Appendix A

EPA Office of Air Quality Planning and Standards (OAQPS) Modeling Report

SUBJECT: Analysis of Hydrogen Sulfide Emissions from Georgia Pacific in Crossett, AR

FROM: James Hirtz, Air Toxics Assessment Group (C555-K)

TO: Margaret Osbourne; Region 6 Toxics Enforcement Section Chief

DATE: October 26, 2017

Background

From early October 2014 to the present, continuous ambient monitoring of hydrogen sulfide (H_2S) has been conducted by Georgia Pacific (GP) at their Crossett, Arkansas pulp and paper mill. The ambient monitoring program has been conducted by GP in response to community concerns regarding H_2S/sulfide exposure from waste water treatment (WWT) emissions at the facility. Based on the public concerns and monitored levels observed at the GP monitor, EPA Region 6 expanded the monitoring network to include an additional 20 monitors using passive monitor tubes. The passive monitor tubes are placed in the field for a 14-day period in which they are continuously exposed to the ambient air. At the end of each 14-day period they are collected and analyzed. Figure 1 depicts the layout of the Region 6 monitor locations. 11 of the monitors were sited to estimate source emissions over a 4.5-mile stretch of the WWT system (on-site process monitors) while the remaining 9 monitors were placed in the nearby community and other off-site locations (residential monitors) to help evaluate the WWT plume's dispersion and potential public exposure to H_2S. Further information on the monitoring program can be found in "Georgia- Pacific CAA Investigations Monitoring Activities in EPA Region 6", dated December 14, 2016 [1]."

At the request of EPA Region 6 staff, the Office of Air Quality Planning and Standards (OAQPS) provided air dispersion modeling support for the following two tasks:

1) Using dispersion modeling and ambient monitoring data, estimate the most likely H_2S emissions for 9 specific WWT fugitive emission points; and
2) Using the emissions estimated in Task 1 and dispersion modeling, estimate chronic and acute ambient levels and any potential public health impacts associated with these emissions to the local community and discuss the uncertainty associated with these analyses.

WWT Operations

Table 1 lists the potential fugitive emissions that are expected from the WWT system. Figure 1 shows their locations in reference to the monitoring sites. H_2S emissions from the WWT system have only been quantified from the point source. These data were provided by the Arkansas Department of Environmental Quality (ADEQ) for the 2014 calendar year. Emissions from all

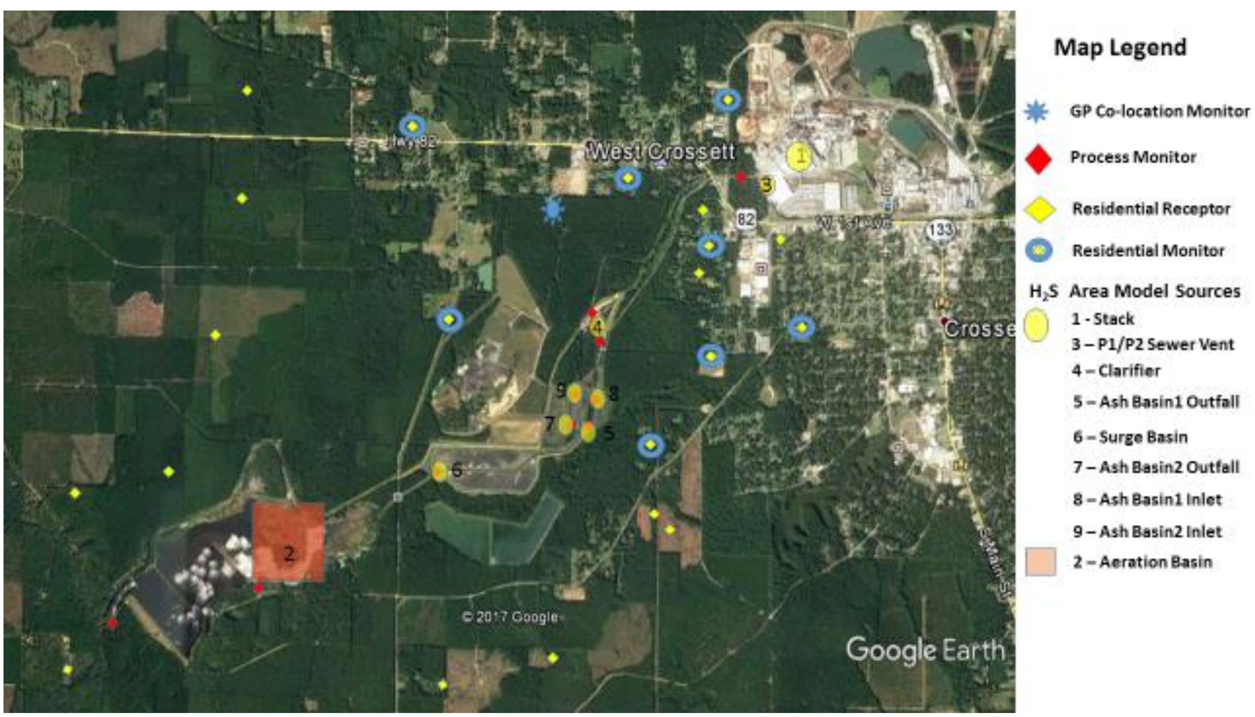
[1] EPA R6 QAPP; "Georgia-Pacific CAA Investigative Monitoring Activities in Region 6"; December 14, 2016.

