WEEKLY REPORT FOR WEEK 43
(MAY 26, 2019 – JUNE 1, 2019)

Report No. 53005-81-RPT-061

September 2019

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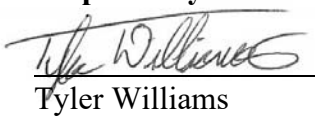

Date: 09/20/2019

Tyler Williams

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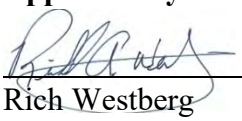

Date: 09/20/2019

Rich Westberg

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
0	09/2019	All	Original Issue.

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Figures

Tables

Acronyms and Abbreviations

COPC	Chemical of Potential Concern
CSM	Central Shift Manager
CSO	Central Shift Office
MBK	2-hexanone
MDL	Method Detection Limit
ML	Mobile Laboratory
NDEA	N-nitrosodiethylamine
NDMA	N-nitrosodimethylamine
NEMA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
PTR-TOF	Proton Transfer Reaction – Time-of-Flight
QA	Quality Assurance
QC	Quality Control
RL	Reporting Limit
SME	Subject Matter Expert

1.0 INTRODUCTION

During the week of May 26, 2019, through June 1, 2019, the Mobile Laboratory (ML) performed area monitoring around the 200 East Area of the Hanford Site. The data team continued processing data collected from the previous week. The reporting team worked towards the completion of weekly reports for Weeks 39 through 42 and monthly reports.

2.0 MAY 28, 2019 – AREA MONITORING

2.1 Quality Assessment

Data from May 28, 2019, were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004, *Mobile Laboratory Operational Procedure*, was adequately documented and all checks passed the acceptance limits.

2.2 Summary

On May 28, 2019, the ML arrived at the TerraGraphics warehouse in Pasco, WA at 04:55. The Quality Assurance/Quality Control (QA/QC) zero-air/span check was performed on the Proton Transfer Reaction – Mass Spectrometer (PTR-MS) beginning at 05:14. The ML Operators stopped for fuel at 05:23 and arrived at the Hanford Site to check in with Central Shift Office (CSO) at 06:26. After leaving the CSO, the ML headed traveled to TY/TX Tank Farms for area monitoring. At 06:56, the ML was parked on the east fence line between TY and TX Farms. At 07:19, the wind shifted and required the ML to be relocated and was parked South of TX Tank Farm. After an hour of monitoring, the ML was driven to U Farm at 07:58. At 08:06, the ML was parked at the southeast corner of U Farm. At 08:31, wind shifted and required the ML to be relocated. The ML was parked south of U Farm at 08:39 and remained in this location until 09:13. At 09:27, site survey loops began. The ML was parked north of AW Tank Farm at 10:00 and Operators noted the wind direction was shifting frequently. A second set of site survey loops began at 10:27 and upon completion, the ML was parked West of A Farm at 10:46. The ML was relocated to the east of A Farm at 11:00 and by 11:04 moved to the east of AX Farm. At 11:22, the wind shifted, and the ML was relocated northeast of the evaporator shortly thereafter. The ML was parked near the north fence line of AW Tank Farm at 12:17 and remained in this position until 12:29. A third set of site survey loops ended at 13:00 when the ML was parked east of A Tank Farm. At 13:45, a final set of site survey loops began. The ML Operators ended their shift by checking out with the Central Shift Manager (CSM) at 14:01.

Table 2-1 illustrates the times and locations on May 28, 2019, where the ML Operators noted a potential source, or a peak of interest was observed. At 06:25 PST, the rise in signal is seen for methanol (Figure 2-5), acetaldehyde (Figure 2-7), but-3-en-2-one (Figure 2-17), and butanal (Figure 2-18) as well as mass 43, C_2-benzenes and C_3-benzenes seen in Diesel Combustion Markers (Figure 2-49). The ML was parked south of the CSO at this time where vehicle and worker foot traffic are regular, and the volatile organic compound identified at this time are expected to be seen in vehicle emission. The plumes noted from 09:58 PST through 11:59 PST are seen in succession, and the compounds identified at these times occur when the ML Operators note a change in wind direction. These plumes are possibly related to the change in wind direction moving ML diesel generator emission to the inlet. At 10:55, the ML Operators also note workers nearby smoking cigarettes which could be the potential source of the raised signal in benzene (2-50), methanol, and toluene (Figure 2-51) identified at this time.

Table 2-1. Mobile Laboratory Summary of Events.

Time	Activity	Observed
06:25	Arrived at CSO	Spikes in wind speed
09:58	Parked north of AW Farm	Shift in wind direction
11:07	Parked east of A Farm	Workers smoking and vehicle traffic
11:20	Parked northeast of Evaporator	Shift in wind direction
11:59	Parked north of AW Farm	Shift in wind direction

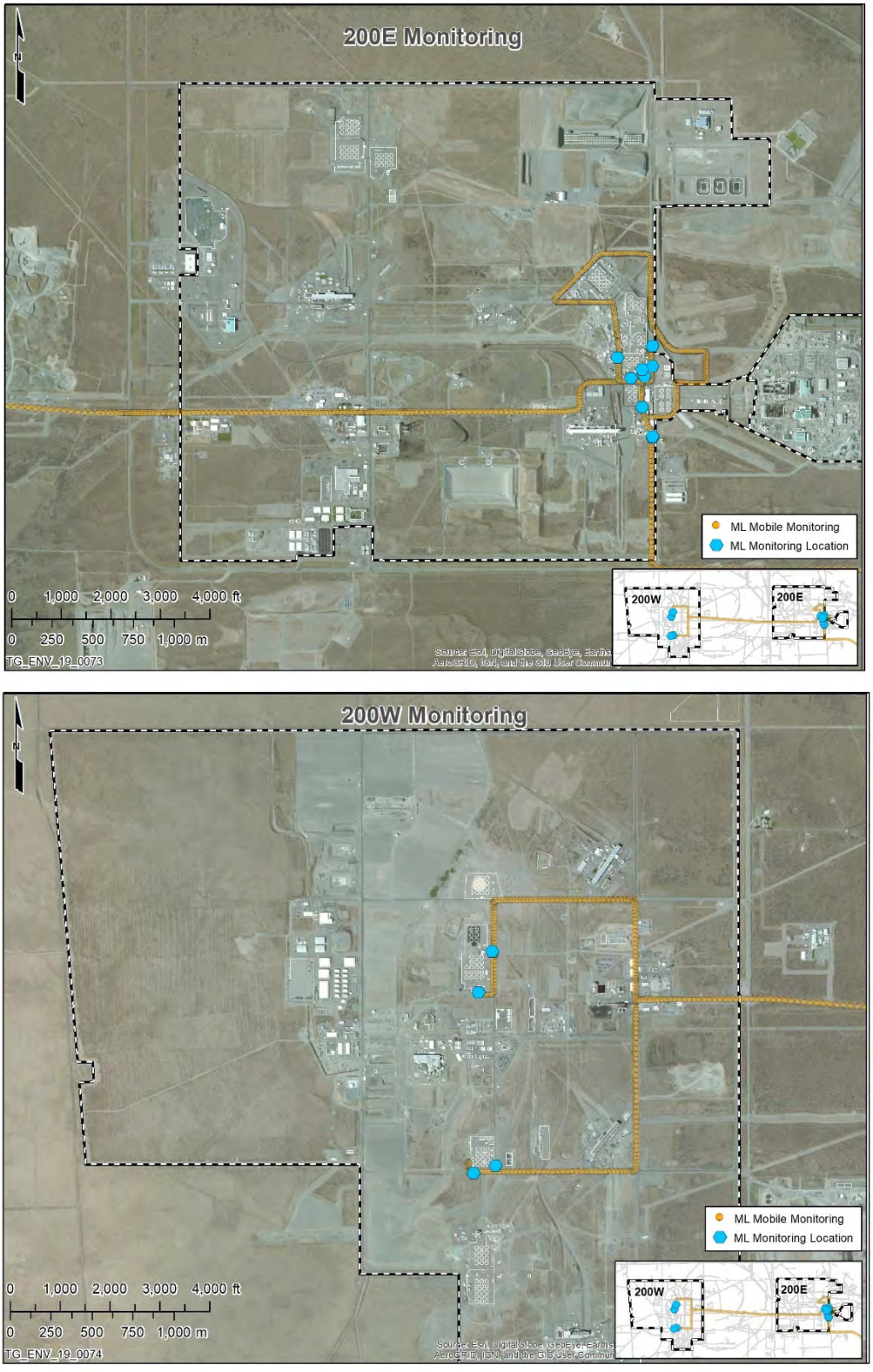

Figure 2-1. Location of the Mobile Laboratory for the Duration of the Monitoring Period.

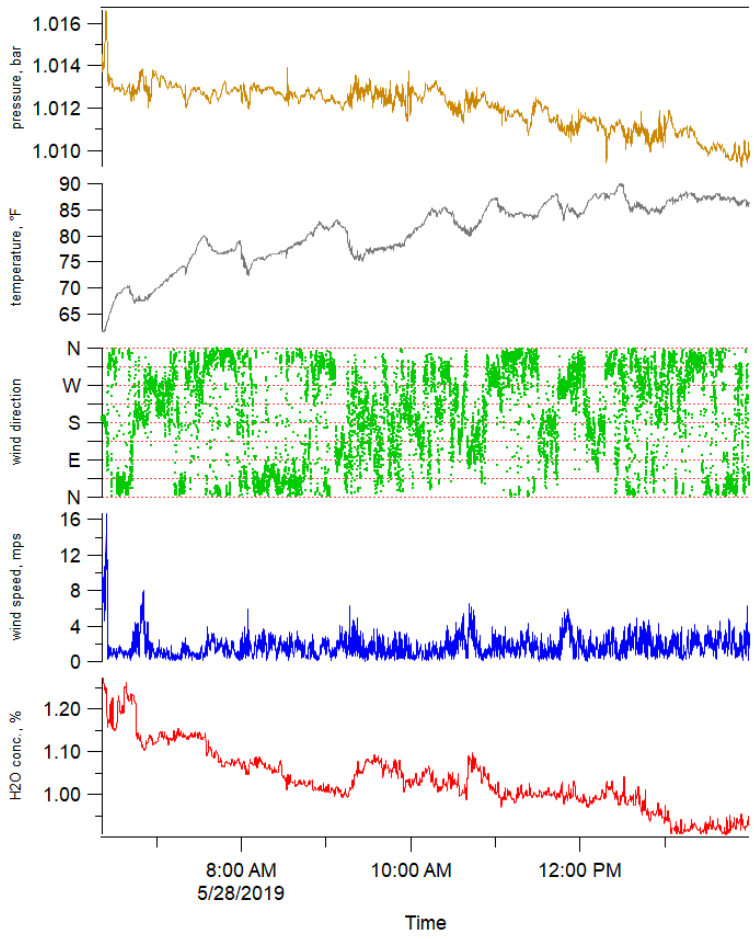

Figure 2-2. Weather Data for the Duration of the Monitoring Period.

Figure 2-2 illustrates the summary of meteorological for the monitoring period on May 28, 2019. The temperature rose slowly from 65˚F to reach a high near 85˚F for the afternoon. The wind was light, with moderate gusts around 8 mps (18 mph) and shifting throughout the day.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- Proton Transfer Reaction – Time-of-Flight (PTR-TOF) 6000 X2,
- LI-COR®[1] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Airmar®[2] Weather Station.

Confirmatory air samples were not collected during this period.

[1] LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.
[2] Airmar is a registered trademark of Airmar Technology Corporation, Milford, New Hampshire.

2.4 Area Monitoring

The ML Operators performed area monitoring from approximately 06:56 to 14:01. The table below displays the chemical of potential concern (COPC) statistical results during that monitoring period.

Table 2-2. Chemical of Potential Concern Statistical Information for the Area Monitoring on May 28, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
1	ammonia	25000	6.225	14.506†	3.205	22.094	28.704	13.462†
2	formaldehyde	300	1.721	<1.721	0.102	15.124	1.344	<1.721
3	methanol	200000	5.758	8.930†	1.395	15.619	43.086	8.684†
4	acetonitrile	20000	0.085	0.197†	0.039	19.592	0.715	0.195†
5	acetaldehyde	25000	1.027	1.795†	0.430	23.952	4.308	1.687†
6	ethylamine	5000	0.069	<0.069	0.014	59.011	0.091	<0.069
7	1,3-butadiene	1000	0.183	0.197†	0.069	35.049	0.623	0.187†
8	propanenitrile	6000	0.107	<0.107	0.018	39.140	0.175	<0.107
9	2-propenal	100	0.340	<0.340	0.049	41.333	0.624	<0.340
10	1-butanol + butenes	20000	0.214	<0.214	0.048	44.440	0.617	<0.214
11	methyl isocyanate	20	0.069	<0.069	0.021	47.820	0.139	<0.069
12	methyl nitrite	100	0.098	0.101†	0.031	30.488	0.356	0.098†
13	furan	1	0.062	<0.062	0.015	46.435	0.126	<0.062
14	butanenitrile	8000	0.039	<0.039	0.013	59.160	0.126	<0.039
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	200, 1, 1	0.041	0.071†	0.035	48.968	N/A*	N/A*
16	butanal	25000	0.061	0.205	0.051	24.724	0.568	0.197
17	NDMA**	0.3	0.082	<0.082	0.020	192.612	0.179	<0.082
18	benzene	500	0.236	<0.236	0.050	40.340	1.280	<0.236
19	2,4-pentadienenitrile + pyridine	300, 1000	0.085	<0.085	0.014	39.974	0.151	<0.085
20	2-methylene butanenitrile	300	0.036	<0.036	0.008	67.786	0.118	<0.036
21	2-methylfuran	1	0.043	0.045†	0.021	46.235	0.226	0.042†
22	pentanenitrile	6000	0.036	<0.036	0.010	65.741	0.070	<0.036
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.043	0.044†	0.023	52.904	0.204	0.040†
24	NEMA**	0.3	0.058	<0.058	0.017	163.791	0.158	<0.058
25	2,5-dimethylfuran	1	0.032	<0.032	0.015	61.640	0.117	<0.032
26	hexanenitrile	6000	0.031	<0.031	0.007	87.565	0.049	<0.031
27	2-hexanone (MBK)	5000	0.036	<0.036	0.012	83.393	0.143	<0.036
28	NDEA**	0.1	0.034	<0.034	0.010	145.822	0.080	<0.034

Table 2-2. Chemical of Potential Concern Statistical Information for the Area Monitoring on May 28, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
29	butyl nitrite + 2-nitro-2-methylpropane	100, 300	0.058	<0.058	0.011	41.904	0.081	<0.058
30	2,4-dimethylpyridine	500	0.036	<0.036	0.009	87.728	0.191	<0.036
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.027	<0.027	0.011	84.173	0.069	<0.027
32	heptanenitrile	6000	0.027	<0.027	0.006	90.491	0.047	<0.027
33	4-methyl-2-hexanone	500	0.033	<0.033	0.008	91.372	0.062	<0.033
34	NMOR**	0.6	0.021	<0.021	0.008	168.825	0.052	<0.021
35	butyl nitrate	2500	0.022	<0.022	0.005	114.331	0.035	<0.022
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.028	<0.028	0.009	82.729	0.060	<0.028
37	6-methyl-2-heptanone	8000	0.028	<0.028	0.008	81.381	0.048	<0.028
38	2-pentylfuran	1	0.026	<0.026	0.010	63.858	0.063	<0.026
39	biphenyl	200	0.022	<0.022	0.007	116.326	0.045	<0.022
40	2-heptylfuran	1	0.067	<0.067	0.010	39.945	0.068	<0.067
41	1,4-butanediol dinitrate	50	0.036	<0.036	0.007	84.992	0.045	<0.036
42	2-octylfuran	1	0.020	<0.020	0.005	203.586	0.044	<0.020
43	1,2,3-propanetriol 1,3-dinitrate	50	0.011	<0.011	0.003	380.017	0.035	<0.011
44	PCB	1000	0.034	<0.034	0.006	67.734	0.044	<0.034
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.025	<0.025	0.005	96.488	0.033	<0.025
46	furfural acetophenone	1	0.064	<0.064	0.010	41.024	0.072	<0.064
N/A*	The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.247 ppb and the median value was 0.063† ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 200, which provide widely variant bases for these numbers.							
**	Nitrosamine results are suspect due to isobaric interferants causing positive bias that have been encountered during previous background [53005-81-RPT-007, *PTR-MS Mobile Laboratory Vapor Monitoring Background Study, (3/18/2018 – 4/20/2018)*, and *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, RJ Lee Group, Inc.].							
<	COPC Averages below the MDL.							
†	COPC Averages between the RL and the MDL.							
	COPC Averages >100% of the OEL.							
	COPC Averages 50-100% of the OEL.							
	COPC Averages 10-50% of the OEL.							

Figure 2-3 through Figure 2-51 display 46 COPC signals, overlaid with the same signal smoothed using a 1-minute moving average (in cases where a moving average assist with data visualization), and CO_2, for the monitoring period May 28, 2019. If within range of the plot's left axis, a green horizontal line representing 50% of the COPC's occupational exposure limit (OEL), a blue horizontal line representing the COPC's OEL, a horizontal purple line representing the reporting limit (RL), and a pink horizontal line representing the method detection limit (MDL) are shown.

Figure 2-3 through Figure 2-51 also display the Area Monitoring period, and the data shown were edited from the entire data, eliminating the daily span checks performed as well as any traveling done off the Hanford Site. Figure 2-3 displays the signal for ammonia for the monitoring period with a slight decay in concentration from the start of monitoring as the sample line equilibrates from the daily ammonia span check.

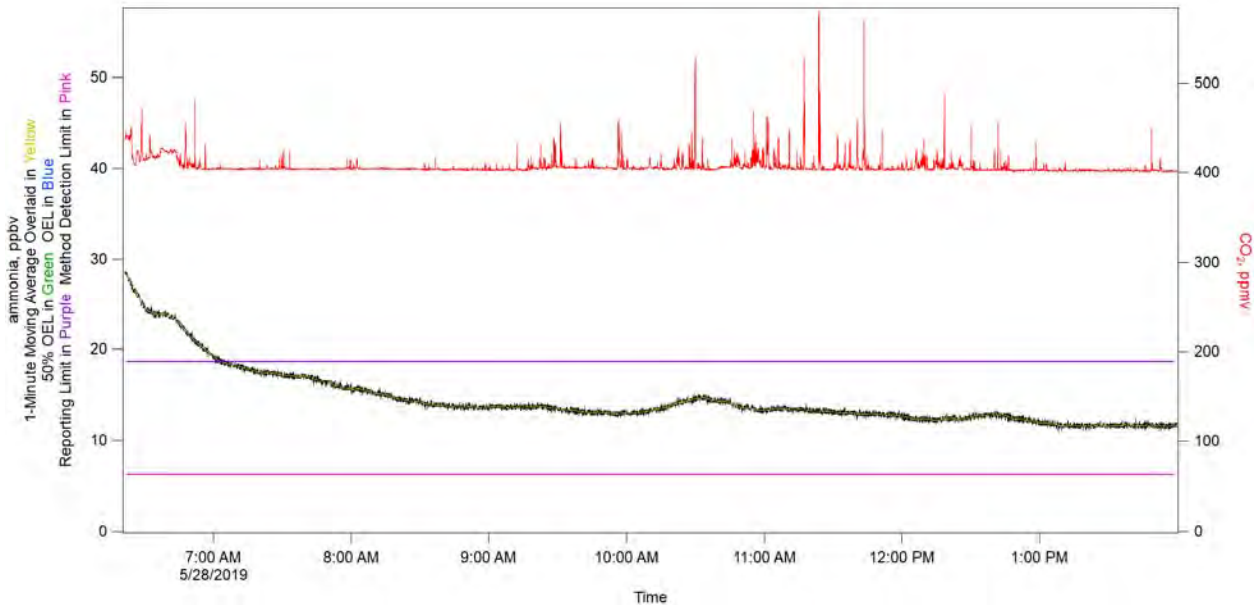

Figure 2-3. Ammonia.

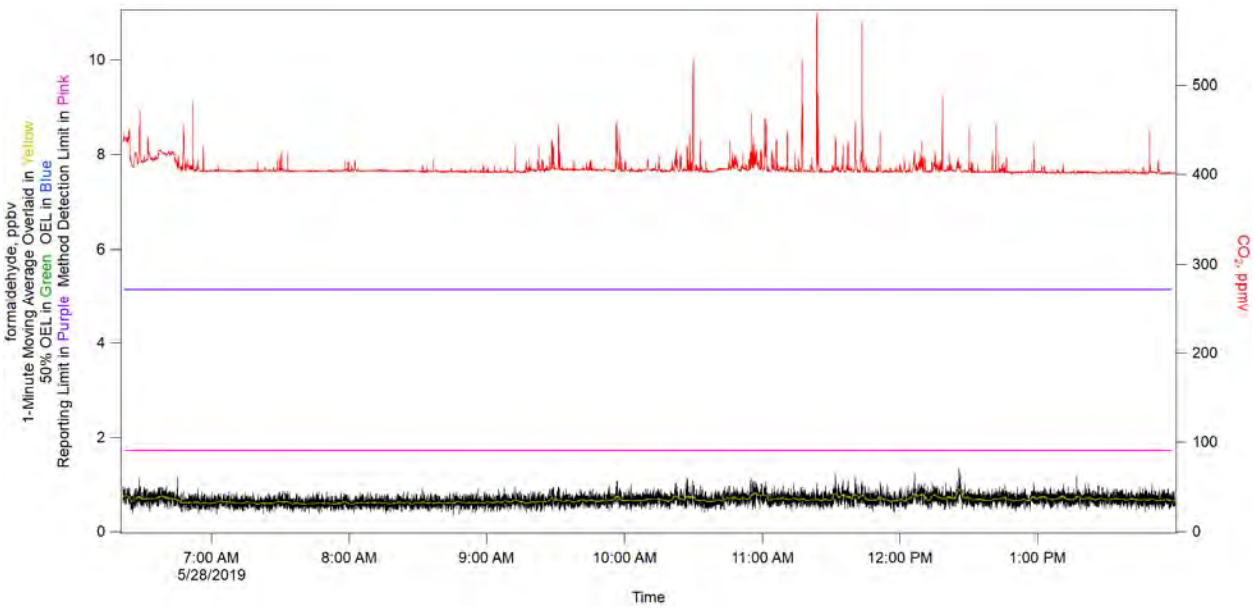

Figure 2-4. Formaldehyde.

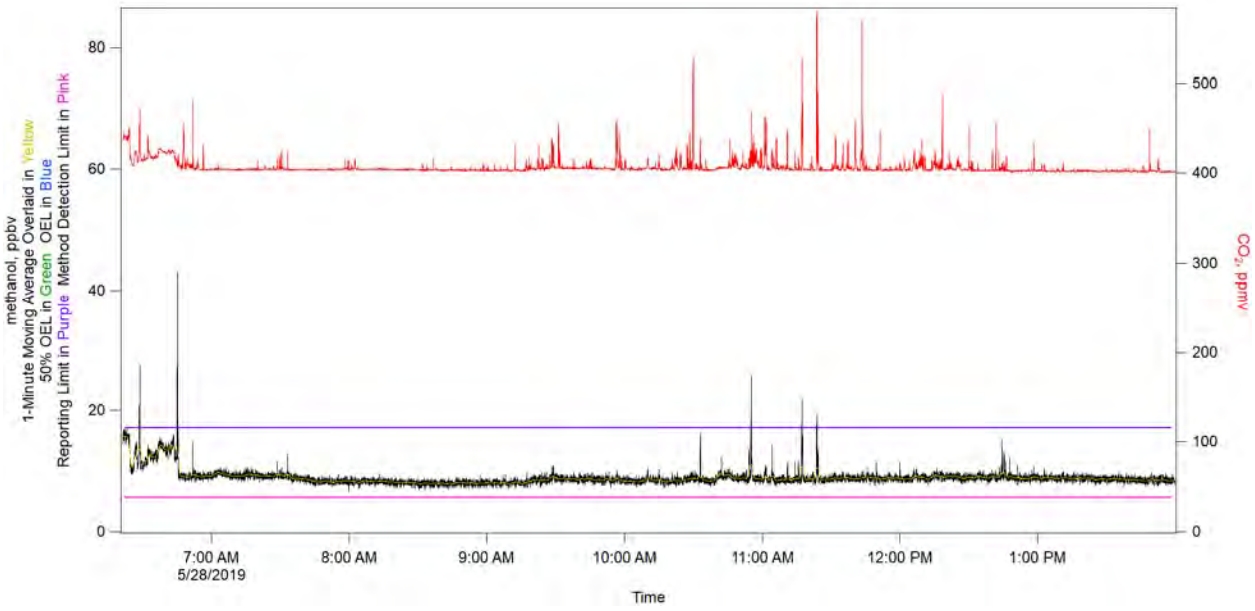

Figure 2-5. Methanol.

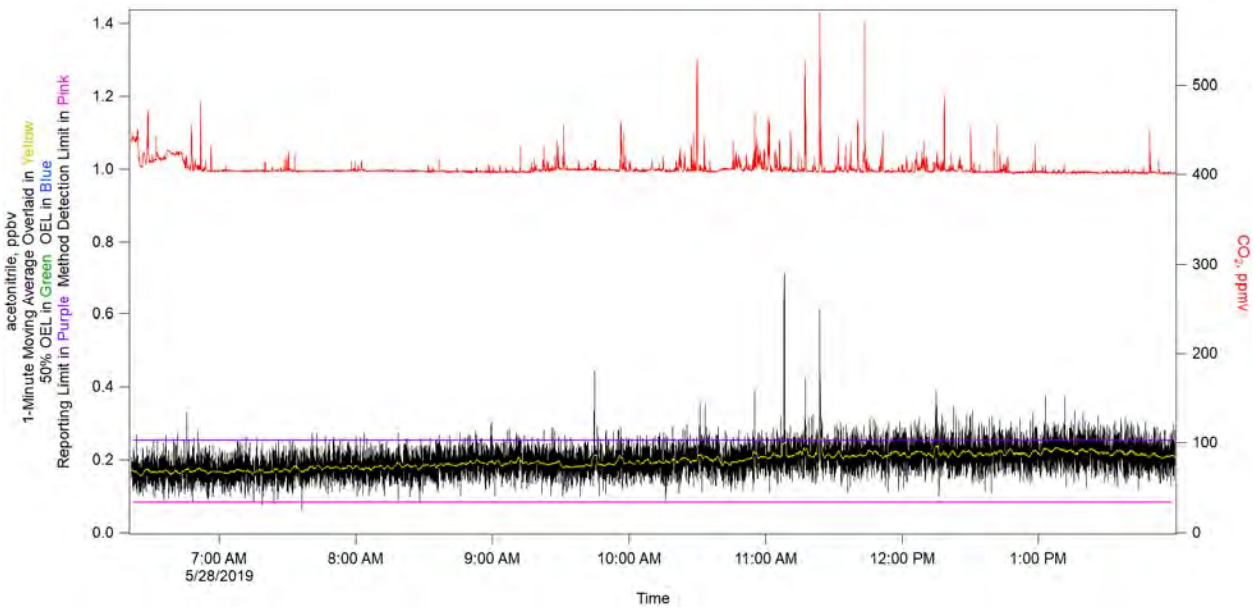

Figure 2-6. Acetonitrile.

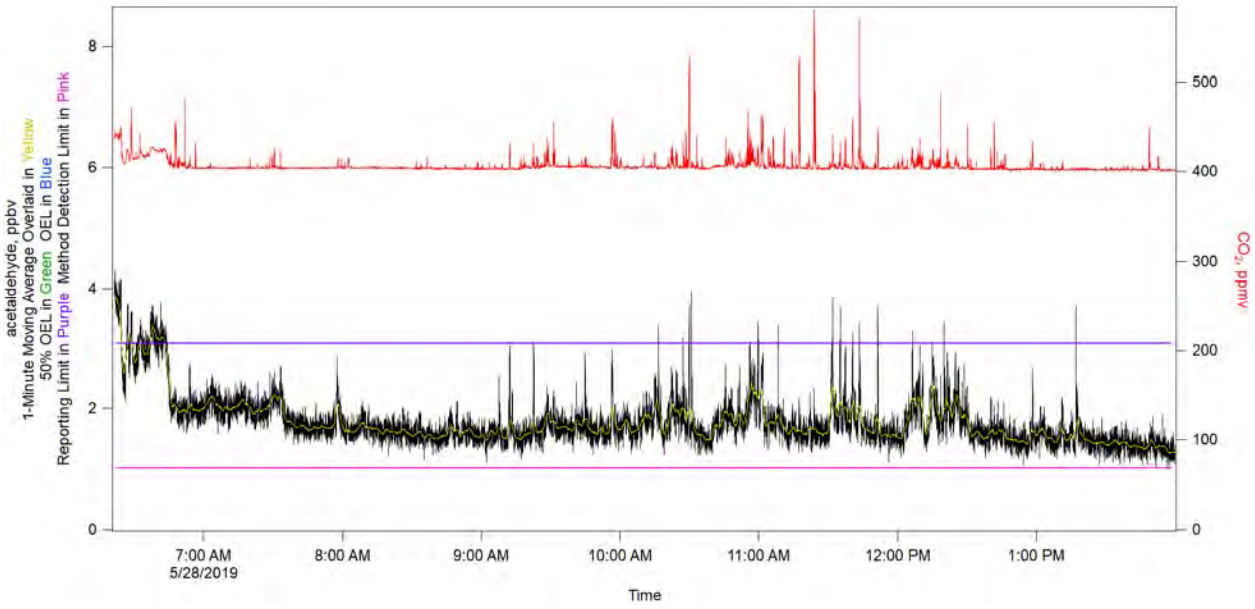

Figure 2-7. Acetaldehyde.

