, based on DAQ's review of air pollution control devices in place at other wood pellet manufacturing facilities at the time of Enviva's permit application, Enviva's MACT analysis should have included controls on the facility's pellet coolers and pellet presses. DAQ therefore directed Enviva to submit a revised case-by-case MACT determination. Enviva responded to DAQ's letter by disputing DAQ's assertion that Enviva's September 3, 2014 permit application had been deficient. This dispute was resolved through a settlement agreement, which obligates Enviva to submit a permit application within six months of issuance of this permit requesting authorization for installation of an RCO/RTO to control VOC and HAP emissions from the pellet presses and pellet coolers as contemplated by DAQ's March 1, 2019 letter. The agreement also requires Enviva to submit an application for installation of an RCO/RTO to control VOC and HAP emissions from the dry hammermills (or an engineering solution that will result in equal or greater VOC and HAP reductions). As a result of the control technology that DAQ is requiring Enviva to install, and the significant reductions in VOC emissions that will occur as a result of these controls, DAQ anticipates the facility may no longer be a major source of VOC emissions and therefore, no longer be subject to BACT when this control technology is implemented. In the event Enviva does not seek reclassification of the facility as a PSD minor source in connection with installation of these controls, Enviva will be required to seek a modification of BACT limits in the permit to ensure that such limits are no less stringent than limits established pursuant to Section 112(g) of the Clean Air Act (See Clean Air Act, Section 169).

At this time, the specific design of control technology has not been established and the associated costs are unknown and may depend upon the outcome of the permitting process associated with those controls. That permitting process is not a part of this permitting action. For the foregoing reasons, DAQ does not think it is appropriate to account for the installation of MACT controls as a sunk cost at this time.

2. Enviva Failed to Consider Numerous Control Alternatives as BACT and Therefore Failed to Consider More Cost-Effective Control Alternatives

EIP/SELC contends Enviva Sampson should have considered a single RTO/RCO to control combined emissions from the dry hammermills and PPCs and rerouting emissions to the dryer furnaces and/or dryer RTO as control alternatives in it is cost analysis for BACT. Discussion on these control alternatives are provided below:

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NCDAQ Response to EIP Comments on BACT Analysis

- *Single RTO/RCO Controlling Dry Hammermills and Pellet Coolers* – On August 1, 2019, DAQ requested Enviva Sampson to submit a revised cost analysis containing this control alternative. Enviva Sampson initially submitted the revised cost analysis on August 2, 2019 but errors were discovered in the calculations. Enviva Sampson subsequently submitted the corrected cost analysis for this alternate control option on August 15, 2019. Attachment 1 to these comments provides the detailed cost analysis for this control option. As shown in Table 1 below, a larger RTO to control emissions from the combined dry hammermills and PPCs is not cost effective.

- *Utilizing the Dryer Furnaces and/or Dryer RTO* – On August 1, 2019, DAQ requested Enviva Sampson to submit a revised cost analysis containing this control alternative. In an e-mail dated August 2, 2019 Enviva Sampson provided information indicating this control option is technically infeasible due to limitations of the furnace's secondary air fan, as described below:

  "The furnace manufacturer advises Enviva that the only safe location to add VOC laden combustion air to the furnace is as secondary combustion air. The amount of VOC laden combustion air added cannot exceed the amount of secondary combustion air needed under the varying operating conditions of the furnace. The amount of secondary combustion air required is affected by variables such as ambient air conditions, fuel quality and moisture content, operating load, and heat load required for processing. Taking all these factors into consideration, only about 35 % of the capacity of the fan can be substituted as secondary combustion air when the furnace is operated at normal load.

  The design air flow for the dry Hammer Mill RCO is 120,000 actual cubic feet per minute (acfm) and is 90,000 acfm for the Pellet Mill/Cooler RCO. Thirty-five percent of fan [capacity] is 20,000 acfm. Even if Enviva were to ignore the varying operating conditions of the furnace discussed above, with the existence of storage vessels between the dryer and downstream unit operations, the furnace secondary air fan is not capable of accommodating the total flow needed for adequate treatment of VOC-laden air."

- *RCO as a Control Option* – EIP/SELC also contends Enviva Sampson should have considered a RCO in its cost analysis. On August 23, 2019, DAQ requested Enviva Sampson to submit cost analyses for RCOs. Enviva submitted cost estimates for RCOs on the dry hammermill and the pellet coolers on August 29, 2019 and estimates were received on September 10, 2019 for the dry wood handling and the combined dry hammermills and PPCs. The results of the costs analysis for the RCOs are included in Table 1 and show that the RCOs are slightly less expensive to operate and have a slightly lower cost per ton than the RTOs for these sources.

  Because RCOs were shown to be less expensive to operate, DAQ requested Enviva Sampson to submit an updated BACT analysis for VOC emission sources. The revised BACT analysis was received on September 10, 2019. Enviva Sampson's revised analysis specify rejected RCOs as BACT based on the cost ineffectiveness and the additional environmental and energy impacts.

3. Enviva's Cost Estimates for the Dry Hammermills and Pellet Coolers are Far Higher than the Cost Estimated Using EPA's Control Cost Manual.

On July 26, 2019, DAQ requested Enviva Sampson to submit a revised cost analysis for controls on the dry hammermills and pellet coolers. Enviva Sampson initially submitted the revised cost analysis on August 2, 2019 but errors were discovered in the calculations. On August 15, 2019, Enviva Sampson subsequently submitted corrected revised control costs for RTOs on the dry hammermills, the PPCs, and the combined exhaust from the dry hammermills/PPCs using methodology in EPA's Control Cost Manual. The revised control costs are provided in Attachment 1 and are summarized in the table below. The revised control costs indicate RTOs on these emissions are not cost effective on a dollar-per-ton basis.

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Table 1. Revised Control Costs

Emission Point Number(s)	Unit/Service Description	Control Option	Uncontrolled VOC PTE Emissions (TPY)	VOC Control Efficiency (%)	VOC Controlled Emission Rate (ton/yr)	VOC Reduction (ton/yr)	Total Annual Cost ($/yr)	Technology Cost Effectiveness ($/ton VOC Removed)
VOC Controls- RTOs								
ES-CLR-1 through 6	Pellet Coolers	RTO	572	95%	28.6	543.4	$3,740,642	$6,884
ES-HM-1 through 8	Dry Hammermills	RTO	168	95%	8.4	159.6	$2,934,883	$18,389
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RTO	740	95%	37.0	703.0	$6,553,936	$9,294
ES-DWH	Dry wood handling	RTO	41	95%	2.0	36.8	$598,594	$15,440
VOC Controls- RCOs								
ES-CLR-1 through 6	Pellet Coolers	RCO	572	95%	28.6	543.4	$3,715,499	$6,838
ES-HM-1 through 8	Dry Hammermills	RCO	168	95%	8.4	159.6	$2,907,090	$18,215
ES-CLR-1 through 6 and ES-HM-1 through 8	Pellet Coolers and Dry Hammermills	RCO	740	95%	37.0	703.0	$5,869,334	$8,349
ES-DWH	Dry wood handling	RCO	41	95%	2.0	36.8	$541,505	$13,968
PM Controls								
Emission Point Number(s)	**Unit/Service Description**	**Control Option**	**Uncontrolled PTE Emissions (TPY)**	**PM Control Efficiency (%)**	**PM Controlled Emission Rate (ton/yr)**	**PM Reduction (ton/yr)**	**Total Annual Cost ($/yr)**	**Technology Cost Effectiveness ($/ton PM Removed)**
ES-CLR-1 through 6	Pellet Coolers	baghouse	151	99%	1.5	149.5	$1,072,056	$7,171

Notes:
1. VOC control efficiency from US EPA Air Pollution Control Technology Fact Sheet: Regenerative Incinerator (EPA-452/F-03-021). https://www3.epa.gov/ttn/catc/dir1/fregen.pdf
2. Control costs for the RTOs on the pellet coolers includes cost of baghouse, as this equipment is required to ensure proper operation of the RTO.