fugitive sources including vents, basins, and the clarifier were not quantified in the ADEQ inventory. The goal of this study, under Task 1, is to quantify these H_2S emissions using available monitoring data, site configuration information, local meteorology, and a dispersion model.

Table 1: GP WWT Model H_2S Emission Sources

Emission Point	Source Type	Description	X (UTM- m)	Y (UTM -m)
1	POINT	Stack Emissions	595643	3667665
2	AREA/Fugitive Emissions	Aeration Stabilization Basin: Zone 1	590958	3663862
3	AREA/Fugitive Emissions	P1/P2 Sewer Vents	595334	3667111
4	AREA/Fugitive Emissions	Primary Clarifier	593851	3665921
5	AREA/Fugitive Emissions	East Ash Basin Outlet	593789	3665075
6	AREA/Fugitive Emissions	Surge Basin Outlet	592525	3664713
7	AREA/Fugitive Emissions	West Ash Basin Outlet	593680	3665143
8	AREA/Fugitive Emissions	East Ash Basin Inlet	593853	3665317
9	AREA/Fugitive Emissions	West Ash Basin Inlet	593736	3665361

Figure 1 – GP WWT Model Emission Source, Monitor, and Residential Receptor Locations



<u>Task 1 Approach</u>

As noted above, the initial task (Task 1) was to quantify expected emissions from the WWT fugitive sources. The ambient data used to estimate the emissions were passively monitored samples collected from January 13, 2017 through May 5, 2017, identified as Episodes 1-8, or Event 1-8. These episodes were selected based on measured results collected over a period in which process operations were consistent. In late April and early May, GP experienced a plant outage, causing reduced production at their pulping operations, resulting in potentially lower H_2S emissions. Additionally, GP began adjusting their plant operations and WWT processes to attempt H_2S reductions in June 2017. Because of uncertainties associated with plant operations during this time period, Episodes 9-12 were excluded from the analysis.

For all dispersion modeling, OAQPS used the AERMOD [2] dispersion modeling system. AERMOD is EPA's preferred model for near-field dispersion modeling. Meteorological data for input to the model included wind speed and direction data from an on-site meteorological tower. We obtained other required meteorological data from the nearby Monticello-AR Municipal Airport (LLQ). LLQ is about 55 miles north-north-east of the paper mill and has similar land features, and therefore has similar meteorological conditions to that at the WWT site. The meteorological data was processed into model-ready format using the EPA's AERMET and AERSURFACE processing routines. Receptors were placed at each of the 20 passive monitoring locations used in the monitoring study. In addition, a receptor was placed at the background monitor location, identified as COM4 at Clemmie Wimberly Athletic Park (North Missouri and West 6th Avenue). This location is about 1,800 meters east of the WWT primary clarifier. Receptor locations are also depicted in Figure 1. A listing of the dispersion models and modeling parameters employed in the study are summarized in Table 2.

