NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date: October 30, 2019

Region: Fayetteville Regional Office
County: Richmond
NC Facility ID: 7700096
Inspector's Name: Gregory Reeves
Date of Last Inspection: 08/20/2019
Compliance Code: 3 / Compliance - inspection

Facility Data

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

Facility Address:
Enviva Pellets Hamlet, LLC
1125 North NC Highway 177
Hamlet, NC 28345

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: 15A NCAC 02D .0515, .0521, 02Q .0301
NSPS: N/A
NESHAP: N/A
PSD: N/A
PSD Avoidance: Modification to existing avoidance condition
NC Toxics: N/A
112(r): N/A
Other: N/A

Contact Data

Facility Contact	Authorized Contact	Technical Contact
Mat Riemenschneider EHS Manager (919) 616-3316 1125 North Highway 177 Hamlet, NC 28345	Paul Pereira Plant Manager (919) 218-6800 1125 North Highway 177 Hamlet, NC 28345	Kai Simonsen Air Permit Engineer (919) 789-3628 4242 Six Forks Road, Suite 1050 Raleigh, NC 27609

Application Data

Application Number: 7700096.19A
Date Received: 07/03/2019
Application Type: Modification
Application Schedule: State

Existing Permit Data
Existing Permit Number: 10365/R03
Existing Permit Issue Date: 01/14/2019
Existing Permit Expiration Date: 02/28/2021

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP

No emissions inventory on record. The emissions inventory is due June 30th of every year.

Review Engineer: Kevin Godwin

Review Engineer's Signature: **Date:** 10-29-19

Kevin T. Godwin

Comments / Recommendations:

Issue 10365/R04
Permit Issue Date: 10/30/2019
Permit Expiration Date: 02/28/2021

I. Introduction and Purpose of Application

A. According to application No. 7700096.19A, Enviva Pellets Hamlet, LLC (Enviva) was initially permitted to construct a wood pellets manufacturing plant in Richmond County, North Carolina under the authorization of Prevention of Significant Deterioration (PSD) Permit No. 10365R00 on March 29, 2016.

On May 14, 2018, Enviva submitted an application for various equipment changes and to request an enforceable limit of less than 250 tons per year for VOC, NOx, and CO emissions in order to be classified as a PSD minor stationary source. Permit No. 10365R03 was issued on January 14, 2019 to authorize these changes and included a PSD avoidance condition. The facility is classified as a major source of hazardous air pollutant (HAP) emissions.

The plant is currently permitted to produce up to 625,011 oven-dried tons (ODT) per year of wood pellets with a maximum of 85% softwood on a 12-month rolling basis. The plant consists of the following processes: Log De-barker, Log Chipper, Bark Hog, Green Wood Hammermills, Rotary Dryer, Dry Hammermills, Pellet Presses and Coolers, Product Loadout operations and other ancillary activities.

Enviva began commercial production on July 24, 2019.

B. This Permit action is in accordance with the Settlement Agreement dated June 3, 2019, entered into by Enviva, DEQ, and Clean Air Carolina in Contested Case 19 EHR 00866. The Settlement Agreement requires Enviva to submit an application for modification of existing Permit No. 10365R03 to include an express 85% limit on throughput on the dry hammermills at the facility, as was contemplated by the Permit R03 application.

C. As part of this application, Enviva is requesting several minor changes including:
1. Addition of a wet hardwood hopper (ID No. IES-GWH),
2. Addition of a fifth green wood storage pile (ID No. IES-GWSP-5), and
3. Addition of a small caustic parts washer (IES-PW) in the maintenance building.

II. Application Chronology

Application received and deemed complete	July 3, 2019
Draft provided to the applicant and Fayetteville Regional Office	September 19, 2019
Draft provided to DAQ Supervisor	October 17, 2019
Final Permit signed	October 30, 2019

III. Changes to Existing Air Permit

The following table provides a summary of changes made with this permit revision.

Page No.	Section	Description of Changes
N/A	Attachment – List of Insignificant Activities	Added the following sources: Green wood storage pile (ID No. IES-GWSP-5), wet hardwood hopper IES-GWH), and Parts Washer (ID No. IES-PW)
6	2.1 A.1.f.	Included the RTO and RCO in reporting activities pertaining to 15A NCAC 02D .0515.
6	2.1 A.1.f.	Revised monitoring, recordkeeping, and reporting requirements for WESP, RCO, and RTO to match the Enviva – Sampson Air Quality Permit (10386R04).
7	2.1 A.3.e.	Included a requirement for the Permittee to submit a summary report of monitoring and recordkeeping activities pertaining to 15A NCAC 02D .0521.

Page No.	Section	Description of Changes
8	2.1 A.4.b.	Replaced the word "initial" with "periodic."
9	2.2 A.2.b.iv.	Included the following restriction in the existing PSD avoidance condition: iv. total dry hammermill throughput shall not exceed 85% of the total facility-wide wood pellet production, on a rolling 12-month basis.
10	2.2 A.2.c.vi.	Revised initial performance testing to match the Enviva – Sampson Air Quality Permit (10386R04).
11	2.2 A.2.d.iv.	Revised periodic testing language to the following: (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.
11	2.2 A.2.d.v.	Removed "The Permittee shall submit a written report of results for the periodic performance test as described in Section 2.2.A.2.d.iv (C) to the Regional Supervisor, DAQ, within 60 days of completion of the test" as it is not necessary per the line above that requires 90-day submittal.
11	2.2 A.2.f.	Replaced the word "investigated" with "implemented."
11	2.2 A.2.h.	Revised monitoring and recordkeeping language as follows: The monthly pellet production in oven dried tons (ODT), the rolling 12-month total pellet production in ODT, monthly average softwood content, and 12-month rolling average softwood content shall be recorded in a monthly log kept on site.
11	2.2 A.2.j.	Included the following monitoring and recordkeeping requirement in the existing PSD avoidance condition: j. The Permittee shall monitor and record the total dry hammermill throughput, in ODT and percentage of total pellet production, on a monthly and 12-month rolling basis.
12	2.2 A.2.k.iii., iv., and v.	Included the following reporting requirement in the existing PSD avoidance condition: iii. The monthly and 12-month rolling total dry hammermill throughput and percentage of facility-wide total pellet production; iv. The monthly and 12-month rolling facility-wide total pellet production [as required in Condition 2.2 A.2.h.]; and v. The monthly hardwood/softwood mix [as required in Condition 2.2 A.2.h.].
12	2.2 A.6.	Included a condition referencing the State-Enforceable only Odor Rule, 15A NCAC 02D .1806.

IV. Statement of Compliance

The most recent compliance inspection of the Enviva facility was performed by Mr. Gregory Reeves on August 20, 2019. According to Mr. Reeves' inspection report dated August 21,2019, during the inspection the plant was operating at reduced capacity. At the time of inspection, the plant appeared to be in compliance with their Air Quality Permit. Because the facility has only been operating since their initial start-up in July 2019, there is no history of non-compliance.

V. Modification Description

A. Green Hardwood Handling and Storage (ID No. IES-GWH) – Green hardwood chips will be unloaded via truck dumpers and transferred to a new Green Wood Storage Pile (ID No. IES-GWSP-5) by front-end loader. From the pile, a front-end loader will transfer the green hardwood chips to the Wet Hardwood Hopper which will gravity feed the chips through an enclosed chute onto the enclosed conveyor to the Green Hammermills. The addition of the hopper will allow adjustment of the hardwood/softwood mix as needed.

Fugitive PM emissions from chip transfer operations were calculated based on AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles*. Transfer from the Wet Hardwood Hopper to the conveyor that feeds the Green Hammermills is completely enclosed, therefore, emissions were only quantified for the drop points to the storage pile and hopper. Potential PM emissions = 8.5E-02 tons per year (tpy).

B. Green Wood Storage Pile (ID No. IES-GWSP-5) – PM emission factors used to quantify fugitive emissions from storage pile wind erosion were calculated based on USEPA's Control of Open Fugitive Dust Sources. The PM emission factor is 8.6 lb/day/acre. VOC emissions from the storage pile were quantified based on an emission factor from the National Council for Air and Stream Improvement (NCASI) of 3.6 lb VOC as carbon lb/day/acre. Potential PM emissions = 0.29 tpy. Potential VOC as propane emissions = 0.15 tpy.