EIP/SELC's comments include annualized costs for the PPCs and the dry hammermills based on the methodologies in EPA's Control Cost Manual in its comments. EIP/SELC did not provide documentation for its annualized cost calculations for the RTOs, which were given as $1,062,597 for the dry hammermills and $1,141,000 for the PPCs. EIP/SELC's comments do not provide a basis for concluding that Enviva Sampson's annualized cost calculations are incorrect.

4. Enviva's Cost Estimates are Far Higher Than in Previous Enviva Applications.

On August15, 2019, Enviva Sampson submitted revised control costs for the dry hammermills and the PPCs using methodology in EPA's Control Cost Manual. These revised costs are comparable to the costs on vendor estimates submitted in the 2018 permit application and are larger than reported in the 2014 permit application.

Potential emissions of VOC cited in the 2018 permit application increased due to expanded production (25% increase in permitted throughput), increased softwood percent (permitted at 100%), and revised emission factors. The table below compares potential VOC emissions as provided in the 2014 and 2018 permit applications.

Emissions Unit	2014 permit application	2018 permit application	
	Uncontrolled VOC emissions (tpy)	Uncontrolled VOC emissions (tpy)	Controlled VOC emissions (tpy)
Dryer System	288.3	1011.6	50.6
Green Wood Hammermills	72.2		
Dry Hammermills	34.4	167.5	167.5
Pellet Presses and Coolers	227.6	572.2	572.2
Dried Wood Handling	---	40.8	40.8
Total Emissions	622.5	1792.1	831.1

Notes:

- Uncontrolled emissions from dryer system and green wood hammermills calculated with a 95% control efficiency from the RTO.
- No controls on VOCs in 2014

As noted in the table above, uncontrolled VOC emissions increased from 622.4 tpy to 1,792 tons per year in the 2018 permit application. The increase in VOC emissions (2.9 times 2014 levels) results in higher costs due to larger RTOs and increased natural gas/propane consumption. Therefore, the control costs are expected to be much higher in the 2018 BACT analysis.

EIP/SELC also contends Enviva Sampson should have considered an RCO in its cost analysis. DAQ requested Enviva Sampson to submit a revised BACT analysis that included an economic, environmental, and energy impacts for RCOs. Enviva Sampson submitted the revised analysis on September 10, 2019. As discussed in Section I.D.2 above, the revised analysis rejected RCOs as BACT based on cost ineffectiveness and additional environmental and energy impacts.

5. The Pellet Cooler Cost Analysis Improperly Considered the Cost of Particulate Matter Controls as Part of the Cost of VOC Controls.

DAQ concluded that BACT for PM from the PPCs are cyclones. Because additional PM controls are required to ensure proper operation of the RTO, including those costs in the cost analysis is appropriate. See responses for items I.D.6 and II below for more discussion of PM controls on the PPCs.

6. Enviva Has Failed to Demonstrate that It Cannot Install RTO/RCOs on the Pellet Coolers as Currently Equipped with Cyclones

Control of particulate matter is essential to ensure proper operation of RTOs. Particulate matter 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 such as fires and other significant operational and maintenance related difficulties.

Several different types of heat transfer media are used for RTOs, including random packing, monolithic (honeycomb) structured block, and corrugated structure packing. The different media are able to accommodate varying levels of particulate matter in the inlet stream. For instance, "vendors recommend adding particulate removal devices upstream of the RTO if the particulate concentration is greater than 0.005 gr/dscf to 0.002 gr/dscf,"36 for monolithic packing according EPA's Control Cost Manual. Other types of RTOs can handle higher PM loads. An online search of literature found some RTOs that can handle inlet streams with particulate matter up to 0.02 gr/dscft.37 The existing cyclones on the PPCs at Enviva Sampson are estimated to have an outlet PM loading of 0.04 gr/dscf, which is higher than inlet PM loading referenced in these examples. Therefore, PM controls beyond the existing cyclones at Enviva Sampson are warranted when used prior to a RTO.

In an e-mail dated August 2, 2019, Enviva Sampson provided specific examples of the operation and safety concerns associated with using only a cyclone for PM control prior to RTO/RCO. The use of cyclones only to control PM prior to RTO/RCOs has resulted in explosions within ductwork and downstream thermal oxidizers in certain applications. In short, cyclones provide insufficient particulate control of flue gas streams being processed by a downstream thermal oxidizer. Fiber that would otherwise be controlled by a bagfilter or wet scrubber can accumulate in the RCO/RTO packing and result in the following:

- smoldering resulting in formation of VOC and CO that reduces the overall control efficiency of the thermal oxidative device and contributes to higher than expected emissions;
- causing the RCO to overheat and shutdown to prevent more catastrophic results;
- causing a series of deflagration events that can damage or destroy the RCO;
- increased risk of upstream equipment failure, and;

36 Chapter 2, Incinerators and Oxidizers, EPA's Cost Control Manual, November 2017, retrieved from https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf
37 Information on NESTEC RTO retrieved from https://www.nestecinc.com/wp-content/uploads/2017/01/RTO-Sell-Sheet.pdf

- increased safety risk to plant personnel and neighbors.

7. Enviva's 20% Contingency Factor is Far Too High for RTOs

DAQ agrees that the contingency factor of 20% used in Enviva Sampson's initial cost analysis is higher than cited in EPA's Control Cost Manual. The manual indicates contingency factors can range from 5 to 15% of the total capital investment (TCI). On August 15, 2019, Enviva Sampson submitted a revised cost analysis that used a contingency factor of 10%, which is in line with guidance from EPA's Control Cost Manual. As shown in Table 1 above, the revised cost analysis continues to demonstrate that RTOs on the dry hammermills and PPCs and that bagfilters on the PPCs are not cost effective.