Table 2. GP WWT - AERMOD Modeling System Parameters.

Parameter	
Version	AERMOD (16216r) AERMET (15181) AERMAP (11103)
Terrain Elevations	Included
Building Downwash	Not included
Meteorological Data	
Surface Data	Monticello Municipal Airport with On-site wind speed/direction (01/1/2017 – 07/01/2017)
Upper Air Data	Monticello Municipal Airport (01/1/2017 – 07/01/2017)
Urban or Rural Dispersion	Rural

Task 1 – WWT Emission Estimates

[2] http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

By conducting an iterative approach, we varied the emissions into the dispersion model from each of the nine H_2S Area Model Sources to best match the on-site process monitoring values. Because there are nine fugitive emissions sources in which we need to estimate an emissions rate, there is a great deal of uncertainty in these emission estimates. A review of the off-site monitoring data at the community monitors identified monitor (COM4) with the lowest ambient levels of approximately 1 $\mu g/m^3$. Because this value is low compared to ambient levels measured at other monitor locations, a background correction was not including in the analysis.

Table 3 presents the best fit absolute ratios comparing each monitoring episode (event) with concentrations predicted by the AERMOD model for the corresponding time period. For ratio values in which the monitor values were greater than model values, an inverse ratio was applied and is depicted by the yellow highlight. Figure 2 shows the on-site process monitor locations along with the average absolute ratios. In general, the model tended to under-predict ambient levels. When averaged over the first 8 episodes, all but two on-site process monitor and two off-site community monitors were within a factor of 2. In all cases where the ratio was greater than 2, the model under predicted the monitor value. This analysis also showed that for all episodes the ratios associated with emissions from CONV, THUR, and COM 8 are under predicted by the model.

There are several observations to be made regarding the cases where the ratio of monitored-to-modeled values are greater than 2. This pattern may indicate an increased loading of TRS compounds entering the WWT system or generation of increased H_2S from biological activity. Also, estimating emissions is problematic due to the physical area encompassed by the system (3 million square meters) as well as unpredictable changes in the chemical composition of the industrial process waste streams entering the WWT system. In addition, on-site parameters such as process water temperature, ambient air levels, water flow, and basin retention times are not well documented.

Attachments 1 and 2 contain a complete summary of the monitoring and modeling results for each of the 8 episodes evaluated from the on-site and offsite process monitors, respectively.