C. Paved Roads – Fugitive PM emission factors were calculated based on Equation 2 from AP-42 Section 13.2.1, *Paved Roads*. A 90% control efficiency was applied for water/dust suppression activities followed by sweeping. Potential PM emissions = 0.50 tpy.

D. Unpaved Roads – Fugitive PM emission factors were calculated based on Equation 1A from AP-42 Section 13.2.2, *Unpaved Roads*. A 90% control efficiency was applied for water/dust suppression activities. Potential PM emissions = 5.12 tpy.

E. Parts Washer – Enviva is proposing to install a small caustic parts washer in the maintenance building. The waste caustic will be collected by the vendor and transported off-site. As reported in the application, there will be no quantifiable air emissions associated with the new parts washer.

Copies of detailed potential emissions calculations spreadsheets are included in Attachment 1 of this document and in the application, Appendix E.

VI. Regulatory Review – Specific Emission Source Limitations and Conditions

A. 15A NCAC 02D .0515 "Particulates from Miscellaneous Industrial Processes" – This regulation establishes an allowable emission rate for particulate matter from any stack, vent, or outlet resulting from any industrial process for which no other emission control standards are applicable. This regulation applies to Total Suspended Particulate (TSP) or PM less than 100 micrometers (μm). The allowable emission rate is calculated using the following equation:

$E = 4.10 \times P^{0.67}$ for $P < 30$ tph
$E = 55 \times P^{0.11} - 40$ for $P \geq 30$ tph

where, E = allowable emission rate (lb/hr)
P = process weight rate (tph)

According to the application, the most significant source of PM emissions is the dryer system operating at 80 ODT/hr. The allowable emission rate is calculated to be 49.1 lb/hr. Maximum PM emission rate estimate is provided by the dryer vendor. The maximum hourly controlled emission rate is 7.6 lb/hr. The proposed new Wet Hardwood Hopper (ID No. IES-GWH), new Green Wood Storage Pile (ID No. IES-GWSP-5), and parts washer will also comply with this requirement. Therefore, compliance is indicated.

B. 15A NCAC 02D .0521 "Control of Visible Emissions" – This regulation establishes a visible emission standard for sources based on the manufacture date. For sources manufactured after July 1, 1971, the standard is 20 percent opacity when averaged over a 6-minute period except under the following conditions:

1. No six-minute period exceeds 87 percent opacity,
2. No more than one 6-minute period exceeds 20 percent opacity in any hour, and
3. No more than four 6-minute periods exceed 20 percent opacity in any 24-hour period.

The Permittee will be required to establish 'normal' visible emissions from these sources within the first 30-days of the permit effective date. In order to demonstrate compliance, the Permittee will be required to observe actual visible emissions on a monthly basis for comparison to 'normal'. If emissions are observed outside of 'normal', the Permittee shall take corrective action. Recordkeeping and reporting are required. Because all emission sources are designed to be well controlled, compliance with this standard is expected.

VII. Regulatory Review – Multiple Emission Source Limitations and Conditions

A. 15A NCAC 02D .1111 "Maximum Achievable Control Technology, 112(g)" - Clean Air Act (CAA) Section 112(g)(2)(B) requires that a new or reconstructed stationary source that does not belong to a regulated "source category" for which a NESHAP has been promulgated must control emissions to levels that reflect "maximum achievable control technology" (MACT). Because Wood Pellet Manufacturing Plants are not a regulated source category under 40 CFR 63, the Hamlet plant was subject to 112(g) and underwent a Case-by-Case MACT analysis pursuant to 40 CFR 63 Subpart B as part of the initial PSD construction permitting process. Because this application is not requesting construction of a major source or reconstruction of the process or production unit, the proposed project does not trigger a requirement to perform a new Case-by-Case MACT evaluation under Section 112(g).

B. Compliance Assurance Monitoring (CAM)
This permit (revision R04) is a non-Title V permit and CAM will be addressed at the time the Title V permit is developed.

C. 15A NCAC 02Q .0317 "Avoidance Conditions" for avoidance of 15A NCAC 02D .0530 "Prevention of Significant Deterioration (PSD)" – The existing Permit includes a condition limiting potential emissions of VOC, NOx, and CO to less than 250 tpy in order to avoid applicability of PSD. With this Permit modification, restriction iv. below is being added.

To ensure that the limits established above are not exceeded,

i. the greenwood hammermills and pellet dryer will be controlled by a regenerative thermal oxidizer (ID No. CD-RTO-1),
ii. the pellet mills and pellet coolers will be controlled by a regenerative catalytic oxidizer (ID No. CD-RCO),
iii. the facility will not process more than 625,011 oven dried tons per year (ODT/year) with a maximum of 85% softwood, on a rolling 12-month average basis, and
iv. total dry hammermill throughput shall not exceed 85% of the total facility-wide wood pellet production, on a rolling 12-month basis.

To ensure compliance with the added restriction, the Permittee shall monitor and record the total dry hammermill throughput, in ODT and percentage of total pellet production, on a monthly and 12-month rolling basis.

The Permittee must report the monthly and 12-month rolling total dry hammermill throughput and percentage of total pellet production; the monthly and 12-month rolling facility-wide total pellet production [as required in Condition 2.2 A.2.h.]; and the monthly hardwood/softwood mix [as required in Condition 2.2 A.2.h.].

D. 15A NCAC 02D .1100 Control of Toxic Air Pollutant (TAP) Emissions
15A NCAC 02D .1100 outlines the procedures that must be followed if a TAP permit and associated modeling are required under 15A NCAC 02Q .0700. In accordance with 15A NCAC 02Q .0704(d), a permit application filed pursuant to this Rule is required to include an evaluation of the TAP emissions from the facility's sources, excluding exempt sources listed in Rule .0702 of this Section. The proposed changes requested in this application will not result in an increase in TAP emissions. Therefore, no additional TAP evaluation or modeling are required.

E. 15A NCAC 02Q .0500 "Title V Permitting"
This application is being processed under the state construction and operating permit program initially. Within one year after commencement of facility operation, the Permittee will be required to submit a complete Title V application. The facility notified DAQ that operation commenced on July 24, 2019.

VIII. Other Regulatory Considerations

- An application fee of $970.00 was received by DAQ on June 3, 2019.
- The appropriate number of application copies was received by DAQ.
- A Professional Engineer's Seal is required for this application and was provided (ref. Russell Kemp, P.E. Seal # 19628, 7-1-19).
- Because this modification does not involve a plant expansion, a new zoning consistency determination is not required. A zoning consistency determination was received for application No. 770096.18A and was acknowledged by Tracy R. Parris, Planning Director, Richmond County on May 15, 2018 that the proposed operation is consistent with applicable zoning ordinances.
- Public notice is not required for this modification to the State Permit issued under 15A NCAC 02Q .0300.
- IBEAM Emission Source Module (ESM) update was verified on October 10, 2019.
- According to the application, the facility does not store any materials in excess of the 112r applicability threshold and is therefore not required to maintain a written risk management plan (RMP).
- The application was signed by Mr. Paul Pereira, Plant Manager on June 26, 2019 as the Responsible Official.

IX. Recommendations

This application has been reviewed by DAQ to determine compliance with all procedures and requirements. The Division has determined that this facility appears to be or is expected to achieve compliance as specified in the permit with all applicable requirements. A draft permit was provided to the Fayetteville Regional Office (FRO) on September 19, 2019. FRO responded with comments to the draft on September 19, 2019. A draft permit was provided to the applicant on September 19, 2019. The applicant responded with comments on October 11, 2019. All comments have been addressed. DAQ recommends issuance of Permit No. 10365R04.

ATTACHMENT 1

Table 1
Calculation Inputs
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Operational Data	
Green Hammermills, Dryers, Pellet Coolers	
Short-Term Throughput (ODT/hr)	80
Annual Throughput (ODT/yr)	625,011
Hours of Operation (hr/yr)	8,760
Softwood Composition	85%
Dry Hammermills	
Short-Term Throughput (ODT/hr)	68
Annual Throughput (ODT/yr)[1]	531,259
Hours of Operation (hr/yr)	8,760
Softwood Composition	85%

Notes:
1. 85% of raw material is processed by the dry hammermills.