8. The Cost Analysis for the Dry Hammermills Appears to be Inflated Compared to the Pellet Coolers.

Enviva Sampson revised its cost analysis using EPA's Control Cost Manual. The revised analysis for the dry hammermills eliminated the media replacement cost, reduced fuel usage for the RTO, reduced the contingency factor to 10%, and corrected the life expectancy of the RTO to 20 years. These changes should eliminate any concern that the dry hammermill costs have been inflated. (Note that annual operating cost reported in the 2018 permit for the RTO on the dry hammermills is $2,926,411 compared to the revised estimated based on EPA's Control Cost Manual is $2,934,883.)

9. Enviva Underestimates VOC Emissions From the Dry Hammermills

DAQ disagrees that the VOC emissions from the dry hammermills at Enviva Sampson have been underestimated and does not agree with EIP/SELC's use of a VOC emission factor of 1.4 lb/ODT for the dry hammermills at Enviva Sampson. Facilities ideally develop emission factors from site-specific testing during representative operating conditions. Emission factors developed from testing at other similar facilities can be used absent site-specific test data. However, care must be taken when applying an emission factor from one facility/source to another to ensure the representativeness of that emission factor. For wood pellet facilities, emissions may vary from facility to facility based on the softwood percentage, type of equipment (e.g., vertical vs. horizontal hammermills), die sizes (surface area), among other factors.

An example of specific differences between facilities is in the hammermills at Cottondale and Enviva Sampson. The emission factor of 1.4 lb/ODT was developed from testing at the Cottondale facility, which operates mostly vertical hammermills. Enviva Sampson operates only horizontal hammermills. Joe Harrel of Enviva Sampson indicated via e-mail that the facility uses "horizontal [hammermills] with fresh air sweep systems that conveys the wood fiber to the cyclone. We have discovered [that] fresh air sweeps cool the wood fiber that exits the hammermills causing lower wood temperatures."

Because lower temperatures may lead to lower VOC emissions from the horizontal hammermills, applying an emission factor based on testing at vertical hammermills (e.g., 1.4 lb/ODT from the Cottondale facility) would be inappropriate for Enviva Sampson.

The assumption that horizontal hammermills have lower VOC emissions will be confirmed through the extensive testing required in the final permit for Enviva Sampson.

10. Total Corrected Cost Determinations

i. Dry Hammermills Dedicated RTO/RCO

DAQ disagrees with EIP/SELC's calculation of cost-per-ton for the dry hammermills. As noted in response to item 9 above, DAQ does not agree with EIP/SELC's use of 1.4 lb/ODT as an emission factor from the dry hammermills. DAQ also disagrees with using 2014 cost data as the "corrected cost" for evaluating BACT for the dry hammermills. The 2014 cost data is not valid because the RTO was sized for lower VOC emissions based on a smaller throughput (25% less) and lower softwood percentage. Therefore, simply scaling 2014 costs using a cumulative rate of inflation is not appropriate.

ii. Pellet Cooler RTO/RCO

DAQ disagrees with using 2014 cost data as the "corrected cost" for evaluating BACT for the PPCs. The 2014 cost data should not be used because the RTO was sized for lower VOC emissions due to a smaller throughput (25% less) and lower softwood percentage. Therefore, simply scaling the 2014 cost using a cumulative rate of inflation is not appropriate. Additionally, EIP/SELC did not consider the cost of additional PM controls, which is necessary to ensure proper function of the RTO. Note the 2014 BACT analysis also included the cost of additional PM control in the cost estimate for the RTO.

iii. Single RTO/RCO Controlling Dry Hammermills and Pellet Coolers

On August 1, 2019, DAQ requested that Enviva Sampson submit a revised cost analysis containing this control alternative. Enviva Sampson initially submitted the revised cost analysis on August 2, 2019 but errors were discovered in the calculations. Enviva Sampson subsequently submitted revised cost analysis on August 15, 2019 that indicated a single RTO on the dry hammermills and PPCs is not cost effective. (See Table 1 and Attachment 1). DAQ also disagrees with using a cost analysis for another facility (Drax Morehouse) as the basis for EIP/SELC's "corrected cost." As noted in Item I.B above, control costs are site-specific, and thus, control costs developed for a Drax Morehouse plant in Louisiana should not be used to represent control costs for Enviva in Sampson County, North Carolina.

iv. Utilizing the Dryer Furnaces and/or Dryer RTO

This control was determined to be technically infeasible as discussed previously in response to Item 1.D.2.

11. Neither Enviva nor DAQ Have Provided Support for the Vague Claim that RTOs/RCOs Would Not Be Environmentally Beneficial.

1. Reducing 700 tons of VOCs is a Net Benefit Despite Minor Increases in Other Pollutants.

Ozone formation is a complicated nonlinear process that requires certain meteorological conditions in addition to VOC and NOx emissions.38 Although decreasing VOCs emissions can lead to decreased ozone formation, the importance of increases in NOx emissions should not be discounted, especially in areas like North Carolina that are "NOx limited" with respect to ozone formation. Based on 20 years of experience and scientific research, North Carolina's approach to control NOx emissions instead of VOC emissions has proven to be the most effective method for reducing ozone in the state,39 and future reductions in VOC emissions may have little to no impact on ambient ozone concentrations.40

In their comments, EIP/SELC relies on VOC/NOx ratios and associated isopleths to justify the benefits of increased VOC reductions. While ozone isopleths help demonstrate the relationship between VOCs and NOx in ozone formation, the state of the science has evolved far beyond simply using these graphs for calculating the complex reactions of ozone formation. EPA discusses limitations of using this simplistic approach in determining the effectiveness in ozone reduction in its initial (1996) Photochemical Assessment Monitoring Station (PAMS) Data Analysis "Results" Report. The report states, "[while] the VOC/NOx method is theoretically sound, application of the technique has several limitations:

1. Historically, applications have relied upon morning, center-city VOC and NOx measurements, yet the ratio varies widely in time and space. PAMS improves the spatial and temporal coverage of data, and therefore tempering this particular concern.

2. Assuming only limited measurement-related difficulties, the ratios delineating NOx and VOC-limited regimes vary with time and location and are affected by vertical mixing processes that often are not accounted for in surface measurements. Additionally, the prevailing atmospheric chemistry (e.g., composition and age of air mass) can impart different control responses at the same VOC/NOx ratios.

3. Inconsistent and uncertain measurement techniques affect the ratio. These include various interpretations of total [non-methane volatile organic compounds] NMOC, measurement uncertainties and artifacts in NOx and NMOC, and the representativeness of observations (this latter issue is more problematic for emission inventory evaluation).

