Passive Sampler: ST18

Start:	1/30/2018	2/13/2018	2/27/2018
	1/30/18 8:00	2/13/18 8:00	2/27/18 8:00
End:	2/13/18 8:00	2/27/18 8:00	3/13/18 8:00

Wind Vector Segment ° - °	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	0.38%	7.00	13.00	0.00
10-20	0.45%	3.00	3.00	4.00
20-30	0.39%	3.00	4.00	2.00
30-40	0.43%	3.00	5.00	10.00
40-50	0.33%	6.00	12.00	16.00
50-60	0.37%	4.00	20.00	8.00
60-70	0.37%	4.00	13.00	3.00
70-80	0.40%	8.00	17.00	7.00
80-90	0.53%	7.00	6.00	2.00
90-100	0.69%	5.00	1.00	3.00
100-110	0.89%	3.00	6.00	2.00
110-120	0.72%	3.00	1.00	2.00
120-130	0.69%	5.00	4.00	0.00
130-140	1.03%	5.00	2.00	2.00
140-150	1.61%	2.00	5.00	0.00
150-160	2.13%	6.00	5.00	1.00
160-170	2.76%	4.00	5.00	2.00
170-180	3.53%	6.00	10.00	0.00
180-190	3.78%	23.00	6.00	7.00
190-200	4.86%	20.00	11.00	7.00
200-210	5.20%	13.00	17.00	12.00
210-220	3.81%	9.00	15.00	5.00
220-230	2.55%	12.00	27.00	11.00
230-240	2.16%	7.00	30.00	7.00
240-250	2.34%	11.00	17.00	4.00
250-260	2.65%	11.00	7.00	13.00
260-270	2.10%	6.00	9.00	18.00
270-280	1.04%	5.00	5.00	14.00
280-290	0.50%	13.00	8.00	16.00
290-300	0.49%	10.00	8.00	15.00
300-310	0.46%	28.00	10.00	7.00
310-320	0.42%	24.00	10.00	20.00
320-330	0.39%	15.00	6.00	18.00
330-340	0.45%	19.00	5.00	40.00
340-350	0.43%	14.00	9.00	43.00
350-360	0.55%	12.00	4.00	15.00
	ΣHours	**336.00**	**336.00**	**336.00**
	ΣMET Data Hours (check)	**336.00**	**336.00**	**336.00**
	Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):	1.64%	1.73%	1.18%
	Measured Fenceline Concentration (MFC) (μg/m^3):	17.00	2.60	1.50
	Upper 95% Conf. Limit (MFCavg + 2 * σ_i):	5.12	5.12	5.12
	Transient Non-routine Event?:	**Yes**	No	No
	NFStransient, = Concentration attributed to a transient event from a NFS (if applicable):	0.00	--	--
	NFSactual.conc (μg/m^3):	0.08	0.04	0.02
	Uniform Background (UB) (μg/m^3):	1.20	1.00	0.70
	Uniform Background Source:	ST22	ST25	ST22
	Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)(μg/m^3):	**15.72**	**1.56**	**0.78**

Passive Sampler: ST18

Start:	3/13/2018	3/27/2018	4/10/2018	4/24/2018	5/8/2018	5/22/2018	6/5/2018
	3/13/18 8:00	3/27/18 8:00	4/10/18 8:00	4/24/18 8:00	5/8/18 8:00	5/22/18 8:00	6/5/18 8:00
End:	3/27/18 8:00	4/10/18 8:00	4/24/18 8:00	5/8/18 8:00	5/22/18 8:00	6/5/18 8:00	6/19/18 8:00