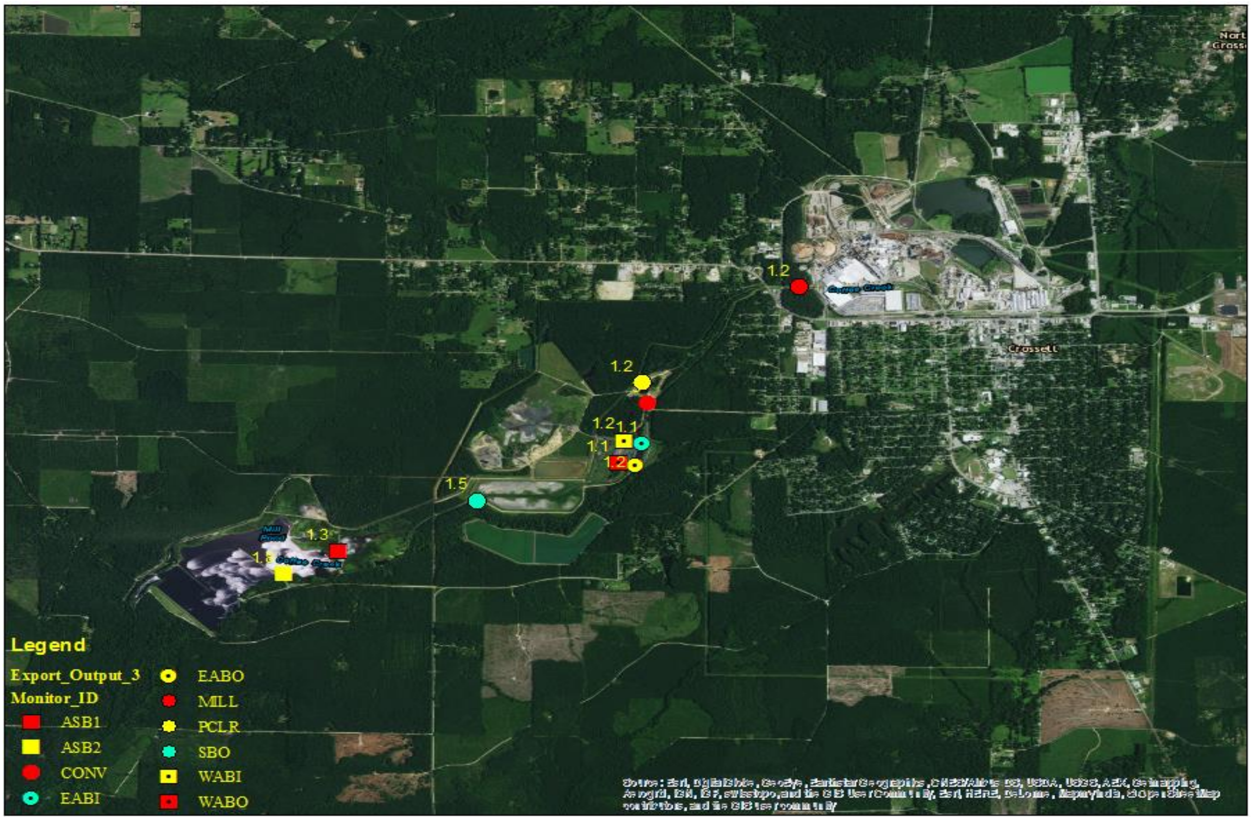
Table 3: GP WWT - H_2S Model to Monitor Ratio Analysis
Process and Community Monitors

On-site Process Monitors - H2S (Model/Monitor) Comparison											
Monitor ID	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Avg Monitored Value (Events 1-8) ug/m^3	Avg Modeled Value (Events 1-8) ug/m^3	Model to Monitor Ratio
ASB1	1.3	1.3	1.3	1.6	1.3	1.5	1.3	1.5	114	87	1.3
ASB2	1.4	1.8	2.5	6.6	2.1	2.8	1.0	1.5	51	28	1.8
CONV	2.0	7.9	4.0	3.5	2.0	3.0	1.3	1.3	30	10	3.0
EABI	1.0	1.7	2.1	3.4	1.2	1.4	1.0	2.1	93	88	1.1
EABO	1.3	1.3	4.7	2.5	1.5	1.3	1.2	1.5	74	87	1.2
MILL	1.1	4.7	3.0	1.7	1.1	1.4	2.1	6.3	17	14	1.2
OUT	1.4	6.0	11.2	8.4	2.6	1.4	2.1	1.1	3.8	1.0	3.9
PCLR	1.5	1.3	1.3	2.0	2.0	1.3	3.0	1.7	57	69	1.2
SBO	1.5	1.8	1.2	1.5	1.4	1.8	1.2	2.0	127	84	1.5
WABI	3.0	1.5	2.4	1.2	1.5	1.6	1.3	NS	97	116	1.2
WABO	1.5	2.3	1.0	1.1	1.1	1.0	1.1	1.2	112	103	1.1