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38 Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program, April 30, 2019, retrieved from https://www.epa.gov/sites/production/files/2019-05/documents/merps2019.pdf

39 Letter from the North Carolina Division of Air Quality to Mary S. Walker of the US EPA, May 10, 2019, retrieved from https://files.nc.gov/ncdeq/Air%20Quality/planning/attainment/1101_voc_work_practices/1---Final-Sec110-l--VOC-WP-Stds-Transmittal-Letter-051019-SPeCS.pdf

40 Letter from the North Carolina Division of Air Quality to EPA Docket Center, February 13, 2017 retrieved from https://www.cleanairact.org/news/documents/NorthCarolinaDEQ-2-13-2017.pdf

By themselves, VOC/NOx ratios probably cannot be used unambiguously to infer NOx or VOC control strategy effectiveness. However, in combination with other observational (and gridded model techniques), the VOC/NOx method adds corroborative value."41

2. The Environmental Impacts Portion Ignores HAP Emissions and Secondary Particulate Matter Formation

EPA discusses the consideration of emissions of toxic and hazardous air pollutants (HAPs) in its draft guidance for BACT analysis. According to the draft guidance, the generation or reduction of HAPs should be considered as part of the environmental impacts analysis for BACT. Several acceptable methods, including risk assessment, exist to incorporate air toxics concerns into the BACT decision. EPA has acknowledged that the permitting authority (i.e., DAQ) "has flexibility in determining the methods by which it factors air toxics considerations into BACT determinations, subject to the obligation to make reasonable efforts to consider air toxics."42

DAQ considered the environmental impact of HAPs in its evaluation of the facility's compliance with NC Air Toxics Regulations. Acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propionaldehyde are the HAPs expected to be emitted from the dry hammermills and the PPCs at Enviva Sampson. All of these except for methanol and propionaldehyde are also considered toxic air pollutants (TAPs) under North Carolina's Air Toxic regulations. Enviva Sampson conducted facility-wide air dispersion modeling for phenol and formaldehyde to demonstrate compliance with NC Air Toxics Regulations. No air dispersion modeling was required for acetaldehyde because emissions from this TAP were below its TAP permitting emission rate (TPER). The dry hammermills and PPCs were modeled without VOC controls as specified in the permit application. Nancy Jones of the Air Quality Analysis Branch (AQAB) of DAQ approved the air dispersion modeling in a memorandum dated July 25, 2019. The memo indicated the air dispersion modeling adequately demonstrates compliance on a source-by-source basis for all TAPs modeled. Thus, the TAPs/HAPs modeled do not present an "an unacceptable risk to human health," even with no VOC controls on the dry hammermills and PPCs.

Because methanol is not a TAP, no air dispersion modeling was conducted for this pollutant. While emissions of methanol are larger than other HAPs/TAPs emitted from Enviva Sampson, methanol is one of the least toxic HAPs. A general indication of relative toxicity can be ascertained by comparing the reference concentrations (RfC) of methanol and chlorine, both of which are noncarcinogens. Chlorine has a RfC of 0.00015 mg/m^3 while the RfC for methanol is 20 $mg/m.^3$ Given the low toxicity of methanol and chlorine's margin of compliance with its acceptable ambient level (<1% of the AAL), DAQ does not anticipate any health risks due to emissions of methanol from Enviva Sampson, even with no VOC controls on the dry hammermills and PPCs.

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41 Chapter 4, Observational Based Methods for Determining VOC/NOx Effectiveness, in EPA EPA-454/R-96-006, Retrieved from https://www3.epa.gov/ttnamti1/files/ambient/pams/chap4.pdf
42 New Source Review Workshop Manual: Prevention of Significant Deterioration and Nonattainment Area Permitting, DRAFT, October 1990, retrieved from https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf

EPA has recently finalized guidance for addressing ambient impacts of ozone and PM2.5 precursors in nonattainment areas, such as North Carolina, in its *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program.* The MERP framework may be used to describe an emission rate of an individual precursor that is expected to result in a change in the level of ambient ozone or PM2.5, as applicable, that would be less than a specific air quality threshold for ozone or PM2.5 that a permitting authority adopts and chooses to use in determining whether a projected impact causes or contributes to a violation of the NAAQS for ozone or PM2.5, such as the significant impact levels (SILs) recommended by EPA. In the context of the PSD program, precursors to ozone include VOCs and NO_X and precursors to PM2.5 generally include SO_2 and NO_X. In other words, VOCs are not evaluated as a precursor to PM2.5 in EPA's guidance for a Tier 1 demonstration under the PSD permitting program.43 DAQ has considered environmental impacts resulting from the installation of RTOs/RCOs on the VOC emission sources in determining BACT. At the request of DAQ, Enviva Sampson submitted a revised BACT analysis for VOC emission sources on September 10, 2019. The emissions from these controls are provided below.

Emission Source	Control Technology	Emissions (tpy)					
		NOx	**SO_2**	**PM**	**CO**	**VOC**	**GHG**
PPCs	RTO	6.96	0.025	0.32	4.29	0.46	5,697
	RCO	4.24	0.013	0.17	2.72	0.25	3,079
Dry Hammermills	RTO	6.85	0.027	0.035	4.03	0.50	6,298
	RCO	3.84	0.015	0.19	2.30	0.27	3,403
PPCs and Dry Hammermills	RTO	13.82	0.052	0.67	8.32	0.96	11,995
	RCO	8.08	0.028	0.36	5.02	0.52	6,482
Dried Wood Handling	RTO	1.15	0.004	0.06	0.68	0.08	1,030
	RCO	0.65	0.002	0.03	0.40	0.04	557
Notes: These emissions differ than provided in the Preliminary Determination and have been updated to reflect the revised BACT analysis submitted on September 10, 2019.							

The GHG emissions above account only for the combustion of propane in the RTOs/RCOs. DAQ estimated additional GHG (CO2) resulting from combustion the of VOCs (assumed to be alpha pinene) in the exhaust from the dry hammermills, the PPCs, combined dry hammermills and PPCs, and the dry wood handling. (See calculation in Attachment 2). The estimated GHG emissions are provided in the table below.

Emission Source	CO2e from RCO/RTO (ton/yr)	CO2 from alpha Pinene (ton/yr)	Total CO2 (ton/yr)
RTO			
PPCs	5,697	1,755	7,452
Dry Hammermills	6,298	516	6,814
PPCs and Dry Hammermills	11,995	2,271	14,266
Dried Wood Handling	1,030	126	1,156
RCO			
PPCs	3,079	1,755	4,834
Dry Hammermills	3,403	516	3,919

43 Op. Cit., MERPS, April 30, 2019.

Emission Source	CO2e from RCO/RTO (ton/yr)	CO2 from alpha Pinene (ton/yr)	Total CO2 (ton/yr)
PPCs and Dry Hammermills	6,482	2,271	8,753
Dried Wood Handling	557	126	683
Notes: Emission calculations assume 95% control efficiency in the control device.			

II. The Pellet Cooler BACT Determination for Particulates is Also Flawed.

DAQ does not agree that the BACT determination for baghouses on the PPCs is flawed because it relies on a cost-per-ton method to dismiss controls that are not cost effective. However, DAQ acknowledges that more detail is needed regarding the adverse environmental impact of solid waste generated from the disposal of baghouse filter media and requested this data in an e-mail dated August 1, 2019. Enviva Sampson responded to this request via e-mail dated August 2, 2010 and provided following additional information:

> Bag replacements would be required every 45 days resulting in a total of 960 bags from 6 baghouses to control PM from the pellet coolers. This is estimated to be more than 160,000 lbs of solid waste generation annually that would be disposed of in a landfill.

