

From: [McDowell, Sara](#)
To: [Aponte, Anna](#); [Holmes, Jill R](#)
Cc: [Allison, Steve](#); [Hamby, Terri](#); [Gijon-felix, Ruben](#); [Boylan, James](#); [Brown, Delveccio](#); [Zufall, Maria J](#); [Kuhlman, Steve J](#); [Wright, Jay B](#)
Subject: RE: Updates to your Regional Haze 4 Factor Analysis based on EPA comments
Date: Tuesday, June 14, 2022 9:47:01 AM
Attachments: [image001.png](#)
[Brunswick Regional Haze Analysis \(2022-06-13\)v2.pdf](#)

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Anna,
Additional information on EPA's comments is provided below in blue and in the attached file. Please let us know if you have any questions or need anything else.

Thanks,
Sara McDowell
GP Environmental Affairs
Cell: 830-243-8061
sara.mcdowell@gapac.com

From: Aponte, Anna <Anna.Aponte1@dnr.ga.gov>
Sent: Friday, June 10, 2022 4:09 PM
To: McDowell, Sara <SARA.MCDOWELL@GAPAC.COM>; Holmes, Jill R <JILL.HOLMES@GAPAC.com>
Cc: Allison, Steve <Steve.Allison2@dnr.ga.gov>; Hamby, Terri <Terri.Hamby@dnr.ga.gov>; Gijon-felix, Ruben <ruben.gijon-felix@dnr.ga.gov>; Boylan, James <James.Boylan@dnr.ga.gov>; Brown, Delveccio <delveccio.brown@dnr.ga.gov>
Subject: Re: Updates to your Regional Haze 4 Factor Analysis based on EPA comments

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Ok thank you for the update. We understand it takes time to gather the type of information we requested.

[Anna Aponte](#)
Unit Manager
Planning & Regulatory Development Unit
Air Protection Branch
Phone: (470) 251-2942

[4244 International Parkway, Suite #120](#)
[Atlanta, GA 30354](#)

From: McDowell, Sara <SARA.MCDOWELL@GAPAC.COM>

Sent: Friday, June 10, 2022 5:08:19 PM

To: Aponte, Anna <Anna.Aponte1@dnr.ga.gov>; Holmes, Jill R <JILL.HOLMES@GAPAC.com>

Cc: Allison, Steve <Steve.Allison2@dnr.ga.gov>; Hamby, Terri <Terri.Hamby@dnr.ga.gov>; Gijon-felix, Ruben <ruben.gijon-felix@dnr.ga.gov>; Boylan, James <James.Boylan@dnr.ga.gov>; Brown, Delveccio <delveccio.brown@dnr.ga.gov>

Subject: RE: Updates to your Regional Haze 4 Factor Analysis based on EPA comments

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Anna,

Just to follow up with you, I am preparing responses to the two comments below but don't have the responses ready for you yet. I should be able to send them early next week though.

Thanks,

Sara McDowell

GP Environmental Affairs

Cell: 830-243-8061

sara.mcdowell@gapac.com

From: Aponte, Anna <Anna.Aponte1@dnr.ga.gov>

Sent: Friday, June 3, 2022 2:03 PM

To: Holmes, Jill R <JILL.HOLMES@GAPAC.com>; McDowell, Sara <SARA.MCDOWELL@GAPAC.COM>

Cc: Allison, Steve <Steve.Allison2@dnr.ga.gov>; Hamby, Terri <Terri.Hamby@dnr.ga.gov>; Gijon-felix, Ruben <ruben.gijon-felix@dnr.ga.gov>; Boylan, James <James.Boylan@dnr.ga.gov>; Brown, Delveccio <delveccio.brown@dnr.ga.gov>

Subject: Updates to your Regional Haze 4 Factor Analysis based on EPA comments

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Jill,

To continue our conversation from last week, we have come up with a list of items that we need your help addressing from the EPA Region 4 comments on our pre-draft SIP.

- 1) Key Comment 1.b - Evaluate emissions of Recovery Furnace No. 5 and Recovery Furnace No. 6. EPA identified these units as being uncontrolled and they don't have any Monitoring, Recordkeeping or Reporting Requirements (MRR).
GP Response: Monitoring of the quantity of fuel oil fired in the No. 5 Recovery Furnace is required by existing permit condition 3.2.11 and the associated recordkeeping is specified in condition 5.2.3.d.iii. SO₂ emissions from the No. 6 Recovery Furnace are limited by existing permit conditions 3.2.12.d. and 3.2.12.e. Monitoring of the quantity

of fuel oil fired in the No. 6 Recovery Furnace is required by existing permit condition 3.2.14 and the associated recordkeeping is specified in condition 5.2.3.d.iv. Reporting of any exceedances of the annual fuel oil firing limits for the recovery furnaces is required in existing conditions 6.1.7.b.iii(A) for the No. 6 Recovery Furnace and 6.1.7.b.iii(B) for the No. 5 Recovery Furnace.