Table 2
Summary of Facility-wide Potential Emissions
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

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	--	--	--	--	--	--	--	--	1.56	--
IES-BARKHOG	Bark Hog	--	--	--	--	0.23	0.13	--	--	0.28	--
ES-DRYER	250.4 MMBtu/hr Wood-fired Direct Heat Drying System	CD-WESP CD-RTO-1	WESP; RTO	219	219	33.3	33.3	33.3	27.4	38.7	243,754
ES-GHM-1 through 3	Three (3) Green Wood Hammermills										
ES-HM-1 through 8	Eight (8) Dry Hammermills	CD-HM-BH1 through 8	Eight (8) baghouses	--	--	18.0	18.0	0.31	--	135	--
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse	--	--	0.23	0.23	0.23	--	--	--
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse	--	--	0.075	0.075	0.075	--	--	--
ES-PCLP	Pellet Cooler LP Fines Relay System	CD-PCLP-BH	One (1) baghouse	--	--	0.47	0.47	0.47	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse	--	--	0.37	0.37	0.37	--	--	--
ES-CLR-1 through 6[1]	Six (6) Pellet Coolers	CD-CLR-1 through 6 (or CD-WSB) CD-RCO	Six (6) baghouses (one on each cooler) or wet scrubber; RCO	12.3	14.6	14.6	4.57	1.48	0.082	24.1	20,683
ES-DCTB	Pellet Dust Collection Transfer Bin	CD-PDCTB-BH	One (1) baghouse	--	--	0.45	0.45	0.45	--	--	--
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse	--	--	1.28	1.16	0.022	--	--	--
ES-PB-1 and 2	Two (2) Pellet Loadout Bins										
ES-DWH	Dried Wood Handling Operations	CD-DWH-BH1 and 2	Two (2) baghouses	--	--	0.30	0.30	0.30	--	38.8	--
ES-ADD	Additive Handling and Storage	CD-ADD-BH	One (1) baghouse	--	--	0.15	0.15	0.15	--	--	--
IES-GWH	Green Wood Handling Operations	--	--	--	--	0.085	0.040	0.0061	--	--	--
IES-TK-1	1,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	0.00058	--
IES-TK-2	185 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	0.00016	--
IES-TK-3	5,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	0.0033	--
IES-GWSP-1 through 5	Green Wood Storage Piles	--	--	--	--	13.5	6.73	1.01	--	7.02	--
IES-BFSP-1 and 2	Bark Fuel Storage Piles	--	--	--	--	0.56	0.28	0.042	--	0.29	--
IES-DRYSHAVE	Dry Shaving Material Handling	--	--	--	--	0.054	0.025	0.0039	--	--	--
IES-DEBARK-1	Debarker	--	--	--	--	1.08	0.59	--	--	--	--
IES-BFB[2]	Bark Fuel Bin	--	--	--	--	--	--	--	--	--	--
IES-GN	500 kW Diesel-fired Emergency Generator	--	--	0.14	2.46	0.0078	0.0078	0.0078	0.00066	1.68	179
IES-FWP	250 hp Diesel-fired Fire Water Pump	--	--	0.070	0.18	0.0092	0.0092	0.0092	0.00048	0.008	50.4
--	Paved Roads	--	--	--	--	16.3	3.26	0.80	--	--	--
--	Unpaved Roads	--	--	--	--	5.12	1.46	0.15	--	--	--
			Total Emissions:	**231**	**236**	**106**	**71.6**	**39.2**	**27.5**	**248**	**264,666**
			Total Excluding Fugitives[3]:	**231**	**236**	**70.5**	**59.8**	**37.1**	**27.5**	**241**	**264,666**
			PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**

Notes:

1. The pellet coolers will be equipped with either six (6) baghouses (one on each cooler) or a single wet scrubber for PM control. The emissions are expected to be the same whether the scrubber or baghouses are installed. In addition, the pellet coolers will be equipped with an RCO for VOC control that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions during thermal mode usage.
2. Bark is transferred from the primary Bark Fuel Storage Pile by walking floor to covered conveyors which transfer the bark into the fully enclosed Bark Fuel Bin. There are no emissions expected from transfer of material into the bin.
3. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

Abbreviations:

ES - Emission Source
IES - Insignificant Emission Source
CO - carbon monoxide
CO_2e - carbon dioxide equivalent
NO_X - nitrogen oxides
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - Regenerative Thermal Oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compounds
WESP - Wet Electrostatic Precipitator

Table 3
Summary of Facility-wide HAP Emissions
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Pollutant	CD-RTO-1[1] (tpy)	ES-HM-1 through 8 (tpy)	CD-RCO[2] (tpy)	ES-DWH (tpy)	IES-GN (tpy)	IES-FWP (tpy)	IES-BARKHOG (tpy)	IES-CHIP-1 (tpy)	Total HAP (tpy)
Acetaldehyde	1.8	2.4	0.13	--	9.0E-04	1.8E-04	--	--	4.3
Acetophenone	1.8E-07	--	--	--	--	--	--	--	1.8E-07
Acrolein	1.0	2.9	0.79	--	1.1E-04	2.1E-05	--	--	4.7
Antimony and compounds	6.3E-04	--	--	--	--	--	--	--	6.3E-04
Arsenic and compounds	1.8E-03	--	2.7E-05	--	--	--	--	--	1.8E-03
Benzene	0.23	--	2.9E-04	--	1.1E-03	2.1E-04	--	--	0.23
Benzo(a)pyrene	1.4E-04	--	1.6E-07	--	2.2E-07	4.3E-08	--	--	1.4E-04
Beryllium metal	8.9E-05	--	1.6E-06	--	--	--	--	--	9.1E-05
Butadiene, 1,3-	--	--	--	--	4.6E-05	9.0E-06	--	--	5.5E-05
Cadmium Metal	4.8E-04	--	1.5E-04	--	--	--	--	--	6.3E-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	4.7E-04	--	1.9E-04	--	--	--	--	--	6.6E-04
Chromium-Other compounds	1.4E-03	--	--	--	--	--	--	--	1.4E-03
Cobalt compounds	5.3E-04	--	1.2E-05	--	--	--	--	--	5.4E-04
Dichlorobenzene	1.6E-04	--	1.6E-04	--	--	--	--	--	3.3E-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	0.94	2.1	0.50	0.26	1.4E-03	2.7E-04	--	--	3.8
Hexane	0.25	--	0.25	--	--	--	--	--	0.49
Hydrochloric acid	2.1	--	--	--	--	--	--	--	2.1
Lead and lead compounds	3.9E-03	--	6.9E-05	--	--	--	--	--	4.0E-03
Manganese and compounds	0.13	--	5.2E-05	--	--	--	--	--	0.127
Mercury, vapor	3.1E-04	--	3.6E-05	--	--	--	--	--	3.5E-04
Methanol	2.1	1.4	3.8	0.61	--	--	5.7E-02	0.31	8.2
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	-[3]	8.4E-05	--	1.0E-04	1.9E-05	--	--	5.6E-03
Nickel metal	2.9E-03	--	2.9E-04	--	--	--	--	--	3.2E-03
Nitrophenol, 4-	6.0E-06	--	--	--	--	--	--	--	6.0E-06
Pentachlorophenol	5.6E-05	--	--	--	--	--	--	--	5.6E-05
Perchloroethylene	4.2E-02	--	--	--	--	--	--	--	0.042
Phenol	1.3	1.1	0.39	--	--	--	--	--	2.8
Phosphorus metal, yellow or white	2.1E-03	--	--	--	--	--	--	--	2.1E-03
Polychlorinated biphenyls	4.5E-07	--	--	--	--	--	--	--	4.5E-07
Propionaldehyde	0.45	5.0	0.17	--	--	--	--	--	5.6
Selenium compounds	2.3E-04	--	3.3E-06	--	--	--	--	--	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	--	4.7E-04	--	4.8E-04	9.4E-05	--	--	3.2E-03
Total PAH (POM)	0.14	--	9.6E-05	--	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	--	--	--	3.3E-04	6.5E-05	--	--	1.8E-03
Total HAP Emissions[3] (tpy)	**11**	**15**	**6.0**	**0.87**	**4.5E-03**	**8.9E-04**	**0.06**	**3.1E-01**	**34**
Maximum Individual HAP (tpy)	**Hydrochloric acid**	**Propionaldehyde**	**Methanol**	**Methanol**	**Formaldehyde**	**Formaldehyde**	**Methanol**	**Methanol**	**Methanol**
Maximum Individual HAP Emissions (tpy)	**2.1**	**5.0**	**3.8**	**0.61**	**1.4E-03**	**2.7E-04**	**0.06**	**3.1E-01**	**8.2**

Notes:

1. Includes emissions at outlet of RTO-1 stack as well as the HAP combustion emissions resulting from NG by the RTO-1 burners. RTO-1 controls emissions from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3).
2. Includes emissions at outlet of RCO stack as well as the HAP combustion emissions resulting from NG by the RCO burners. RCO controls emissions from the pellet coolers and pellet mill (ES-CLR-1 through 6). The pellet coolers will be equipped with an RCO that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions during thermal mode usage.
3. Because benzo(a)pyrene and naphthalene emissions were presented individually and as components of total PAH emissions, the total HAP emissions presented here do not match the sum of all pollutant emissions to avoid double counting benzo(a)pyrene and naphthalene emissions.