Wind Vector Segment ° - °	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	0.38%	18.00	10.00	6.00	5.00	12.00	7.00	1.00
10-20	0.45%	2.00	10.00	2.00	2.00	6.00	0.00	2.00
20-30	0.39%	4.00	3.00	2.00	2.00	5.00	2.00	6.00
30-40	0.43%	21.00	5.00	0.00	4.00	3.00	2.00	4.00
40-50	0.33%	15.00	7.00	3.00	5.00	17.00	6.00	3.00
50-60	0.37%	12.00	4.00	10.00	5.00	33.00	11.00	21.00
60-70	0.37%	8.00	9.00	19.00	16.00	34.00	28.00	11.00
70-80	0.40%	8.00	8.00	19.00	14.00	32.00	29.00	13.00
80-90	0.53%	12.00	4.00	8.00	14.00	16.00	14.00	9.00
90-100	0.69%	1.00	9.00	3.00	11.00	13.00	3.00	5.00
100-110	0.89%	2.00	4.00	3.00	2.00	10.00	9.00	4.00
110-120	0.72%	1.00	4.00	2.00	7.00	12.00	13.00	6.00
120-130	0.69%	4.00	4.00	7.00	3.00	11.00	9.00	3.00
130-140	1.03%	2.00	8.00	1.00	5.00	4.00	7.00	7.00
140-150	1.61%	1.00	5.00	1.00	5.00	7.00	5.00	8.00
150-160	2.13%	0.00	5.00	3.00	1.00	4.00	5.00	8.00
160-170	2.76%	0.00	8.00	7.00	0.00	7.00	4.00	9.00
170-180	3.53%	0.00	12.00	6.00	7.00	5.00	3.00	15.00
180-190	3.78%	1.00	14.00	13.00	8.00	8.00	11.00	22.00
190-200	4.86%	3.00	20.00	12.00	4.00	9.00	10.00	21.00
200-210	5.20%	0.00	23.00	20.00	15.00	14.00	16.00	10.00
210-220	3.81%	0.00	13.00	17.00	15.00	7.00	26.00	20.00
220-230	2.55%	2.00	7.00	22.00	29.00	12.00	30.00	26.00
230-240	2.16%	9.00	8.00	14.00	29.00	16.00	17.00	18.00
240-250	2.34%	7.00	8.00	12.00	8.00	5.00	11.00	10.00
250-260	2.65%	15.00	3.00	9.00	5.00	2.00	4.00	3.00
260-270	2.10%	21.00	6.00	16.00	12.00	2.00	2.00	6.00
270-280	1.04%	22.00	7.00	20.00	12.00	0.00	4.00	5.00
280-290	0.50%	18.00	20.00	14.00	17.00	1.00	6.00	7.00
290-300	0.49%	16.00	8.00	3.00	18.00	6.00	3.00	13.00
300-310	0.46%	21.00	8.00	12.00	15.00	5.00	5.00	5.00
310-320	0.42%	27.00	18.00	19.00	5.00	2.00	6.00	8.00
320-330	0.39%	31.00	18.00	13.00	6.00	5.00	5.00	8.00
330-340	0.45%	16.00	23.00	10.00	8.00	1.00	13.00	7.00
340-350	0.43%	9.00	6.00	6.00	7.00	3.00	1.00	6.00
350-360	0.55%	7.00	7.00	2.00	15.00	7.00	9.00	6.00
	ΣHours	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
	ΣMET Data Hours (check)	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):		0.84%	1.73%	1.76%	1.54%	1.28%	1.68%	1.94%
Measured Fenceline Concentration (MFC) ($\mu g/m^3$):		1.40	2.60	2.70	2.20	2.70	2.60	1.80
Upper 95% Conf. Limit (MFCavg + 2 * σ_i):		5.12	5.12	5.12	5.12	5.12	5.12	5.12
Transient Non-routine Event?:		No	No	No	No	No	No	No
NFStransient, = Concentration attributed to a transient event from a NFS (if applicable):		--	--	--	--	--	--	--
NFSactual.conc ($\mu g/m^3$):		0.01	0.04	0.05	0.03	0.03	0.04	0.03
Uniform Background (UB) ($\mu g/m^3$):		0.66	0.88	0.71	0.52	0.59	0.56	0.61
Uniform Background Source:		ST21	ST22	ST22	ST22	ST11	ST22	ST11
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)($\mu g/m^3$):		**0.73**	**1.68**	**1.94**	**1.65**	**2.08**	**2.00**	**1.16**

Passive Sampler: ST18

Start:	6/19/2018	7/3/2018	7/17/2018	7/31/2018	8/14/2018	8/28/2018	9/11/2018
	6/19/18 8:00	7/3/18 8:00	7/17/18 8:00	7/31/18 8:00	8/14/18 8:00	8/28/18 8:00	9/11/18 8:00
End:	7/3/18 8:00	7/17/18 8:00	7/31/18 8:00	8/14/18 8:00	8/28/18 8:00	9/11/18 8:00	9/25/18 8:00