III. The Draft Permit Authorizes Unlawful Periods of Exemption From BACT Limits During Startup, Shutdown, and Malfunction

The language exempting BACT during startup, shutdown, and malfunction (SSM) events is a carryover from the current permit (10386R03), and DAQ agrees this language should be clarified.

The definition of BACT allows for a design, equipment, work practice, operational standard or combination thereof to be prescribed to satisfy the requirement for the application of BACT in situations where the imposition of an emissions standard is infeasible. DAQ has determined that such is the case during SSM events at Enviva Sampson and the SSM permitting language will be clarified.

IV. Failure to Model Emissions and Provide Accurate Emissions Information Regarding Bypass Scenarios Renders the Draft Permit Deficient

A. DAQ Must Require Ambient Air Impacts Modeling Prior to Issuance of the Final Permit.

DAQ required Enviva Sampson to submit revised air dispersion modeling to address the startup and idle bypass scenarios for the furnace. The revised air dispersion modeling was received on July 1, 2019. Nancy Jones of the AQAB of DAQ approved of the revised air dispersion modeling in a memo dated July 25, 2019. The memo indicated the revised air dispersion modeling (which included the bypass scenarios) adequately demonstrated that emissions of total suspended particles (TSP) will not cause or contribute to an exceedance of the State Ambient Air Quality Standard (SAAQS). The revised air dispersion modeling also demonstrated that compliance is indicated for all TAPs modeled.

The malfunction bypass for the furnace and the dryer were not included in the revised air dispersion modeling. Section 8.2.2(d) Source Data Requirements, Appendix W to 40 CFR

Part 51 specifies that malfunctions that may result in excess emissions are not required to be modeled, unless the malfunctions are the result of poor maintenance, careless operation, or other preventable conditions. DAQ anticipates any malfunction emissions from Enviva Sampson will be unplanned and unavoidable and not the result of deficient operational practices. Thus, modeling of malfunctions is not required. If excess emissions are not the result of a malfunction (i.e., emissions caused entirely or in part by poor maintenance, careless operations or any other upset condition within the control of the emission source), DAQ can require modeling in these situations.

The cold-start up, "idle mode," and planned shutdown scenarios for the furnace bypass were included in the revised air dispersion modeling. Emissions from the dryer bypass during shutdown are minimal because neither furnace nor dryer are operating and the dryer drum is empty. Therefore, the dryer bypass was not included in the revised air dispersion modeling because of the minimal emissions.

B. Enviva Improperly Failed to Quantify Emissions From Dryer Bypass Events

The dryer bypass is only operated under two conditions – malfunction and planned shutdown. In a letter dated May 10, 2019, Enviva Sampson provided the following description of these two events:

Malfunction: The dryer system can abort due to power failure, equipment failure, or furnace abort. If the [RTO] goes offline because of an interlock failure, the dryer immediately aborts. This can occur if the dryer temperature is out of range or due to equipment or power failure. Dryer abort is also triggered if a spark is detected.

Planned Shutdown: During planned shutdowns, as the remaining fuel is combusted by the furnace, the operator reduces the chip input to the dryer. When only a small amount of chips remains, the dryer drum is emptied. The dryer bypass stack is then opened, and a purge air fan is used to ensure no explosive build-up occurs in the drum. Emissions during this time are minimal as the furnace and dryer are no longer operating.

Because malfunctions are unexpected emissions and are difficult to quantify, they do not have to be included in the air dispersion modeling as discussed previously. DAQ agrees that emissions from the dryer bypass during shutdown are minimal because neither the furnace nor dryer are operating, and quantification of these emissions is not needed due to the minimal emissions.

V. DAQ Should Require Stack Testing at 100% Softwood or the Maximum Softwood Content that the Facility is Capable and Authorized to Process

Enviva Sampson is currently limited to 50% softwood by a Special Order by Consent with DAQ (SOC 2018-003). When the revised permit is issued, the facility will be able to operate at up to 100% softwood. The permit limits initial testing to 80% softwood to ensure the facility can demonstrate compliance with emission limits prior to operating at 100% softwood. The limitation should not be construed to mean that DAQ requires no testing above 80%. In fact, the Draft Permit specifically requires Enviva Sampson to conduct periodic source testing within 90 days of operating at 90% softwood.

The permit requires an extensive testing regime, including initial testing at permit issuance and upon completion of the softwood expansion project, and periodic testing when either the softwood percentage or throughput increase by 10 percentage points. At a minimum, Enviva Sampson must conduct testing annually at its maximum normal production rate and the maximum normal operating softwood percentage. If Enviva Sampson is operating at a softwood percentage at or near 100%, these conditions will be reflected in the periodic annual performance test.

VI. The Draft Permit Lacks Monitoring Sufficient to Assure Compliance with the Applicable 20% Opacity Limit

(1) DAQ has not demonstrated that monthly monitoring is sufficient to assure compliance with a 20% opacity limit that applies at all times,
(2) DAQ has not demonstrated that the parameter being monitored ("normal" opacity) correlates with demonstrating that opacity remains below 20% at all times,
(3) the permit fails to specify the method that the facility must use to determine opacity.

These visible observation procedures are long established by DAQ and are sufficient to ensure compliance with 15A NCAC 02Q .0521. EPA periodically conducts audits of DAQ's Title V permitting program and routinely reviews Title V permits. EPA has never indicated DAQ's visible observations procedures are in anyway deficient or fail to meet the intent of the Title V monitoring requirements.

(4) the permit lacks recordkeeping and reporting needed to document the results of required monitoring.

The permit does require sufficient recordkeeping as specified in Section 2.1 A.3.d, which states the following:

<u>**Recordkeeping**</u> [15A NCAC 02Q .0308(a)]

d. The results of the monitoring shall be maintained in a logbook (written or electronic format) on-site and made available to an authorized representative upon request. The logbook shall record the following:
   i. the date and time of each recorded action;
   ii. the results of each observation and/or test noting those sources with emissions that were observed to be in noncompliance along with any corrective actions taken to reduce visible emissions; and
   iii. the results of any corrective actions performed.

See response to Comment VIII below in regard to reporting.

VII. DAQ Should Require Enviva Sampson to Prepare and Implement a Fugitive Dust Control Plan

Pursuant with 15A NCAC 02D .0540(d), a fugitive dust plan is triggered by "a second substantive complaint in a 12-month period." No fugitive dust complaints have been received against Enviva Sampson since its operation began in October 2016. Requiring a fugitive dust plan at this point is not appropriate.

VIII. The Draft Permit Should Implement Periodic Reporting Requirements

Facilities holding Title V permits are required to submit reports of any required monitoring at least every six months pursuant with 40 CFR 70.6(a)(3)(iii)(A). Although classified as a Title V facility, Enviva Sampson has not yet been issued a Title V permit. Permits issued in accordance with 15A NCAC 02Q .0300 procedures (aka referred to as "R" permits), such as Enviva Samson's Draft Permit, do not require semiannual reporting of monitoring activities. However, DAQ can include semiannual reporting in "R" permits if deemed necessary to ensure compliance pursuant with 15A NCAC 02D .0605(b).