Abbreviations:

HAP - hazardous air pollutant
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
tpy - tons per year

Table 4
Potential Emissions at Outlet of RTO-1 Stack
ES-DRYER and ES-GHM-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput	80 ODT/hr
Annual Throughput	625,011 ODT/yr
Hourly Heat Input Capacity	250.4 MMBtu/hr
Annual Heat Input Capacity	2,193,504 MMBtu/yr
Hours of Operation	8,760 hr/yr
Number of RTO Burners	4 burners
RTO Burner Rating	8 MMBtu/hr
RTO Control Efficiency	95%

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Controlled Emission Factor	Units	Emissions at RTO-1 Outlet[1]	
			(lb/hr)	(tpy)
CO	50	lb/hr[2]	50	219
NO_x	50	lb/hr[2]	50	219
SO_2	0.025	lb/MMBtu[3]	6.3	27
VOC	0.12	lb/ODT[4]	10	39
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr[2]	7.6	33
CO_2	780	lb/ODT[5]	62,400	243,754

Notes:

1. Exhaust from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3) are routed to a WESP and then RTO for control of VOC, HAP, and particulates.
2. Emission rate based on data provided by RTO vendor (Lundberg) and include thermal emissions from the use of the RTO.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. VOC emission factor based on source test results from similar Enviva facilities.
5. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryer at Hamlet uses a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Table 4
Potential Emissions at Outlet of RTO-1 Stack
ES-DRYER and ES-GHM-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
Biomass Source								
Acetaldehyde	Y	Y	Y	5.7E-03	lb/ODT	1	0.46	1.8
Acrolein	Y	Y	Y	3.2E-03	lb/ODT	1	0.26	1.0
Formaldehyde	Y	Y	Y	3.0E-03	lb/ODT	1	0.24	0.92
Methanol	Y	N	Y	6.6E-03	lb/ODT	1	0.53	2.1
Phenol	Y	Y	Y	4.1E-03	lb/ODT	1	0.33	1.3
Propionaldehyde	Y	N	Y	1.4E-03	lb/ODT	1	0.12	0.45
Acetophenone	Y	N	Y	3.2E-09	lb/MMBtu	1	4.0E-08	1.8E-07
Antimony and compounds	Y	N	N	7.9E-06	lb/MMBtu	2,4	1.4E-04	6.3E-04
Arsenic	Y	Y	N	2.2E-05	lb/MMBtu	2,4	4.0E-04	1.7E-03
Benzene	Y	Y	Y	4.2E-03	lb/MMBtu	2,3	5.3E-02	0.23
Benzo(a)pyrene	Y	Y	Y	2.6E-06	lb/MMBtu	2,3	3.3E-05	1.4E-04
Beryllium	Y	Y	N	1.1E-06	lb/MMBtu	2,4	2.0E-05	8.7E-05
Cadmium	Y	Y	N	4.1E-06	lb/MMBtu	2,4	7.4E-05	3.3E-04
Carbon tetrachloride	Y	Y	Y	4.5E-05	lb/MMBtu	2,3	5.6E-04	2.5E-03
Chlorine	Y	Y	N	7.9E-04	lb/MMBtu	2	0.20	0.87
Chlorobenzene	Y	Y	Y	3.3E-05	lb/MMBtu	2,3	4.1E-04	1.8E-03
Chloroform	Y	Y	Y	2.8E-05	lb/MMBtu	2,3	3.5E-04	1.5E-03
Chromium VI	-[3]	Y	N	3.5E-06	lb/MMBtu	2,4,5	6.4E-05	2.8E-04
Chromium-Other compounds	Y	N	N	1.8E-05	lb/MMBtu	2,4	3.2E-04	1.4E-03
Cobalt compounds	Y	N	N	6.5E-06	lb/MMBtu	2,4	1.2E-04	5.2E-04
Dichloroethane, 1,2-	Y	Y	Y	2.9E-05	lb/MMBtu	2,3	3.6E-04	1.6E-03
Dichloropropane, 1,2-	Y	N	Y	3.3E-05	lb/MMBtu	2,3	4.1E-04	1.8E-03
Dinitrophenol, 2,4-	Y	N	Y	1.8E-07	lb/MMBtu	2,3	2.3E-06	9.9E-06
Di(2-ethylhexyl)phthalate	Y	Y	Y	4.7E-08	lb/MMBtu	2,3	5.9E-07	2.6E-06
Ethyl benzene	Y	N	Y	3.1E-05	lb/MMBtu	2,3	3.9E-04	1.7E-03
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	Y	1.8E-11	lb/MMBtu	2,3	2.2E-10	9.8E-10
Hydrochloric acid	Y	Y	N	1.9E-02	lb/MMBtu	2,6	0.48	2.1
Lead and lead compounds	Y	N	N	4.8E-05	lb/MMBtu	2,4	8.7E-04	3.8E-03
Manganese and compounds	Y	Y	N	1.6E-03	lb/MMBtu	2,4	2.9E-02	0.13
Mercury, vapor	Y	Y	N	3.5E-06	lb/MMBtu	2,4	6.4E-05	2.8E-04
Methyl bromide	Y	N	Y	1.5E-05	lb/MMBtu	2,3	1.9E-04	8.2E-04
Methyl chloride	Y	N	Y	2.3E-05	lb/MMBtu	2,3	2.9E-04	1.3E-03
Methyl ethyl ketone	N	Y	Y	5.4E-06	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methylene chloride	Y	Y	Y	2.9E-04	lb/MMBtu	2,3	3.6E-03	1.6E-02
Naphthalene	Y	N	Y	9.7E-05	lb/MMBtu	2,3	1.2E-03	5.3E-03
Nickel metal	Y	Y	N	3.3E-05	lb/MMBtu	2,4	6.0E-04	2.6E-03
Nitrophenol, 4-	Y	N	Y	1.1E-07	lb/MMBtu	2,3	1.4E-06	6.0E-06
Pentachlorophenol	Y	Y	N	5.1E-08	lb/MMBtu	2	1.3E-05	5.6E-05
Perchloroethylene	Y	Y	N	3.8E-05	lb/MMBtu	2	9.5E-03	4.2E-02
Phosphorus metal, yellow or white	Y	N	N	2.7E-05	lb/MMBtu	2,4	4.9E-04	2.1E-03
Polychlorinated biphenyls	Y	Y	Y	8.2E-09	lb/MMBtu	2,3	1.0E-07	4.5E-07
Polycyclic Organic Matter	Y	N	N	1.3E-04	lb/MMBtu	2	3.1E-02	0.14
Selenium compounds	Y	N	N	2.8E-06	lb/MMBtu	2,4	5.1E-05	2.2E-04
Styrene	Y	Y	Y	1.9E-03	lb/MMBtu	2,3	2.4E-02	0.10
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	Y	8.6E-12	lb/MMBtu	2,3	1.1E-10	4.7E-10
Toluene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	3.8E-04	1.6E-03
Trichloroethane, 1,1,1-	Y	Y	N	3.1E-05	lb/MMBtu	2	7.8E-03	3.4E-02
Trichloroethylene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	3.8E-04	1.6E-03
Trichlorofluoromethane	N	Y	Y	4.1E-05	lb/MMBtu	2,3	5.1E-04	2.2E-03
Trichlorophenol, 2,4,6-	Y	N	Y	2.2E-08	lb/MMBtu	2,3	2.8E-07	1.2E-06
Vinyl chloride	Y	Y	Y	1.8E-05	lb/MMBtu	2,3	2.3E-04	9.9E-04
Xylene	Y	Y	Y	2.5E-05	lb/MMBtu	2,3	3.1E-04	1.4E-03
				Total HAP Emissions (related to biomass)			**2.76**	**11.2**
				Total TAP Emissions (related to biomass)			**2.08**	**8.51**