Wind Vector Segment ° - °	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	0.38%	7.00	6.00	12.00	3.00	2.00	5.00	12.00
10-20	0.45%	7.00	5.00	5.00	0.00	0.00	3.00	5.00
20-30	0.39%	2.00	3.00	3.00	4.00	0.00	4.00	5.00
30-40	0.43%	1.00	5.00	2.00	4.00	3.00	27.00	11.00
40-50	0.33%	14.00	6.00	7.00	4.00	12.00	25.00	34.00
50-60	0.37%	10.00	2.00	6.00	11.00	10.00	28.00	43.00
60-70	0.37%	8.00	3.00	9.00	5.00	8.00	21.00	31.00
70-80	0.40%	6.00	6.00	10.00	3.00	9.00	20.00	47.00
80-90	0.53%	13.00	12.00	11.00	4.00	11.00	24.00	15.00
90-100	0.69%	10.00	21.00	7.00	5.00	10.00	17.00	7.00
100-110	0.89%	4.00	10.00	14.00	16.00	6.00	10.00	18.00
110-120	0.72%	3.00	9.00	11.00	4.00	5.00	3.00	8.00
120-130	0.69%	5.00	13.00	16.00	8.00	7.00	3.00	8.00
130-140	1.03%	6.00	6.00	22.00	11.00	4.00	0.00	4.00
140-150	1.61%	5.00	6.00	36.00	2.00	4.00	1.00	11.00
150-160	2.13%	9.00	10.00	20.00	10.00	6.00	7.00	7.00
160-170	2.76%	18.00	4.00	13.00	6.00	2.00	7.00	2.00
170-180	3.53%	16.00	8.00	6.00	9.00	4.00	6.00	4.00
180-190	3.78%	18.00	11.00	8.00	10.00	10.00	6.00	11.00
190-200	4.86%	10.00	26.00	14.00	31.00	21.00	9.00	4.00
200-210	5.20%	12.00	18.00	11.00	30.00	21.00	10.00	7.00
210-220	3.81%	13.00	20.00	7.00	30.00	23.00	15.00	2.00
220-230	2.55%	13.00	35.00	7.00	28.00	28.00	23.00	2.00
230-240	2.16%	22.00	25.00	11.00	28.00	29.00	22.00	3.00
240-250	2.34%	20.00	12.00	5.00	8.00	21.00	10.00	2.00
250-260	2.65%	4.00	4.00	2.00	9.00	12.00	0.00	2.00
260-270	2.10%	3.00	0.00	1.00	5.00	10.00	1.00	0.00
270-280	1.04%	6.00	2.00	3.00	7.00	8.00	1.00	0.00
280-290	0.50%	6.00	7.00	12.00	8.00	14.00	0.00	2.00
290-300	0.49%	5.00	5.00	6.00	7.00	3.00	2.00	0.00
300-310	0.46%	5.00	6.00	3.00	7.00	3.00	3.00	2.00
310-320	0.42%	9.00	2.00	2.00	6.00	9.00	2.00	1.00
320-330	0.39%	10.00	1.00	3.00	6.00	5.00	5.00	6.00
330-340	0.45%	15.00	6.00	8.00	3.00	7.00	4.00	4.00
340-350	0.43%	11.00	7.00	10.00	0.00	6.00	6.00	10.00
350-360	0.55%	10.00	14.00	13.00	4.00	3.00	6.00	6.00
	ΣHours	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
	ΣMET Data Hours (check)	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):		1.77%	2.03%	1.54%	2.37%	2.05%	1.39%	0.92%
Measured Fenceline Concentration (MFC) (μg/m^3):		4.10	1.90	2.60	3.00	4.60	3.00	2.00
Upper 95% Conf. Limit (MFCavg + 2 * σ_i):		5.12	5.12	5.12	5.12	5.12	5.12	5.12
Transient Non-routine Event?:		No	No	No	No	No	No	No
NFStransient, = Concentration attributed to a transient event from a NFS (if applicable):		--	--	--	--	--	--	--
NFSactual.conc (μg/m^3):		0.07	0.04	0.04	0.07	0.09	0.04	0.02
Uniform Background (UB) (μg/m^3):		0.63	0.69	0.75	0.83	0.55	0.64	0.62
Uniform Background Source:		ST8	ST22	ST33	ST22	ST22	ST36	ST36
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)(μg/m^3):		**3.40**	**1.17**	**1.81**	**2.10**	**3.96**	**2.32**	**1.36**

Passive Sampler: ST18

Start:	9/25/2018	10/9/2018	10/23/2018	11/6/2018	11/20/2018	12/4/2018	12/18/2018
	9/25/18 8:00	10/9/18 8:00	10/23/18 8:00	11/6/18 8:00	11/20/18 8:00	12/4/18 8:00	12/18/18 8:00
End:	10/9/18 8:00	10/23/18 8:00	11/6/18 8:00	11/20/18 8:00	12/4/18 8:00	12/18/18 8:00	1/2/19 8:00