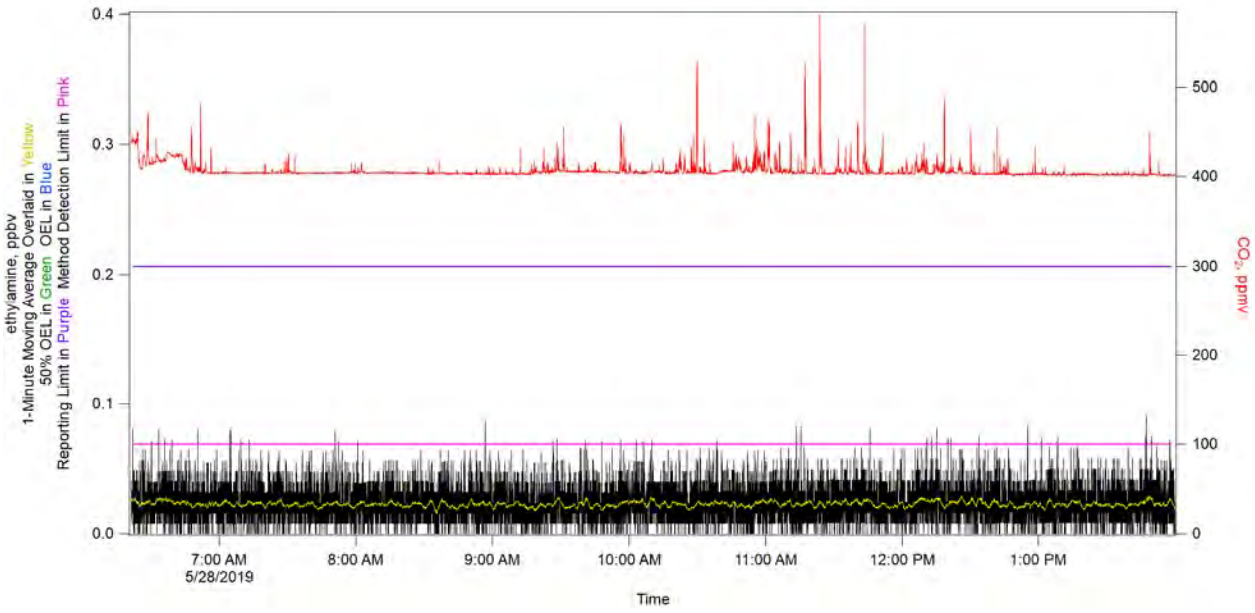

Figure 2-8. Ethylamine.

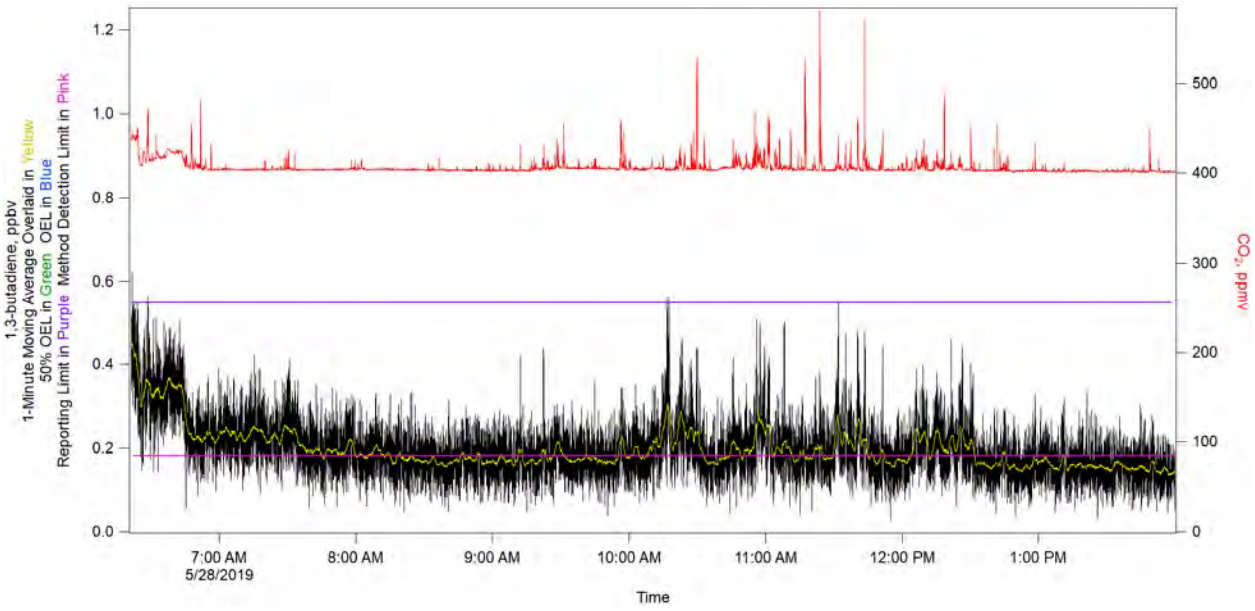

Figure 2-9. 1,3-butadiene.

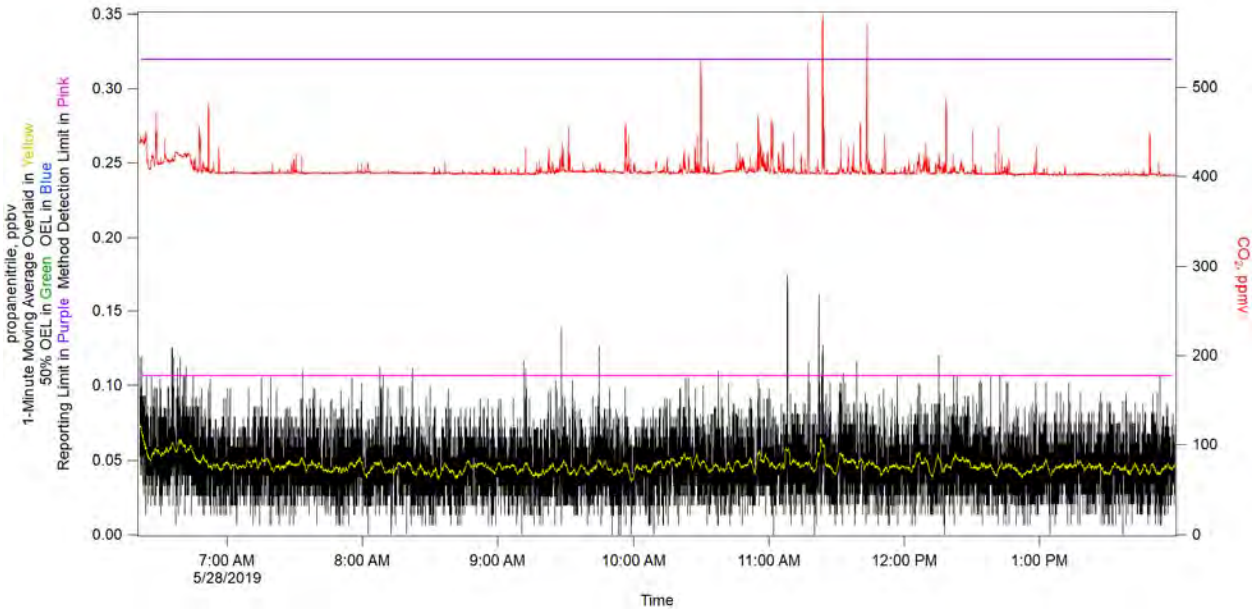

Figure 2-10. Propanenitrile.

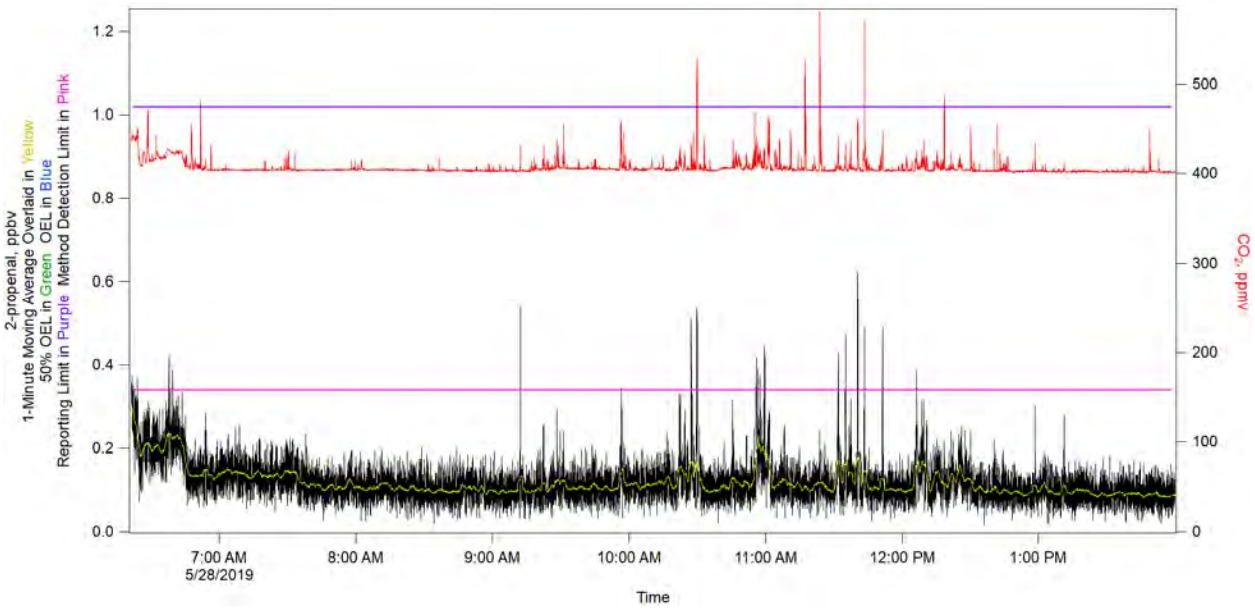

Figure 2-11. 2-propenal.

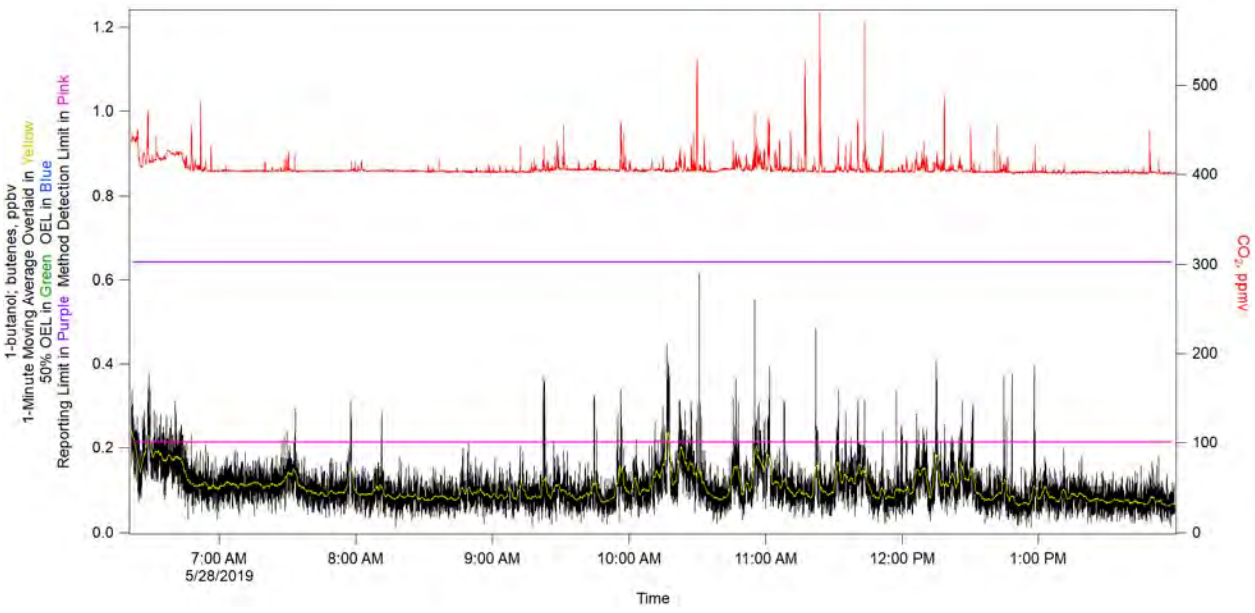

Figure 2-12. 1-butanol; Butenes.

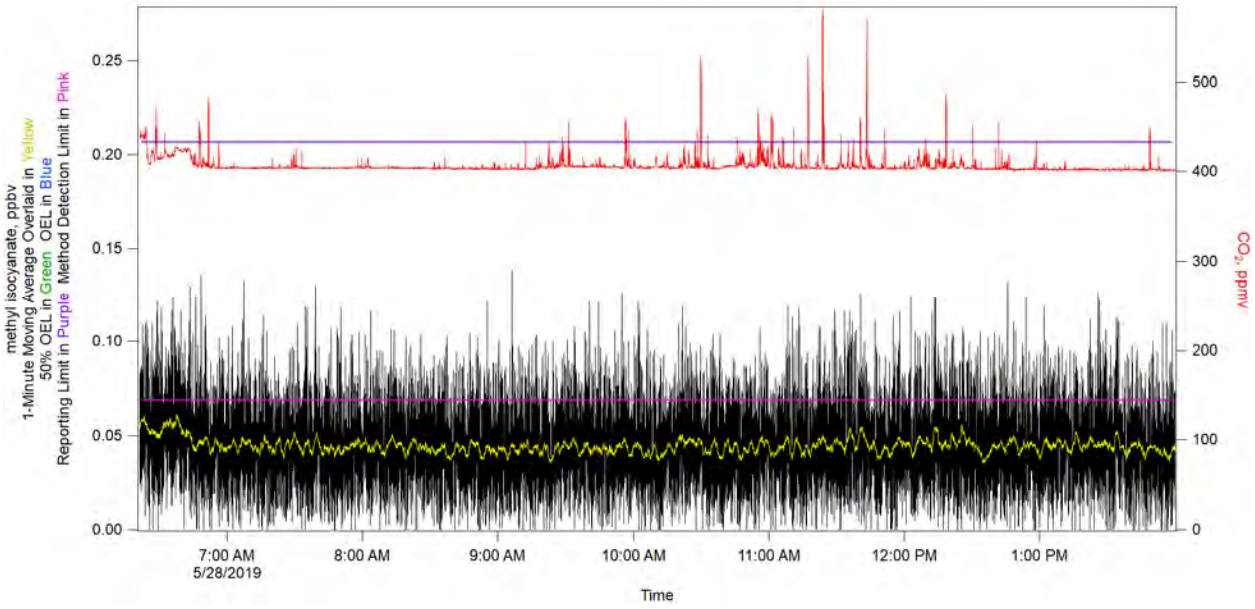

Figure 2-13. Methyl Isocyanate.

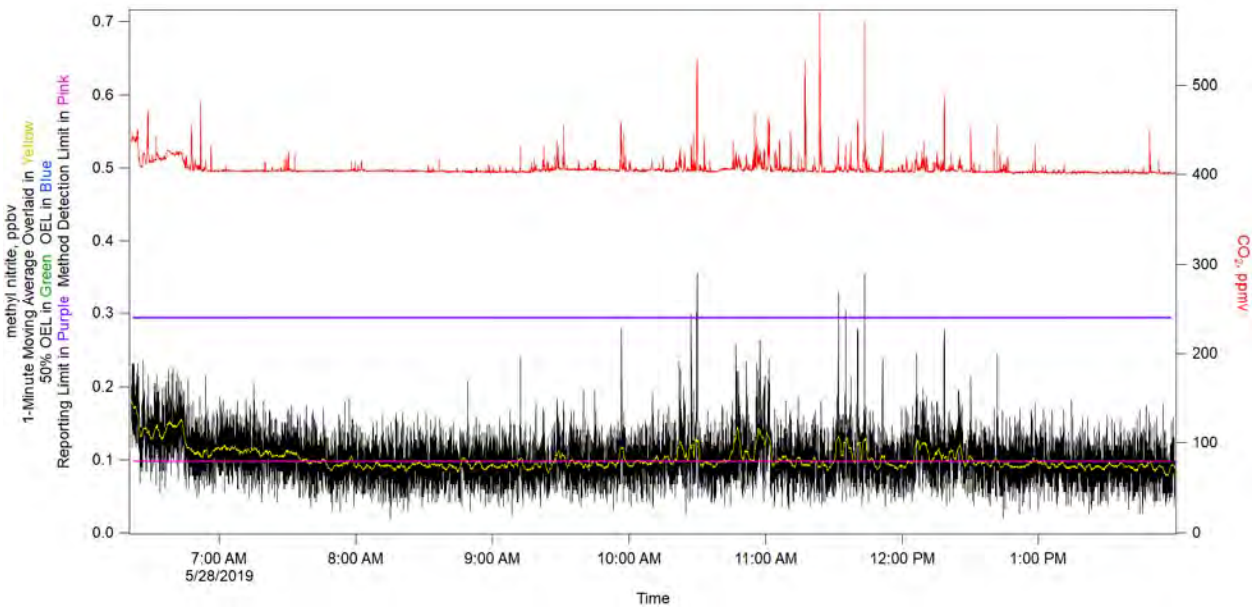

Figure 2-14. Methyl Nitrite.

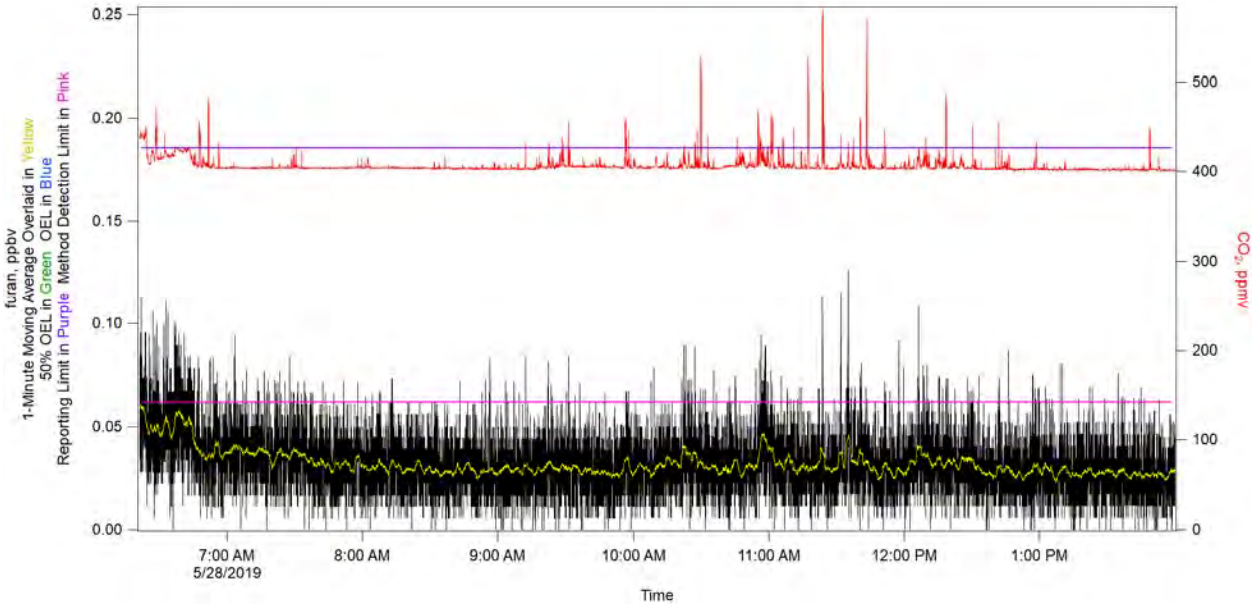

Figure 2-15. Furan.

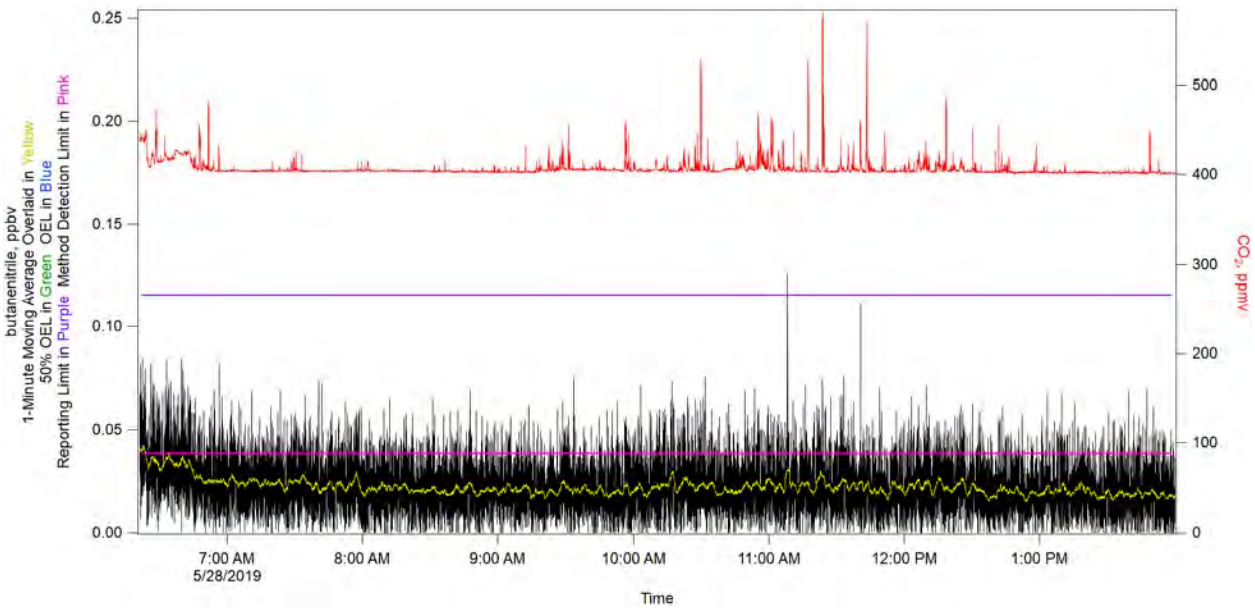

Figure 2-16. Butanenitrile.

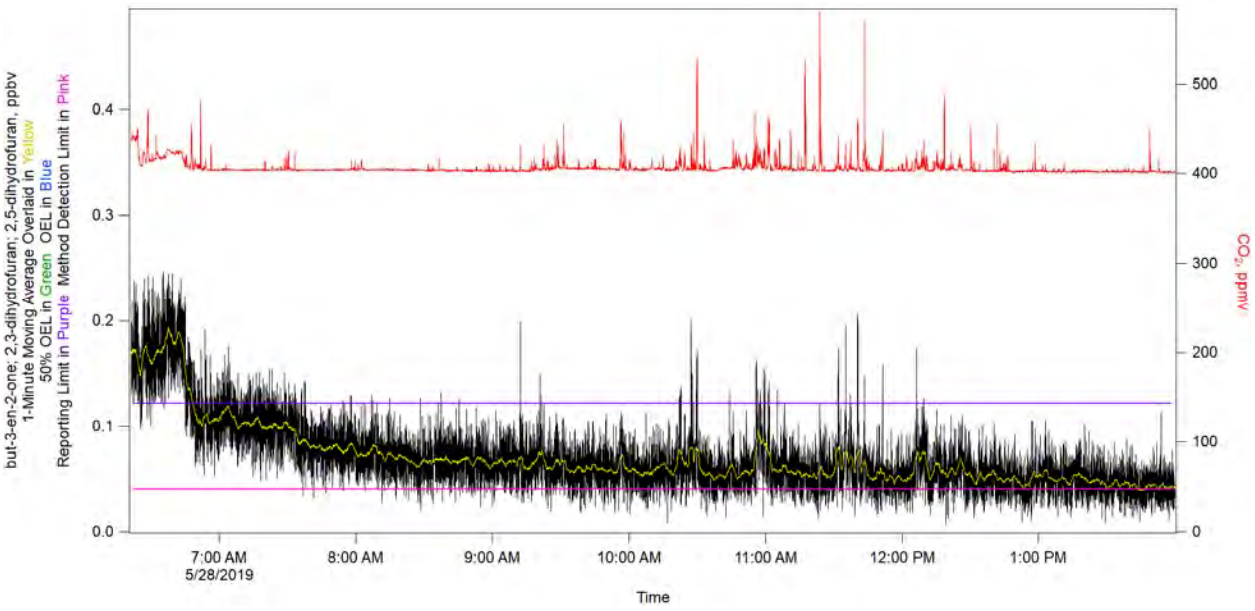

Figure 2-17. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

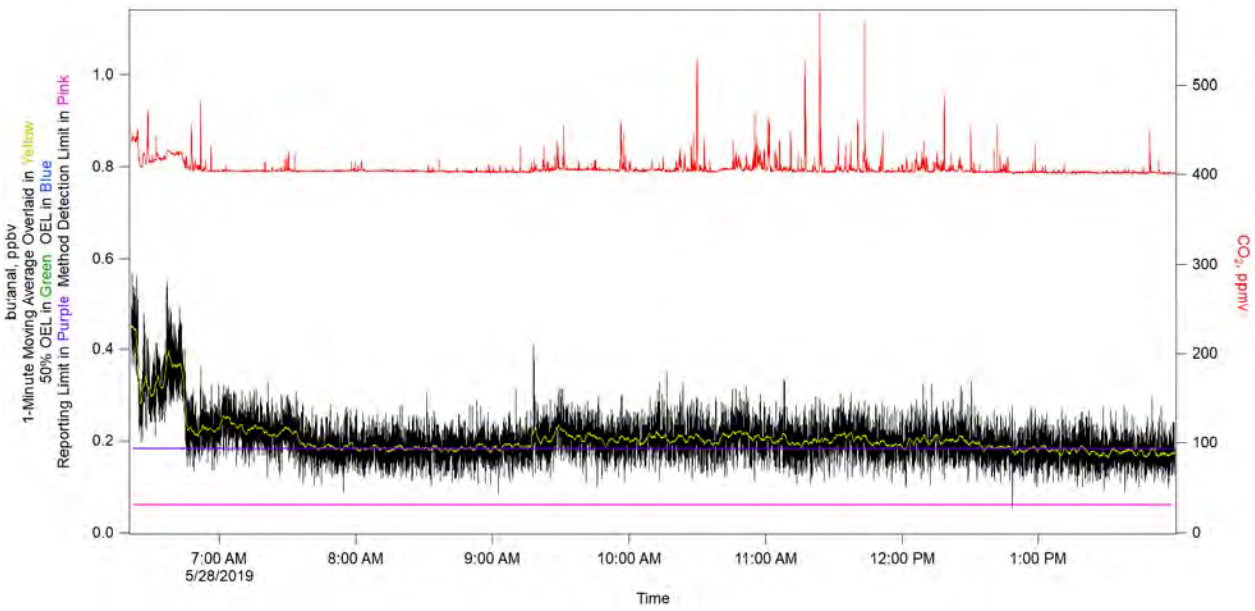

Figure 2-18. Butanal.

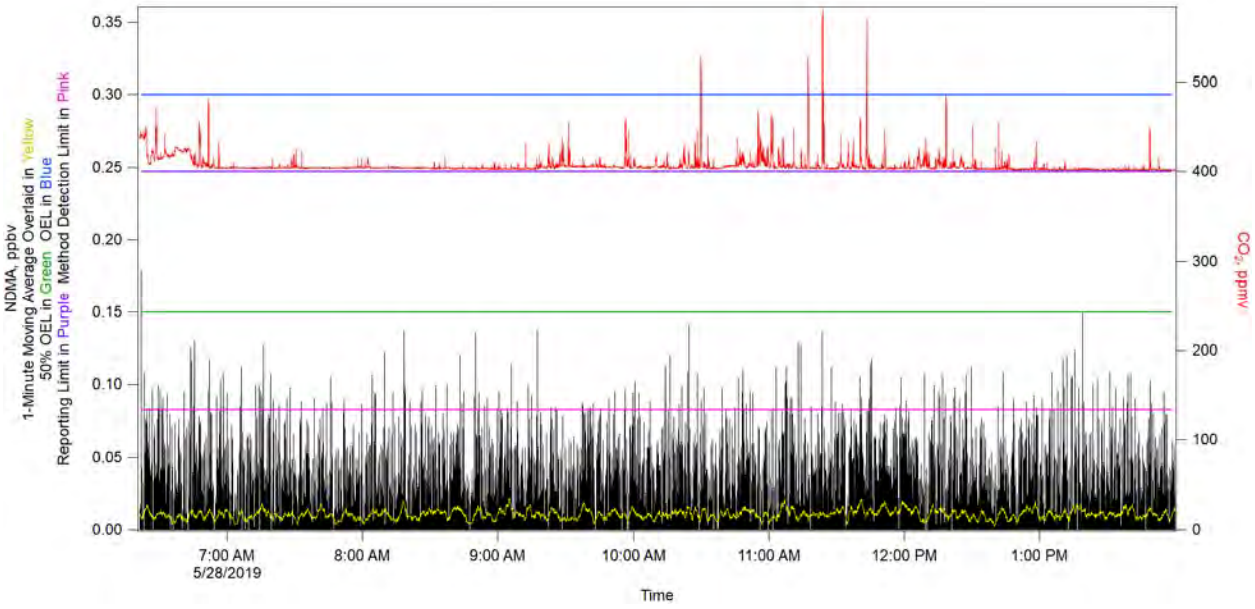

Figure 2-19. N-nitrosodimethylamine (NDMA).