- 2) General Comment 8.a – EPA asked for additional justification on how the cost-effectiveness of the replacement of the No. 6 fuel oil with one percent fuel oil factored into the decision of the cost effectiveness values listed - \$4,221/ton and \$4,154/ton.
GP Response: The attached calculations provide some additional information on the cost effectiveness of firing the lower sulfur fuel oil blend (new information is in the blue highlighted cells). The No. 4 Power Boiler has been excluded from the updated analysis since GP has already agreed to eliminate TDF firing and reduce fuel oil firing to reduce SO₂ emissions from that unit. This essentially means that the analysis is looking at the cost effectiveness of firing a lower sulfur fuel oil blend in the No. 5 Recovery Furnace or the No. 5 Recovery Furnace and the No. 5 Lime Kiln.

Note that in this analysis, adjustments were made to the No. 5 Recovery Furnace emissions because sulfur emissions fuels are lower in a recovery furnace than conventional combustion due to the reducing conditions and fume particles which “capture” SO₂. NCASI’s Technical Bulletin 578 examined the impact of burning No. 6 fuel oil in non-direct contact recovery furnaces equipped with ESPs and showed that actual SO₂ emissions from the tested units while firing No. 6 fuel oil as a supplemental fuel were consistently lower than the emissions predicted by assuming all the sulfur in the fuel oil was emitted. The reduction in emissions from calculated to measured ranged from 35% to 90% due to the recovery furnace environment. The attached calculations show that if the actual SO₂ emissions are even 20% lower than the calculated SO₂ emissions for the No. 5 Recovery Furnace, the cost per ton of the use of a lower sulfur fuel oil blend would exceed \$5,000.

The information requested can be submitted as a supplement to your 4 Factor Analysis and we would appreciate your response by June 10th . Of course, if you have any questions, feel free to reach out to me.

Anna Aponte
Unit Manager
Planning & Regulatory Development Unit
Air Protection Branch
Phone: (470) 251-2942

4244 International Parkway, Suite #120
Atlanta, GA 30354



Cost Evaluation for the Use of a Lower Sulfur Fuel Oil (Includes the No 5 Lime Kiln)

No. 6 Fuel Oil Usage - Total for all Units (Mgal)				1.5% Sulfur Fuel Oil					1% Sulfur Fuel Oil					No. 2 Fuel Oil					Scenario
				Heat Content of 1.5% Sulfur Fuel Oil (Btu/gal)	Additional 1.5% Sulfur Fuel Required (Mgal)	SO ₂ Emissions from 1.5% Sulfur Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)	Heat Content of 1% Sulfur Fuel Oil (Btu/gal)	Additional 1% Sulfur Fuel Required (Mgal)	SO ₂ Emissions from 1% Sulfur Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)	Heat Content of No. 2 Fuel Oil (Btu/gal)	Additional No. 2 Fuel Oil Required (Mgal)	SO ₂ Emissions from No. 2 Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)	
1,613				147,506	51	140	\$120,794	\$14,909	145,465	75	95	\$186,798	\$3,846	138,000	166	2.20	\$937,212	\$6,511	Original
1,613				147,506	51	107	\$120,794	\$19,326	145,465	75	73	\$186,798	\$5,028	138,000	166	2.20	\$937,212	\$8,527	Reduced 5RF Emissions
1,493				147,506	47	93	\$111,645	\$20,993	145,465	69	63	\$172,701	\$5,448	138,000	153	2.18	\$866,867	\$9,184	Reduced 4PB
1,240				147,506	39	62	\$92,412	\$28,503	145,465	57	42	\$143,111	\$7,051	138,000	127	2.10	\$719,526	\$11,631	No 4PB

Capital & Operating Cost Evaluation for Combustion Unit Modifications

Cost Category	Value	Notes
Approximate Combustion Modification Costs (\$) =	\$345,000	Includes modifications for all three emission units
Total Capital Investment (TCI)	\$345,000	
Capital Recovery		
Capital Recovery Factor (CRF)	0.063209454	CRF = 4.75% interest (current bank prime rate as of 6/16/2022) and 30-yr equipment life based on July 2020 Draft Section 5 Control Cost Manual
Capital Recovery Cost (CRC)	\$21,807	CRC = TCI × CRF
Total Annualized Cost (AC) =	\$21,807	AC = CRC + DOC + IOC

Cost Evaluation for the Use of a Lower Sulfur Fuel Oil in the No. 4 Power Boiler, No. 5 Recovery Furnace, and No 5 Lime Kiln, continued

Notes

1. Fuel consumption values and SO₂ emissions from combusting No. 6 fuel oil are based on the most recent 3 calendar years of operating data (2017 - 2019).
2. Cost data and blended fuel heat content provided by the fuel vendor.