Wind Vector Segment ° - °	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	0.38%	19.00	3.00	3.00	3.00	8.00	11.00	5.00
10-20	0.45%	8.00	5.00	2.00	4.00	0.00	8.00	1.00
20-30	0.39%	3.00	0.00	3.00	4.00	2.00	3.00	2.00
30-40	0.43%	4.00	1.00	9.00	11.00	7.00	6.00	1.00
40-50	0.33%	6.00	1.00	11.00	24.00	12.00	26.00	5.00
50-60	0.37%	8.00	1.00	11.00	16.00	9.00	23.00	6.00
60-70	0.37%	12.00	0.00	20.00	14.00	9.00	14.00	4.00
70-80	0.40%	17.00	0.00	13.00	7.00	10.00	12.00	8.00
80-90	0.53%	14.00	4.00	5.00	7.00	3.00	12.00	16.00
90-100	0.69%	9.00	0.00	5.00	8.00	7.00	3.00	4.72
100-110	0.89%	6.00	1.00	5.00	6.00	4.00	0.00	11.23
110-120	0.72%	6.00	1.00	2.00	3.00	4.00	1.00	12.80
120-130	0.69%	5.00	3.00	2.00	1.00	8.00	2.00	5.35
130-140	1.03%	4.00	5.00	2.00	3.00	1.00	6.00	7.00
140-150	1.61%	8.00	3.00	5.00	3.00	1.00	0.00	10.00
150-160	2.13%	5.00	6.00	2.00	4.00	1.00	1.00	5.00
160-170	2.76%	13.00	16.00	2.00	2.00	0.00	0.00	2.00
170-180	3.53%	17.00	9.00	6.00	2.00	2.00	0.00	8.28
180-190	3.78%	10.00	14.00	7.00	4.00	2.00	0.00	4.00
190-200	4.86%	28.00	20.00	18.00	6.00	2.00	2.00	9.20
200-210	5.20%	21.00	17.00	16.00	3.00	1.00	2.00	9.00
210-220	3.81%	14.00	8.00	10.00	2.00	3.00	3.00	6.00
220-230	2.55%	14.00	16.00	12.00	13.00	7.00	7.00	11.95
230-240	2.16%	13.00	25.00	19.00	19.00	11.00	5.00	18.40
240-250	2.34%	5.00	18.00	14.00	18.00	16.00	4.00	19.73
250-260	2.65%	7.00	12.00	18.00	24.00	18.00	10.00	11.92
260-270	2.10%	3.00	17.00	9.00	11.00	8.00	11.00	7.00
270-280	1.04%	1.00	10.00	19.00	20.00	28.00	14.00	15.00
280-290	0.50%	2.00	21.00	18.00	16.00	44.00	15.00	30.00
290-300	0.49%	1.00	19.00	11.00	22.00	20.00	19.00	32.00
300-310	0.46%	7.00	23.00	14.00	10.00	16.00	25.00	21.00
310-320	0.42%	3.00	28.00	14.00	8.00	16.00	14.00	24.00
320-330	0.39%	14.00	14.00	12.00	9.00	18.00	14.00	17.00
330-340	0.45%	10.00	6.00	10.00	13.00	12.00	21.00	5.32
340-350	0.43%	6.00	6.00	4.00	11.00	11.00	19.00	4.00
350-360	0.55%	13.00	3.00	3.00	5.00	15.00	23.00	0.00
	ΣHours	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**359.90**
	ΣMET Data Hours (check)	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**359.90**
Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):		1.92%	1.93%	1.63%	1.23%	0.98%	0.78%	1.35%
Measured Fenceline Concentration (MFC) (μg/m^3):		2.30	1.60	1.90	2.20	4.70	6.60	3.00
Upper 95% Conf. Limit (MFCavg + 2 * σ_i):		7.37	7.03	6.94	5.89	5.81	5.65	6.19
Transient Non-routine Event?:		No	No	No	No	No	**Yes**	No
NFStransient, = Concentration attributed to a transient event from a NFS (if applicable):		--	--	--	--	--	0.00	--
NFSactual.conc (μg/m^3):		0.04	0.03	0.03	0.03	0.05	0.04	0.04
Uniform Background (UB) (μg/m^3):		0.98	0.67	0.58	0.92	0.93	1.10	1.10
Uniform Background Source:		ST11	ST11	ST22	ST11	ST36	ST11	ST22
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)(μg/m^3):		**1.28**	**0.90**	**1.29**	**1.25**	**3.72**	**5.46**	**1.86**

Passive Sampler: ST18

Start:	1/2/2019	1/16/2019	1/30/2019	2/13/2019	2/27/2019	3/13/2019
	1/2/19 8:00	1/16/19 8:00	1/30/19 8:00	2/13/19 8:00	2/27/19 8:00	3/13/19 8:00
End:	1/16/19 8:00	1/30/19 8:00	2/13/19 8:00	2/27/19 8:00	3/13/19 8:00	3/27/19 8:00