Off-site Community Monitors - H2S (Model/Monitor) Comparison											
Site Name	Even t 1	Even t 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Avg. Monitor Periods (1 -8) ug/m3	Avg. Model Periods (1 -8) ug/m3	Model to Monitor Ratio
COM1	1.0	7.6	2.0	1.9	3.1	2.2	1.6	1.4	4.1	2.0	2.0
COM2	2.4	1.5	1.1	1.3	1.5	1.1	1.1	4.3	2.7	3.3	1.3
COM3	8.6	2.7	10.7	2.3	2.8	4.8	1.9	1.0	1.9	2.8	1.5
COM4	1.3	2.8	1.1	3.6	2.9	2.5	3.6	1.6	0.9	0.9	1.0
COM5	1.2	4.9	2.6	1.4	2.3	1.0	1.9	2.4	2.8	1.3	2.2
COM6	1.1	2.0	1.7	1.1	3.6	1.0	1.6	1.4	2.8	2.3	1.2
COM7	6.3	2.7	2.5	1.4	1.2	1.7	2.4	11.8	2.5	3.3	1.3
COM8	1.3	24.5	6.1	4.2	12.3	3.3	9.2	3.4	6.5	0.9	7.5
THUR	8.2	72.0	4.1	6.1	10.0	9.8	9.9	7.8	15.7	1.3	12.1

Modeled value less than Monitor value over the same period depicts the inverse ratio of the model to monitor values

Figure 2 – GP WWT – Average Monitor vs. Modeled H_2S Concentration Ratio at On-Site Process Monitors for Episodes (1-8).



<u>Note: For ratio values that monitor values were greater than model values an inverse ratio was applied. This approach helps identify the appropriate bias of the comparison as being within a (+/-) factor of 2 when looking at model performance, refer to Table 3 (ie. ASB1, ASB2, … WABO).</u>

Table 4 summarizes the modeled emissions associated with each WWT source associated with the model to monitor ratios presented in Table 3. A review of the Toxic Release Inventory (TRI) for 2016 provided by GP, shows close agreement with the model's estimated total WWT emissions of 126 TPY H_2S, with respective TRI release amount of 159 TPY.[3] The TRI estimate by GP was based upon site-specific emission factors for stack releases and fugitive emissions from their WWT system. Further analysis and emission measurements would be needed refine the emission estimates any further.

[3] 2016 TRI Form R from GP for hydrogen sulfide; https://oaspub.epa.gov/enviro/tri_formr_partone_v2.get_thisone?rpt_year=2016&dcn_num=1316215662584&ban_flag=Y

Table 4: GP WWT - Emission Inventory Information

Emission Point	Source Type	Description	Area Emission Rate	Emission Rate	Stack Height	Stack Diam	Stack Exit Velocity	Stack Exit Temp	Length_X	Length_Y
			(grams/sec/m^2)	TPY	[m]	[m]	[m/s]	[K]	[m]	[m]
1	POINT [a]	Stack Emissions	0.4	13.9	50	0.9	11.3	343		
2	AREA	Aeration Basin - Zone 1	0.00000485	60.6	1				600	600
3	AREA	P1/P2 Sewer Vents	0.00025	23.4	3				20	135
4	AREA	Clarifier	0.0002	11.1	1.5				40	40
5	AREA	Ash Basin Outfall	0.00006	2.0	1				15	65
6	AREA	Surge Basin	0.000033	1.0	1				30	30
7	AREA	Ash Basin 2 (NW)	0.001	7.8	1				15	15
8	AREA	Ash Basin Inlet (SE)	0.0001	4.2	1				40	30
9	AREA	Ash Basin Inlet (NW)	0.0003	1.6	1				10	15
		Total H_2S Emissions		125.7						

a -- Point source emission rate is in grams/second

Task 2 - Health Benchmark Information

There are several health benchmarks associated with both chronic (long-term) and acute (short-term) inhalation exposures. The Integrated Risk Information System (IRIS) is an EPA database that contains scientific health assessment information, including dose-response information. EPA has developed dose-response assessments for chronic exposure for many pollutants, including H_2S. These assessments typically provide a qualitative statement regarding the strength of scientific data and specify a reference concentration (RfC, for inhalation). The RfC is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfC in IRIS for H_2S is 2 ug/m^3.