Table 4
Potential Emissions at Outlet of RTO-1 Stack
ES-DRYER and ES-GHM-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
Natural Gas Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	Y	N	3.2	lb/MMscf	7	0.10	0.44
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	N	Y	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	7	3.8E-07	1.6E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	7	3.5E-05	1.5E-04
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	7	4.4E-05	1.9E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt	Y	N	N	8.4E-05	lb/MMscf	7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	Y	7.5E-02	lb/MMscf	7	2.4E-03	1.0E-02
Hexane	Y	Y	Y	1.8	lb/MMscf	7	5.6E-02	0.25
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	7	1.6E-05	6.9E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	7	1.2E-05	5.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	7	8.2E-06	3.6E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium	Y	N	N	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
			Total HAP Emissions (related to natural gas)				**0.059**	**0.26**
			Total TAP Emissions (related to natural gas)				**0.16**	**0.70**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities.
2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. The control efficiency of 95% for the RTO is applied to all VOC hazardous and toxic pollutants for those emission factors that are not derived from Enviva stack test data.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
5. Chromium VI is a subset of chrome compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.
6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

Abbreviations:

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

Table 5
Summary of Potential Emissions from Baghouses
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate[1]	Exit Grain Loading	Particulate Speciation		Potential Emissions					
								PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-HM-1	Dry Hammermill	CD-HM-BH1	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-2	Dry Hammermill	CD-HM-BH2	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-3	Dry Hammermill	CD-HM-BH3	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-4	Dry Hammermill	CD-HM-BH4	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-5	Dry Hammermill	CD-HM-BH5	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-6	Dry Hammermill	CD-HM-BH6	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-7	Dry Hammermill	CD-HM-BH7	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HM-8	Dry Hammermill	CD-HM-BH8	One (1) baghouse[2, 3]	15,000	0.004	100%	1.7%	0.51	2.3	0.51	2.25	8.7E-03	0.038
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse[2, 4]	1,500	0.004	100%	100%	0.051	0.23	0.051	0.23	0.051	0.23
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse[2, 4]	500	0.004	100%	100%	0.017	0.075	0.017	0.075	0.017	0.075
ES-PCLP	Pellet Cooler LP Fines Relay System	CD-PCLP-BH	One (1) baghouse[2, 4]	3,102	0.004	100%	100%	0.11	0.47	0.11	0.47	0.11	0.47
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse[2, 4]	2,444	0.004	100%	100%	0.084	0.37	0.084	0.37	0.084	0.37
ES-CLR-1	Pellet Cooler	CD-CLR-BH1	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-CLR-2	Pellet Cooler	CD-CLR-BH2	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-CLR-3	Pellet Cooler	CD-CLR-BH3	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-CLR-4	Pellet Cooler	CD-CLR-BH4	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-CLR-5	Pellet Cooler	CD-CLR-BH5	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-CLR-6	Pellet Cooler	CD-CLR-BH6	One (1) baghouse[5]	15,000	0.004	26.1%	3.2%	0.51	2.3	0.13	0.59	0.016	0.072
ES-DCTB	Pellet Dust Collection Transfer Bin	CD-PDCTB-BH	One (1) baghouse[2, 4]	3,000	0.004	100%	100%	0.10	0.45	0.10	0.45	0.10	0.45
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse[3,6]	8,500	0.004	91%	1.7%	0.29	1.3	0.27	1.16	5.0E-03	0.022
ES-PB-1 and 2	Two (2) Pellet Loadout Bins												
ES-DWH	Dried Wood Handling-Operations (conveyors)	CD-DWH-BH1	One (1) baghouse[2, 4]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15
		CD-DWH-BH2	One (1) baghouse[2, 4]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15
ES-ADD	Additive Handling and Storage	CD-ADD-BH	One (1) baghouse[2, 4]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15

Notes:

1. Control device flow rate (cfm) based on updated emission point data provided by Enviva on 3/16/18.
2. No speciation data is available for PM_{10}. Therefore, it is conservatively assumed to be equal to total PM.
3. Dry Hammermills and finished product handling $PM_{2.5}$ speciation based on April 2014 Enviva Southampton $PM_{2.5}$ speciation tests.
4. No speciation data is available for $PM_{2.5}$. Therefore, it is conservatively assumed to be equal to total PM.
5. Exit flow rate provided by Enviva. Exit grain loading assumed to be the same as for other baghouses at the facility. A single wet scrubber may be used in place of the six (6) baghouses for PM control. The emissions are expected to be the same whether the scrubber or baghouses are installed. Baghouse or scrubber emissions will exhaust through CD-RCO.
6. Finished product handling PM_{10} speciation based on emission factors for wet wood combustion controlled by a mechanical separator from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03. Because the particle size of particulate matter from finished product handling is anticipated to be larger than flyash, this factor is believed to be a conservative indicator of speciation.

Abbreviations:

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

Table 6
Dry Hammermill Potential VOC and HAP Emissions
ES-HM-1 through 8
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput	68 ODT/hr
Annual Throughput[1]	531,259 ODT/yr
Hours of Operation	8,760 hr/yr

Notes:
1. Enviva is requesting a throughput limit of 531,259 ODT/yr (i.e. 85% of the total facility-wide throughput of 625,011 ODT/yr) for the Dry Hammermills.

Potential VOC and HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1]	Potential Emissions	
				(lb/ODT)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	0.0091	0.62	2.42
Acrolein	107-02-8	Y	Y	0.011	0.73	2.87
Formaldehyde	50-00-0	Y	Y	0.0080	0.55	2.14
Methanol	67-56-1	N	Y	0.0052	0.35	1.37
Phenol	108-95-2	Y	Y	0.0041	0.28	1.08
Propionaldehyde	123-38-6	N	Y	0.019	1.28	5.00
Total HAP Emissions					**3.81**	**14.9**
Total TAP Emissions					**2.18**	**8.51**
Total VOC	--	--	Y	0.51	34.7	135

Notes:
1. Emission factors are based on stack testing data from comparable Enviva facilities.

Abbreviations:

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

Table 7
Potential VOC and HAP Emissions at Outlet of RCO Stack
ES-CLR-1 through 6
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput	80 ODT/hr
Annual Throughput	625,011 ODT/yr
Hours of Operation	8,760 hr/yr
Number of Burners	4 burners
RCO/RTO Burner Rating	8 MMBtu/hr
RCO/RTO Control Efficiency	95%

Pellet Cooler and Pellet Mill Potential Process VOC and HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Uncontrolled Emission Factor[1]	Emissions at RCO Outlet[2]	
				(lb/ODT)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	0.0084	0.034	0.13
Acrolein	107-02-8	Y	Y	0.050	0.20	0.79
Formaldehyde	50-00-0	Y	Y	0.031	0.12	0.49
Methanol	67-56-1	N	Y	0.24	0.96	3.75
Phenol	108-95-2	Y	Y	0.025	0.10	0.39
Propionaldehyde	123-38-6	N	Y	0.011	0.043	0.17
				Total HAP Emissions	**1.46**	**5.72**
				Total TAP Emissions	**0.46**	**1.80**
Total VOC	--	--	Y	1.5	5.98	23.4

Notes:

1. Emission factors were derived based on stack testing data from comparable Enviva facilities.
2. A 95% control efficiency is applied to the potential emissions for the RCO. The pellet coolers will be equipped with an RCO that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions during thermal mode usage.