Wind Vector Segment ° - °	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	0.38%	0.00	0.00	0.00	0.00	0.00	0.00
10-20	0.45%	4.00	5.80	8.87	6.53	7.93	12.53
20-30	0.39%	4.63	1.82	4.20	6.43	4.07	2.28
30-40	0.43%	6.75	1.10	4.58	5.45	10.25	3.53
40-50	0.33%	10.80	9.95	6.43	9.67	5.70	5.87
50-60	0.37%	18.90	13.27	10.22	17.32	21.43	8.27
60-70	0.37%	5.57	5.65	10.65	7.32	12.00	3.38
70-80	0.40%	5.98	11.58	16.43	12.58	4.83	11.60
80-90	0.53%	6.88	7.92	13.45	7.68	6.72	6.68
90-100	0.69%	5.48	11.47	4.93	3.45	10.18	3.90
100-110	0.89%	3.58	18.23	9.32	3.53	3.40	5.87
110-120	0.72%	0.00	4.00	11.17	0.53	4.72	7.90
120-130	0.69%	9.38	6.77	3.63	1.58	8.43	2.00
130-140	1.03%	8.00	2.00	5.00	2.13	6.43	0.00
140-150	1.61%	7.83	7.00	1.00	1.32	2.73	5.00
150-160	2.13%	4.00	1.92	2.00	5.08	8.07	2.00
160-170	2.76%	5.45	2.00	0.00	2.00	0.28	7.50
170-180	3.53%	3.73	8.83	4.00	3.33	2.08	6.00
180-190	3.78%	1.10	15.20	1.00	2.00	2.00	21.00
190-200	4.86%	1.15	17.27	3.00	3.00	3.65	12.00
200-210	5.20%	3.47	10.45	17.88	8.08	1.28	11.90
210-220	3.81%	1.00	5.17	9.02	10.30	3.47	13.60
220-230	2.55%	4.80	9.20	7.20	1.00	2.35	14.33
230-240	2.16%	6.00	15.63	21.07	6.58	2.85	9.00
240-250	2.34%	13.65	4.53	6.80	9.15	9.38	6.00
250-260	2.65%	12.08	8.87	17.23	15.42	9.00	11.00
260-270	2.10%	13.00	11.67	9.38	25.07	13.05	8.07
270-280	1.04%	13.42	7.27	11.93	12.20	16.83	8.30
280-290	0.50%	14.42	15.27	12.00	21.83	25.98	19.80
290-300	0.49%	28.65	15.37	14.20	15.88	22.08	25.30
300-310	0.46%	17.07	26.47	20.95	19.68	15.00	25.68
310-320	0.42%	21.10	15.87	17.30	13.45	17.48	12.22
320-330	0.39%	26.12	13.07	6.33	15.37	23.93	4.62
330-340	0.45%	16.00	5.60	15.58	17.98	11.22	3.00
340-350	0.43%	6.03	11.47	10.02	15.02	9.93	4.50
350-360	0.55%	25.97	8.35	19.22	28.03	27.23	31.37
	ΣHours	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
	ΣMET Data Hours (check)	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**	**336.00**
Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):		0.98%	1.48%	1.30%	1.15%	0.91%	1.58%
Measured Fenceline Concentration (MFC) (µg/m^3):		3.10	3.00	5.40	3.30	2.40	7.10
Upper 95% Conf. Limit (MFCavg + 2 * σ)[1]		6.21	6.21	5.12	5.40	5.42	5.40
Transient Non-routine Event?:		No	No	**Yes**	No	No	**Yes**
NFStransient = Concentration attributed to a transient event from a NFS (if applicable):		--	--	0.00	--	--	0.00
NFSactual.conc (µg/m^3):		0.03	0.04	0.07	0.04	0.02	0.09
Uniform Background (UB) (µg/m^3):		1.10	1.30	1.90	1.20	1.00	0.96
Uniform Background Source:		ST22	ST36	ST22	ST21	ST11	ST11
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)(µg/m^3):		**1.97**	**1.66**	**3.43**	**2.06**	**1.38**	**6.05**

3.3 Identification of Fenceline Monitoring Locations Impacted by NFS

All of the fenceline monitors are impacted to a degree by near-field sources.

3.4 Reduction Methodology

3.4.1 Overview

Per §63.658(i), PES may request approval for a site-specific monitoring plan to reduce measured benzene concentrations by contributions from near-field sources. In accordance with these requirements, this section provides a detailed explanation for how the facility plans to reduce future measured benzene concentrations by the contributions of the near-field sources. PES conducted refined air dispersion modeling to determine the contributions of near-field source emissions to total ground level concentrations of benzene at receptors placed at each Method 325A fenceline sample location.

3.4.2 Benzene Emission Source Evaluation

In order to evaluate contributions to individual passive tube sampling locations, two groups of emission sources were identified: PES benzene emission sources subject to 40 CFR §63.658 benzene fenceline monitoring requirements and PES benzene emission sources subject to the HON MACT and exempt from 40 CFR §63.658 benzene fenceline monitoring requirements.

For these sources, an emissions inventory, including key source characteristics e.g., emission release heights, diameters, velocities, temperatures, etc. was developed using actual emissions data. Emission data for 2016 and 2017 was used for the PES Refining Complex. Refer to **Appendix C** and **Appendix D** for more detail.

For the refined air dispersion modeling, PES used average hourly emission rates based on the annual average actual emissions reported for each source. Each source's annual average emission rate was divided by 8760 hours/year, regardless of sources actual hours of operation. Furthermore, emissions associated with maintenance, startup, shutdown and malfunctions were excluded from the model. This approach was used as an equitable way to remove any short-term and/or non-normal emissions bias from the analysis.

A final summary of emission source air dispersion model inputs can be found in **Appendix D.**

3.4.3 Method Description

The EPA AERMOD dispersion model (current version 18081) was used to conduct the refined modeling scenarios. The modeling scenarios covered the period for which passive tube data was collected at the refining complex (i.e., during 2018). Hourly observations of wind speed and wind direction were collected from the Philadelphia International Airport surface meteorological station (WBAN ID 13739) and processed into an AERMOD-ready format using the AERMET meteorological preprocessor. The met data was input into the model and the emissions sources were grouped into two sets: 1) all sources (ALL) and 2) only near-field sources (NFS).