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

ATTACHEMNT 1

Revised Control Cost Analysis

ATTACHEMNT B
NCDAQ Response to EIP Comments on BACT Analysis

RTO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,975,364	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	197,536	10% of incinerator and auxiliary equipment costs
Sales tax	$	59,261	3% of incinerator and auxiliary equipment costs
Freight	$	98,768	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**2,330,929**	
Direct installation costs			
Foundations and supports	$	186,474	8% of total purchased equipment costs
Handling and erection	$	326,330	14% of total purchased equipment costs
Electrical	$	93,237	4% of total purchased equipment costs
Piping	$	46,619	2% of total purchased equipment costs
Insulation for ductwork	$	23,309	1% of total purchased equipment costs
Painting	$	23,309	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**699,279**	
Total Direct Costs	**$**	**3,030,208**	
Indirect installation costs			
Engineering	$	233,093	10% of total purchased equipment costs
Construction and field expenses	$	116,546	5% of total purchased equipment costs
Contractor fees	$	233,093	10% of total purchased equipment costs
Start-up	$	46,619	2% of total purchased equipment costs
Performance test	$	23,309	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**652,660**	
Contingency at 10%	$	368,286.83	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**4,051,155**	
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			
Propane Usage	$	2,048,911	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	273,361	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	$	81,023	2% TCI
Property Taxes	$	40,512	1% TCI
Insurance	$	40,512	1% TCI
Capital Recovery	$	382,400	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**2,934,883**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	122,243	scfm (based on actual measured data for Sampson dry hammermills)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	122,243	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.08	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.33	auxiliary fuel usage (scfm), per Equation 2.45
	838.74	btu/min
Total Energy Input	3,508,409.04	btu/min, per Equation 2.22
5% of Total Energy Input	175,420.45	btu/min
Max of Equation 2.45 and Equation 2.22	175,420.45	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

RCO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

		Capital Equipment Costs	
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,975,364	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	197,536	10% of incinerator and auxiliary equipment costs
Sales tax	$	59,261	3% of incinerator and auxiliary equipment costs
Freight	$	98,768	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	$	2,330,929	
Direct installation costs			
Foundations and supports	$	186,474	8% of total purchased equipment costs
Handling and erection	$	326,330	14% of total purchased equipment costs
Electrical	$	93,237	4% of total purchased equipment costs
Piping	$	46,619	2% of total purchased equipment costs
Insulation for ductwork	$	23,309	1% of total purchased equipment costs
Painting	$	23,309	1% of total purchased equipment costs
Total Direct Installation Costs	$	699,279	
Total Direct Costs	$	3,030,208	
Indirect installation costs			
Engineering	$	233,093	10% of total purchased equipment costs
Construction and field expenses	$	116,546	5% of total purchased equipment costs
Contractor fees	$	233,093	10% of total purchased equipment costs
Start-up	$	46,619	2% of total purchased equipment costs
Performance test	$	23,309	1% of total purchased equipment costs
Total Indirect Installation Costs	$	652,660	
Contingency at 10%	$	368,286.83	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	$	4,051,155	
		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
Catalyst Bed Replacement	$	535,235	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 733 ft^3.
Utilities			
Propane Usage	$	1,107,192	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	330,911	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	346,703	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	81,023	2% TCI
Property Taxes	$	40,512	1% TCI
Insurance	$	40,512	1% TCI
Capital Recovery	$	382,400	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	$	2,907,090	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers* , November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Dry Hammermill VOC Emissions
ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	122,243	scfm (based on actual measured data for Sampson dry hammermills)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	122,243	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.08	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.34	auxiliary fuel usage (scfm), per Equation 2.45
	876.96	btu/min
Total Energy Input	1,895,876.98	btu/min, per Equation 2.22
5% of Total Energy Input	94,793.85	btu/min
Max of Equation 2.45 and Equation 2.22	94,793.85	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	733	Overall bulk volume of catalyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

RTO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

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			
Propane Usage	$	335,218	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	44,724	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	$	**598,594**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

RTO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate of 2 DWH baghouses	20,000	cfm

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	20,000	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.60	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	2.03	auxiliary fuel usage (scfm), per Equation 2.45
	5170.35	btu/min
Total Energy Input	574,003.47	btu/min, per Equation 2.22
5% of Total Energy Input	28,700.17	btu/min
Max of Equation 2.45 and Equation 2.22	28,700.17	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

RCO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

	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
Catalyst Bed Replacement	$	87,569	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 120 ft^3.
Utilities			
Propane Usage	$	181,145	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	54,140	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	**$**	**541,505**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Dried Wood Handling VOC Emissions
ES-DWH
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	20,000	cfm
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	20,000	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	1.60	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	2.13	auxiliary fuel usage (scfm), per Equation 2.45
	5408.01	btu/min
Total Energy Input	310,180.47	btu/min, per Equation 2.22
5% of Total Energy Input	15,509.02	btu/min
Max of Equation 2.45 and Equation 2.22	15,509.02	Per Section 2.4.2 and Step 8c of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	120	Overall bulk volume of catalyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

RTO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,812,441	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	181,244	10% of incinerator and auxiliary equipment costs
Sales tax	$	54,373	3% of incinerator and auxiliary equipment costs
Freight	$	90,622	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	$	2,138,680	
Direct installation costs			
Foundations and supports	$	171,094	8% of total purchased equipment costs
Handling and erection	$	299,415	14% of total purchased equipment costs
Electrical	$	85,547	4% of total purchased equipment costs
Piping	$	42,774	2% of total purchased equipment costs
Insulation for ductwork	$	21,387	1% of total purchased equipment costs
Painting	$	21,387	1% of total purchased equipment costs
Total Direct Installation Costs	$	641,604	
Total Direct Costs	$	2,780,284	
Indirect installation costs			
Engineering	$	213,868	10% of total purchased equipment costs
Construction and field expenses	$	106,934	5% of total purchased equipment costs
Contractor fees	$	213,868	10% of total purchased equipment costs
Start-up	$	42,774	2% of total purchased equipment costs
Performance test	$	21,387	1% of total purchased equipment costs
Total Indirect Installation Costs	$	598,830	
Contingency at 10%	$	337,911.47	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	$	3,717,026	
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			
Propane Usage	$	1,853,579	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	247,301	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	$	74,341	2% TCI
Property Taxes	$	37,170	1% TCI
Insurance	$	37,170	1% TCI
Capital Recovery	$	350,861	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	$	2,668,586	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RTO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	110,589	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	3.93	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.38	auxiliary fuel usage (scfm), per Equation 2.45
	972.07	btu/min
Total Energy Input	3,173,937.08	btu/min, per Equation 2.22
5% of Total Energy Input	158,696.85	btu/min
Max of Equation 2.45 and Equation 2.22	158,696.85	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