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02 MMBtu/lb
Uncontrolled VOC emissions	467 tons/yr
Heat input of uncontrolled VOC emissions	17,284 MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	8.2E-02	lb/MMBtu[1]	0.16	0.71
NO_X	9.8E-02	lb/MMBtu[1]	0.19	0.85

Natural Gas Combustion Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	8.2E-02	lb/MMBtu[1]	2.64	12
NO_X	9.8E-02	lb/MMBtu[1]	3.14	14
SO_2	5.9E-04	lb/MMBtu[1]	0.019	0.082
VOC	5.4E-03	lb/MMBtu[1]	0.17	0.76
PM	7.5E-03	lb/MMBtu[1]	0.24	1.0
PM_{10}	7.5E-03	lb/MMBtu[1]	0.24	1.0
$PM_{2.5}$	7.5E-03	lb/MMBtu[1]	0.24	1.0
CO_2	66.9	kg/MMBtu[2]	4,718	20,666
CH_4	1.0E-03	kg/MMBtu[2]	0.071	0.31
N_2O	1.0E-04	kg/MMBtu[2]	0.0071	0.031
CO_2e			4,722	20,683

Table 7
Potential VOC and HAP Emissions at Outlet of RCO Stack
ES-CLR-1 through 6
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Natural Gas Combustion Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
Natural Gas Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	3	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	3	5.0E-07	2.2E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	3	4.8E-07	2.1E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	3	5.6E-07	2.5E-06
Ammonia	N	Y	N	3.2	lb/MMscf	3	0.10	0.44
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	3	7.5E-08	3.3E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	3	6.3E-06	2.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Benzene	Y	N	Y	2.1E-03	lb/MMscf	3	6.6E-05	2.9E-04
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	3	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	3	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	3	3.8E-07	1.6E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	3	3.5E-05	1.5E-04
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	3	4.4E-05	1.9E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Cobalt	Y	N	N	8.4E-05	lb/MMscf	3	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	3	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	3	3.8E-05	1.6E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	3	9.4E-08	4.1E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	3	8.8E-08	3.8E-07
Formaldehyde	Y	Y	Y	7.5E-02	lb/MMscf	3	2.4E-03	1.0E-02
Hexane	Y	Y	Y	1.8	lb/MMscf	3	5.6E-02	0.25
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	3	5.6E-08	2.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	3	1.6E-05	6.9E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	3	1.2E-05	5.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	3	8.2E-06	3.6E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	3	1.9E-05	8.4E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	3	6.6E-05	2.9E-04
Phenanathrene	Y	N	Y	1.7E-05	lb/MMscf	3	5.3E-07	2.3E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	3	1.6E-07	6.9E-07
Selenium	Y	N	N	2.4E-05	lb/MMscf	3	7.5E-07	3.3E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	3	1.1E-04	4.7E-04
				Total HAP Emissions (natural gas combustion)			**0.059**	**0.26**
				Total TAP Emissions (natural gas combustion)			**0.16**	**0.70**

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for natural gas combustion by the burners obtained from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.
3. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

Abbreviations:

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

Table 8
Dried Wood Handling Potential Emissions
ES-DWH
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput[1]	80 ODT/hr
Annual Throughput[1]	625,011 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor (lb/ODT)	Potential Emissions[1]	
		(lb/hr)	(tpy)
Formaldehyde	8.4E-04	0.067	0.26
Methanol	2.0E-03	0.16	0.61
Total HAP Emissions		**0.22**	**0.87**
VOC as carbon[2]	0.10	8.1	32
VOC as propane[3]	0.12	9.9	39

Notes:

1. Hourly and annual throughputs assumed to be the same as dry hammermill throughput.
2. Emission factors derived from NCASI's Wood Products Database (February 2013) for dry wood handling operations at an OSB mill, mean emission factors. The emission factors were converted from lb/MSF (3/8") to lb/ODT using the typical density and moisture content of an OSB panel.
3. VOC as propane = (1.22 x VOC as carbon) + formaldehyde.

Abbreviations:

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

Table 9
Emergency Generator Potential Emissions
IES-GN
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Engine Output	500 kW
Horsepower Rating	671 brake hp
Diesel Heating Value	19,300 Btu/lb
Hours of Operation	500 hr/yr
Conversion factor	2,545 Btu/hr/hp
Hourly Fuel Consumption	31.9 gal/hr[1]
Energy Input	4.37 MMBtu/hr[2]

Notes:
1. Fuel consumption calculated using a factor of 0.0476 gal/hr-hp. Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
2. Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO[2]	0.39	g/hp-hr	0.58	0.14
NO_x[2]	6.65	g/hp-hr	9.8	2.5
SO_2[3]	15	ppmw	2.7E-03	6.6E-04
VOC[2]	0.01	lb/hp-hr	6.7	1.7
PM[2]	0.021	g/hp-hr	3.1E-02	7.8E-03
PM_{10}[2]	0.021	g/hp-hr	3.1E-02	7.8E-03
$PM_{2.5}$[2]	0.021	g/hp-hr	3.1E-02	7.8E-03
CO_2	74.0	kg/MMBtu[4]	713	178
CH_4	3.0E-03	kg/MMBtu[4]	2.9E-02	7.2E-03
N_2O	6.0E-04	kg/MMBtu[4]	5.8E-03	1.4E-03
CO_2e			715	179

Notes:
1. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
2. Emission factors for Particulate Matter (TSP/PM_{10}/$PM_{2.5}$), Nitrous Oxide (NO_x), Volatile Organic Matter (VOC), and Carbon Monoxide (CO) obtained from generator's spec sheet. The generator's spec sheet does not include an emission factor for VOC so the hydrocarbon (HC) emission factor was used as a surrogate for VOC.
3. Sulfur content in accordance with Year 2013 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
4. Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1]	Potential Emissions[2]	
				(lb/hp-hr)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	5.37E-06	3.6E-03	9.0E-04
Acrolein	107-02-8	Y	Y	6.48E-07	4.3E-04	1.1E-04
Benzene	71-43-2	Y	Y	6.53E-06	4.4E-03	1.1E-03
Benzo(a)pyrene[3]	50-32-8	Y	Y	1.32E-09	8.8E-07	2.2E-07
1,3-Butadiene	106-99-0	Y	Y	2.74E-07	1.8E-04	4.6E-05
Formaldehyde	50-00-0	Y	Y	8.26E-06	5.5E-03	1.4E-03
Naphthalene[3]	91-20-3	N	Y	5.94E-07	4.0E-04	1.0E-04
Total PAH (POM)	--	N	Y	1.18E-06	7.9E-04	2.0E-04
Toluene	108-88-3	Y	Y	2.86E-06	1.9E-03	4.8E-04
Xylene	1330-20-7	Y	Y	2.00E-06	1.3E-03	3.3E-04
			Total HAP Emissions		**1.8E-02**	**4.5E-03**
			Total TAP Emissions		**1.7E-02**	**4.3E-03**

Notes:
1. Emission factors obtained from AP-42 Section 3.3 - Stationary Internal Combustion Engines, 10/96, Table 3.3-2.
2. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
3. Benzo(a)pyrene and naphthalene are included as HAPs in Total PAH.

Abbreviations:

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

Table 10
Fire Pump Potential Emissions
IES-FWP
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Engine Output	0.10 MW
Horsepower Rating	131 brake hp
Diesel Density[1]	7.1 lb/gal
Hours of Operation	500 hr/yr
Hourly Fuel Consumption	9 gal/hr[1]
Energy Input	1.23 MMBtu/hr[2]

Notes:
1. Diesel density from AP-42 Section 3.4 - Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96, Table 3.4-1, footnote a.
2. Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO[2]	1.3	g/kW-hr	0.28	7.0E-02
NO_x[2]	3.4	g/kW-hr	0.72	0.18
SO_2[3]	15	ppmw	1.9E-03	4.8E-04
VOC[2]	0.15	g/kW-hr	3.2E-02	8.1E-03
PM[2]	0.17	g/kW-hr	3.7E-02	9.2E-03
PM_{10}[2]	0.17	g/kW-hr	3.7E-02	9.2E-03
$PM_{2.5}$[2]	0.17	g/kW-hr	3.7E-02	9.2E-03
CO_2	74	kg/MMBtu[4]	201	50
CH_4	3.0E-03	kg/MMBtu[4]	8.2E-03	2.0E-03
N_2O	6.0E-04	kg/MMBtu[4]	1.6E-03	4.1E-04
CO_2e			202	50

Notes:
1. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the fire pump are conservatively based on 500 hr/yr.
2. Emissions factors for $PM/PM_{10}/PM_{2.5}$, NO_x, hydrocarbons, and CO obtained from generator's spec sheet.
3. Sulfur content in accordance with Year 2013 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
4. Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1]	Potential Emissions[2]	
				(lb/hp-hr)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	5.4E-06	7.0E-04	1.8E-04
Acrolein	107-02-8	Y	Y	6.5E-07	8.5E-05	2.1E-05
Benzene	71-43-2	Y	Y	6.5E-06	8.6E-04	2.1E-04
Benzo(a)pyrene	50-32-8	Y	Y	1.3E-09	1.7E-07	4.3E-08
1,3-Butadiene	106-99-0	Y	Y	2.7E-07	3.6E-05	9.0E-06
Formaldehyde	50-00-0	Y	Y	8.3E-06	1.1E-03	2.7E-04
Naphthalene	91-20-3	N	Y	5.9E-07	7.8E-05	1.9E-05
Total PAH (POM)[3]	--	N	Y	1.2E-06	1.5E-04	3.9E-05
Toluene	108-88-3	Y	Y	2.9E-06	3.8E-04	9.4E-05
Xylene	1330-20-7	Y	Y	2.0E-06	2.6E-04	6.5E-05
				Total HAP Emissions	**3.6E-03**	**8.9E-04**
				Total TAP Emissions	**3.4E-03**	**8.5E-04**

Notes:
1. Emission factor obtained from NCDAQ Internal Combustion (Small Gasoline and Diesel Engines) Spreadsheet/AP-42 Section 3.3 - Stationary Internal Combustion Engines, 10/96, Table 3.3-2.
2. NSPS allows for only 100 hrs/yr of non-emergency operation of these engines. Potential emissions for the fire pump are conservatively based on 500 hr/yr.
3. The PAH emission factor includes all the PAH compounds listed in AP-42. Emissions for naphthalene and benzo(a)pyrene are also calculated separately. For the purposes of calculating total HAP emissions, the naphthalene and benzo(a)pyrene are not included separately to avoid double counting these emissions.