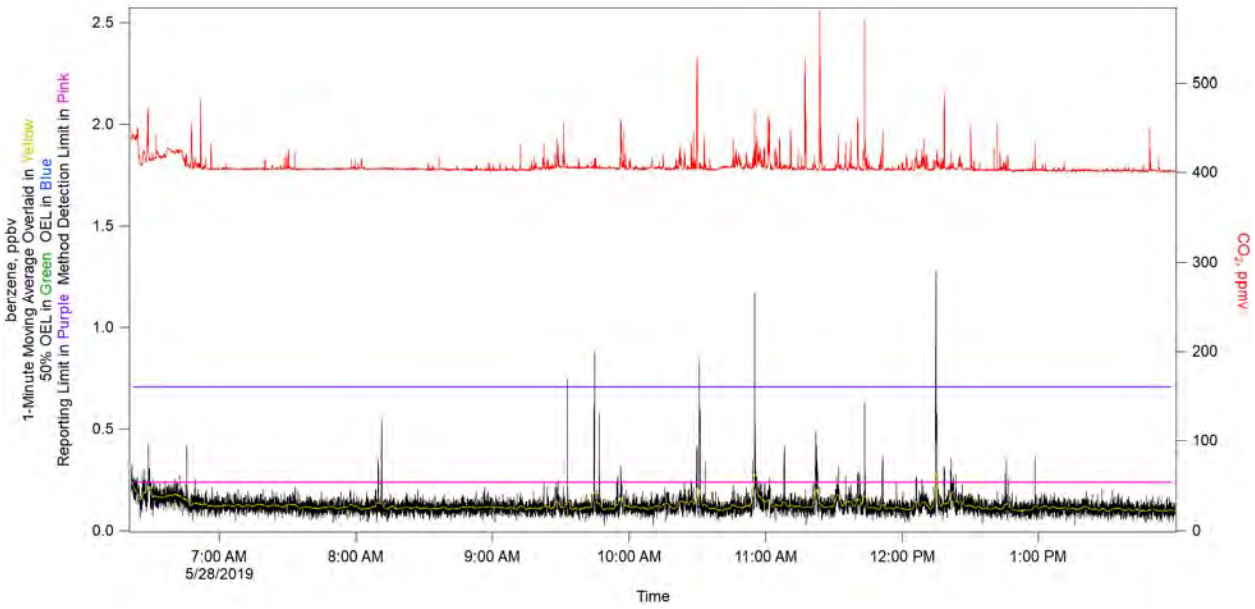

Figure 2-20. Benzene.

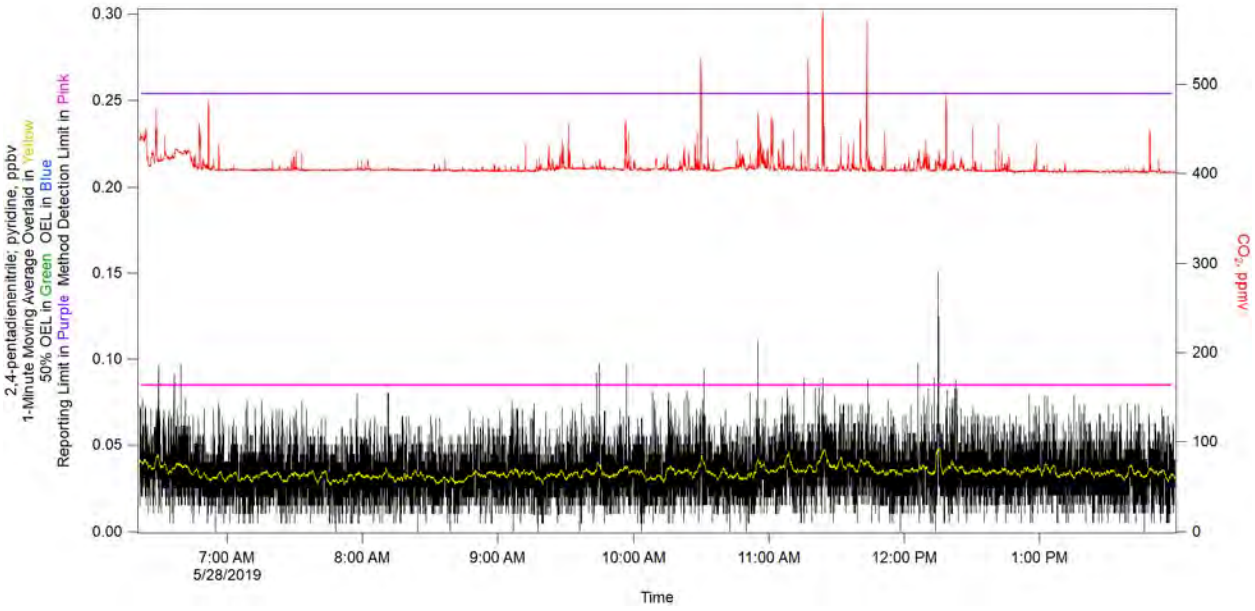

Figure 2-21. 2,4-pentadienenitrile; Pyridine.

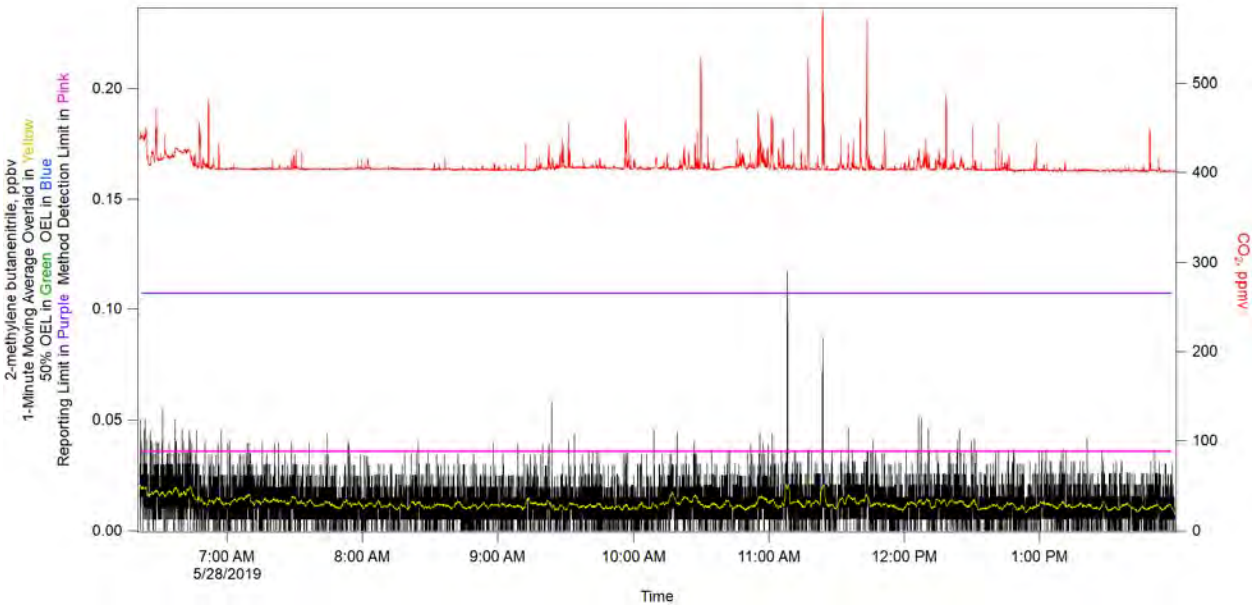

Figure 2-22. 2-methylene Butanenitrile.

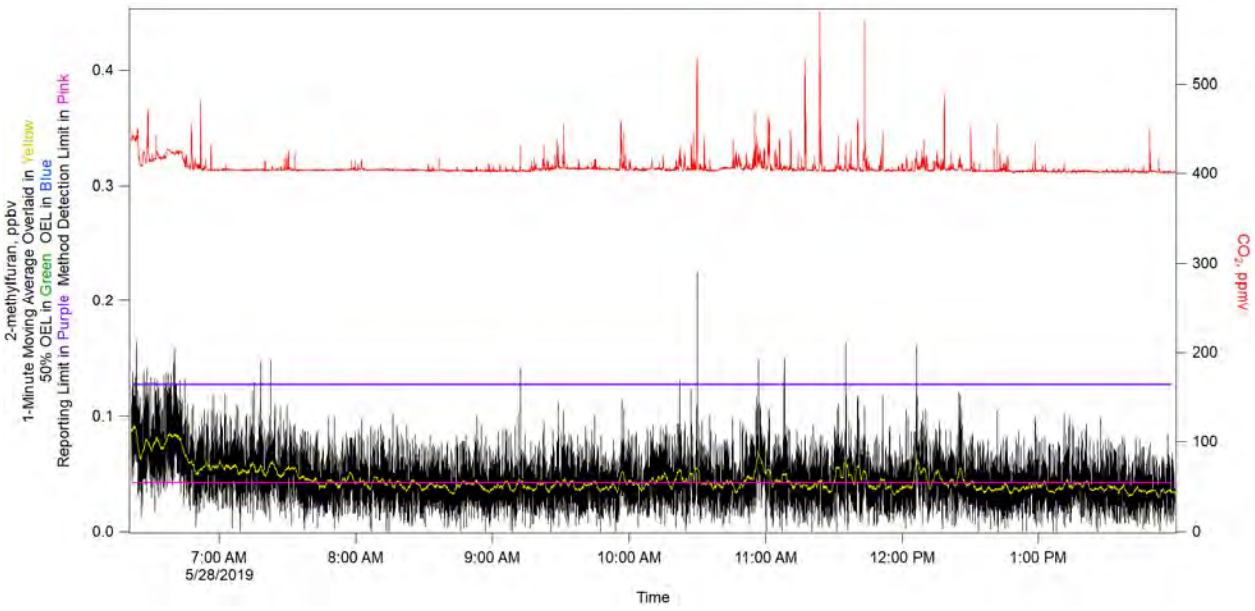

Figure 2-23. 2-methylfuran.

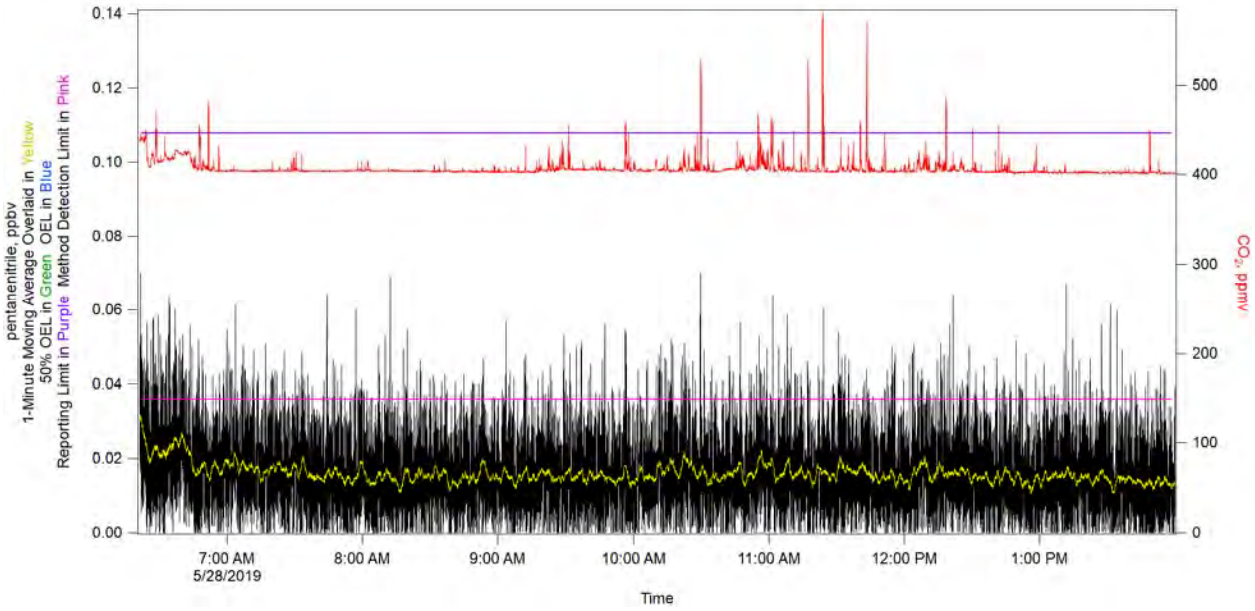

Figure 2-24. Pentanenitrile.

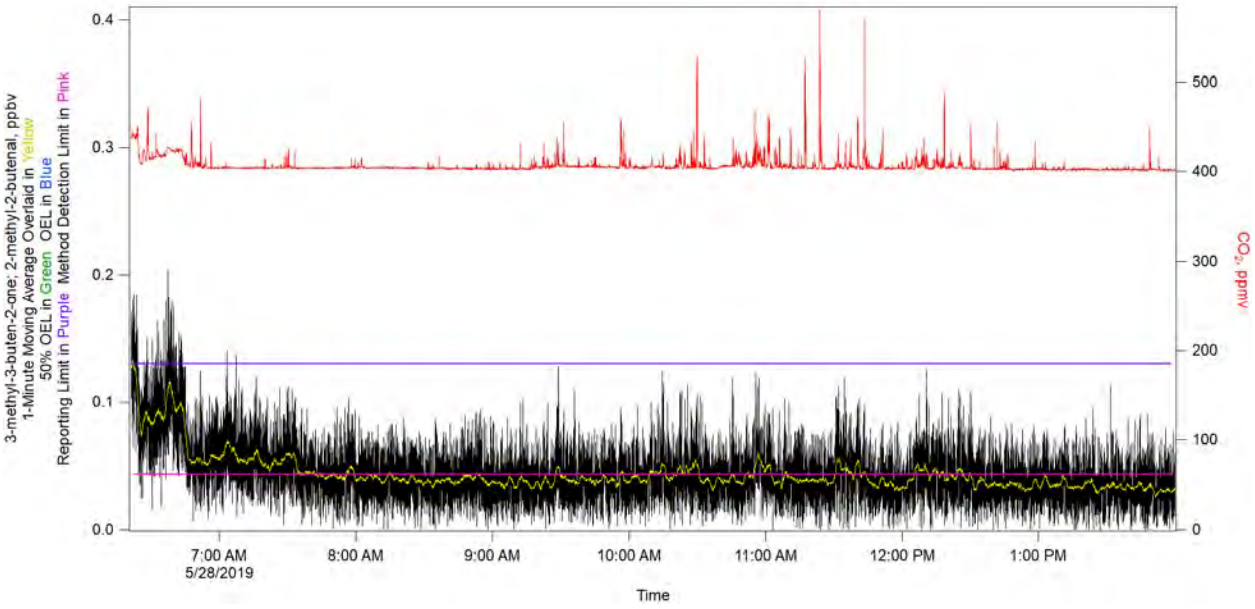

Figure 2-25. 3-methyl-3-buten-2-one; 2-methyl-2-butenal.

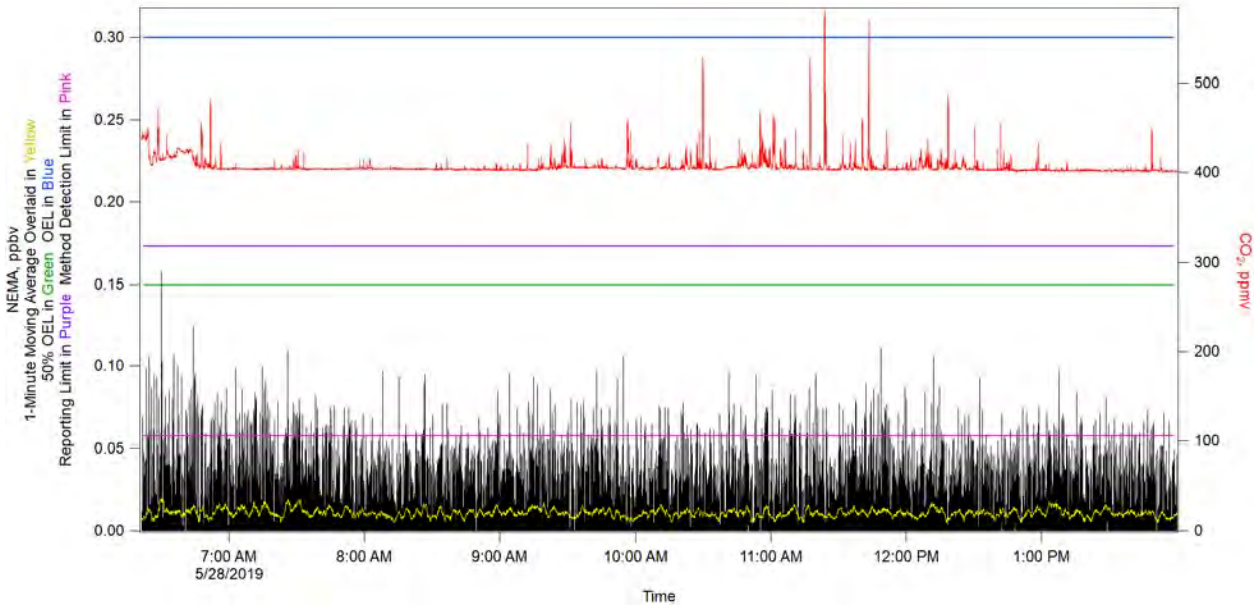

Figure 2-26. N-nitrosomethylethylamine (NEMA).

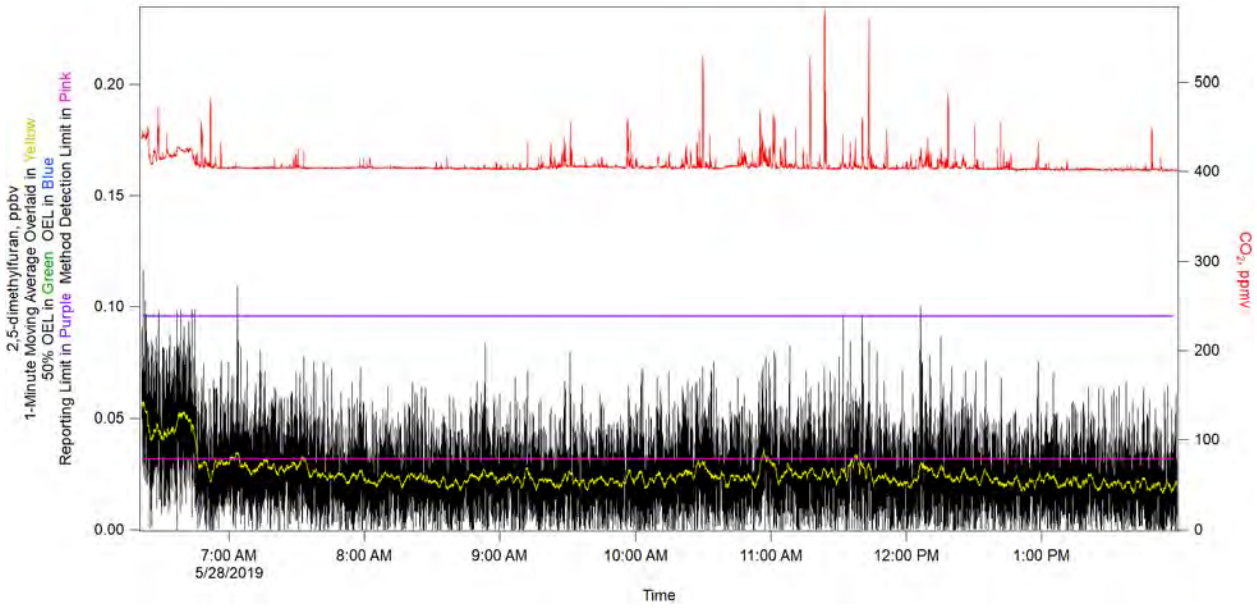

Figure 2-27. 2,5-dimethylfuran.

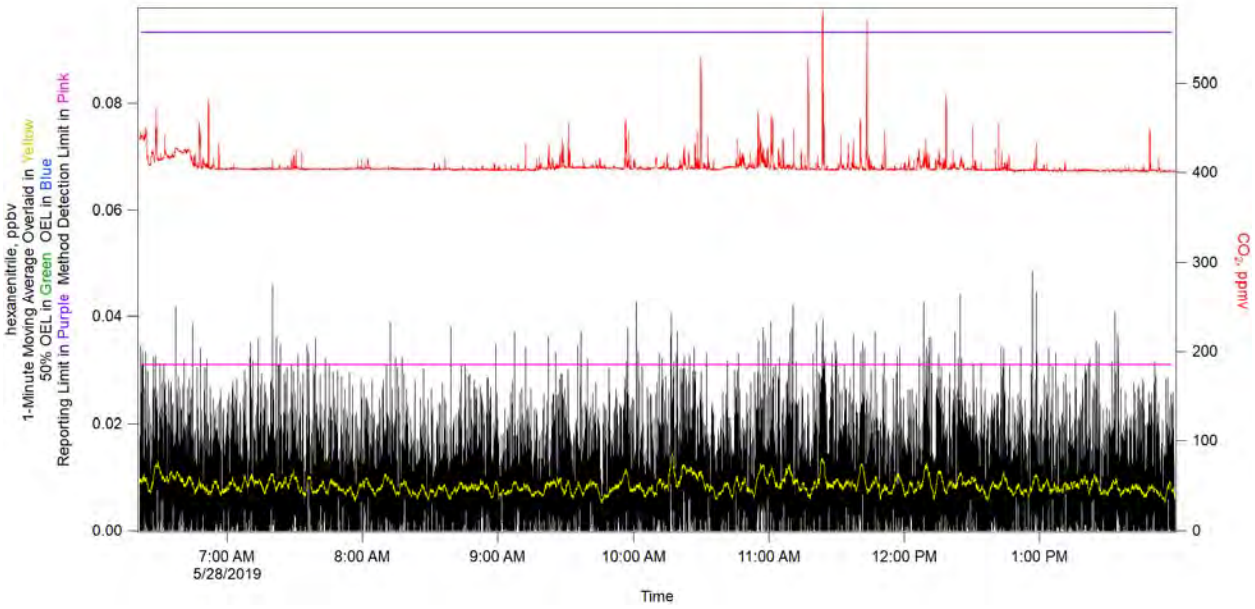

Figure 2-28. Hexanenitrile.

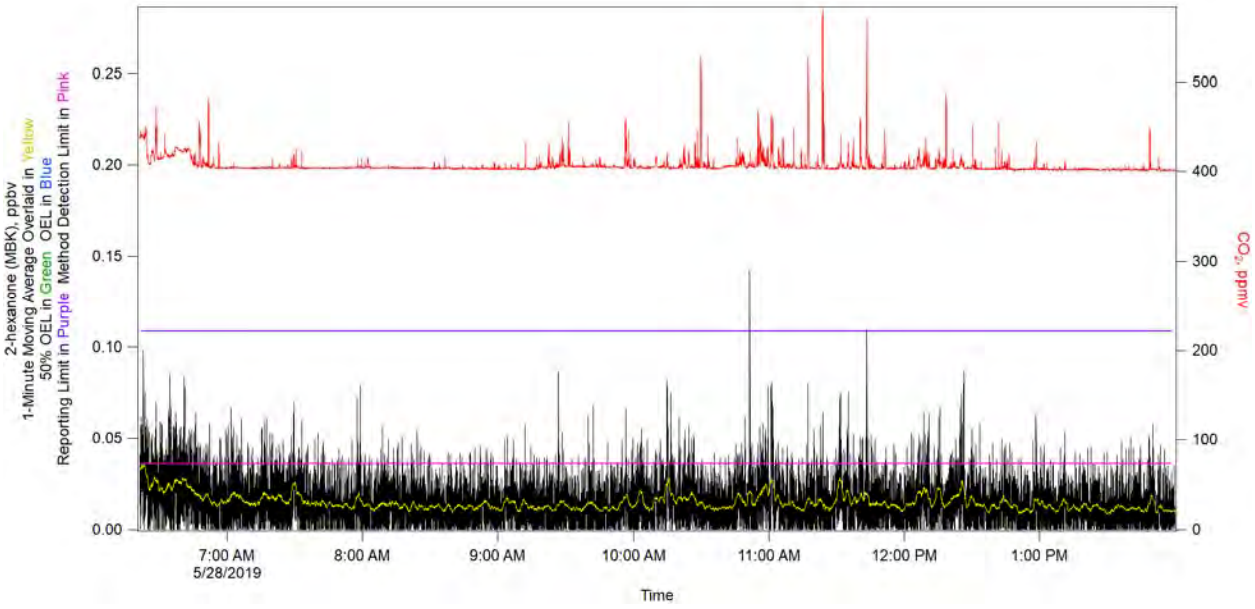

Figure 2-29. 2-hexanone (MBK).

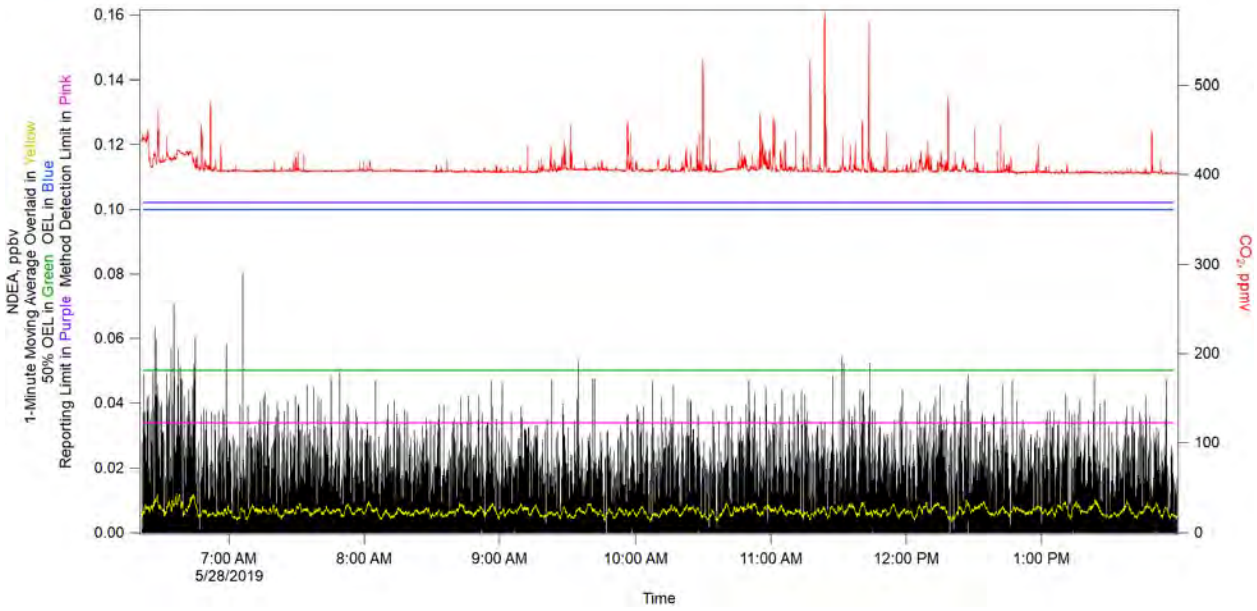

Figure 2-30. N-nitrosodiethylamine (NDEA).

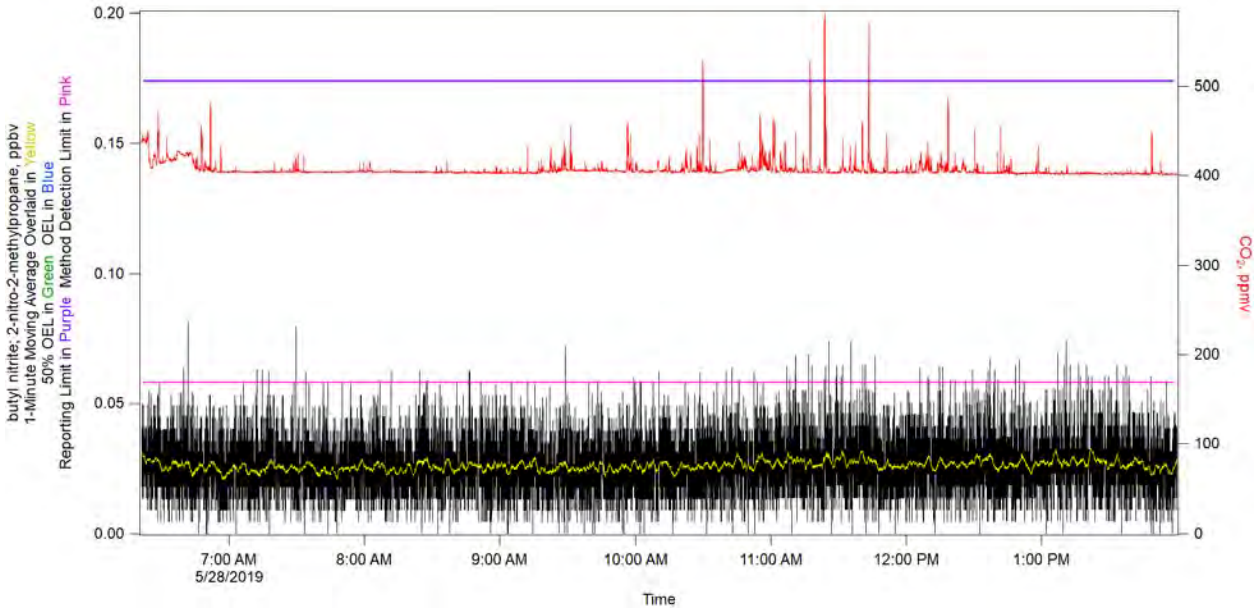

Figure 2-31. Butyl Nitrite; 2-nitro-2-methylpropane.