Cost of No. 6 Fuel Oil = \$60.66 \$/bbl

Incremental Additional Cost for Blended Fuel = \$1.18 \$/bbl for 1.5% Sulfur Fuel Oil

\$1.96 \$/bbl for 1% Sulfur Fuel Oil

Cost of No. 2 Fuel Oil = \$77.12 \$/bbl, average value
3. Other data used in the calculations:

Emission Factor for No. 6 Fuel Oil = 157 S lb/Mgal, Table 1.3-1 of AP-42, where S is the fuel sulfur content as a percentage

Emission Factor for No. 2 Fuel Oil = 142 S lb/Mgal, Table 1.3-1 of AP-42, where S is the fuel sulfur content as a percentage

Sulfur Content of No. 2 Fuel Oil = 0.0015 %S for ULSD
4. The additional fuel required for each blended fuel is calculated as follows:

Additional Fuel Required (Mgal) = [Heat Input from No. 6 Fuel Oil (MMBtu) * 1,000,000 Btu/MMBtu / Heat Content of Blended Fuel (Btu/gal)] / 1000 gal/Mgal - No. 6 Fuel Oil Usage for All Three Units (Mgal)

The additional fuel requirement for each emission unit is calculated as follows:

Emission Unit	Original				Reduced 4PB				No 4PB			
	No. 6 Fuel Oil Usage (Mgal)	No. 6 Fuel Oil Heat Input (MMBtu)	Additional 1.5% Sulfur Fuel Required (Mgal)	Additional 1% Sulfur Fuel Required (Mgal)	No. 6 Fuel Oil Usage (Mgal)	No. 6 Fuel Oil Heat Input (MMBtu)	Additional 1.5% Sulfur Fuel Required (Mgal)	Additional 1% Sulfur Fuel Required (Mgal)	No. 6 Fuel Oil Usage (Mgal)	No. 6 Fuel Oil Heat Input (MMBtu)	Additional 1.5% Sulfur Fuel Required (Mgal)	Additional 1% Sulfur Fuel Required (Mgal)
No. 4 Power Boiler	374	56,939	12	18	253	38,533	8	12	0	0	0	0
No. 5 Recovery Furnace	761	115,817	24	35	761	115,817	24	35	761	115,817	24	35
No. 5 Lime Kiln	479	72,808	15	22	479	72,808	15	22	479	72,808	15	22

5. The SO2 emission rate for the blended fuels was calculated as follows:

SO₂ Emissions from Blended Fuel Combustion (tpy) = [Existing Fuel Oil Usage for the No. 4 Power Boiler and No. 5 Recovery Furnace (Mgal) + Additional Fuel Oil Required for the No. 4 Power Boiler and No. 5 Recovery Furnace (Mgal)] * [157 * Fuel Sulfur Content (%)] lb SO₂/Mgal / 2,000 lb/ton + 3-Year Average SO₂ Emission Rate for the No. 5 Lime Kiln

6. The cost of fuel replacement is calculated as follows:

Cost (\$) = Fuel Oil Usage for All Three Units (Mgal) * 1000 gal/Mgal / 42 gal/bbl * Incremental Cost of Blended Fuel (\$/bbl) + Additional Fuel Required (Mgal) * 1000 gal/Mgal / 42 gal/bbl * (Cost of No. 6 Fuel Oil (\$/bbl) + Incremental Cost of Blended Fuel (\$/bbl))

7. The cost per ton of SO₂ removed is calculated as follows:

Cost per ton (\$/ton) = [Cost of Fuel Replacement (\$) + Annualized Cost of Equipment Modifications (\$)] / [SO₂ Emissions from Firing No. 6 Fuel Oil (tons) - SO₂ Emissions from Firing Blended Fuel (tons)]