The US Agency for Toxic Substances and Disease Registry (ATSDR) develops and publishes Minimal Risk Levels (MRLs) for inhalation exposure to many toxic substances. The MRL is defined as "an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (other than cancer) over a specified duration of exposure." ATSDR describes MRLs as substance-specific estimates to be used by health assessors to select environmental contaminants for further evaluation. ATSDR has developed two MRLs for H_2S, an acute (less than 14-day value) and an intermediate value (between 14-day and a year). The acute and intermediate MRLs for H_2S are 28 ug/m^3 and 98 ug/m^3, respectively.

For shorter time periods, such as an hour, we can compare ambient exposure levels to both "no effects" reference levels for the general public, such as the California Reference Exposure Levels (RELs), and to emergency response levels, such as Acute Exposure Guideline Levels (AEGLs). The acute REL is defined by CalEPA as "the concentration level at or below which no adverse health effects are anticipated for a specified exposure duration (OEHHA, 2015). AEGLs are developed by the National Advisory Committee (NAC). The AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure. The AEGL-2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. The REL for H_2S is 42 ug/m^3. The AEGL-1 and AEGL-2 for H_2S are 714 and 37,800 ug/m^{3,} respectively.

Table 5 summarizes the available health criteria associated with ambient exposure to H_2S. For reference, it also includes the odor threshold.

Table 5: GP WWT - Hydrogen Sulfide Non-Cancer Health Benchmarks

Exposure Duration	Source	Health Benchmark Value (ug/m^3)	Health Benchmark Value (ppb)	Benchmark Uncertainty Factor
Annual Average (chronic)	2003 IRIS (RfC)	2	1.4	300
> 14-day (sub-chronic)	2014 ATSDR (MRL) intermediate	28	20	30
< 14-day (acute)	2014 ATSDR (MRL) acute	98	70	
1-hour (acute)	1999 CAL-EPA (REL)	42	30	
1-hour (acute)	EPA (AEGL-1)	714	510	
1-hour (acute)	EPA (AEGL-2)	37,800	27,120	

Note: Odor threshold for H_2S is approximately at 14 ug/m^3 (10 ppb)

Task 2 – Community Health Considerations

To evaluate the potential for community health impacts, the AERMOD model was run, using the emissions developed in Task 1, for the time period between January 2014 – July 2017. For the purposes of this exercise, the three-and-a-half-year time period was assumed to be representative of someone's long-term (70-year lifetime) exposure. It is important to note that this approach assumes that the emissions developed in Task 1 occur continuously for this entire time period. To represent where people may live for long periods of time, model receptors were placed at census block centroid locations in the surrounding community (See Figure 1). In addition, ambient values were estimated at all passive monitoring site locations. Attachment 3 depicts the results of the chronic and acute ambient concentration estimates at each of these model receptors.

When comparing the average ambient levels for the three-and-a-half-year period to the RfC for H_2S, the AERMOD model predicts ambient levels onsite and adjacent to the GP facility up to 50 times the RfC. However, in these industrial locations, we would not expect exposures over an extended period of time (i.e., not residential locations).

When we look farther away from the GP facility in the nearby residential community, the AERMOD model is predicting ambient levels up to 2-3 times the chronic RfC. A look at the ambient monitors in this location for a 5-month period are in good agreement with the model results.

When examining the potential for acute (1-hour) impacts, the model predicts ambient levels above the REL at most locations and approaching and even slightly above the AEGL-1 thresholds at on-site and near fenceline locations. No predicted value exceeded or approached the AEGL-2 values.