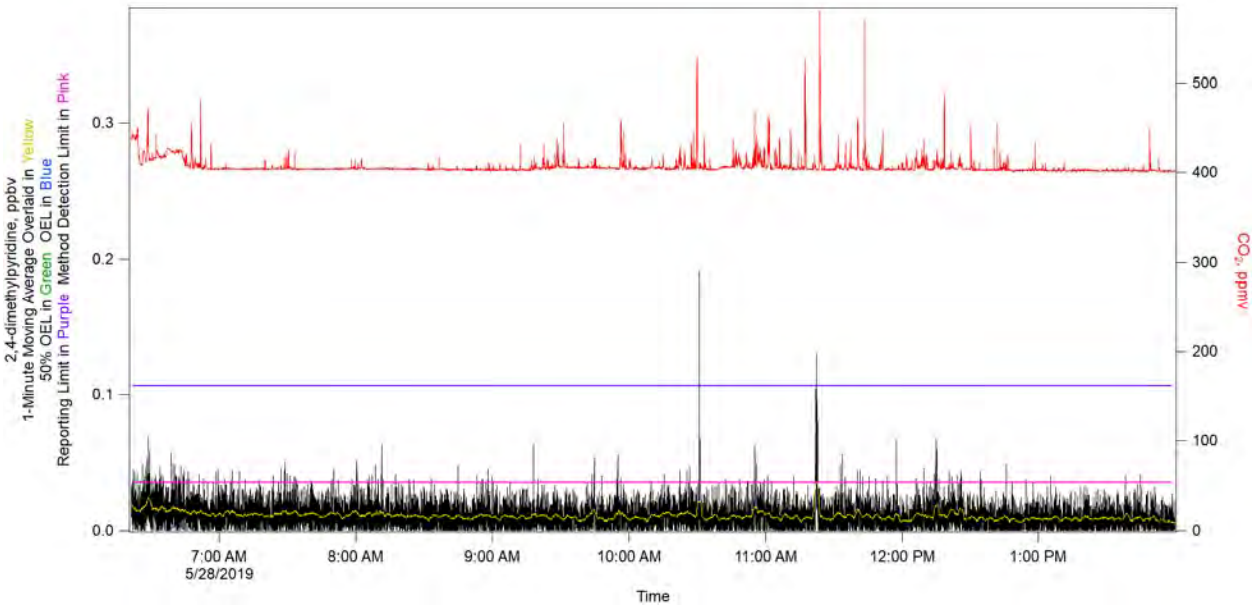

Figure 2-32. 2,4-dimethylpyridine.

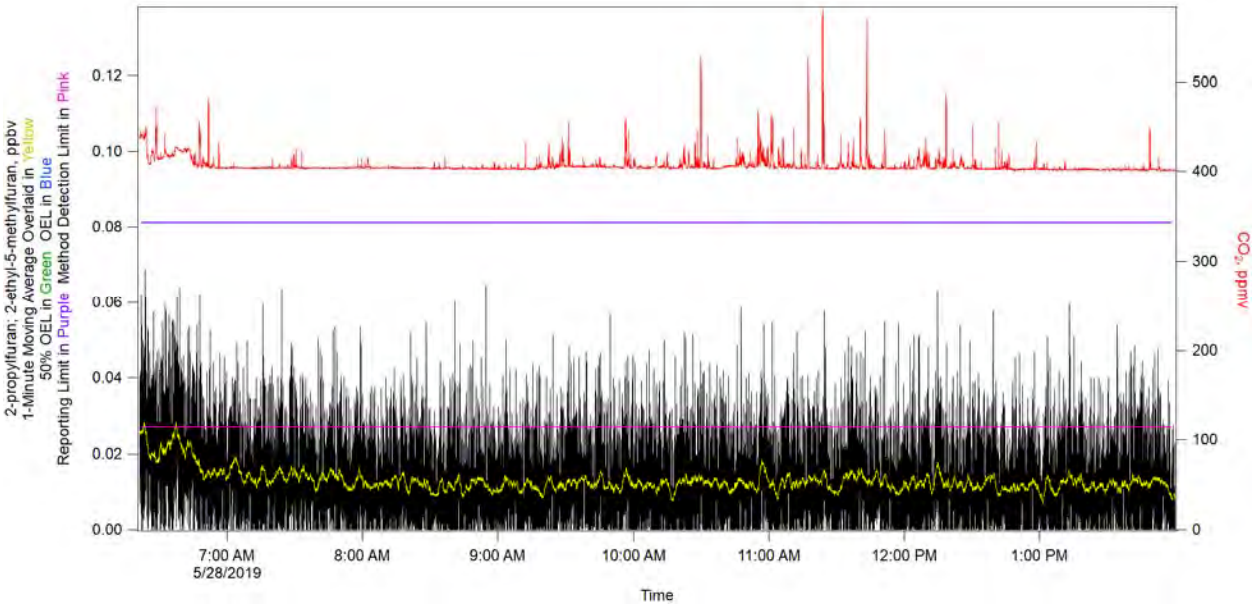

Figure 2-33. 2-propylfuran; 2-ethyl-5-methylfuran.

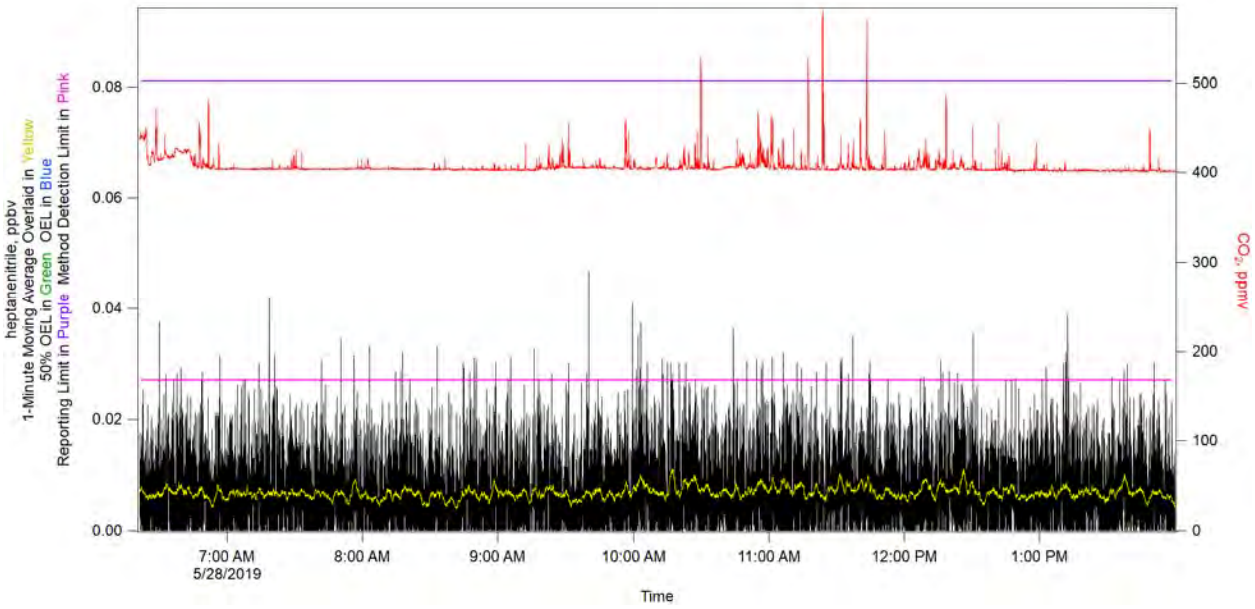

Figure 2-34. Heptanenitrile.

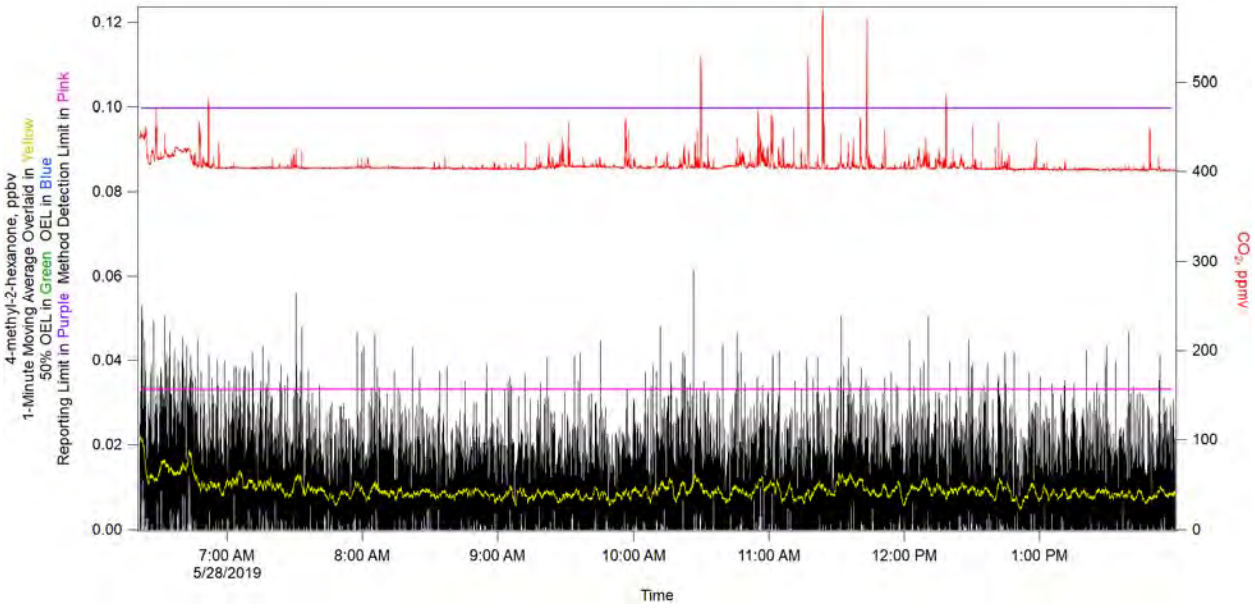

Figure 2-35. 4-methyl-2-hexanone.

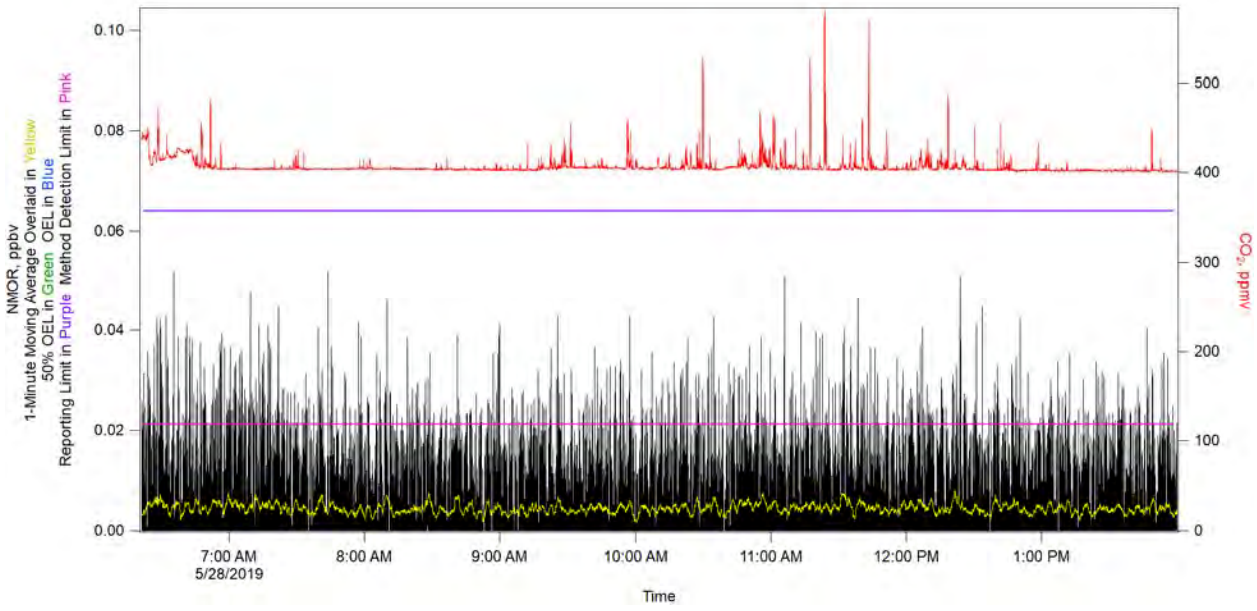

Figure 2-36. N-nitrosomorpholine (NMOR).

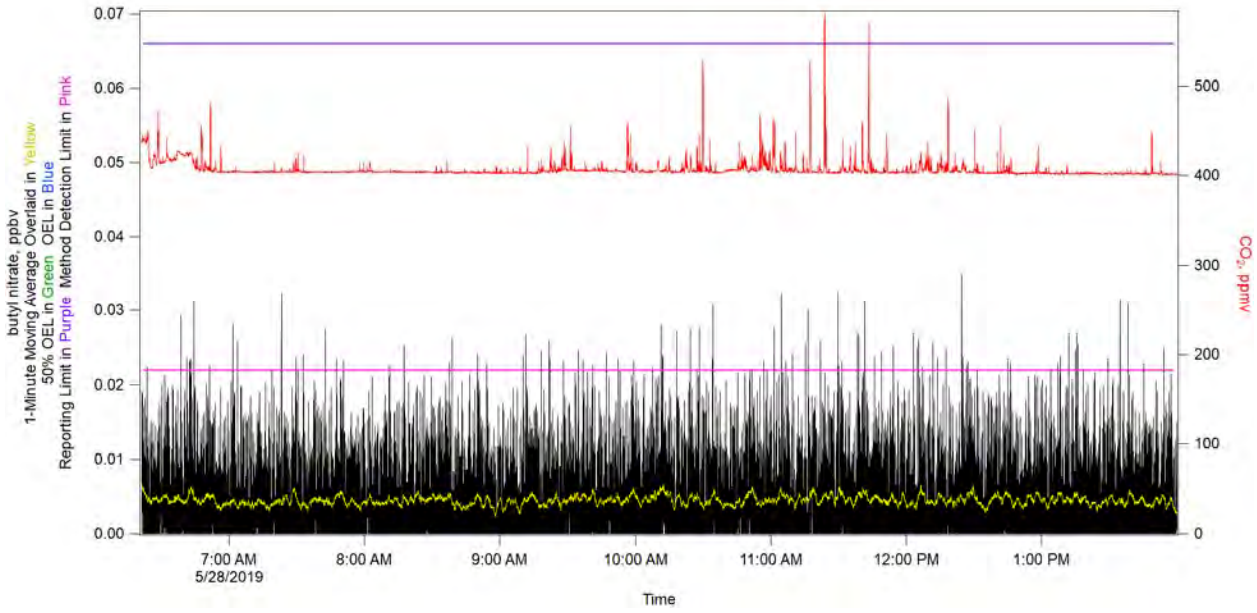

Figure 2-37. Butyl Nitrate.

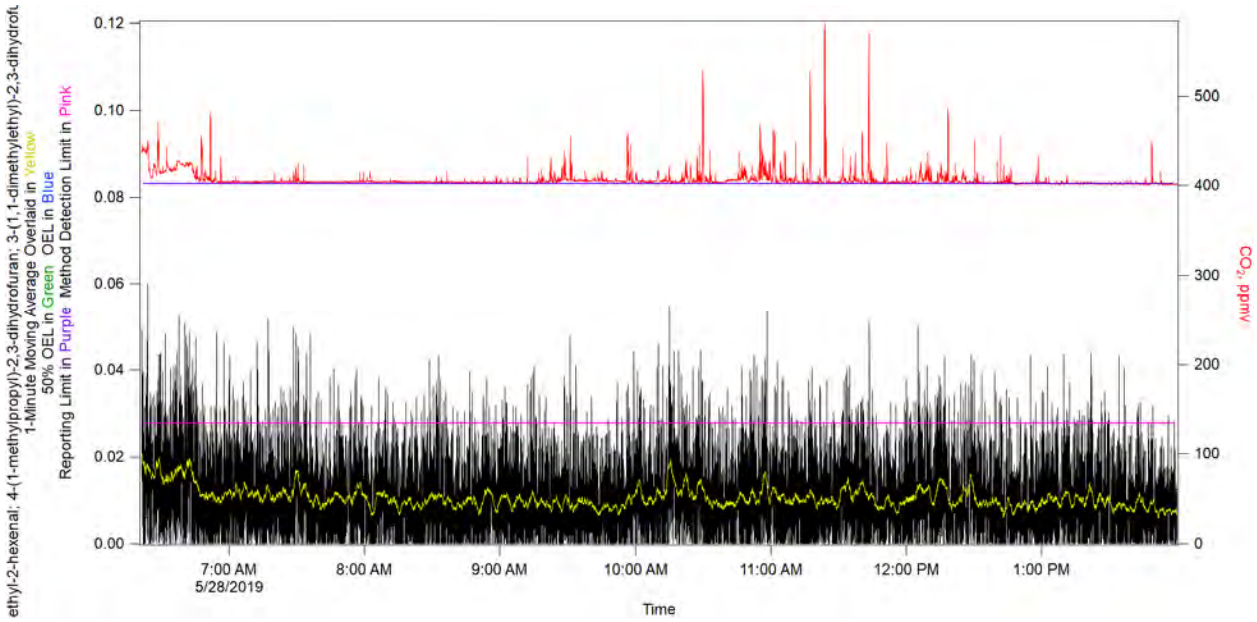

Figure 2-38. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

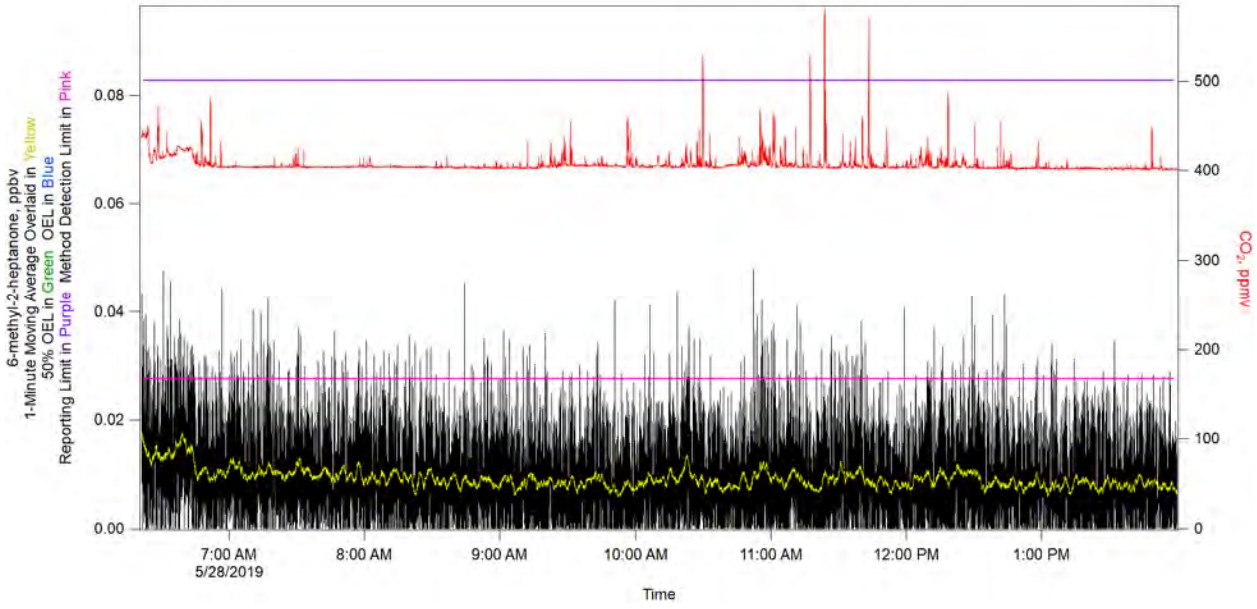

Figure 2-39. 6-methyl-2-heptanone.

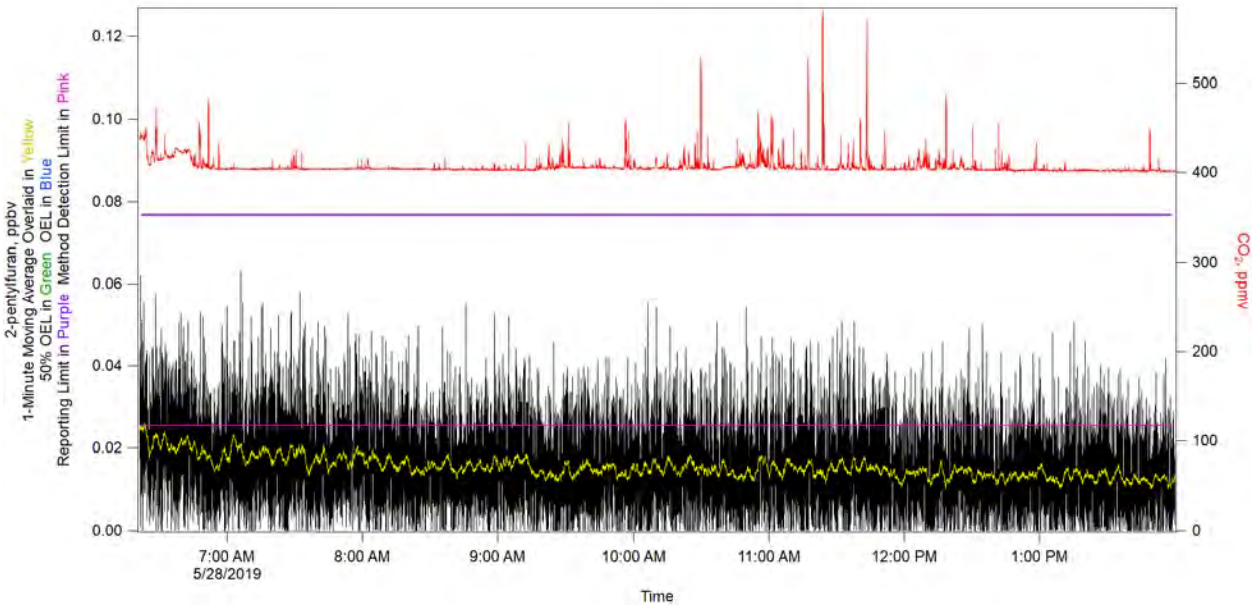

Figure 2-40. 2-pentylfuran.

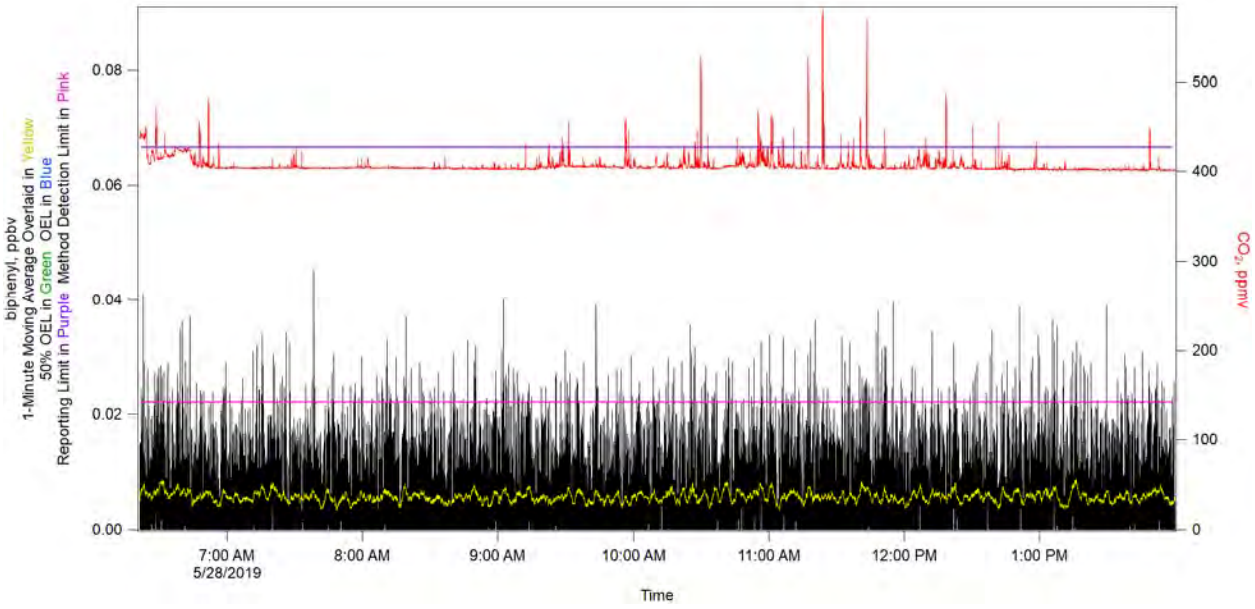

Figure 2-41. Biphenyl.

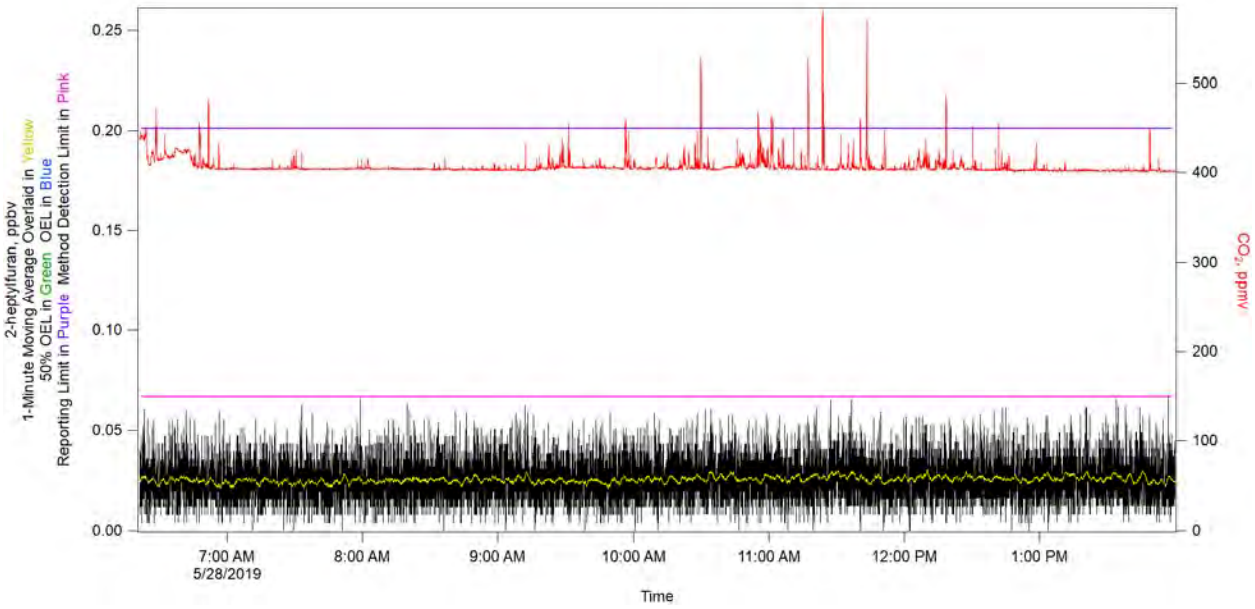

Figure 2-42. 2-heptylfuran.

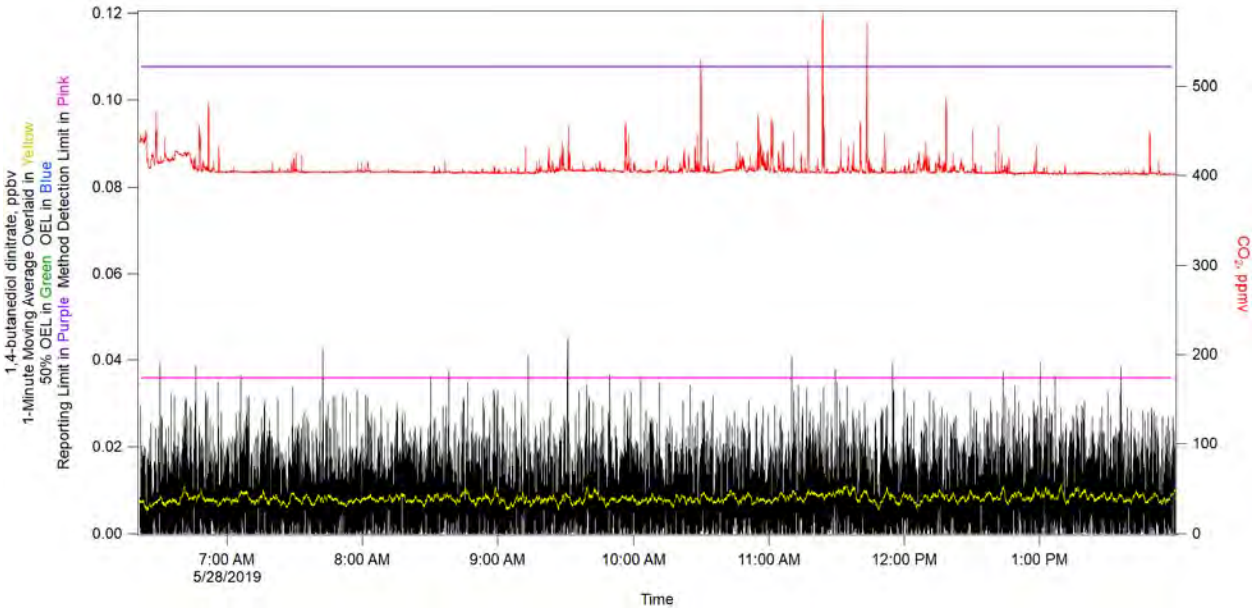

Figure 2-43. 1,4-butanediol Dinitrate.