ED_004461_00018909-00006

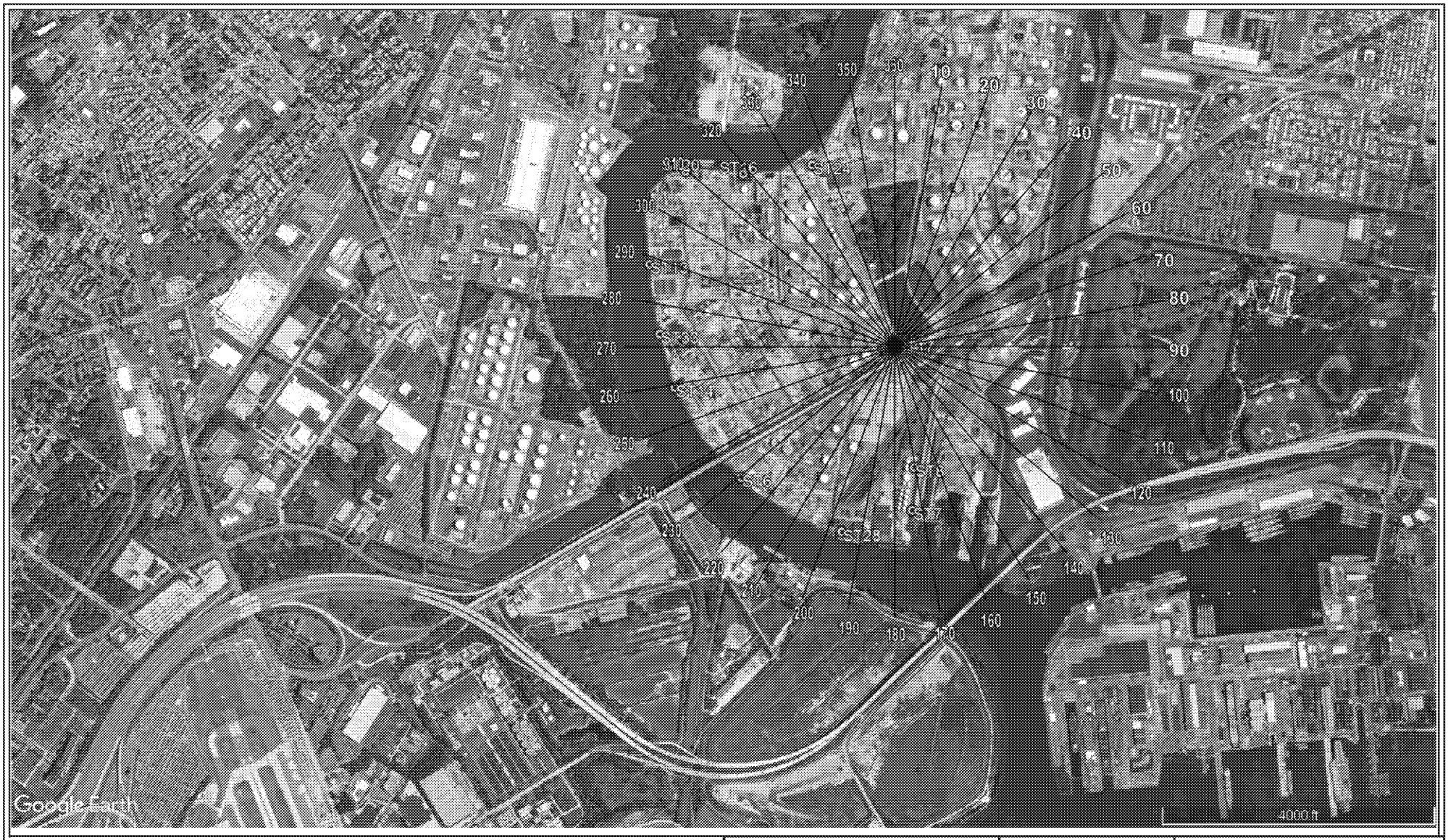
Based on the source groupings, the model was then run using the average hourly emission rates described earlier to obtain the cumulative contribution of the near-field emission sources compared to the overall impacts from all modeled sources at each passive sampling location (receptor) for each hour of the period analyzed. The percent contribution of near-field sources (% NFS Cont.) was estimated for each hour of met data modeled at each receptor by dividing the predicted concentration for the NFS group by the predicted concentration from Source Group ALL.

The results of the final modeling run (particularly the [% NFS Cont.] and wind directions) were used to generate "emission" roses for each sample point location. An "emission" rose is analogous to a wind rose, except that instead of the lengths of the rose petals being proportional to wind speed, they are proportional to measured or model predicted emission concentrations. In this case, the petals represent the % NFS Cont. to the total concentration from modeling all onsite emission sources (Source Group ALL). To prepare an "emission" rose for each sampling point location, a table of hourly POSTFILE modeled concentrations for the entire AERMOD-modeled period, along with each hour's associated % NFS Cont. and wind direction, was compiled. For each receptor, an average of all the hourly % NFS Cont. was determined for each wind vector segments varying by 10 degrees (**Figure 3-1**). This average % NFS Cont. serves as a 1-hour back trajectory that shows how far upwind the NFS contributing parcels travel (on average) before impacting the fenceline receptor location. A plot of average % NFS Cont. (over all hours in the period analyzed) was created for each 10 degrees of wind direction, for each of the sample site locations and can be found in **Appendix B**.