ATTACHEMNT B
NCDAQ Response to EIP Comments on BACT Analysis

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

	Capital Equipment Costs		
Direct Costs			
Purchased Equipment Costs			
Fabric Filter (with insulation)(EC)	$	236,803	Figure 1.9 of EPA Cost Control Manual for Pulse-Jet Filters (modular)
Bags	$	16,254	Bag cost from Table 1.8 based on 6-8 inch bag diameter for Pulse Jet, TR polyester bags
Auxiliary Equipment	$	118,402	Conservatively assumed 50% of Fabric Filter cost
Fabric Filter + Bags + Auxiliary	$	371,459	
Instrumentation	$	37,146	10% of incinerator and auxiliary equipment costs
Sales tax	$	11,144	3% of incinerator and auxiliary equipment costs
Freight	$	18,573	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	$	809,780	
Direct installation costs			
Foundations and supports	$	32,391	4% of total purchased equipment costs
Handling and erection	$	404,890	50% of total purchased equipment costs
Electrical	$	64,782	8% of total purchased equipment costs
Piping	$	8,098	1% of total purchased equipment costs
Insulation for ductwork	$	56,685	7% of total purchased equipment costs
Painting	$	32,391	4% of total purchased equipment costs
Total Direct Installation Costs	$	599,238	
Total Direct Costs	$	1,409,018	
Indirect installation costs			
Engineering	$	80,978	10% of total purchased equipment costs
Construction and field expenses	$	161,956	20% of total purchased equipment costs
Contractor fees	$	80,978	10% of total purchased equipment costs
Start-up	$	8,098	1% of total purchased equipment costs
Performance test	$	8,098	1% of total purchased equipment costs
Contingencies	$	24,293	3% of total purchased equipment costs
Total Indirect Installation Costs	$	364,401	
Total Capital Investment	$	1,773,419	
	Annual Operating Cost		
Direct Annual Costs			
Operating Labor			
Operator	$	57,672	Based on $26.70/hr (2015), 2 hr/shift, 3 shifts/day, and 360 days/yr.
Supervisor	$	8,651	15% Operator
Maintenance			
Labor	$	29,430	Based on $27.25/hr (1998), 1 hr/shift, 3 shifts/day, and 360 days/yr.
Materials	$	29,430	100% Maintenance Labor
Replacement Bags	$	10,053	Equation 1.13, assumes $0.28/ft2 of bag area for labor cost
Utilities			
Compressed air	$	32,041	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1. Assumes 2 scfm of air per 1,000 acfm of flue gas and $0.25 per 1,000 scf of air, 8,640 hr/yr
Electricity	$	133,605	Based on methodology from EPA Cost Control Manual, Section 6, Chapter 1.
Waste disposal	$	457,730	
Indirect Annual Costs			
Overhead	$	75,110	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	35,468	2% TCI
Property Taxes	$	17,734	1% TCI
Insurance	$	17,734	1% TCI
Capital Recovery	$	167,398	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	$	1,072,056	

Note:

Estimation based on *EPA Cost Control Manual, Section 6, Chapter 1, Baghouses and Filters*, December 1998. https://www3.epa.gov/ttn/ecas/docs/cs6ch1.pdf

Cost adjusted for inflation due to cost in manual being in 1998 dollars.

Baghouse Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
CFRB	0.55309	
Interest rate	0.07	
Life of Equipment	2	
Combined exhaust flow rate	110,589	scfm [based on actual measured data for Sampson pellet coolers]
Exhaust flow rate per pellet cooler	20,603	
Gas to cloth ratio	12	acfm/ft2, pulse jet for saw dust per Table 1.1
Net fabric area	10301.27	ft2
Gross fabric area	15451.90	ft2, per Table 1.2
Initial bag cost	10352.78	

RCO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	1,812,441	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	181,244	10% of incinerator and auxiliary equipment costs
Sales tax	$	54,373	3% of incinerator and auxiliary equipment costs
Freight	$	90,622	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	$	2,138,680	
Direct installation costs			
Foundations and supports	$	171,094	8% of total purchased equipment costs
Handling and erection	$	299,415	14% of total purchased equipment costs
Electrical	$	85,547	4% of total purchased equipment costs
Piping	$	42,774	2% of total purchased equipment costs
Insulation for ductwork	$	21,387	1% of total purchased equipment costs
Painting	$	21,387	1% of total purchased equipment costs
Total Direct Installation Costs	$	641,604	
Total Direct Costs	$	2,780,284	
Indirect installation costs			
Engineering	$	213,868	10% of total purchased equipment costs
Construction and field expenses	$	106,934	5% of total purchased equipment costs
Contractor fees	$	213,868	10% of total purchased equipment costs
Start-up	$	42,774	2% of total purchased equipment costs
Performance test	$	21,387	1% of total purchased equipment costs
Total Indirect Installation Costs	$	598,830	
Contingency at 10%	$	337,911.47	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	$	3,717,026	
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
Catalyst Bed Replacement	$	484,209	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 664 ft^3
Utilities			
Propane Usage	$	1,001,639	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal. Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	299,364	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 hr/yr at $0.0689/kWh
Indirect Annual Costs			
Overhead	$	316,087	60% of sum of operating labor and materials, and maintenance labor and materials
Admin Charges	$	74,341	2% TCI
Property Taxes	$	37,170	1% TCI
Insurance	$	37,170	1% TCI
Capital Recovery	$	350,861	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	$	2,643,443	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Pellet Cooler VOC Emissions
ES-CLR-1 through 6
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	110,589	scfm (based on actual measured data for Sampson pellet coolers)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	110,589	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	3.93	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.40	auxiliary fuel usage (scfm), per Equation 2.45
	1018.60	btu/min
Total Energy Input	1,715,134.75	btu/min, per Equation 2.22
5% of Total Energy Input	85,756.74	btu/min
Max of Equation 2.45 and Equation 2.22	85,756.74	Per Section 2.4.2 and Step 8t of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	664	Overall bulk volume of catalyst bed (ft3), per Equation 2.26, space velocity of 10,000 h^{-1}

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

RTO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	3,521,405	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	352,140	10% of incinerator and auxiliary equipment costs
Sales tax	$	105,642	3% of incinerator and auxiliary equipment costs
Freight	$	176,070	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	**$**	**4,155,258**	
Direct installation costs			
Foundations and supports	$	332,421	8% of total purchased equipment costs
Handling and erection	$	581,736	14% of total purchased equipment costs
Electrical	$	166,210	4% of total purchased equipment costs
Piping	$	83,105	2% of total purchased equipment costs
Insulation for ductwork	$	41,553	1% of total purchased equipment costs
Painting	$	41,553	1% of total purchased equipment costs
Total Direct Installation Costs	**$**	**1,246,577**	
Total Direct Costs	**$**	**5,401,835**	
Indirect installation costs			
Engineering	$	415,526	10% of total purchased equipment costs
Construction and field expenses	$	207,763	5% of total purchased equipment costs
Contractor fees	$	415,526	10% of total purchased equipment costs
Start-up	$	83,105	2% of total purchased equipment costs
Performance test	$	41,553	1% of total purchased equipment costs
Total Indirect Installation Costs	**$**	**1,163,472**	
Contingency at 10%	$	656,530.69	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	**$**	**7,221,838**	
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			
Propane Usage	$	3,902,490	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2006-2010, US Energy Information Administration).
Electricity	$	520,662	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	$	144,437	2% TCI
Property Taxes	$	72,218	1% TCI
Insurance	$	72,218	1% TCI
Capital Recovery	$	681,690	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	**$**	**5,461,880**	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:

Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

ATTACHEMNT B
NCDAQ Response to EIP Comments on BACT Analysis

RTO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	232,833	scfm (based on actual measured data for Sampson pellet coolers and dry hammermills)

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	232,833	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	1600	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	2.45	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.18	auxiliary fuel usage (scfm), per Equation 2.45
	450.42	btu/min
Total Energy Input	6,682,346.12	btu/min, per Equation 2.22
5% of Total Energy Input	334,117.31	btu/min
Max of Equation 2.45 and Equation 2.22	334,117.31	Per Section 2.4.2 and Step 8c of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.

ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

RCO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

Capital Equipment Costs			
Direct Costs			
Purchased Equipment Costs			
Incinerator + auxiliary equipment	$	3,521,405	Equation 2.33 from EPA Cost Control Manual, Oxidizer and Incinerator Section, based on maximum measured flow rates corrected to standard conditions.
Instrumentation	$	352,140	10% of incinerator and auxiliary equipment costs
Sales tax	$	105,642	3% of incinerator and auxiliary equipment costs
Freight	$	176,070	5% of incinerator and auxiliary equipment costs
Total Purchased Equipment Costs	$	4,155,258	
Direct installation costs			
Foundations and supports	$	332,421	8% of total purchased equipment costs
Handling and erection	$	581,736	14% of total purchased equipment costs
Electrical	$	166,210	4% of total purchased equipment costs
Piping	$	83,105	2% of total purchased equipment costs
Insulation for ductwork	$	41,553	1% of total purchased equipment costs
Painting	$	41,553	1% of total purchased equipment costs
Total Direct Installation Costs	$	1,246,577	
Total Direct Costs	$	5,401,835	
Indirect installation costs			
Engineering	$	415,526	10% of total purchased equipment costs
Construction and field expenses	$	207,763	5% of total purchased equipment costs
Contractor fees	$	415,526	10% of total purchased equipment costs
Start-up	$	83,105	2% of total purchased equipment costs
Performance test	$	41,553	1% of total purchased equipment costs
Total Indirect Installation Costs	$	1,163,472	
Contingency at 10%	$	656,530.69	Default contingency factor of 10% from EPA Cost Control Manual, Oxidizer and Incinerators Section
Total Capital Investment	$	7,221,838	
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
Catalyst Bed Replacement	$	1,019,444	Based on 4 year catalyst life, catalyst cost of $3,000/ft^3 (noble metal catalysts), and catalyst volume of 1,397 ft^3.
Utilities			
Propane Usage	$	2,108,831	Propane usage is based on 5% of the Total Energy Input (Btu/min) per Equation 2.22 of EPA Cost Control Manual and a heating value of 90,000 btu/gal, Assumes 8760 hr/yr at $2.00/gal (average industrial price for 2008-2010, US Energy Information Administration).
Electricity	$	630,275	Electricity usage calculated using methodology in Section 2.5.2.1 of EPA Cost Control Manual, Oxidizer and Incinerators, Assumes 8760 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	$	144,437	2% TCI
Property Taxes	$	72,218	1% TCI
Insurance	$	72,218	1% TCI
Capital Recovery	$	681,690	CRF*TCI, based on 20 year equipment life and 7% interest
TOTAL ANNUAL OPERATING COST	$	4,797,278	Includes 10% Contingency on TCI (consistent with EPA cost manual)

Note:
Estimation based on *EPA Cost Control Manual, Chapter 2, Incinerators and Oxidizers*, November 2017. https://www.epa.gov/sites/production/files/2017-12/documents/oxidizersincinerators_chapter2_7theditionfinal.pdf

RCO Cost Calculations
Pellet Cooler and Dry Hammermill VOC Emissions
ES-CLR-1 through 6 and ES-HM-1 through 8
Enviva Pellets Sampson, LLC
Faison, Sampson County, North Carolina

CRF =	0.09439	
Interest rate	0.07	
Life of Equipment	20	years
Combined exhaust flow rate	232,833	scfm (based on actual measured data for Sampson pellet coolers and dry hammermills)
Catalyst Life	4	years
FWF =	0.225	

EPA Cost Control Manual, Incinerators and Oxidizers, Appendix B

Pwi	0.0739	density of waste gas (lb/ft3), assumes air
Qwi	232,833	volumetric flow rate of waste gas (scfm)
Cpm	0.255	mean heat capacity (btu/lb-°F)
n	0.015	heat loss fraction, based on Appendix B to cost manual
Tfi	900	oxidizer operating temperature, F
Tref	77	reference temperature, F
Tfo	300	exhaust gas temp, F, assumed based on similar sources
Twi	120	inlet waste gas temp, F
-Δhcwi	2.45	heat of combustion of waste gas (btu/lb)
Paf	0.1175	density of propane gas (lb/scf)
-Δhcaf	21638.00	heat of combustion for propane gas (btu/lb)
Qaf	0.19	auxiliary fuel usage (scfm), per Equation 2.45
	471.43	btu/min
Total Energy Input	3,611,011.72	btu/min, per Equation 2.22
5% of Total Energy Input	180,550.59	btu/min
Max of Equation 2.45 and Equation 2.22	180,550.59	Per Section 2.4.2 and Step 8c of Appendix B, the auxiliary fuel requirement should be set to the larger of the calculated auxiliary fuel or 5% of the Total Energy Input.
Vcat	1397	Overall bulk volume of catalyst bed (ft3), per Equation 2.28, space velocity of 10,000 h^{-1}

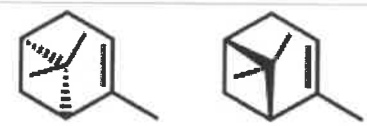
ATTACHEMNT B

NCDAQ Response to EIP Comments on BACT Analysis

Attachment 2

Calculation of CO2 Emissions from Combustion of alpha Pinene

α-Pinene



C10H16 (MW)	136.2	lb/lbmol
CO2(MW)	44	lb/lbmol

Complete Oxidation

$$C_{10}H_{16} + 14O_2 \rightarrow 10CO_2 + 8H_2O$$

Emission Source	Total VOC (ton/yr)	VOC Destroyed (ton/yr)	C10H16 lbmol/yr	CO2 lbmol/yr	CO2 ton/yr
Pellet Mills and Pellet Coolers	572	543.4	7,979.4	79,794.4	1,755.5
Dried Wood Handling	41	38.95	572.0	5,719.5	125.8
Dry Hammermills	168	159.6	2,343.6	23,436.1	515.6
Pellet Mills and Pellet Coolers and Dry Hammermills	740	703	10,323.1	103,230.5	2,271.1

Notes:

Assume VOC is α-pinene

Assume 95% control efficiency of RTO