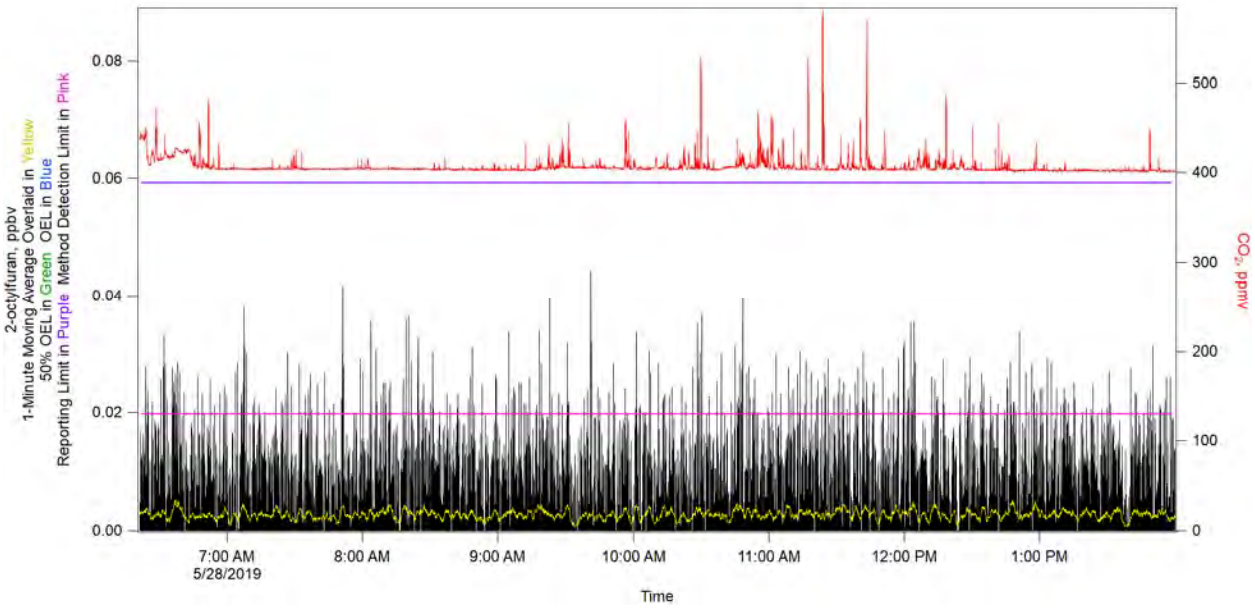

Figure 2-44. 2-octylfuran.

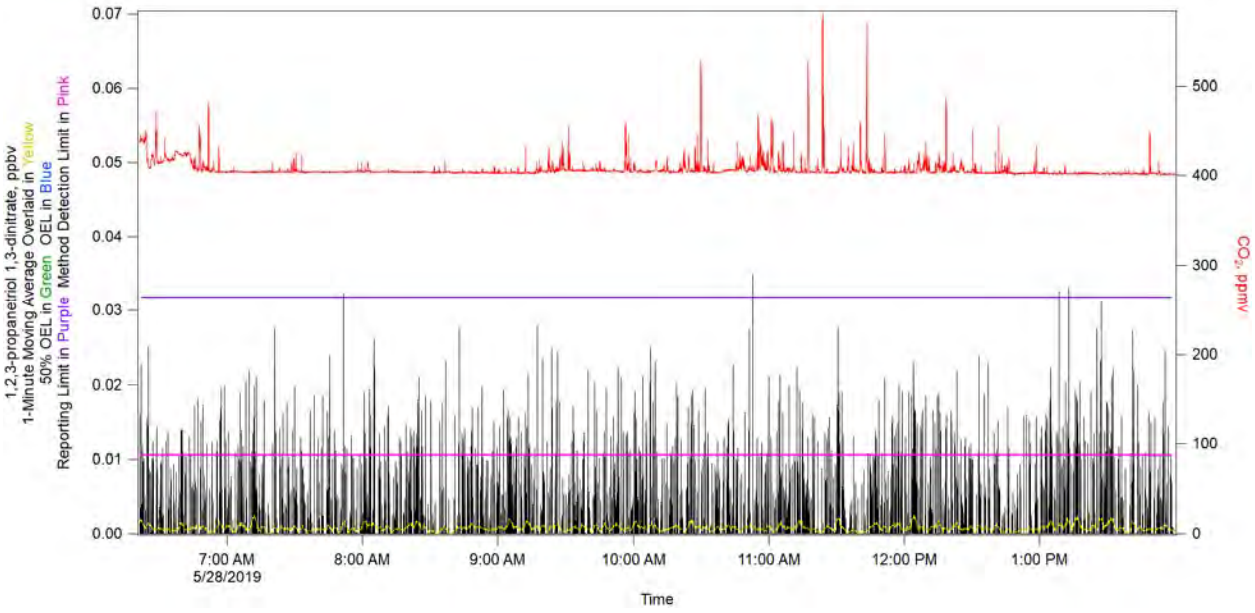

Figure 2-45. 1,2,3-propanetriol 1,3-dinitrate.

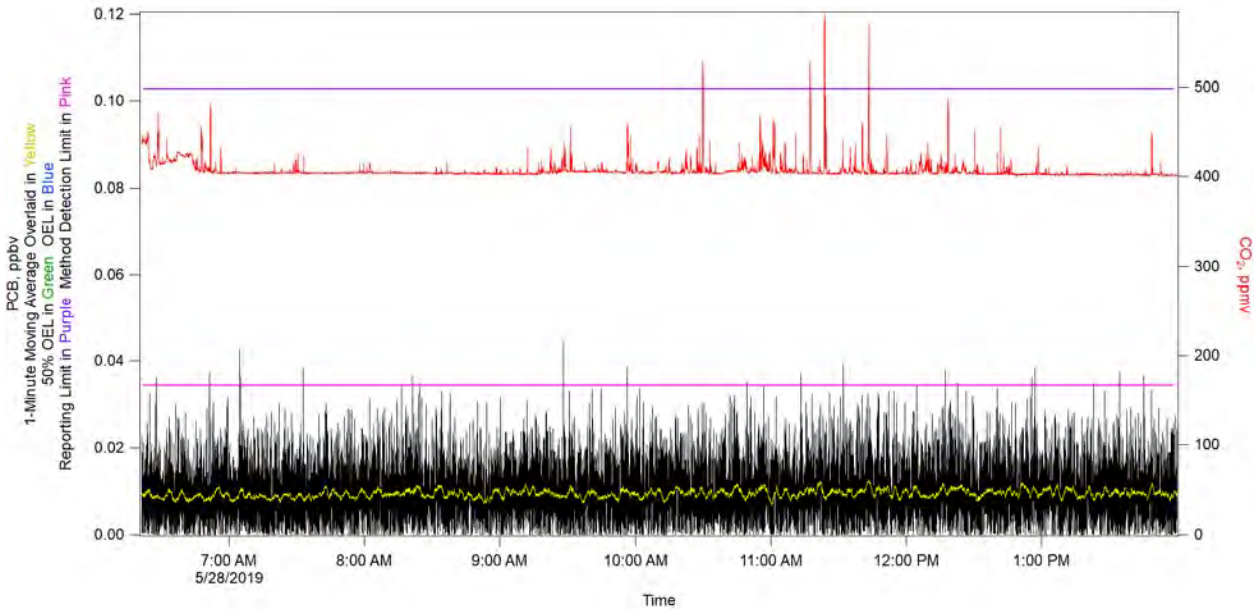

Figure 2-46. PCB.

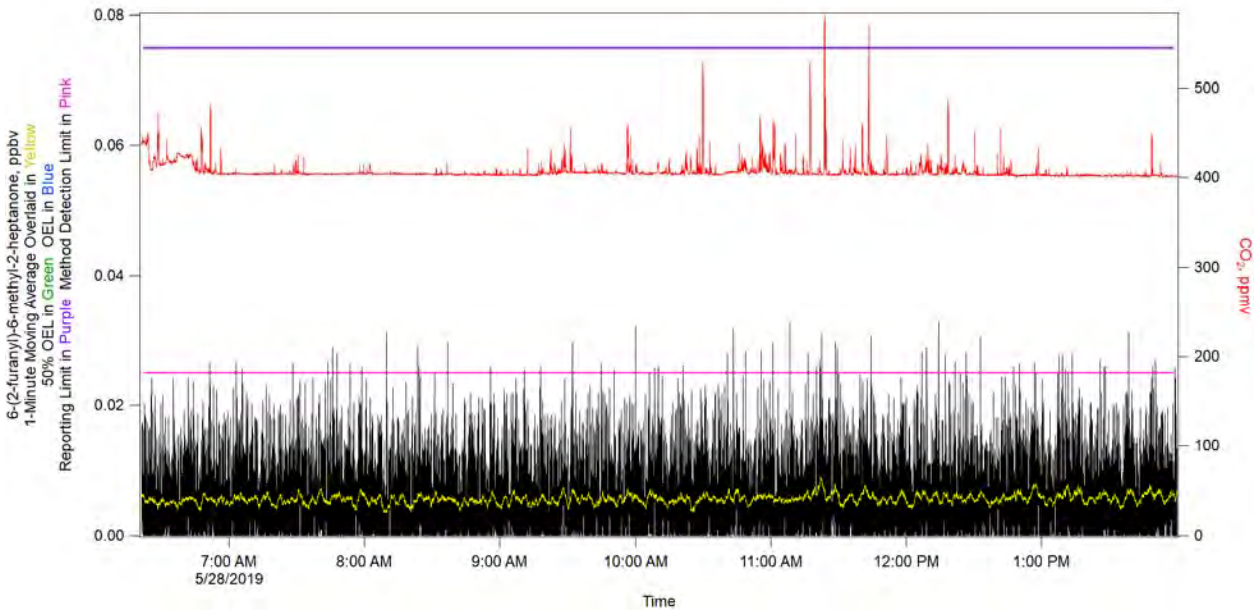

Figure 2-47. 6-(2-furanyl)-6-methyl-2-heptanone.

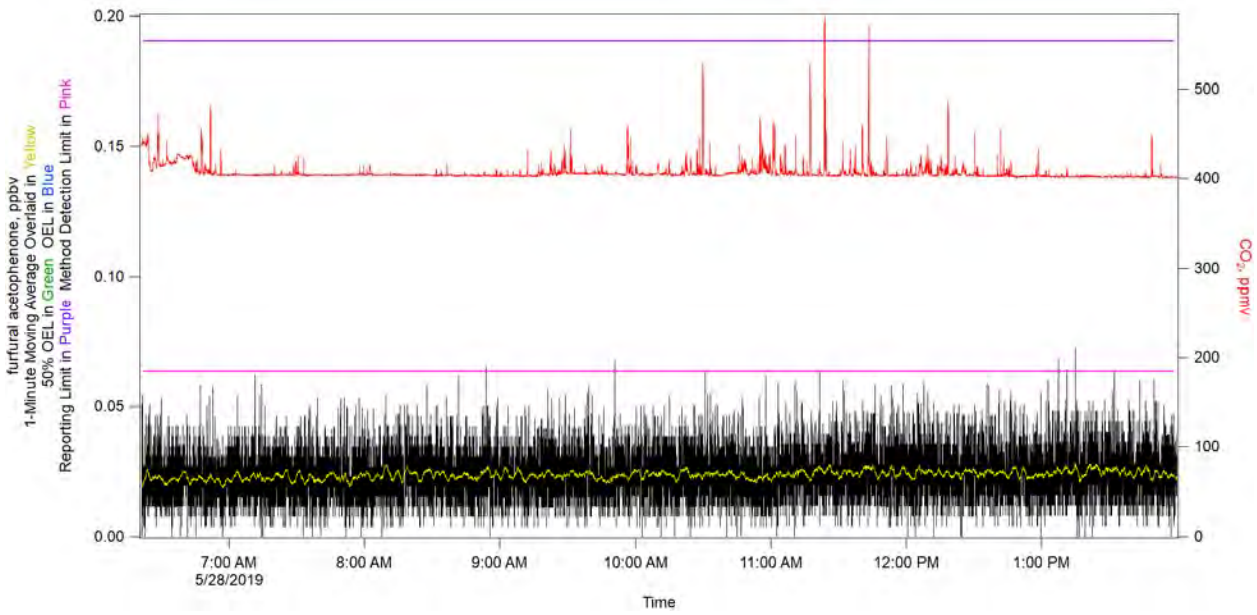

Figure 2-48. Furfural Acetophenone.

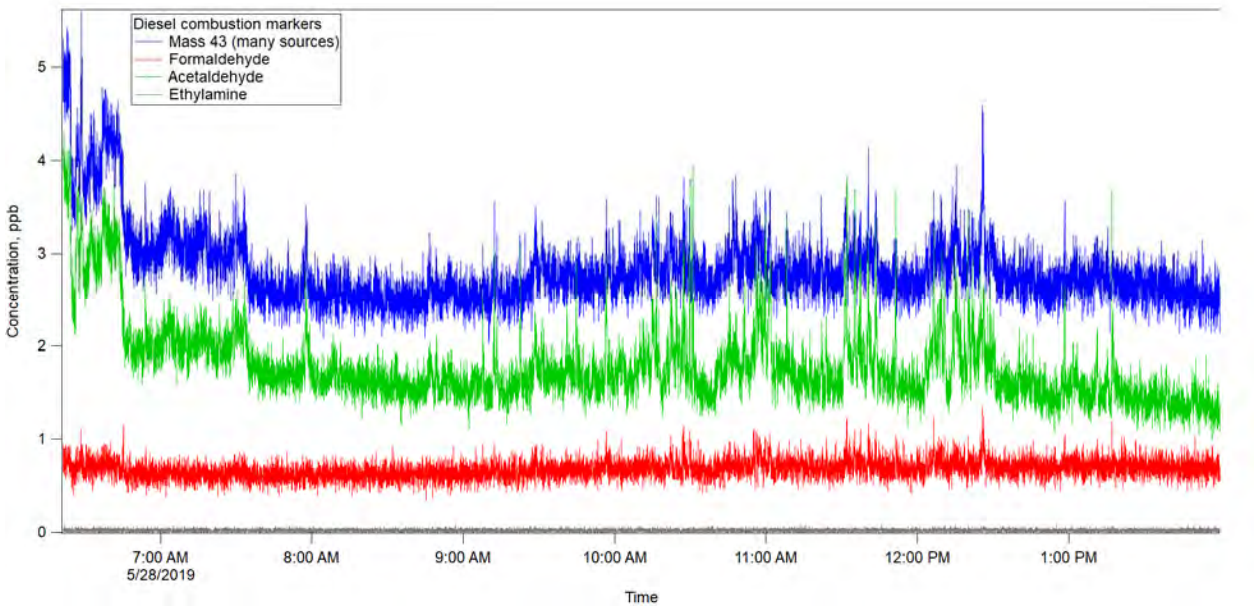

Figure 2-49. Diesel Combustion Markers.

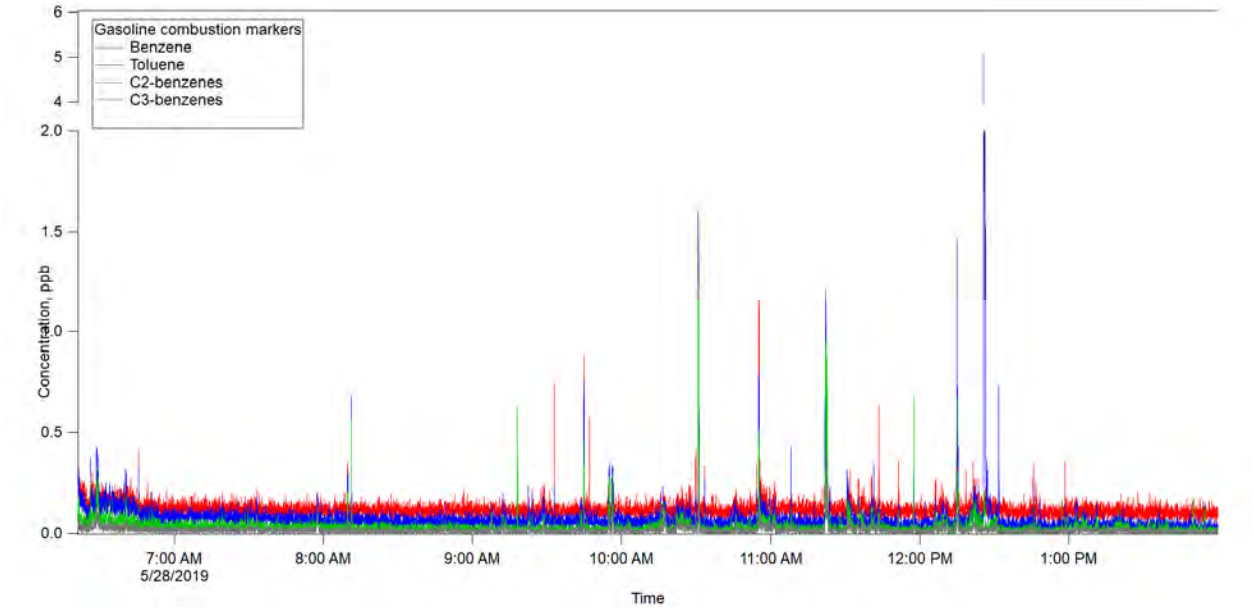

Figure 2-50. Gasoline Combustion Markers.

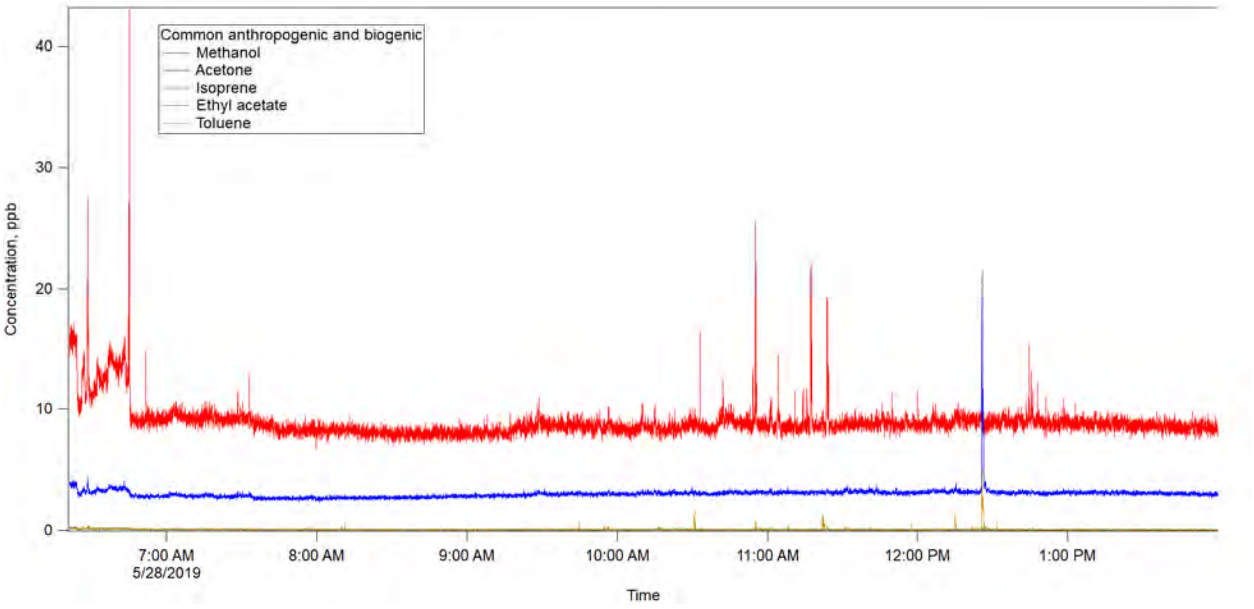

Figure 2-51. Plant and Human Markers.

3.0 MAY 29, 2019 – AREA MONITORING

3.1 Quality Assessment

Data from May 29, 2019, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

3.2 Summary

On May 29, 2019, ML personnel arrived at the TerraGraphics warehouse at 04:58. The QA/QC zero-air/span check was performed on the PTR-MS beginning at 05:19. The ML arrived at the Hanford Site to check in with CSO at 06:09. After leaving the CSO at 06:20, the ML was driven to TY/TX Tank Farms for area monitoring. The ML was parked north of TY Farm at 06:39. The ML was parked north of U Farm at 07:57 and remained there until 09:15. The ML Operators began site survey loops in the A Farm Corridor at 09:40 and upon completion the ML was parked west of AY Tank Farm at 10:07. A second round of site survey loops began at 11:28 followed by parking the ML North of AP Farm at 12:54. After completing a final round of site survey loops, the ML was parked north of AW Tank Farm at 13:22. The ML Operators finished area monitoring activities by checking out with the CSM at 13:58. The ML arrived back at the TerraGraphics warehouse at 14:47.

Table 3-1 illustrates the times and locations on May 29, 2019, where the ML Operators noted a potential source, or a peak of interest was observed. From approximately 10:07 to 11:28, the ML was parked on the west side of 241-AY Farm. During this time, there was a rise in signal for methanol (Figure 3-5), acetaldehyde (Figure 3-7), butanenitrile (Figure 3-16), and 2,4-dimethylpridine (Figure 3-32). The ML Operators noted significant amounts of vehicle traffic and worker activity occurring upwind of the ML at 10:44.

Table 3-1. Mobile Laboratory Summary of Events.

Time	Activity	Observed
08:30	North of U Farm	Shift in wind direction and sampled ML exhaust
10:44	West side of 241-AY	Vehicle traffic and worker activity

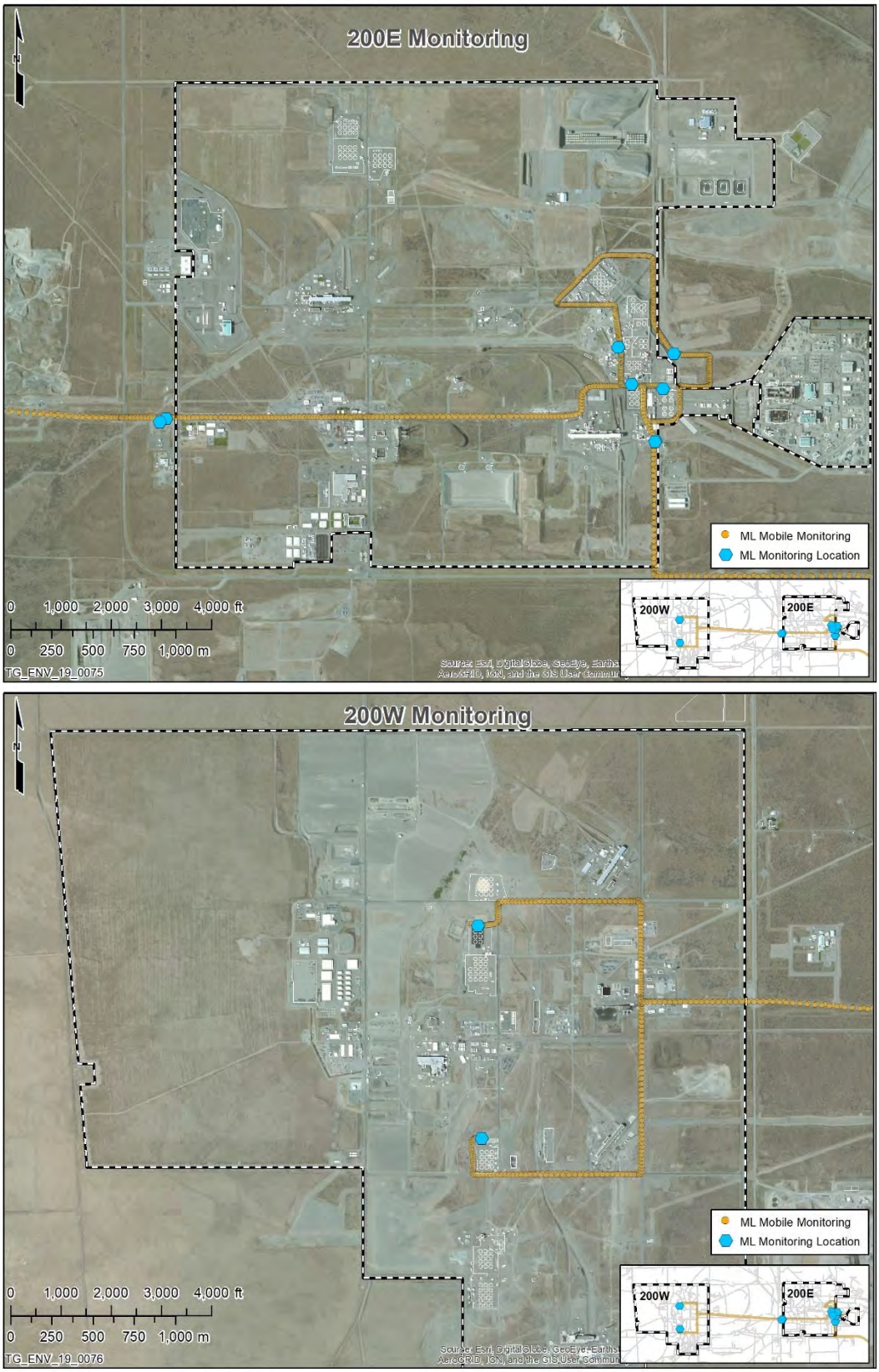

Figure 3-1. Location of the Mobile Laboratory for the Duration of the Monitoring Period.

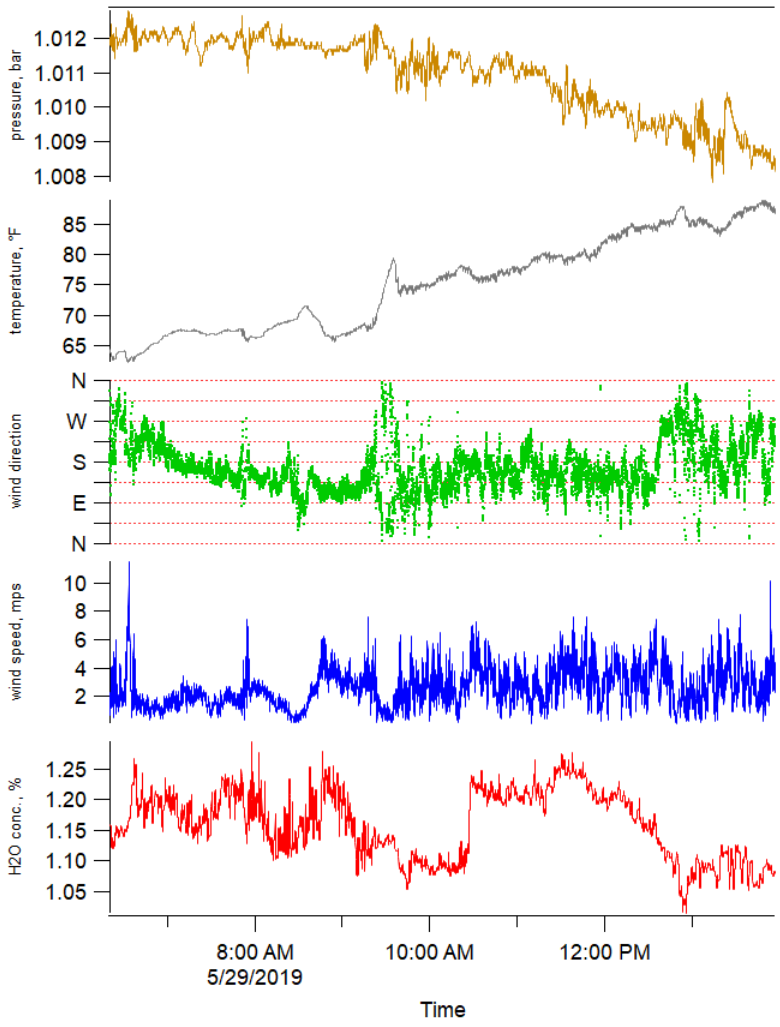

Figure 3-2. Weather Data for the Duration of the Monitoring Period.

Figure 3-2 illustrates the summary of meteorological for the monitoring period on May 29, 2019. The temperature rose slowly from 62˚F to reach a high of 89˚F for the afternoon. The wind was mild with gusts in the low twenties (mph) heading west in the morning and shifting to south/ southeast late morning then shifting again in the afternoon as wind became more moderate.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Airmar Weather Station.

Confirmatory air samples were not collected during this period.

3.4 Area Monitoring

The ML Operators performed area monitoring from approximately 06:39 to 13:58. The table below displays the COPC statistical results during that monitoring period.