All percent NFS concentration contributions within each segment were averaged as a constant to be used for adjustments with future sampling measurements.

The percent NFS contribution profiles will be updated every year based on new emission inventory data and air dispersion modeling runs to account for changes in benzene emitting sources from year to year.

ED_004461_00018909-00007



N

= Property Boundary

= Benzene Monitor

TRICORD CONSULTING

	Figure 3-1
Revision #: 1	Wind Vector Segments
Date: March 2019	Philadelphia Energy Solutions
Project #: P1805	Philadelphia Refinery

ED_004461_00018909-00008

3.4.4 Routine Operations

When conducting passive tube sampling, the results of each two-week sample will be adjusted by using the actual wind rose for the two-week period during sampling and the corresponding passive sampling location "emission" rose (average % NFS Cont. constant by wind vector segment) developed via modeling herein for the passive sampling location. See the following equation:

$$\text{NFS}_i\text{actual } \% = \frac{\sum \text{Wind Vector Segment (NFS \% Cont. Constant}_i * \text{Wind Vector Segment Time)}}{\sum \text{Wind Vector Segment Time}}$$

A time weighted average % NFS Cont. will be determined using the total hours in which the wind was blowing in each wind vector segment (See **Figure 3-2**).

ED_004461_00018909-00009

Figure 3-2: Time Weighted Average NFS Contribution

	Passive Sampler:	ST7		
	Sample Period:	1/30/2018	2/13/2018	2/27/2018
Wind Vector Segment º - º	Avg. NFS Contribution to Modeled Concentrations (%)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)	Total Wind Direction Hours (hrs)
0-10	65%	7.00	13.00	0.00
10-20	74%	3.00	3.00	4.00
20-30	73%	3.00	4.00	2.00
30-40	78%	3.00	5.00	10.00
40-50	75%	6.00	12.00	16.00
50-60	74%	4.00	20.00	8.00
60-70	75%	4.00	13.00	3.00
70-80	70%	8.00	17.00	7.00
80-90	69%	7.00	6.00	2.00
90-100	66%	5.00	1.00	3.00
100-110	72%	3.00	6.00	2.00
110-120	69%	3.00	1.00	2.00
120-130	72%	5.00	4.00	0.00
130-140	73%	5.00	2.00	2.00
140-150	74%	2.00	5.00	0.00
150-160	69%	6.00	5.00	1.00
160-170	71%	4.00	5.00	2.00
170-180	75%	6.00	9.00	0.00
180-190	74%	23.00	6.00	7.00
190-200	81%	20.00	11.00	7.00
200-210	83%	13.00	17.00	12.00
210-220	77%	9.00	15.00	5.00
220-230	77%	12.00	27.00	11.00
230-240	79%	7.00	30.00	7.00
240-250	80%	11.00	17.00	4.00
250-260	84%	11.00	7.00	13.00
260-270	84%	6.00	9.00	18.00
270-280	82%	5.00	5.00	14.00
280-290	80%	13.00	8.00	16.00
290-300	78%	10.00	8.00	15.00
300-310	78%	28.00	10.00	7.00
310-320	81%	24.00	10.00	20.00
320-330	81%	15.00	6.00	18.00
330-340	76%	19.00	5.00	40.00
340-350	79%	14.00	9.00	43.00
350-360	78%	12.00	4.00	15.00
Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):		77.13%	76.64%	78.29%

The resulting time weighted average % NFS Cont. will then be multiplied by the actual benzene concentration measured during the sample period to determine the NFS contributing concentration (NFSi) to then be subtracted from the corresponding Measured Fenceline Concentration (MFCi). See **Figure 3-3** for an example calculation.

ED_004461_00018909-00010

NFS_i actual = Time Weighted Average NFS Contribution (%) * MFC_i

Corrected Fenceline Concentration ($\Delta C = MFC_i - NFS_i$ actual – Uniform Background) ($\mu g/m^3$)

Figure 3-3: Example ΔC Calculation – Routine Operations

Passive Sampler: **ST7**

Sample Event: **1/30/2018**

Wind Vector Segment º - º	**Avg. NFS Contribution to Modeled Concentrations (%)**	**Total Wind Direction Hours (hrs)**
0-10	65%	7.00
10-20	74%	3.00
20-30	73%	3.00
30-40	78%	3.00
40-50	75%	6.00
50-60	74%	4.00
60-70	75%	4.00
70-80	70%	8.00
80-90	69%	7.00
90-100	66%	5.00
•	•	•
•	•	•
•	•	•
320-330	81%	15.00
330-340	76%	19.00
340-350	79%	14.00
350-360	78%	12.00

Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):	77.13%
Measured Fenceline Concentration (MFC) ($\mu g/m^3$):	31.00
12-month Average Measured Fenceline Concentrations ($MFCavg_i$):	14.84
σ_i = Standard Deviation of the 12-month Measured Fenceline Concentrations:	11.31
Upper 95% Conf. Limit (MFCavg + 2 * σ_i):	37.46
Transient Non-routine Event?:	No
$NFStransient_i$ = Concentration attributed to a transient event from a NFS (if applicable):	0.00
NFSactual.conc ($\mu g/m^3$):	**23.91**
Uniform Background (UB) ($\mu g/m^3$):	1.20
Uniform Background Source:	ST23
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)($\mu g/m^3$):	**5.89**

The ΔC for the monitoring period will be the maximum value of ΔC from all of the fenceline monitoring locations for that monitoring period. The annual average ΔC will then be calculated in

ED_004461_00018909-00011

accordance with 40 CFR §62.658(f)(2) by averaging the 26 most recent two-week sample periods and updated after receiving the results of each subsequent two-week sampling period.