Abbreviations:

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

Table 11
Log Chipper Potential Emissions
IES-CHIP-1
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput[1]	275 ton/hr, wet
	138 ODT/hr
Annual Throughput	625,011 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Potential Emissions[1]	
		(lb/hr)	(tpy)
THC as carbon[2]	4.1E-03 lb/ODT	0.56	1.3
VOC as propane[3]	5.0E-03 lb/ODT	0.69	1.6
Methanol[2]	1.0E-03 lb/ODT	0.14	0.31

Notes:

1. Hourly chipper throughput data provided by Enviva (email from Kai Simonsen dated 12/21/17).
2. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Table 9. Emission factors for THC and methanol are the same across all three tables.
3. Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

Hourly Throughput	25 ODT/hr
Annual Throughput[2]	113,638 ODT/yr
	227,277 ton/yr, wet
Approx. Moisture Content[1]	50% of total weight

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Potential Emissions[1]	
		(lb/hr)	(tpy)
THC as carbon[3]	4.1E-03 lb/ODT	0.10	0.23
VOC as propane[4]	5.0E-03 lb/ODT	0.13	0.28
Methanol[3]	1.0E-03 lb/ODT	2.5E-02	5.7E-02
TSP[5]	2.0E-02 lb/ton	0.10	0.23
PM_{10}[5]	1.1E-02 lb/ton	5.5E-02	0.13

Notes:

1. Hourly bark hog throughput data and approximate moisture content provided by Enviva (email from Kai Simonsen dated 12/21/17).
2. Maximum throughput assumes bark hog usage is proportional to the amount of log chipping that occurs for maximum pellet ODT and maximum 75% purchase of green wood from logs.
3. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.
4. Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.
5. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking)*. All PM is assumed to be larger than 2.5 microns. PM emissions are assumed to be controlled due to the bark hog being partially enclosed (assumed 90% control).

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
THC - total hydrocarbon
tpy - tons per year
yr - year

Table 13
Green Wood Handling
IES-GWH
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[2]	PM Emission Factor[3]	PM_{10} Emission Factor[3]	$PM_{2.5}$ Emission Factor[3]	Potential Throughput[4]		Potential PM Emissions[5]		Poter Emi
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr
ES-GWH	Purchased Bark/Fuel Chips Transfer to Outdoor Storage Area	1	48%	5.0E-05	2.4E-05	3.6E-06	25	81,640	1.2E-03	2.0E-03	5.9E-0
	Purchased Wood Chips to Outdoor Storage Area	4	42%	6.0E-05	2.8E-05	4.3E-06	69	312,505	1.6E-02	3.7E-02	7.8E-0
	Purchased Wood Chips to Wet Hardwood Pile	1	42%	6.0E-05	2.8E-05	4.3E-06	50	135,000	3.0E-03	4.0E-03	1.4E-0
	Purchased Wood Chips Transfer to Wet Hardwood Hopper	1	42%	6.0E-05	2.8E-05	4.3E-06	50	135,000	3.0E-03	4.0E-03	1.4E-0
	Processed Wood Chips to Outdoor Storage Area	2	42%	6.0E-05	2.8E-05	4.3E-06	138	312,505	1.6E-02	1.9E-02	7.8E-0
	Chip Truck Dump to Dumpers	2	42%	6.0E-05	2.8E-05	4.3E-06	69	312,505	8.2E-03	1.9E-02	3.9E-0
							Total Emissions:		**4.8E-02**	**8.5E-02**	**2.3E-0**

Notes:

1. These green wood handling emissions are representative of the fugitive emissions at the site.
2. Average moisture content for bark based on material balance provided by design engineering firm (Mid-South Engineering). Moisture content for purchased and process wood chips provid Assumed the lower moisture content between pine and hardwood to conservatively estimate PM emissions. (Hardwood 42% moisture; pine 51% (purchased wood chips) and 49% (proces
3. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06).

where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM	0.74
k = particle size multiplier (dimensionless) for PM_{10}	0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.053
U = mean wind speed (mph)	7.85

4. Throughputs represent dry weight of materials, calculated based on listed material moisture contents. Hourly purchased bark throughput based on bark hog hourly throughput. Hourly purc based on weight of chips delivered to the facility. Hourly processed wood chip throughput based on log chipping hourly throughput.

Abbreviations:

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

Table 14
Storage Pile Wind Erosion
IES-GWSP-1 through -5, and IES-BFSP-1 and -2
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width	Pile Length	Pile Height	Outer Surface Area of Pile[3]	Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions		Potential VOC Emissions as propane[4]	
		(lb/day/acre)	(lb/hr/ft^2)	(lb/day/acre)	(lb/hr/ft^2)	(ft)	(ft)	(ft)	(ft^2)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-GWSP-1	Green Wood Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	100	310	30	66,720	0.55	2.40	0.27	1.20	0.041	0.18	0.28	1.23
IES-GWSP-2	Green Wood Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	100	310	30	66,720	0.55	2.40	0.27	1.20	0.041	0.18	0.28	1.23
IES-GWSP-3	Green Wood Storage Pile No. 3	8.6	8.2E-06	3.6	3.4E-06	220	310	30	120,000	0.99	4.32	0.49	2.16	0.074	0.32	0.50	2.21
IES-GWSP-4	Green Wood Storage Pile No. 4	8.6	8.2E-06	3.6	3.4E-06	220	310	30	120,000	0.99	4.32	0.49	2.16	0.074	0.32	0.50	2.21
IES-GWSP-5	Green Wood Storage Pile No. 5	8.6	8.2E-06	3.6	3.4E-06	51	51	20	8,105	0.067	0.29	0.033	0.146	5.0E-03	2.2E-02	0.034	0.15
IES-BFSP-1	Bark Fuel Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	60	100	15	12,960	0.11	0.47	0.053	0.23	8.0E-03	0.035	0.054	0.24
IES-BFSP-2	Bark Fuel Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	25	25	15	2,550	0.021	0.092	0.010	0.046	1.6E-03	6.9E-03	0.011	0.047
									Total Emissions:	**3.27**	**14.3**	**1.63**	**7.15**	**0.24**	**1.07**	**1.67**	**7.31**

Notes:

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

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

where:		
s, silt content of wood chips (%):	8.4	s - silt content (%) for lumber sawmills (mean) from AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Table 13.2.2-1
p, number of days with rainfall greater than 0.01 inch:	110	Based on AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Figure 13.2.1-2.
f (time that wind exceeds 5.36 m/s - 12 mph) (%):	12.5	Based on meteorological data averaged for 2012-2016 for Maxton, NC National Weather Service (NWS) Station
PM_{10}/TSP ratio:	50%	PM_{10} is assumed to equal 50% of TSP based on U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
$PM_{2.5}$/TSP ratio:	7.5%	$PM_{2.5}$ is assumed to equal 7.5 % of TSP U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

2. Emission factors obtained from NCASI document provided by the South Carolina Department of Health and Environmental Control (DHEC) for the calculation of fugitive VOC emissions from Douglas Fir wood storage piles. Emission factors ranged from 1.6 to 3.6 lb C/acre-day. Enviva chose to employ the maximum emission factor for purposes of conservatism.
3. The surface area is calculated as [2*H*L+2*W*H+L*W] + 20% to consider the sloping pile edges. Length and width based on proposed site design with a conservative height.
4. Emissions are calculated in tons of carbon per year by the following formula:

tons C/year = 5 acres * 365 days * 1.6 lb C/acre-day / 2000 lb/ton

Emission factor converted from as carbon to as propane by multiplying by 1.22.