Table 3-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 29, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
1	ammonia	25000	6.225	15.207†	1.510	9.932	22.461	14.838†
2	formaldehyde	300	1.721	<1.721	0.089	14.245	2.302	<1.721
3	methanol	200000	5.758	9.333†	1.046	11.212	40.363	9.143†
4	acetonitrile	20000	0.085	0.232†	0.035	15.101	0.645	0.231†
5	acetaldehyde	25000	1.027	1.899†	0.304	16.007	6.324	1.850†
6	ethylamine	5000	0.069	<0.069	0.013	59.215	0.082	<0.069
7	1,3-butadiene	1000	0.183	<0.183	0.061	42.085	1.970	<0.183
8	propanenitrile	6000	0.107	<0.107	0.018	37.429	0.180	<0.107
9	2-propenal	100	0.340	<0.34	0.056	35.278	2.283	<0.340
10	1-butanol + butenes	20000	0.214	<0.214	0.056	45.709	2.058	<0.214
11	methyl isocyanate	20	0.069	<0.069	0.022	49.704	0.147	<0.069
12	methyl nitrite	100	0.098	0.107†	0.030	28.419	0.760	0.104†
13	furan	1	0.062	<0.062	0.014	46.032	0.123	<0.062
14	butanenitrile	8000	0.039	<0.039	0.013	57.426	0.128	<0.039
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	200, 1, 1	0.041	0.066†	0.029	43.769	N/A*	N/A*
16	butanal	25000	0.061	0.2138	0.053	24.677	0.647	0.205
17	NDMA**	0.3	0.082	<0.082	0.020	193.260	0.178	<0.082
18	benzene	500	0.236	<0.236	0.065	46.672	1.903	<0.236
19	2,4-pentadienenitrile + pyridine	300, 1000	0.085	<0.085	0.014	38.424	0.151	<0.085
20	2-methylene butanenitrile	300	0.036	<0.036	0.008	67.514	0.099	<0.036
21	2-methylfuran	1	0.043	0.043†	0.020	46.988	0.225	0.041†
22	pentanenitrile	6000	0.036	<0.036	0.011	64.642	0.087	<0.036
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.043	0.045†	0.023	50.272	0.296	0.042†
24	NEMA**	0.3	0.058	<0.058	0.017	168.149	0.117	<0.058
25	2,5-dimethylfuran	1	0.032	<0.032	0.015	61.466	0.173	<0.032
26	hexanenitrile	6000	0.031	<0.031	0.007	88.976	0.053	<0.031
27	2-hexanone (MBK)	5000	0.036	<0.036	0.011	81.969	0.075	<0.036
28	NDEA**	0.1	0.034	<0.034	0.010	148.966	0.066	<0.034

Table 3-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 29, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
29	butyl nitrite + 2-nitro-2-methylpropane	100, 300	0.058	<0.058	0.011	40.317	0.156	<0.058
30	2,4-dimethylpyridine	500	0.036	<0.036	0.009	95.379	0.176	<0.036
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.027	<0.027	0.010	82.774	0.074	<0.027
32	heptanenitrile	6000	0.027	<0.027	0.006	92.012	0.058	<0.027
33	4-methyl-2-hexanone	500	0.033	<0.033	0.008	92.402	0.058	<0.033
34	NMOR**	0.6	0.021	<0.021	0.007	165.216	0.055	<0.021
35	butyl nitrate	2500	0.022	<0.022	0.005	112.504	0.038	<0.022
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.028	<0.028	0.008	83.643	0.062	<0.028
37	6-methyl-2-heptanone	8000	0.028	<0.028	0.008	78.201	0.050	<0.028
38	2-pentylfuran	1	0.026	<0.026	0.010	69.372	0.060	<0.026
39	biphenyl	200	0.022	<0.022	0.006	115.714	0.042	<0.022
40	2-heptylfuran	1	0.067	<0.067	0.010	40.108	0.071	<0.067
41	1,4-butanediol dinitrate	50	0.036	<0.036	0.007	84.789	0.046	<0.036
42	2-octylfuran	1	0.020	<0.020	0.005	203.657	0.046	<0.020
43	1,2,3-propanetriol 1,3-dinitrate	50	0.011	<0.011	0.003	392.483	0.035	<0.011
44	PCB	1000	0.034	<0.034	0.006	68.917	0.042	<0.034
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.025	<0.025	0.005	97.119	0.035	<0.025
46	furfural acetophenone	1	0.064	<0.064	0.009	41.123	0.068	<0.064
N/A*	The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.506 ppb and the median value was 0.059† ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 200, which provide widely variant bases for these numbers.							
**	Nitrosamine results are suspect due to isobaric interferants causing positive bias that have been encountered during previous background [53005-81-RPT-007, *PTR-MS Mobile Laboratory Vapor Monitoring Background Study, (3/18/2018 – 4/20/2018)*, and *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, RJ Lee Group, Inc.].							
<	COPC Averages below the MDL.							
†	COPC Averages between the RL and the MDL.							
	COPC Averages >100% of the OEL.							
	COPC Averages 50-100% of the OEL.							
	COPC Averages 10-50% of the OEL.							

Figure 3-3 through Figure 3-51 display 46 COPC signals, overlaid with the same signal smoothed using a 1-minute moving average (in cases where a moving average assist with data visualization), and CO_2, for the monitoring period May 29, 2019. If within range of the plot's left axis, a green horizontal line representing 50% of the COPC's OEL, a blue horizontal line representing the COPC's OEL, a horizontal purple line representing the RL, and a pink horizontal line representing the MDL are shown.

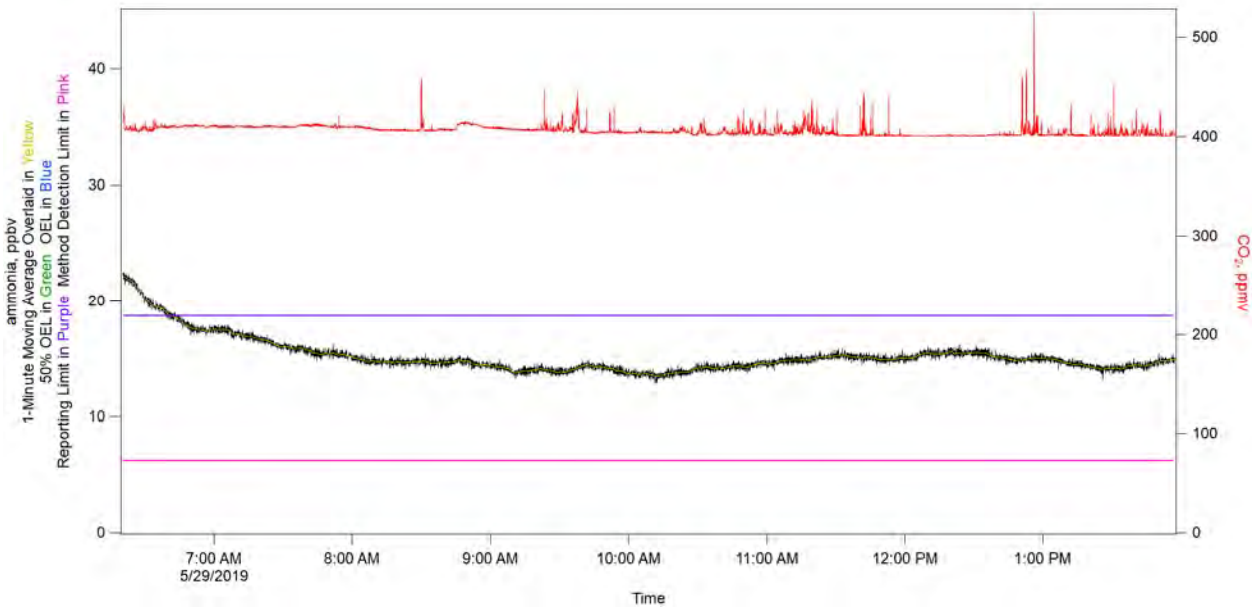

Figure 3-3. Ammonia.

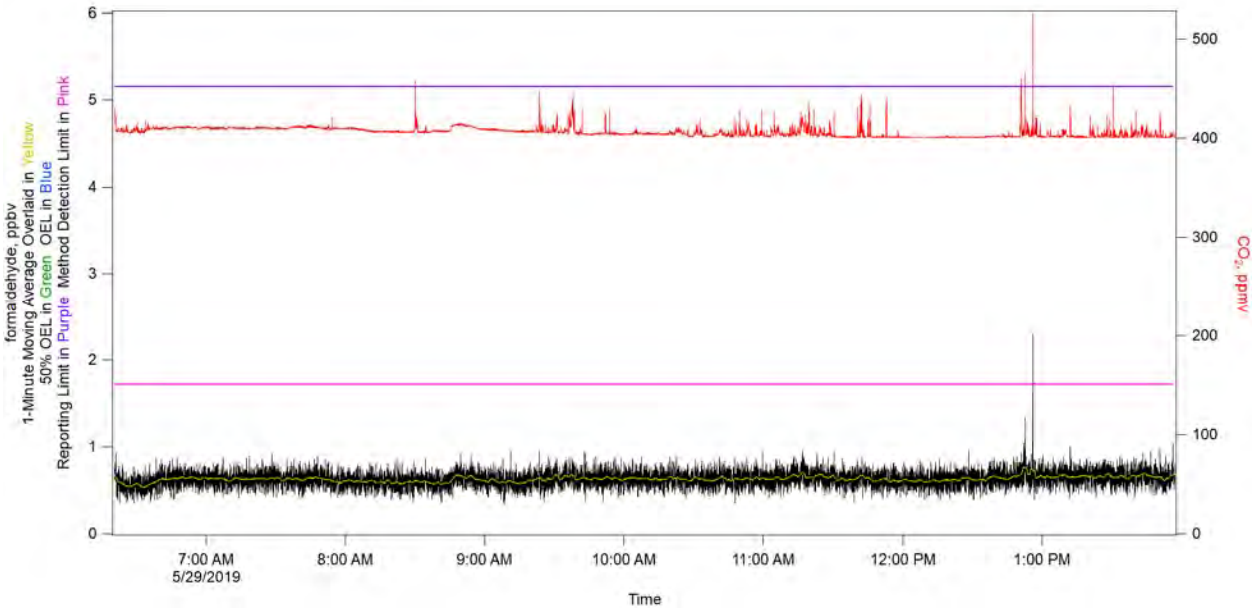

Figure 3-4. Formaldehyde.

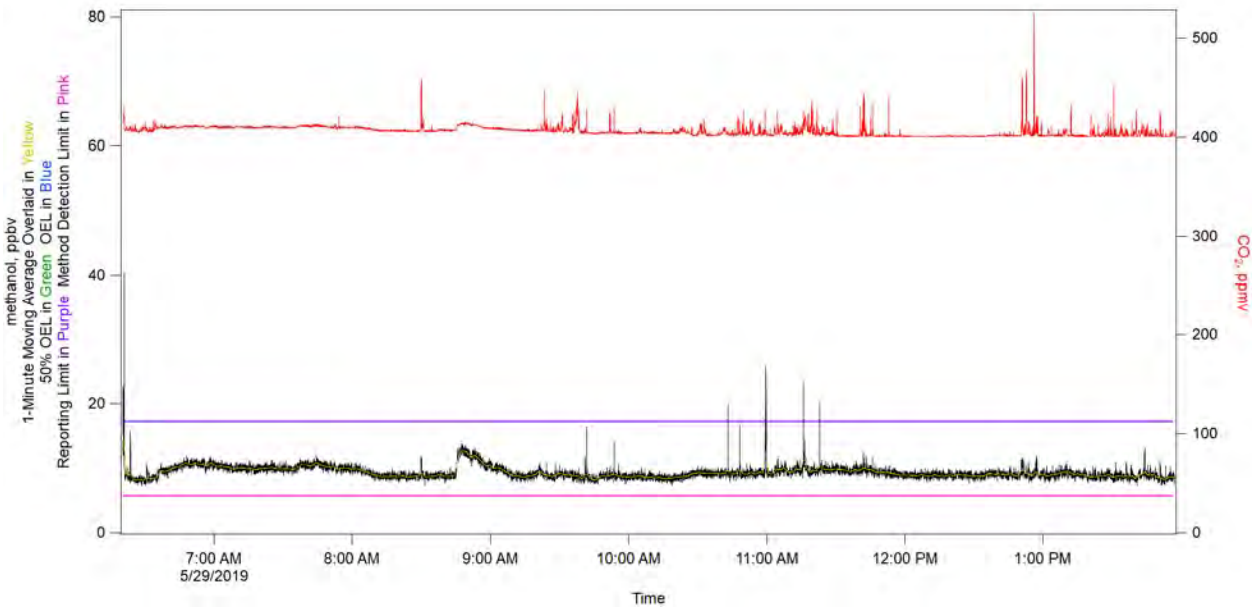

Figure 3-5. Methanol.

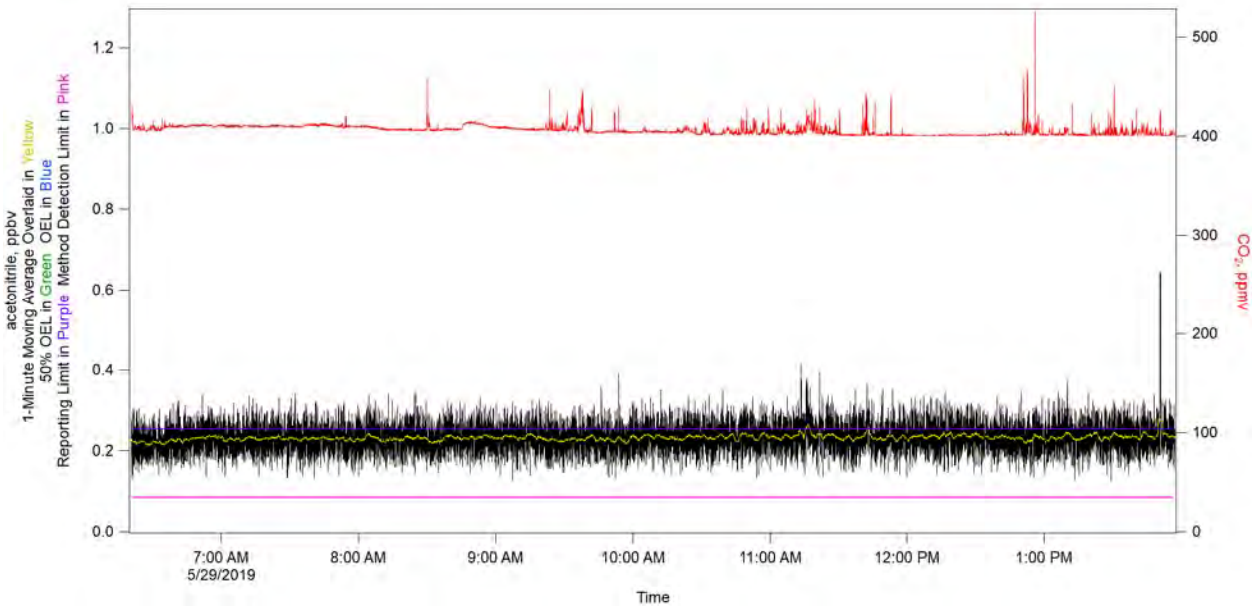

Figure 3-6. Acetonitrile.

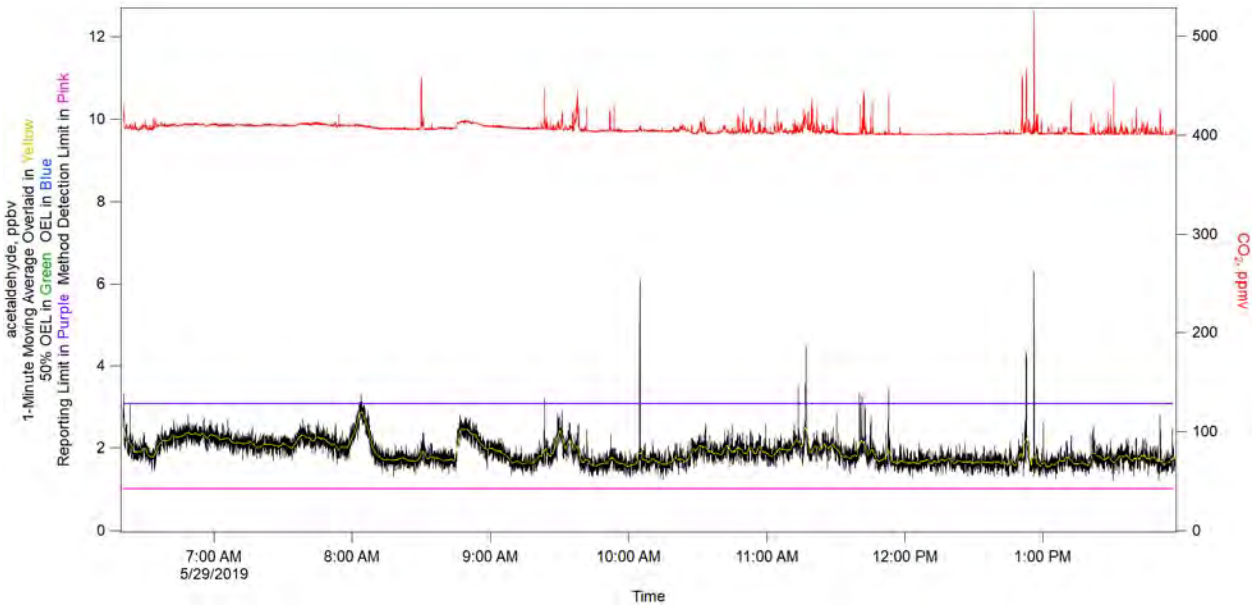

Figure 3-7. Acetaldehyde.

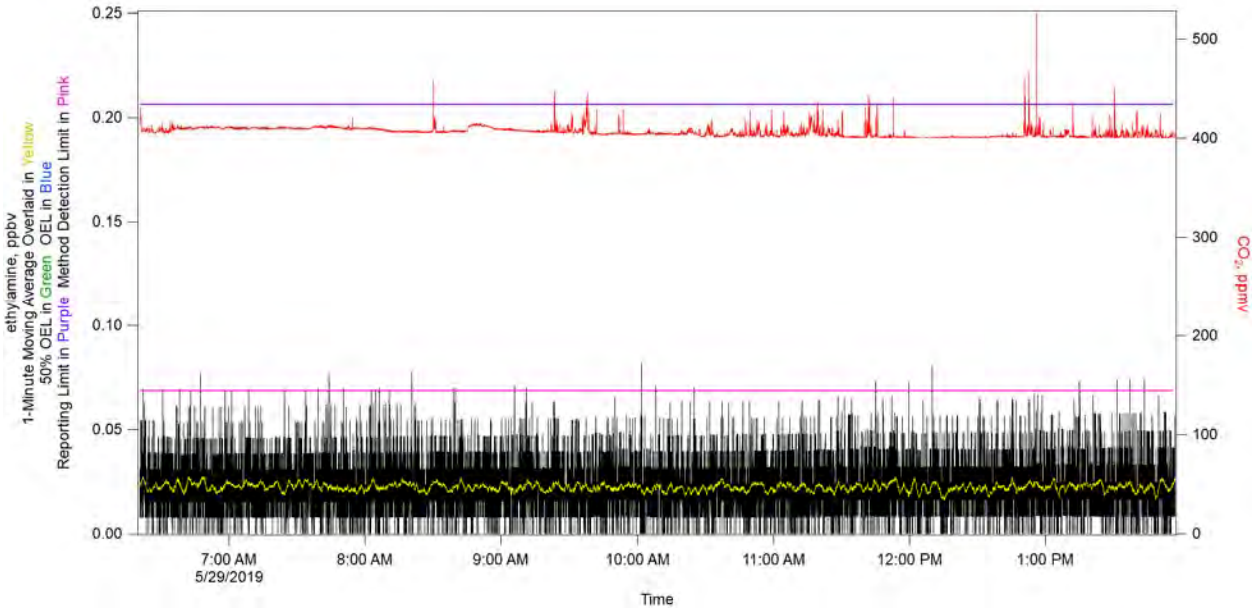

Figure 3-8. Ethylamine.

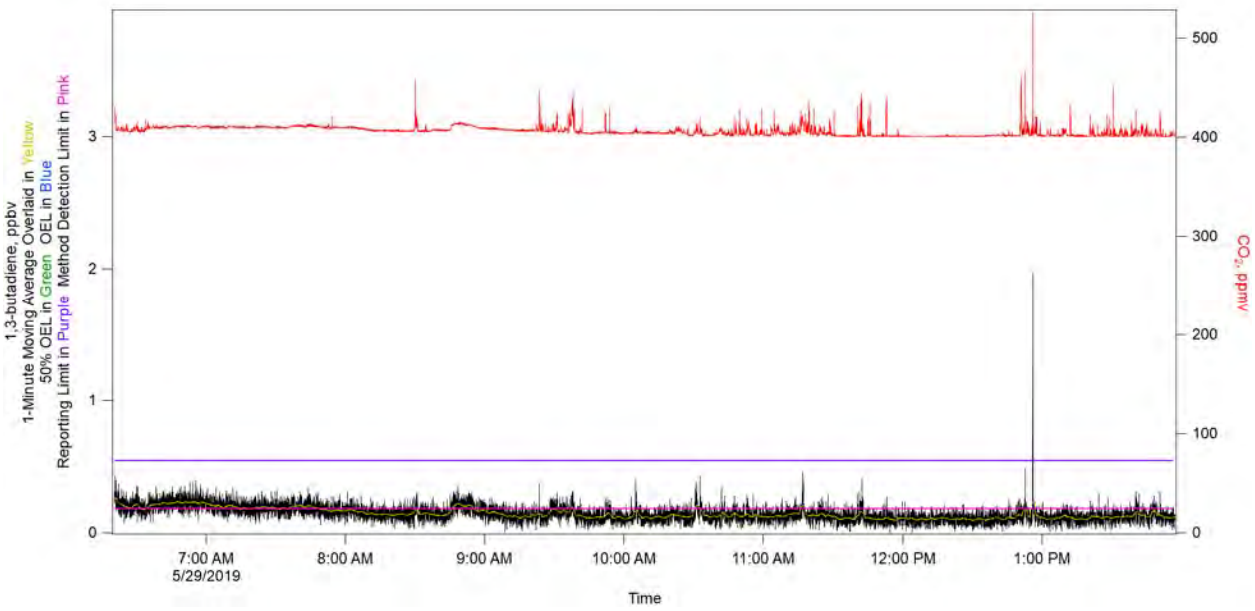

Figure 3-9. 1,3-butadiene.

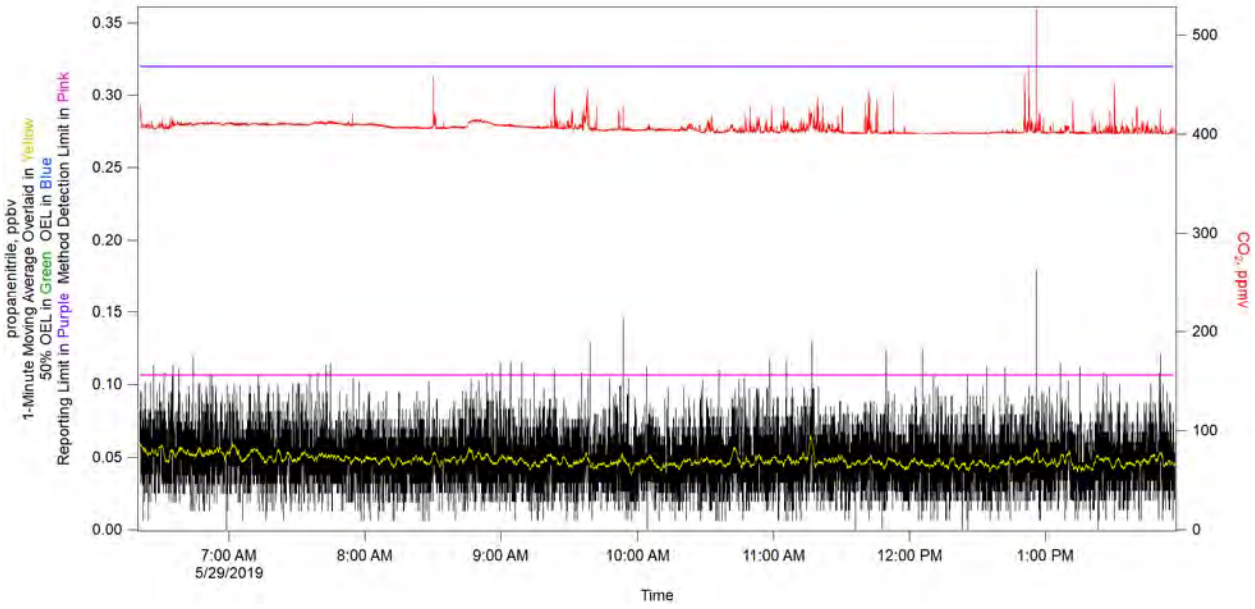

Figure 3-10. Propanenitrile.

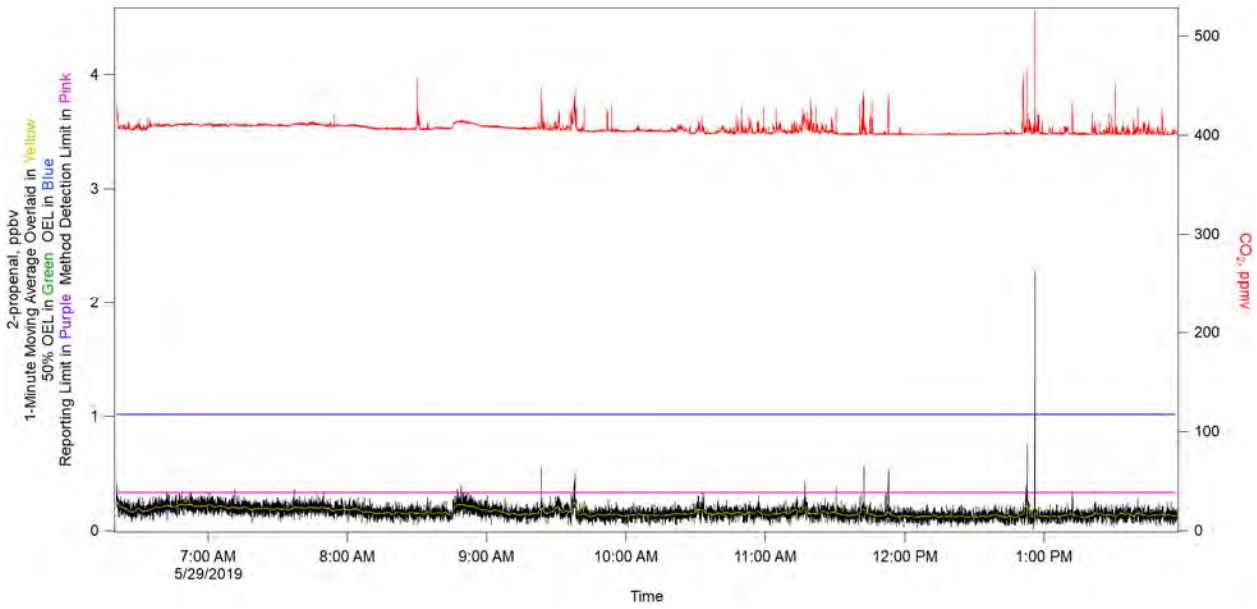

Figure 3-11. 2-propenal.

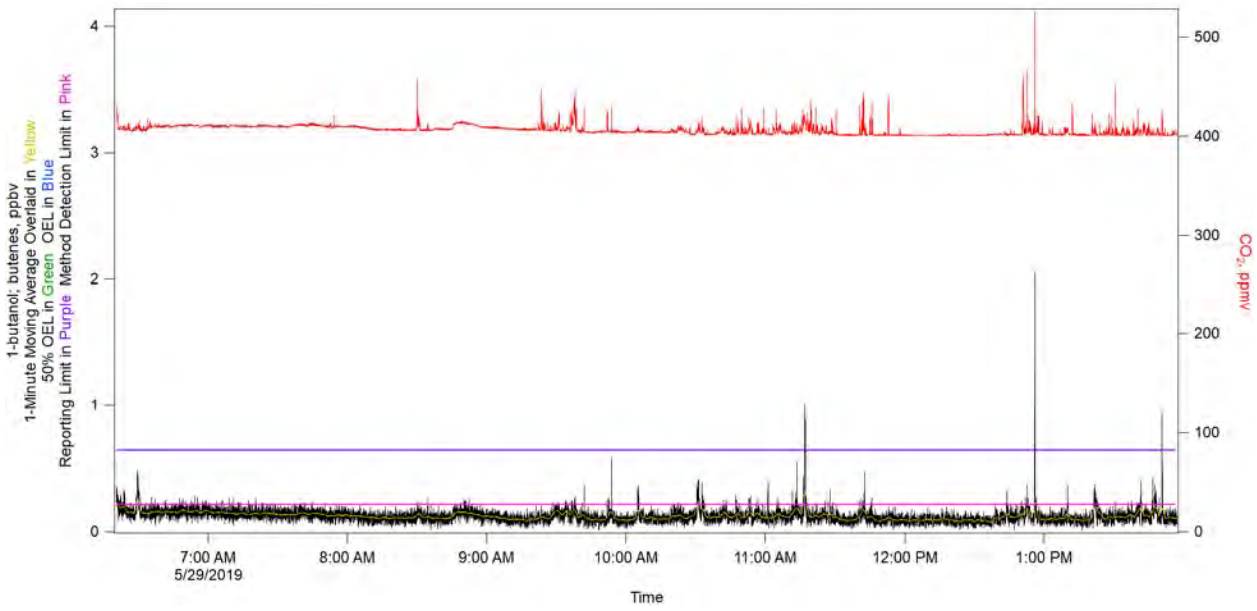

Figure 3-12. 1-butanol; Butenes.