The model and the monitors show ambient levels above the odor threshold value at many locations. Thus, the public awareness of H_2S odors in the ambient air is warranted.

It's important to consider that even though the modeling exercise in Task 2 is estimating ambient levels above the stated health benchmark values, that other exposure factors, such as time spent in indoor locations or away from the home, have not been considered in this analysis.

Attachment 1:

GP WWT - 14-day Passive On-site Monitoring and Modeling Results (Jan – May 2017)

Start Date		1/13/2017		1/27/2017		2/10/2017		2/24/2017		3/10/2017		3/24/2017		4/7/2017		4/21/2017	
		Episode 1 (ug/m^3)		Episode 2 (ug/m^3)		Episode 3 (ug/m^3)		Episode 4 (ug/m^3)		Episode 5 (ug/m^3)		Episode 6 (ug/m^3)		Episode 7 (ug/m^3)		Episode 8 (ug/m^3)	
Receptor ID	Site Description	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model
ASB1	Process	71	90	106	84	118	92	134	84	98	74	134	87	140	110	109	74
ASB2	Process	29	41	48	26	62	25	125	19	83	39	13	37	27	27	20	13
CONV	Process	22	11	57	7	48	12	42	12	22	11	22	7	18	14	9	7
EABI	Process	73	75	137	83	49	104	29	99	87	72	97	69	139	135	133	64
EABO	Process	98	77	85	67	21	98	41	102	92	61	97	77	106	130	53	81
MILL	Process	9	8	31	7	52	17	13	22	15	17	8	11	8	18	2	12
OUT	Process	2	1	4	1	7	1	9	1	5	2	2	1	2	1	0.3	0.3
PCLR	Process	45	68	78	61	91	71	42	83	28	56	62	47	42	127	66	39
SBO	Process	140	92	125	71	101	83	115	79	140	98	154	87	118	101	126	63
THUR	Process	7	1	50	1	7	2	13	2	14	1	10	1	17	2	7	1
WABI	Process	35	105	154	106	53	129	113	136	134	90	130	84	154	197	NS	81
WABO	Process	87	127	168	72	108	105	88	95	101	90	85	89	123	132	139	114

a. monitor values in read are set at 1/2 Detection Limit of the Monitor at 0.3 ug/m^3

b. NS (No Sample)

Attachment 2:

GP WWT - 14-day Passive Community Monitoring and Modeling Results (Jan – May 2017)

Start Date		1/13/2017		1/27/2017		2/10/2017		2/24/2017		3/10/2017		3/24/2017		4/7/2017		4/21/2017	
		Episode 1 (ug/m^3)		Episode 2 (ug/m^3)		Episode 3 (ug/m^3)		Episode 4 (ug/m^3)		Episode 5 (ug/m^3)		Episode 6 (ug/m^3)		Episode 7 (ug/m^3)		Episode 8 (ug/m^3)	
Receptor ID	Site Description	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model	Monitor	Model
COM1	Community	1.8	1.8	10.6	1.4	4.5	2.2	4.6	2.4	4.9	1.6	2.8	1.3	2.2	3.5	1.4	2.0
COM2	Community	0.8	2.0	9.7	14.4	1.8	2.0	3.1	2.3	2.1	1.4	1.3	1.2	2.1	2.3	0.3	1.2
COM3	Community	0.3	4.8	7.8	2.9	0.3	3.0	2.5	1.1	1.1	3.0	1.0	4.8	1.1	2.0	1.0	1.0
COM4	Community	0.3	0.7	3.6	1.3	1.3	1.2	0.3	1.0	0.3	0.8	0.3	0.7	0.3	1.0	1.1	0.7
COM5	Community	1.0	1.2	9.4	1.9	3.1	1.2	2.0	1.4	0.3	0.7	1.5	1.5	1.5	0.8	3.4	1.4
COM6	Community	2.9	2.7	5.5	2.8	2.9	1.7	1.8	1.6	0.3	1.0	3.2	3.2	1.5	2.4	3.9	2.8
COM7	Community	0.6	3.5	6.9	2.5	2.0	4.9	2.4	3.3	1.5	1.8	4.8	2.8	1.7	4.0	0.3	3.3
COM8	Community	1.2	0.9	19.6	0.8	6.7	1.1	4.2	1.0	4.9	0.4	2.9	0.9	10.1	1.1	2.4	0.7

a. monitor values in read are set at 1/2 Detection Limit of the Monitor at 0.3 ug/m^3