Abbreviations:

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

Table 15a
Potential Fugitive PM Emissions from Paved Roads
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[2]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[3] (lb/VMT)	PM_{10} Emission Factor[3] (lb/VMT)	$PM_{2.5}$ Emission Factor[3] (lb/VMT)	Potential PM Emissions (lb/day)	Potential PM Emissions (tpy)	Potential PM_{10} Emissions (lb/day)	Potential PM_{10} Emissions (tpy)	Potential $PM_{2.5}$ Emissions (lb/day)	Potential $PM_{2.5}$ Emissions (tpy)
Logs Delivery to Crane Storage Area	9,000	47	80	365	40,480	102,540	35.8	29,241	2.7	0.53	0.13	21.2	3.88	4.25	0.78	1.04	0.19
Logs Delivery to South Log Storage Area	11,700	31	69	365	40,480	102,540	35.8	25,089	2.7	0.53	0.13	18.2	3.33	3.64	0.67	0.89	0.16
Logs Delivery to North Log Storage Area	8,475	14	23	365	40,480	102,540	35.8	8,261	2.7	0.53	0.13	6.00	1.09	1.20	0.22	0.29	0.054
Chips/Hog Fuel Delivery	8,475	94	151	365	40,960	101,440	35.6	55,071	2.6	0.53	0.13	39.8	7.27	7.96	1.45	1.95	0.36
Pellet Truck Delivery to Pellet Loadout Area (Truck Back-up)	9,075	60	103	10	40,480	102,540	35.8	1,031	2.7	0.53	0.13	27.3	0.14	5.47	0.027	1.34	0.0067
Pellet Truck Delivery to Pellet Loadout Area (Normal Operations)	900	2	0.34	300	40,480	102,540	35.8	102	2.7	0.53	0.13	0.090	0.014	0.018	0.0027	0.0044	6.7E-04
Front End Loader to Green Wood Storage Pile No. 5	200	343	13	350	56,375	63,375	29.9	4,545	2.2	0.44	0.11	2.87	0.50	0.57	0.10	0.14	0.025
Employee Car Parking	2,250	75	32	365	4,000	4,000	2.0	11,665	0.14	0.028	6.9E-03	0.45	0.082	0.089	0.016	0.022	0.0040
											Total Emissions:	**116**	**16.3**	**23.2**	**3.26**	**5.70**	**0.80**

Notes:

1. Distance traveled per round trip was estimated based on truck route and site layout.
2. Daily trip counts based on original permit application estimations and maximum material throughputs.
3. Emission factors calculated based on Equation 2 from AP-42 Section 13.2.1 - Paved Roads, 01/11.
   where:

   E = emission factor (lb/ton)
   k = particle size multiplier (dimensionless) for PM 0.011
   k = particle size multiplier (dimensionless) for PM_{10} 0.0022
   k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.00054
   sL - mean road surface silt loading from AP-42 Table 13.2.1-3 for quarries (g/m^2) 8.2
   P - No. days with rainfall greater than 0.01 inch 110 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Richmond County, NC).
4. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities followed by sweeping. Per Table 5 in Chapter 4 of the Air Pollution Engineering Manual, Air and Waste Management Association, page 141. Control efficiency (%) = 96-0.263*V, where V is the number of vehicle passes since application of water.

Abbreviations:

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

Table 15b
Potential Fugitive PM Emissions from Unpaved Roads
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[2]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Front End Loader to Wet Hardwood Hopper	600	343	39	350	56,375	63,375	29.9	13,636
							29.9	**13,636**

Notes:

1. Distance traveled per round trip was estimated based on truck route and site layout.
2. Daily trip counts based on engineering estimates.

Emission Calculations Unpaved Roads:

Pollutant	Empirical Constant (k)[1]	Silt Content (S)[2]	Particle Constant a[1]	Particle Constant b[1]	Emission Factor[3]	Potential Emissions[4]
	(lb/VMT)	(%)	(-)	(-)	(lb/VMT)	(tpy)
PM	4.9	8.4	0.7	0.45	7.51	5.12
PM_{10}	1.5	8.4	0.9	0.45	2.14	1.46
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.21	0.15

Notes:

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

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

k = particle size multiplier for particle size range and units of interest
E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
P=number of days with at least 0.01 in of precipitation during the averaging period =
= 110 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Richmond County, NC).

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

Abbreviations:

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

Table 16
Diesel Storage Tanks
IES-TK-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Source ID	Description	Design Volume[1] (gal)	Working Volume[2] (gal)	Tank Dimensions[5] Diameter (ft)	Tank Dimensions[5] Length (ft)	Orientation	Throughput[3] (gal/yr)	Turnov
IES-TK-1	Emergency Generator Fuel Storage Tank[2]	1,000	500	5.3	6	Horizontal	15,958	31.9
IES-TK-2	Fire Pump Fuel Storage Tank[2]	185	93	3.3	3.3	Horizontal	4,500	48.6
IES-TK-3	Mobile Fuel Diesel Storage Tank	5,000	2,500	6.0	23.7	Horizontal	200,000	80.0
								Total Emissi

Notes:

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

Abbreviations:

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

Table 17
Dry Shaving Material Handling
IES-DRYSHAVE
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Source	Transfer Activity	Number of Drop Points	Material Moisture Content[1]	PM Emission Factor[2]	PM_{10} Emission Factor[2]	$PM_{2.5}$ Emission Factor[2]	Potential Throughput[3,4]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-DRYSHAVE	Dry Shaving Material Handling - Truck dump to truck dumper	1	10%	4.5E-04	2.1E-04	3.2E-05	25	219,000	1.1E-02	4.9E-02	5.3E-03	2.3E-02	8.0E-04	3.5E-03
	Dry Shaving Material Handling - Bucket elevator to silo[5]	1	10%	4.5E-04	2.1E-04	3.2E-05	25	219,000	1.1E-03	4.9E-03	5.3E-04	2.3E-03	8.0E-05	3.5E-04
								Total Emissions:	**1.2E-02**	**5.4E-02**	**5.8E-03**	**2.5E-02**	**8.8E-04**	**3.9E-03**

Notes:

1. Moisture content for dry shavings based on information provided by Enviva.
2. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06).

where:

E = emission factor (lb/ton)	
k = particle size multiplier (dimensionless) for PM	0.74
k = particle size multiplier (dimensionless) for PM_{10}	0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.053
U = mean wind speed (mph)	7.85

3. Hourly throughput based on a maximum transfer rate of 100 ton/hr of dry shaving material.
4. Annual throughput based on 4 dry shaving deliveries per week and a maximum storage capacity of 1360 tons for the dry shaving material storage silo.
5. Bucket elevator to silo material handling transfer point emissions account for a 90% control efficiency due to the enclosed nature of the silo (San Diego County, 1993).

Abbreviations:

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

Reference:

San Diego County. 1993. Cement & Fly Ash Storage Silos. June 7. Available online at: https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/Toxics_Program/APCD_silo1.pdf.

Table 18
Debarker Potential Emissions
IES-DEBARK-1
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Throughput[1]	275 ton/hr
Annual Throughput[1]	1,078,143 ton/yr

Potential Criteria Pollutant Emissions

Source	Pollutant	Emission Factor (lb/ton)	Potential Emissions	
			(lb/hr)	(tpy)
IES-DEBARK-1	TSP[2]	2.0E-02	0.55	1.1
	PM_{10}[2]	1.1E-02	0.30	0.59

Notes:

1. Hourly bark hog throughput data provided by Enviva (email from Kai Simonsen dated 12/21/17). Annual throughput of logs delivered for debarking, as reported for log chipping. Per 12/21/17 email from Enviva, 2 tons of green material is needed for every 1 ODT of pellets, and 1.15 times that amount for purchased logs. At most, Enviva would purchase 75% of the needed logs with the remaining 25% of green material coming from purchased chips.
2. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants.* Source Classification Code 3-07-008-01 (Log Debarking). All PM is assumed to be larger than 2.5 microns in diameter. PM emissions are assumed to be controlled due to the debarker being partially enclosed (assumed 90% control).

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
tpy - tons per year
yr - year