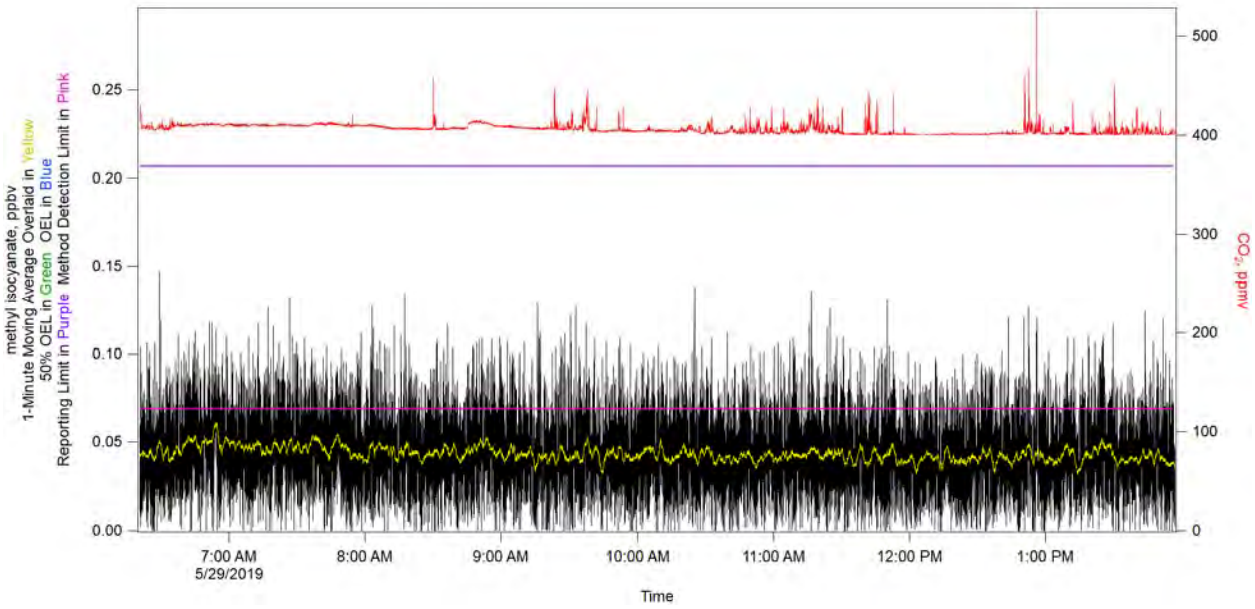

Figure 3-13. Methyl Isocyanate.

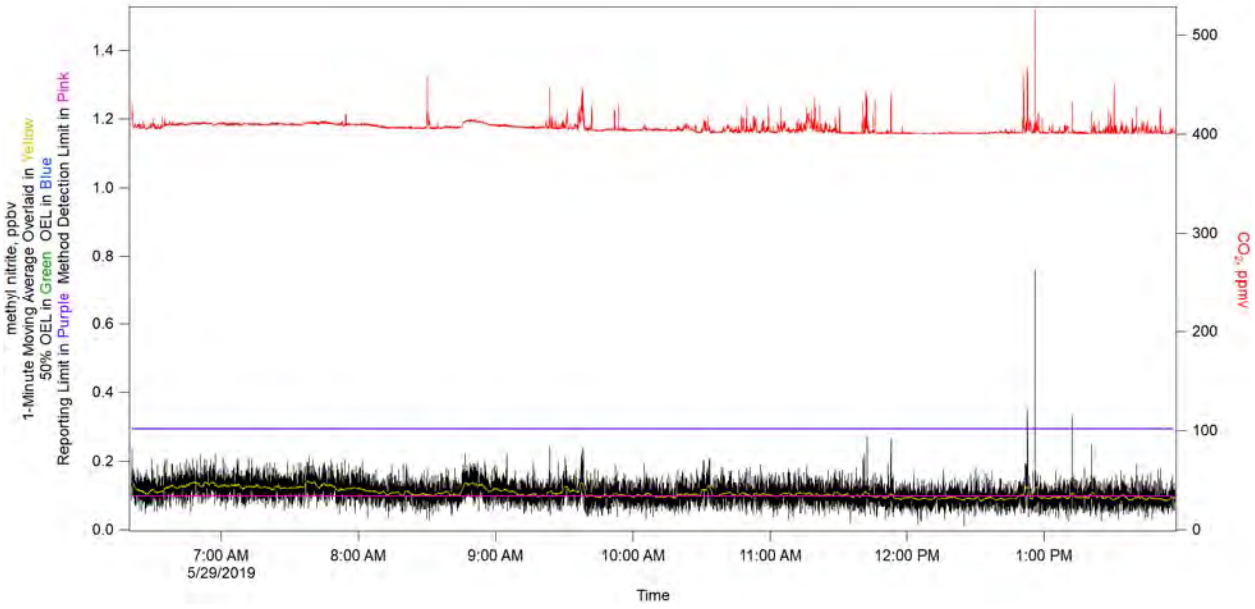

Figure 3-14. Methyl Nitrite.

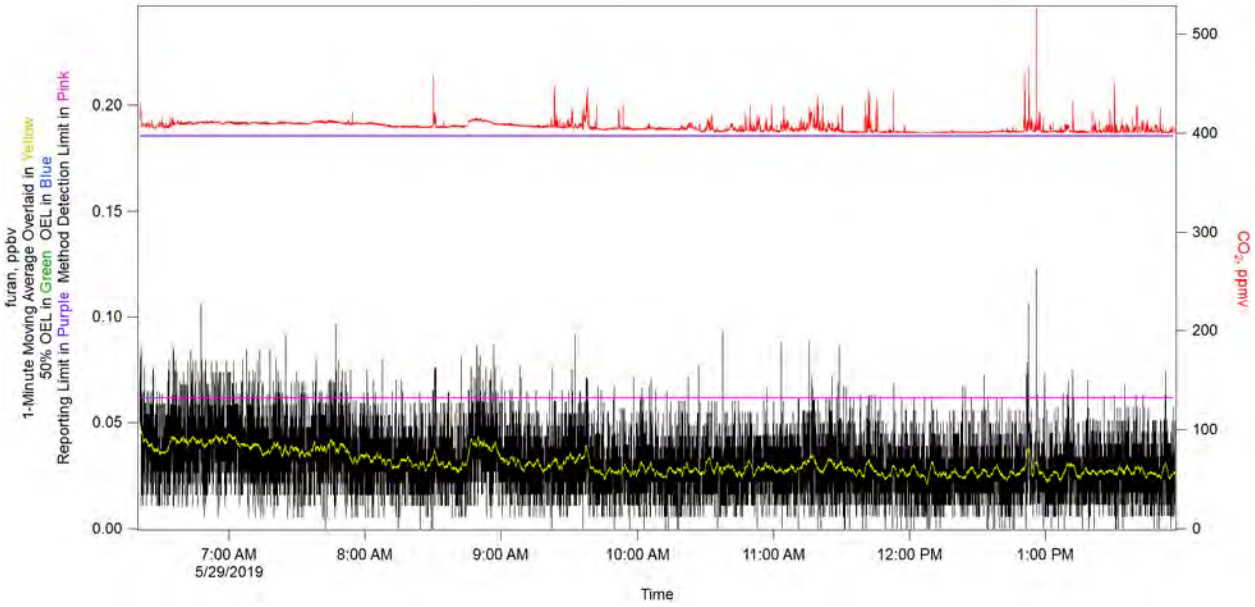

Figure 3-15. Furan.

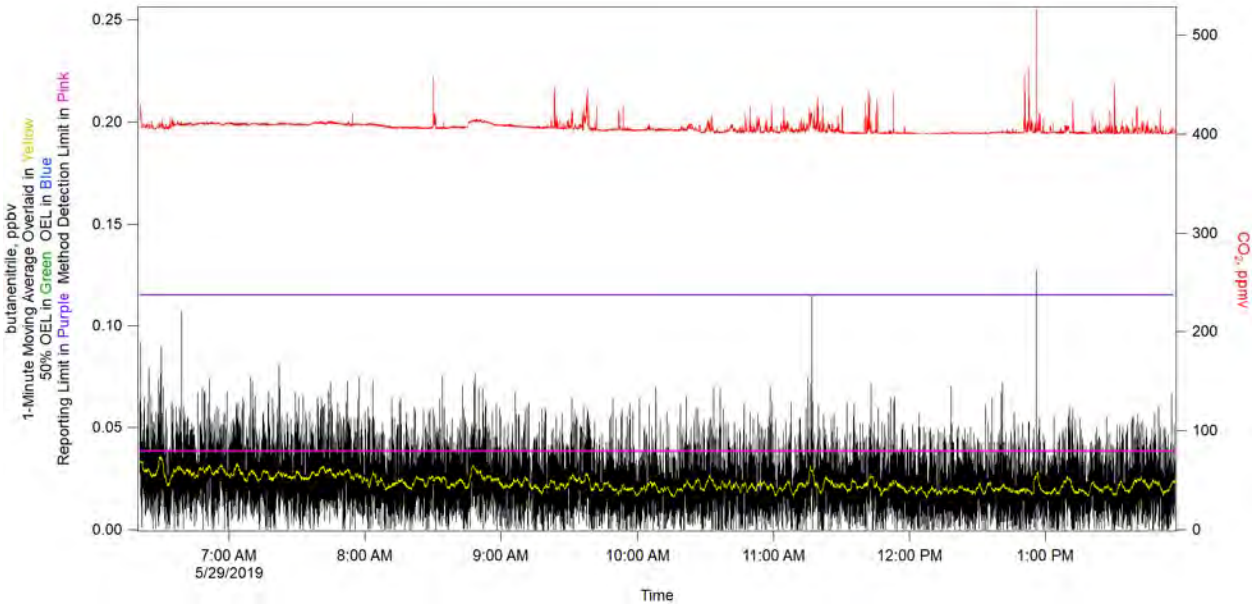

Figure 3-16. Butanenitrile.

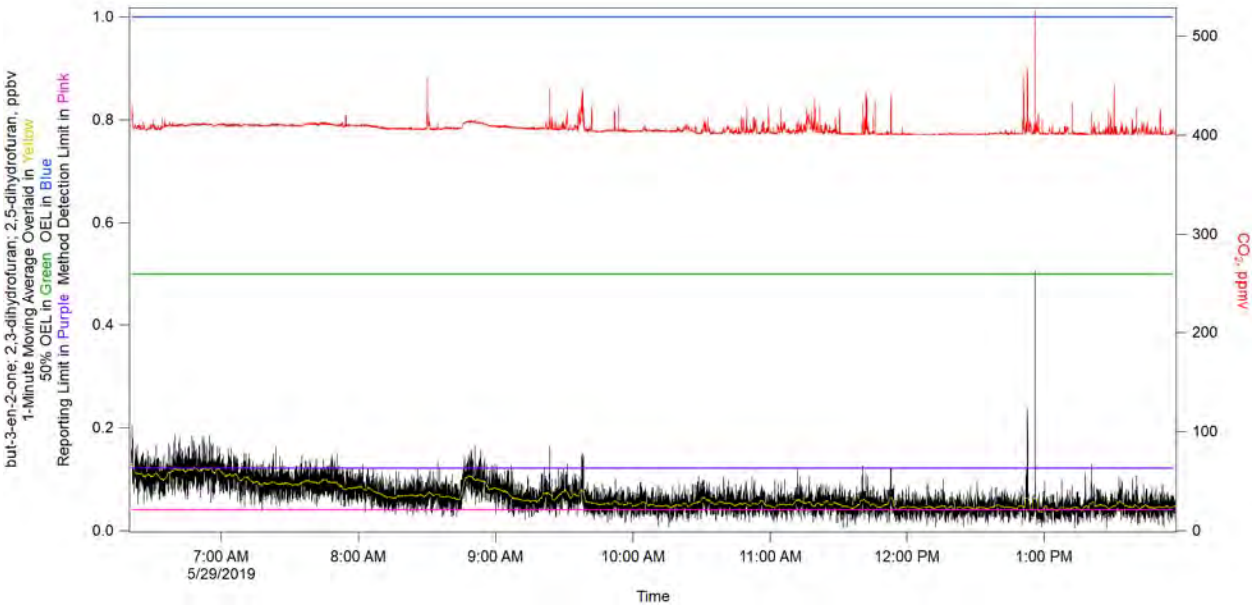

Figure 3-17. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

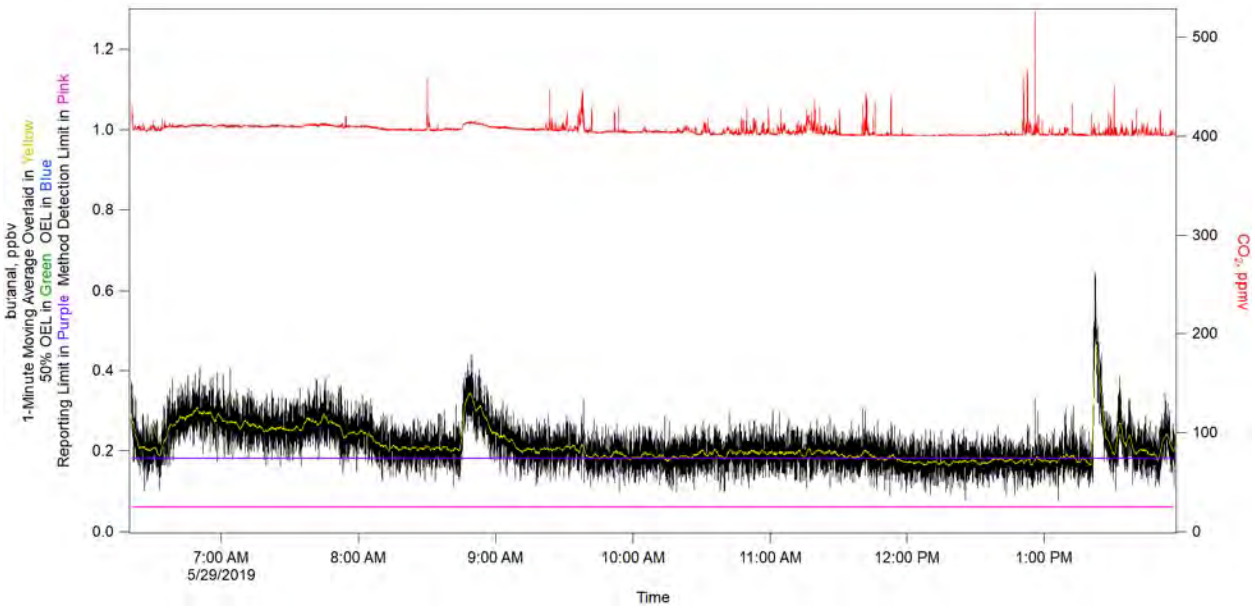

Figure 3-18. Butanal.

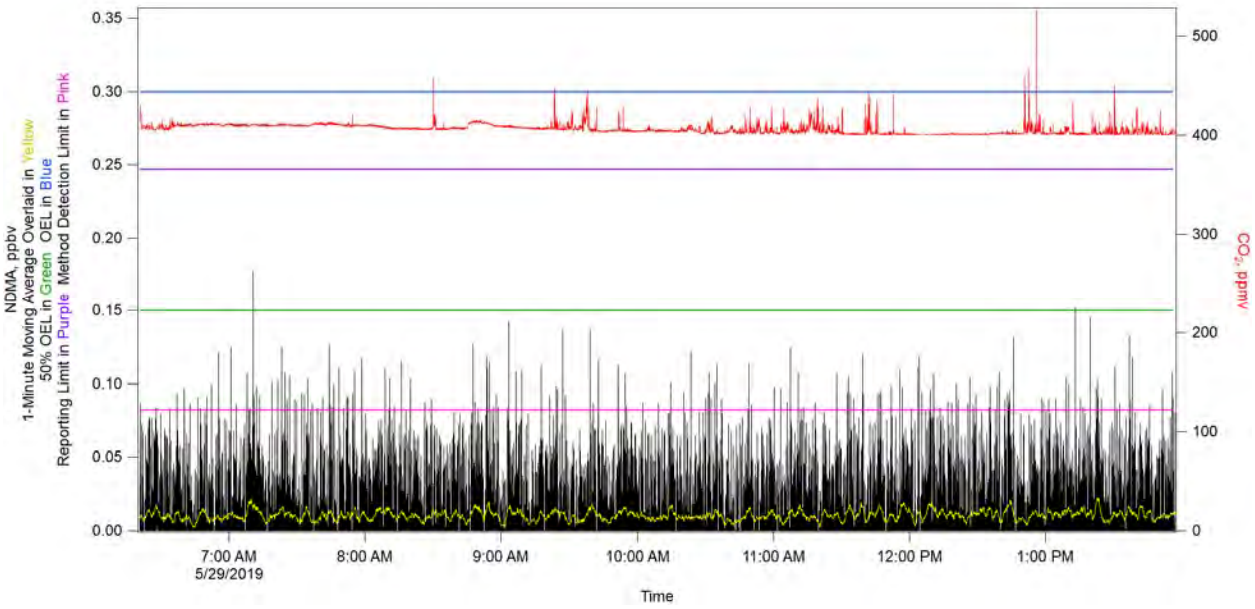

Figure 3-19. N-nitrosodimethylamine (NDMA).

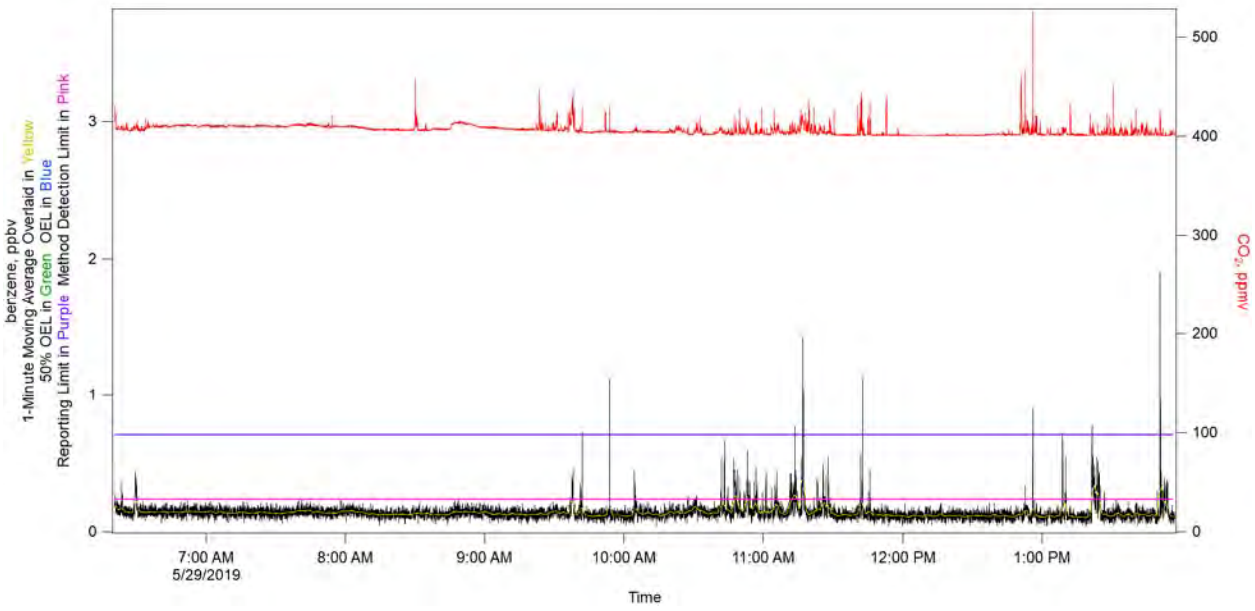

Figure 3-20. Benzene.

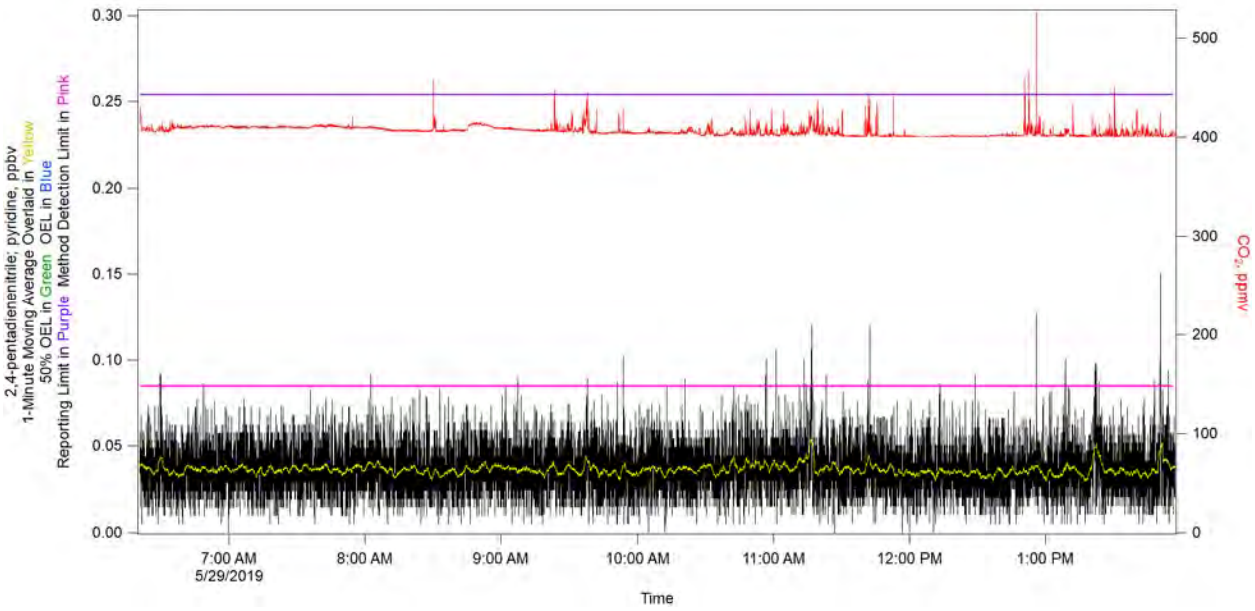

Figure 3-21. 2,4-pentadienenitrile; Pyridine.

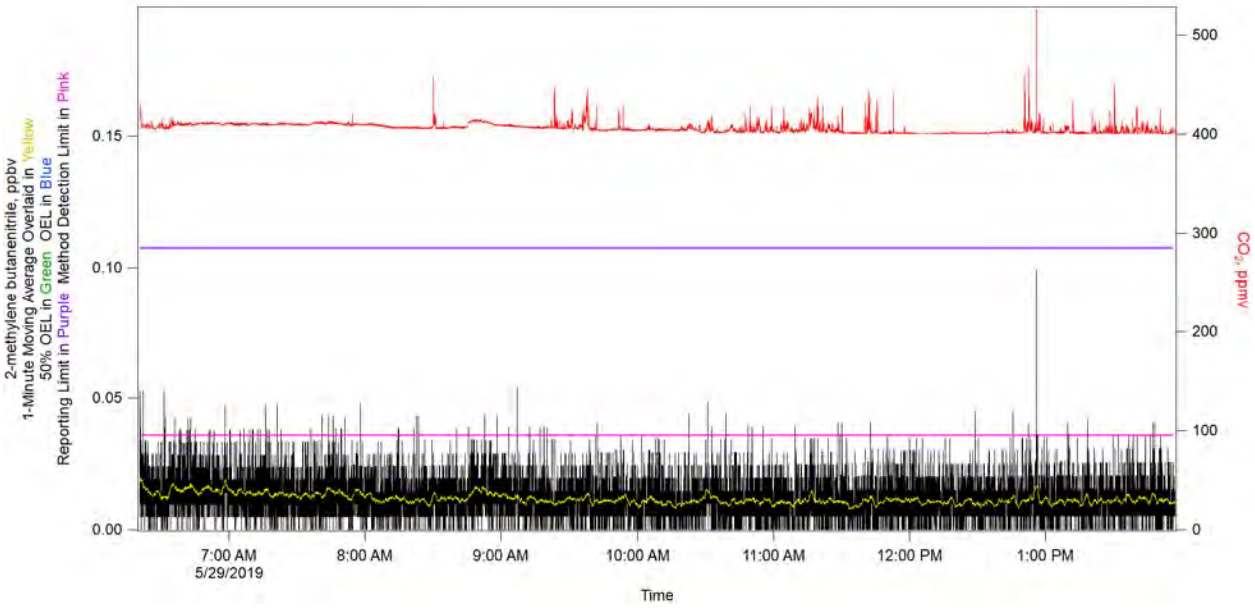

Figure 3-22. 2-methylene Butanenitrile.

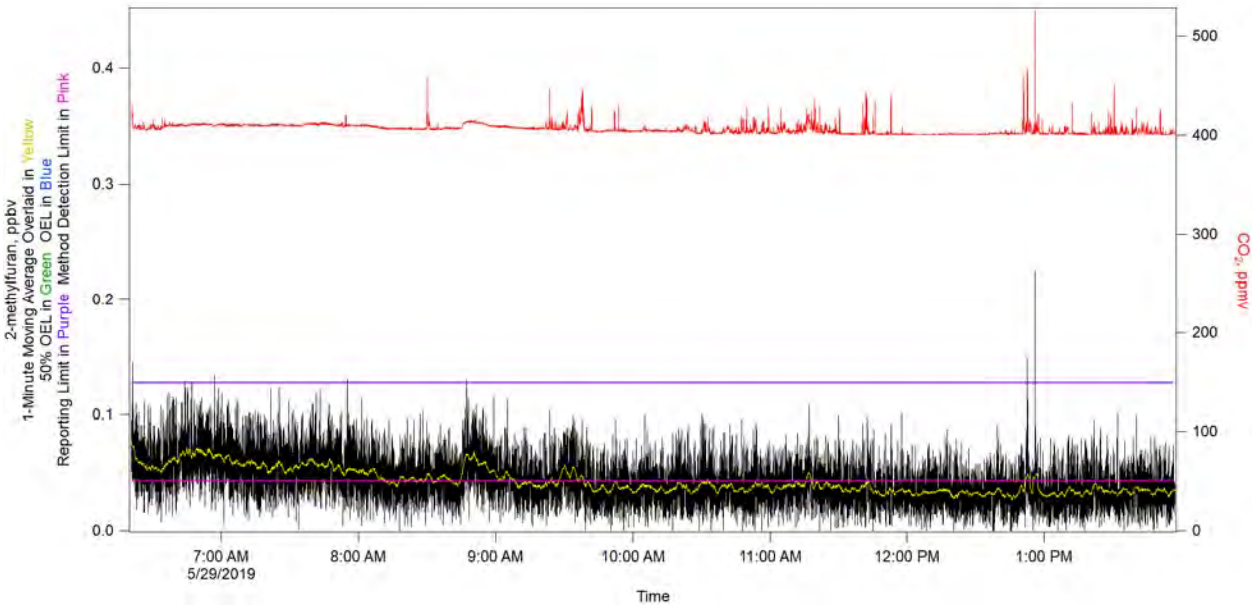

Figure 3-23. 2-methylfuran.

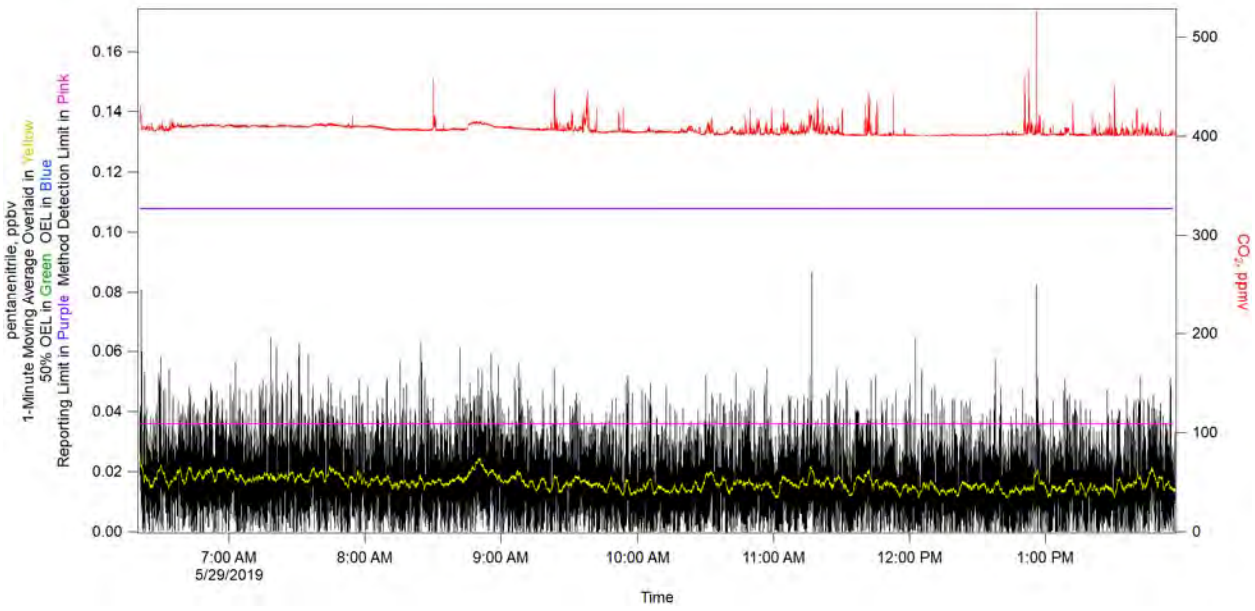

Figure 3-24. Pentanenitrile.