Attachment 3:

GP WWT - AERMOD Discrete Cartesian Receptors – Model and Monitor Comparison

				January 2014 - July 2017		January - May 2017		
				Modeled Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Modeled Concentration (ug/m^3)	Monitored Concentration (ug/m^3)	Modeled Concentration (ug/m^3)
Receptor ID	Description	X	Y	Max 1 Hr	Annual Avg	5-month Avg	5-month Avg	Max 1 Hr
35	ASB1	591411	3664128	1088	124	86	114	502
36	ASB2	590971	3663863	1675	50	28	51	563
37	CONV	593933	3665797	1833	23	14	30	926
38	EAB1	593891	3665356	1897	84	88	93	1511
39	EABO	593827	3665107	1861	104	87	74	859
1	GPMON/COM1	593479	3666914	246	2.6	2.4	5.0	116
40	MILL	595160	3667103	1539	17	14	17	711
41	OUT	589750	3663476	246	2	1	4	112
42	PCLR	593884	3666033	5572	116	103	57	3229
43	SBO	592538	3664699	1945	142	85	127	687
44	WABI	593746	3665387	3071	108	117	97	2571
45	WABO	593696	3665132	4502	159	103	112	4373
26	COM1	593529	3666949	237	2.7	2.5	4.1	118
27	COM2	594153	3667095	244	2.5	2.0	2.7	183
28	COM3	594874	3666568	321	4.3	2.9	1.9	157
29	COM4	595673	3665920	122	1.5	1.0	0.9	83
30	COM5	594896	3665695	185	2.0	1.5	2.8	114
31	COM6	594349	3665011	139	3.2	2.3	2.8	108
32	COM7	595022	3667727	370	3.7	3.3	2.5	202
33	COM8	592279	3667514	116	1.1	1.0	6.5	70
34	THUR	592621	3665953	125	2	1.4	16	88
10	Resid10	590634	3665808	237	2.4	2.3		117
11	Resid11	590242	3664715	240	2.3	2.1		127
12	Resid125	591141	3662778	181	1.5	0.7		87
13	Resid13	590842	3666899	107	1.4	1.2		74
14	Resid14	588400	3664348	122	0.6	0.5		58
15	Resid15	594952	3666925	663	6.9	4.1		309
16	Resid16	594925	3667288	470	4.0	3.7		238
17	Resid17	593538	3663278	143	1.3	0.7		82
18	Resid18	594793	3666842	427	4.4	2.6		208
19	Resid19	595447	3666616	490	5.0	2.7		237
2	Resid2	593497	3666933	218	2.6	2.4		110
20	Resid20	594791	3667271	383	2.9	2.6		195
21	Resid21	590857	3667798	83	0.9	0.9		59
22	Resid22	594998	3667834	327	3.2	2.9		166
23	Resid23	594785	3667540	218	2.5	2.3		144
24	Resid24	594804	3666333	241	3.3	2.3		109
25	Resid25	591827	3667230	108	1.3	1.2		83
3	Resid3	589335	3663357	200	1.3	0.7		93
4	Resid4	589396	3664544	169	1.0	0.9		92
5	Resid5	589014	3663354	171	1.0	0.6		85
6	Resid6	590956	3662241	113	0.9	0.4		28
7	Resid7	588522	3665179	117	0.5	0.4		57
8	Resid8	592582	3663010	204	1.7	0.8		87
9	Resid9	589344	3663107	210	1.2	0.6		99