Cost Evaluation for the Use of a Lower Sulfur Fuel Oil (Excludes the No. 5 Lime Kiln)																			
No. 6 Fuel Oil Usage (Mgal)			1.5% Sulfur Fuel Oil					1% Sulfur Fuel Oil					No. 2 Fuel Oil					Scenario	
			Heat Content of 1.5% Sulfur Fuel Oil (Btu/gal)	Additional 1.5% Sulfur Fuel Required (Mgal)	SO ₂ Emissions from 1.5% Sulfur Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)	Heat Content of 1% Sulfur Fuel Oil (Btu/gal)	Additional 1% Sulfur Fuel Required (Mgal)	SO ₂ Emissions from 1% Sulfur Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)	Heat Content of No. 2 Fuel Oil (Btu/gal)	Additional No. 2 Fuel Oil Required (Mgal)	SO ₂ Emissions from No. 2 Fuel Oil (tpy)	Cost of Fuel Replacement (\$)	Cost per ton (\$/ton)		
1,135	172,756	147	147,506	36	138	\$85,284	\$17,258	145,465	53	93	\$131,718	\$3,899	138,000	117	0.13	\$659,639	\$5,019	Original	
1,135	172,756	113	147,506	36	105	\$85,284	\$22,371	145,465	53	71	\$131,718	\$5,098	138,000	117	0.13	\$659,639	\$6,571	Reduced 5RF Emissions	
1,014	154,350	97	147,506	32	91	\$76,135	\$24,527	145,465	47	60	\$117,621	\$5,401	138,000	104	0.12	\$589,295	\$6,911	Reduced 4PB	
761	115,817	64	147,506	24	60	\$56,902	\$34,109	145,465	35	40	\$88,032	\$7,007	138,000	78	0.06	\$441,954	\$8,181	No 4PB	

Capital & Operating Cost Evaluation for Combustion Modifications and a New Fuel Oil Tank		
Cost Category	Value	Notes
Approximate Combustion Modification Costs (\$) =	\$230,000	
Approximate Tank Costs (\$) =	\$700,000	Approximate cost for a 500,000-gal fuel oil tank based on similar installations at other sites
Total Capital Investment (TCI)	\$930,000	
Capital Recovery		
Capital Recovery Factor (CRF)	0.063209454	CRF = 4.75% interest (current bank prime rate as of 6/16/2022) and 30-yr equipment life based on July 2020 Draft Section 5 Control Cost Manual
Capital Recovery Cost (CRC)	\$58,785	CRC = TCI × CRF
<i>Indirect Operating Costs (IOC) - New Storage Tank Only</i>		
Insurance	\$7,000	J = 1% × TCI
Administrative Charges	\$14,000	K = 2% × TCI
Total Indirect Operating Costs (IOC)	\$21,000	IOC = H + I + J + K
Total Annualized Cost (AC) =	\$79,785	AC = CRC + DOC + IOC

Cost Evaluation for the Use of a Lower Sulfur Fuel Oil in the No. 4 Power Boiler and No. 5 Recovery Furnace, continued

- Notes**
1. Fuel consumption values in this table are based on the most recent 3 calendar years of operating data (2017 - 2019).
2. Cost data and blended fuel heat content provided by the fuel vendor.
- Cost of No. 6 Fuel Oil =

\$60.66 \$/bbl
- Incremental Additional Cost for Blended Fuel =

\$1.18 \$/bbl for 1.5% Sulfur Fuel Oil
- \$1.96 \$/bbl for 1% Sulfur Fuel Oil
- Cost of No. 2 Fuel Oil =

\$77.12 \$/bbl, average value
3. Other data used in the calculations:
- Emission Factor for No. 6 Fuel Oil =

157 S lb/Mgal, Table 1.3-1 of AP-42, where S is the fuel sulfur content as a percentage
- Emission Factor for No. 2 Fuel Oil =

142 S lb/Mgal, Table 1.3-1 of AP-42, where S is the fuel sulfur content as a percentage
- Sulfur Content of No. 2 Fuel Oil =

0.0015 %S for ULSD
4. The additional fuel required for each blended fuel is calculated as follows:
- Additional Fuel Required (Mgal) = [Heat Input from No. 6 Fuel Oil (MMBtu) * 1,000,000 Btu/MMBtu / Heat Content of Blended Fuel (Btu/gal)] / 1000 gal/Mgal - No. 6 Fuel Oil Usage for No. 4 Power Boiler and No. 5 Recovery Furnace (Mgal)

The additional fuel requirement was calculated separately for each emission unit as follows:												
Original					Reduced 4PB				No 4PB			
									Additional			
									1.5% Sulfur			
									Fuel			
									Additional 1%			
									Sulfur Fuel			