3.4.5 Non-Routine Operations

It is possible that there may be periods where some sample points are materially influenced by a transient non-routine event such as the startup, shutdown, maintenance, or malfunction of nearby benzene emitting equipment/source(s). As such, if this occurs, it is appropriate to use a slightly modified version of the approach described above in **Section 3.4.4.**

To determine when this modified approach is necessary, PES will compare the Measured Fenceline Concentration (MFC_i) for each sample point to its respective average $MFCavg_i$, which is the average of the preceding 12-months measurements plus two times the standard deviation (i.e., the upper 95% confidence interval).

If the MFC_i is within its respective confidence interval, then the resulting concentration is reviewed as routine operations and the method described in **Section 3.4.4** will be used to correct the measured fenceline concentration.

If the MFC_i for a sample point is above its respective confidence interval, then the resulting concentration is reviewed as having been affected by a transient non-routine event (considered an outlier, as the term outlier is used within this site-specific monitoring plan) and the NFS contributing concentration for the sampling period (NFS_i actual) will then be determined using the following modified equation:

$$NFS_i \text{ actual} = [\text{Time Weighted Average NFS Contribution (\%)} * MFCavg_i + 2*\sigma_i)]$$

Where:

$MFCavg_i$ = 12-month average of preceding Measured Fenceline Concentrations
(not including any concentration above $MFCavg_i + 2*\sigma_i$ for outliers)

σ_i = Standard deviation of the preceding 12-month MFC_i
(not including any concentration above $MFCavg_i + 2*\sigma_i$ for outliers)

This modified method only applies the Time Weighted Average NFS Contribution (%) to the portion of the measured fenceline concentration that is attributed to routine operations. The difference between the MFC_i and the $MFCavg_i + 2*\sigma_i$ represents the amount of the measured fenceline concentration that was caused by the transient non-routine event. If there is a known transient event (startup, shutdown, malfunction, or turnaround) at a near-field source, the amount of the measured fenceline concentration considered to be caused by the transient non-routine event will be deducted from the MFC_i. Otherwise, the amount will not be deducted and internal corrective action/RCCAA procedures will be followed, if necessary.

Documentation of the cause, duration, wind profile, and emissions of each known transient non-routine event will be kept onsite for 5 years.
To demonstrate this approach using a real example, during the preliminary passive tube sampling conducted by PES, the sample location ST31 experienced a transient event which affected the two-

ED_004461_00018909-00012

week period starting February 13, 2018. Using the data from Table 4-1 of this plan to estimate $MFCavg_i$, see **Figure 3-4** below for an example calculation for estimating the corrected fenceline concentration for the sample period.

Figure 3-4: Example ΔC Calculation – Non-Routine Operations

Passive Sampler: **ST31**

Sample Period: **2/27/2018**

Wind Vector Segment ° - °	**Avg. NFS Contribution to Modeled Concentrations (%)**	**Total Wind Direction Hours (hrs)**
0-10	2%	0.00
10-20	3%	4.00
20-30	4%	2.00
30-40	4%	10.00
40-50	4%	16.00
50-60	4%	8.00
60-70	4%	3.00
70-80	4%	7.00
80-90	4%	2.00
90-100	4%	3.00
•	•	•
•	•	•
•	•	•
290-300	2%	15.00
300-310	4%	7.00
310-320	4%	20.00
320-330	2%	18.00
330-340	3%	40.00
340-350	2%	43.00
350-360	2%	15.00

Time Weighted Avg NFS Contribution (NFSactual = ∑Segment (NFS % Contribution * Segment Time) / ∑Segment Time) (%):	2.91%
Measured Fenceline Concentration (MFC) (μg/m³):	12.00
12-month Average Measured Fenceline Concentrations ($MFCavg_i$):	4.45
σ_i = Standard Deviation of the 12-month Measured Fenceline Concentrations:	3.40
Upper 95% Conf. Limit (MFCavg + 2 * σ_i):	11.26
Transient Non-routine Event?:	Yes
$NFStransient_i$ = Concentration attributed to a transient event from a NFS (if applicable):	0.0000
NFSactual.conc (μg/m³):	**0.33**
Uniform Background (UB) (μg/m³):	0.71
Uniform Background Source:	ST23
Corrected Fenceline Concentration (ΔC = MFC - NFSactual.conc - UB)(μg/m³):	**10.96**

ED_004461_00018909-00013