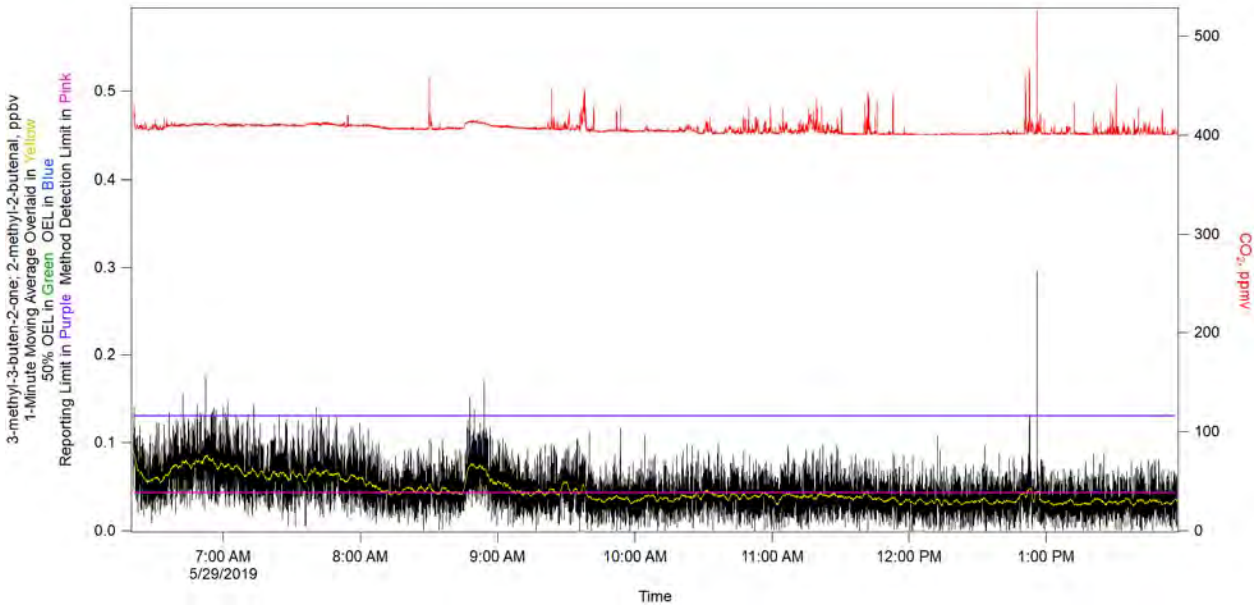

Figure 3-25. 3-methyl-3-buten-2-one; 2-methyl-2-butenal.

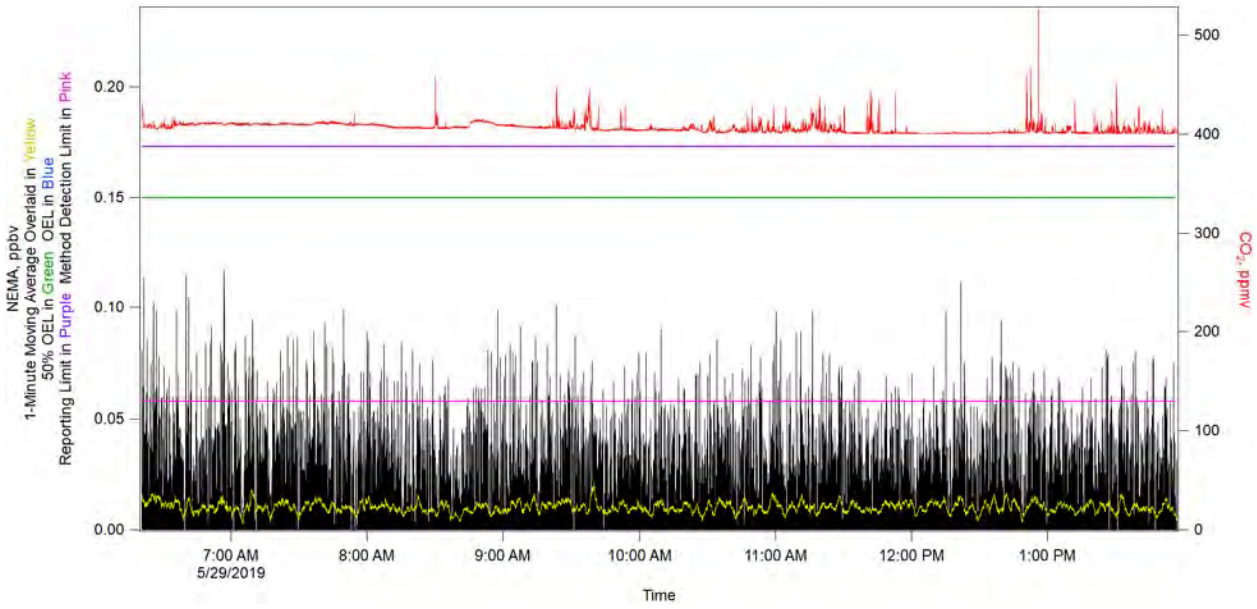

Figure 3-26. N-nitrosomethylethylamine (NEMA).

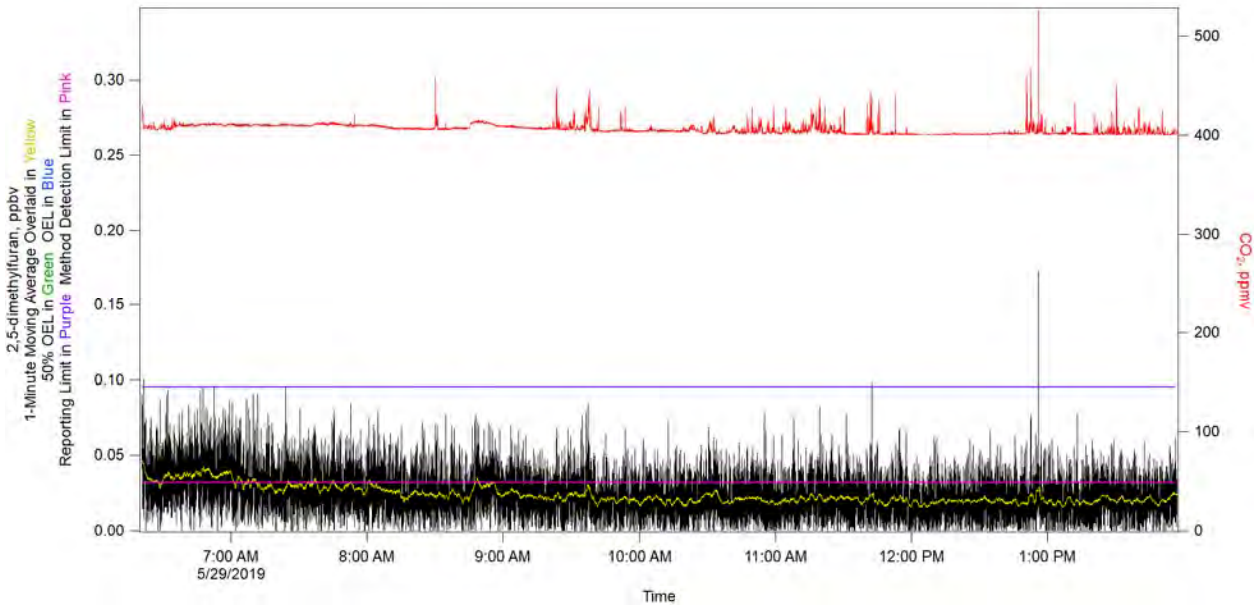

Figure 3-27. 2,5-dimethylfuran.

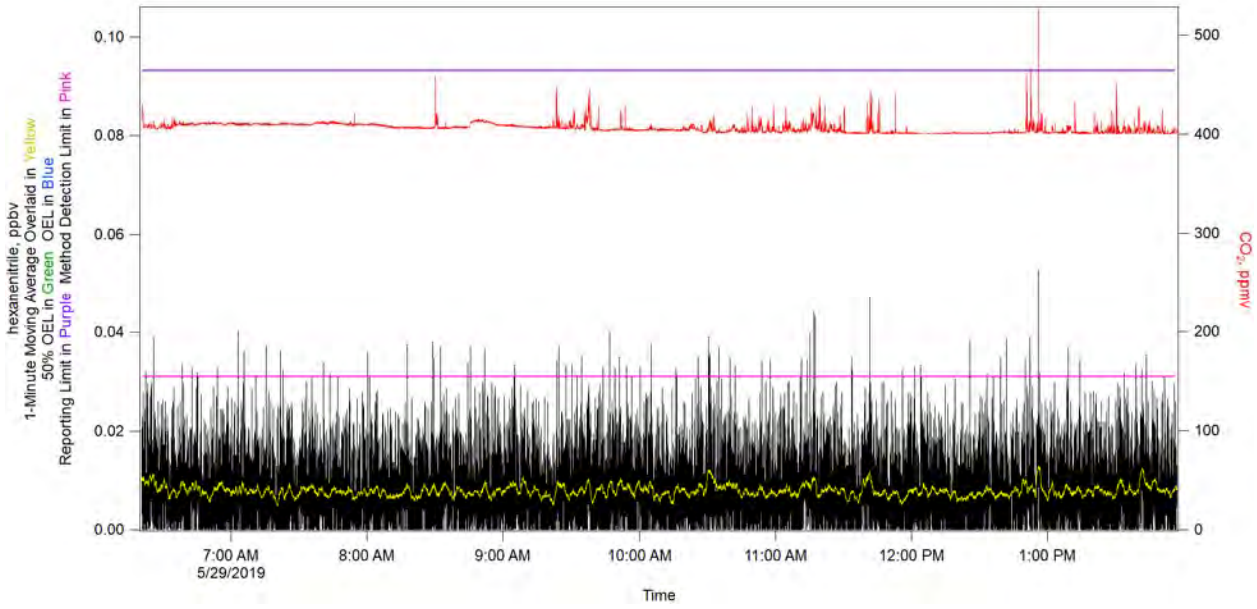

Figure 3-28. Hexanenitrile.

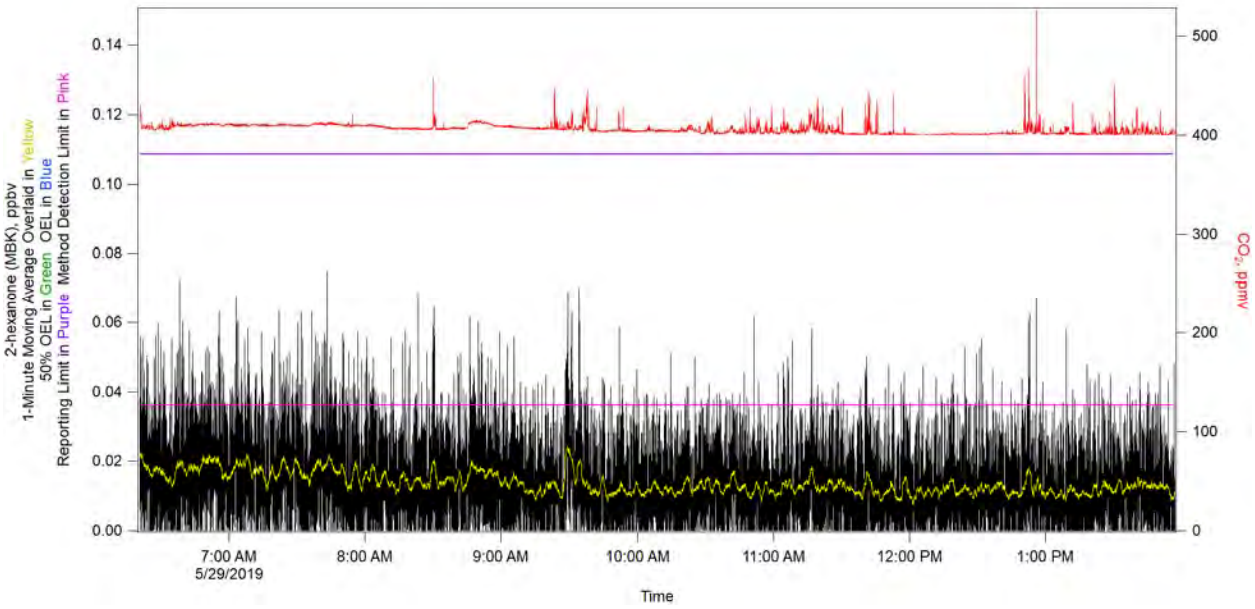

Figure 3-29. 2-hexanone (MBK).

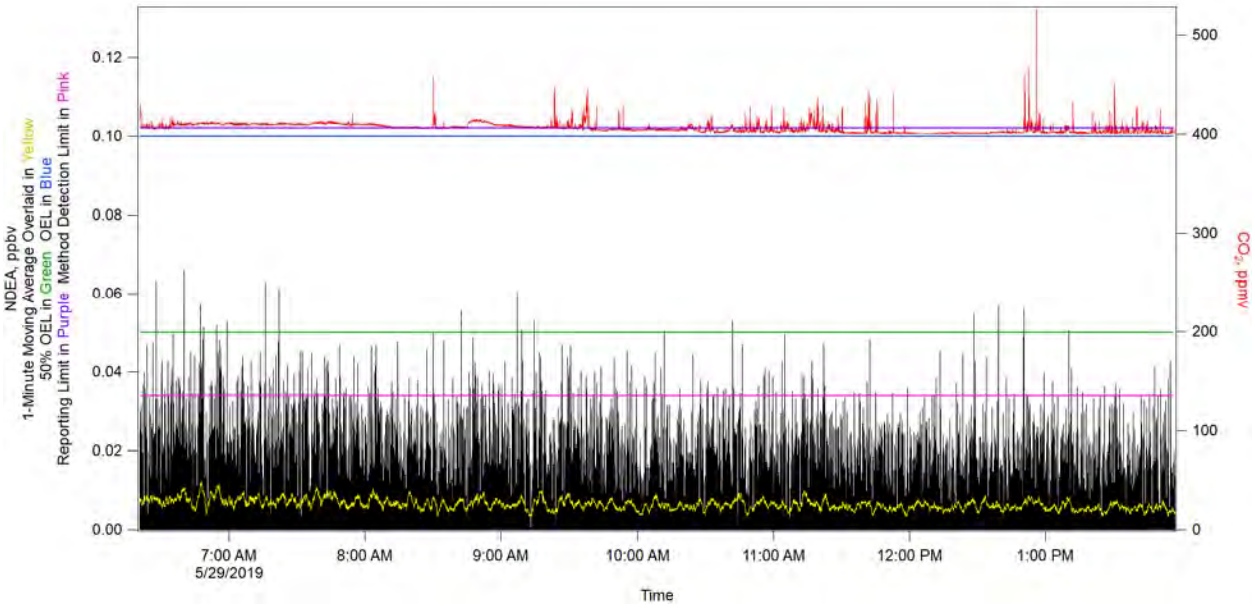

Figure 3-30. N-nitrosodiethylamine (NDEA).

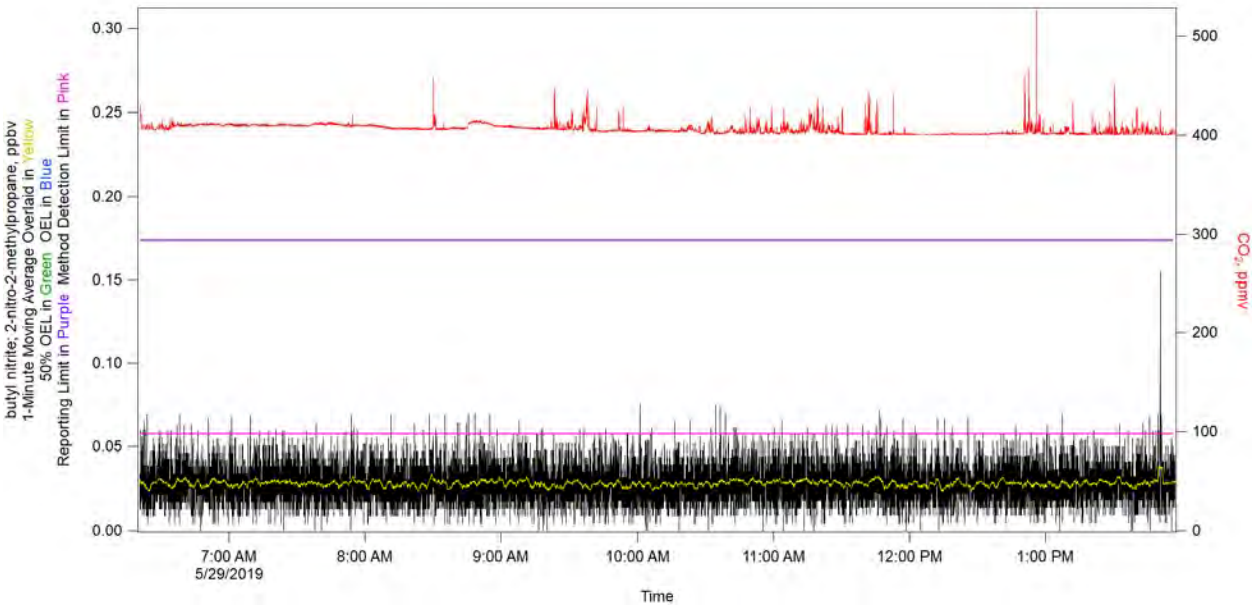

Figure 3-31. Butyl Nitrite; 2-nitro-2-methylpropane.

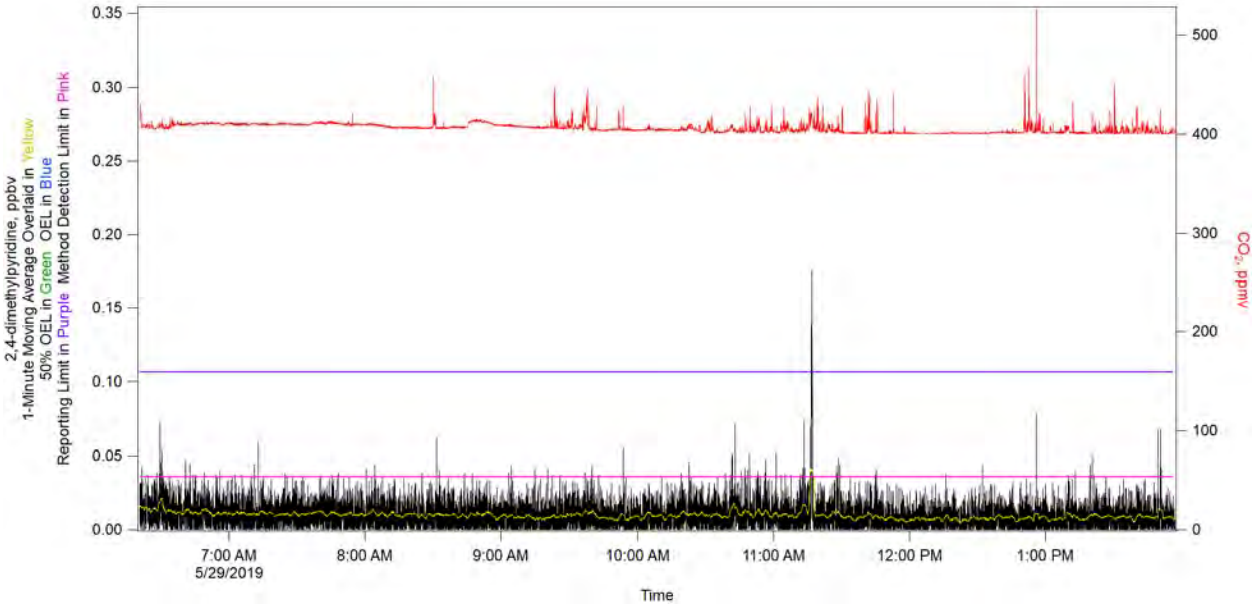

Figure 3-32. 2,4-dimethylpyridine.

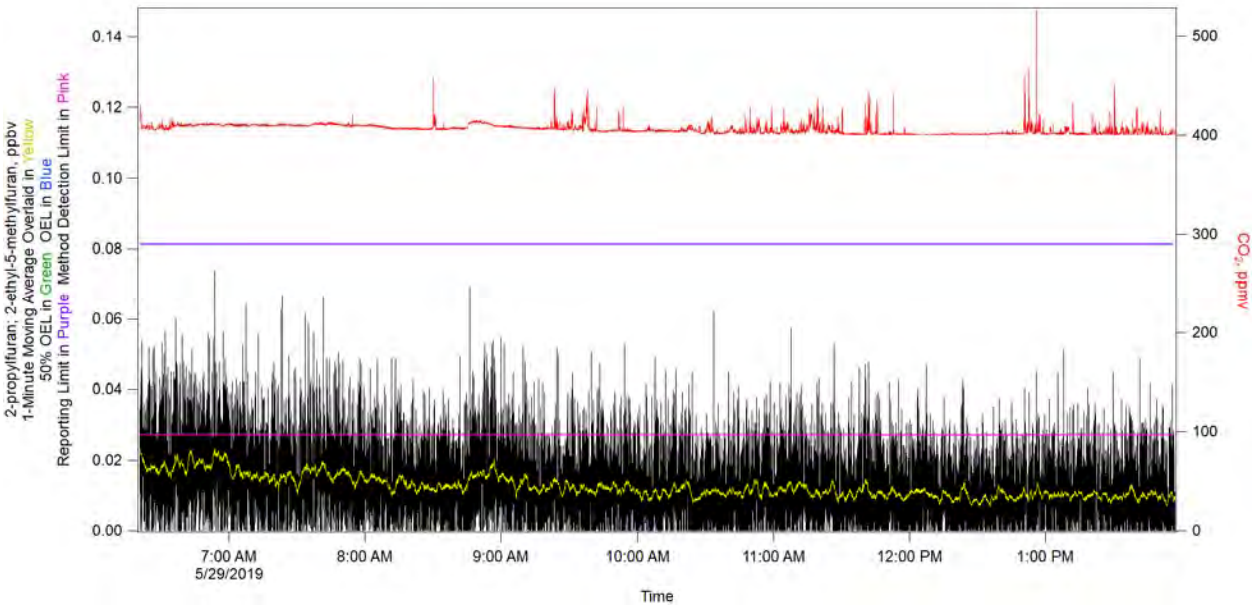

Figure 3-33. 2-propylfuran; 2-ethyl-5-methylfuran.

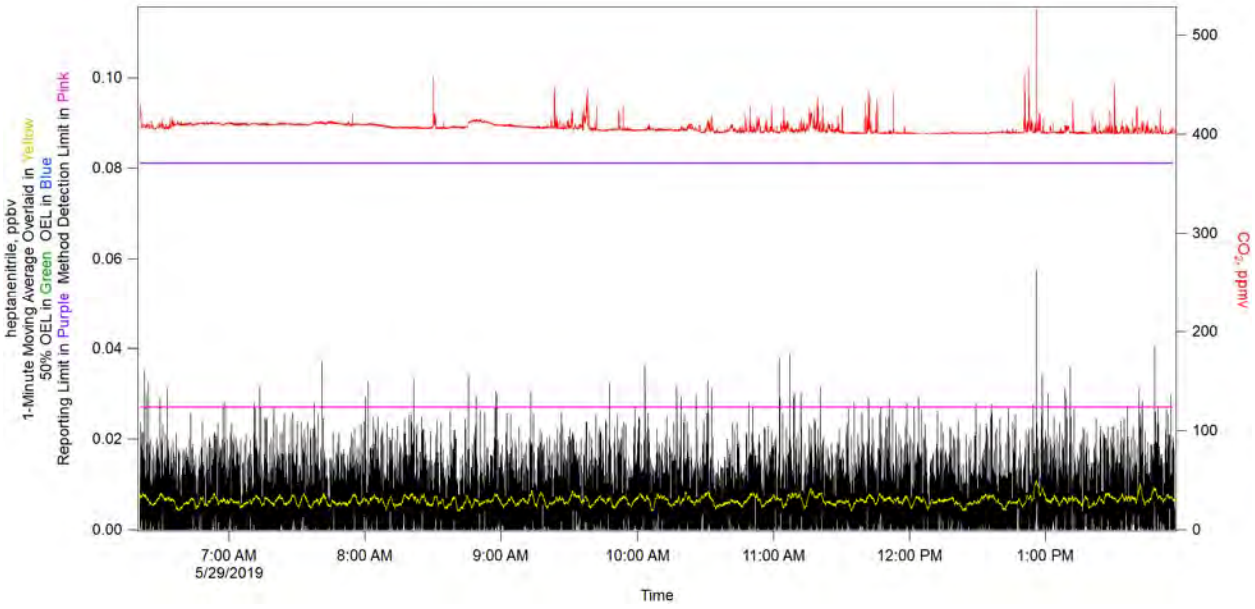

Figure 3-34. Heptanenitrile.

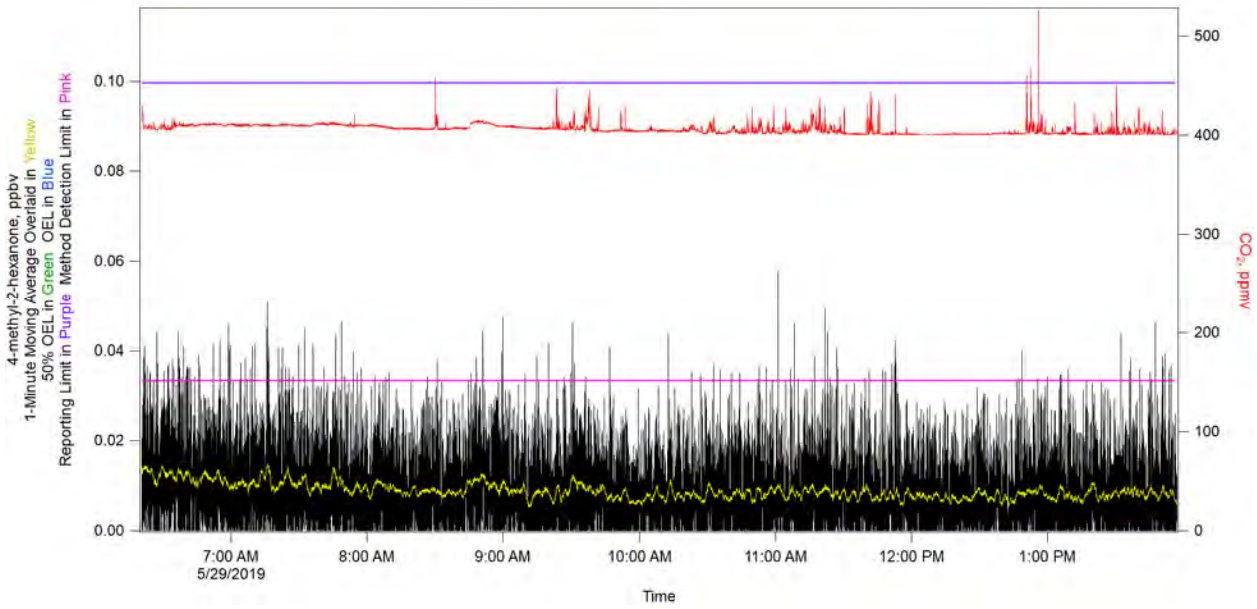

Figure 3-35. 4-methyl-2-hexanone.

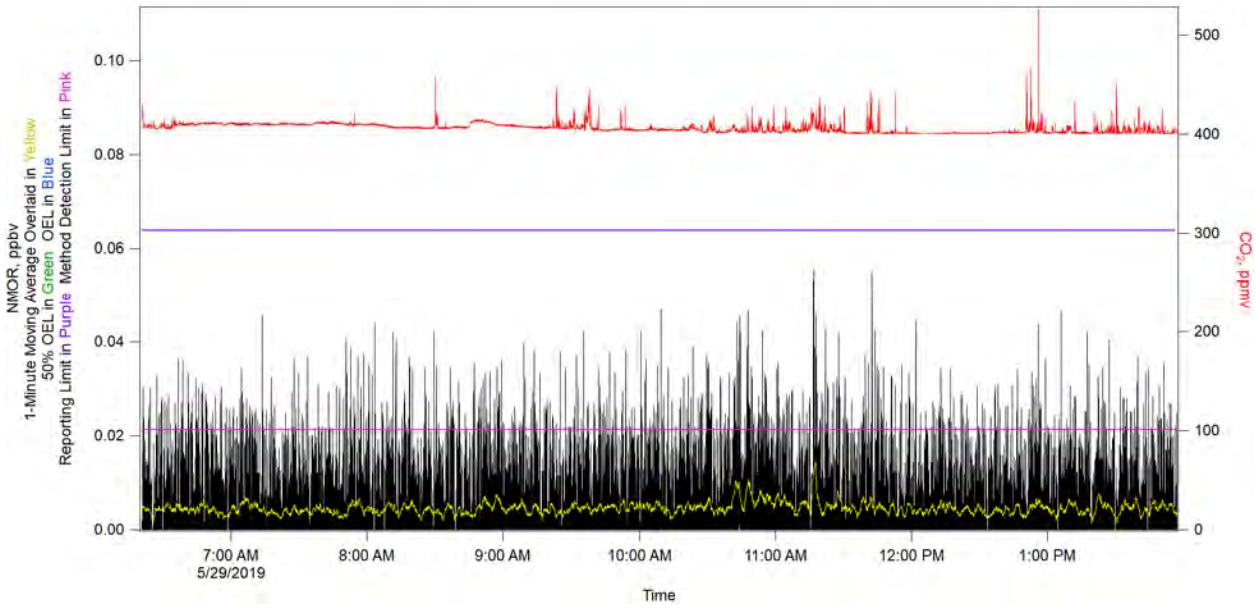

Figure 3-36. N-nitrosomorpholine (NMOR).

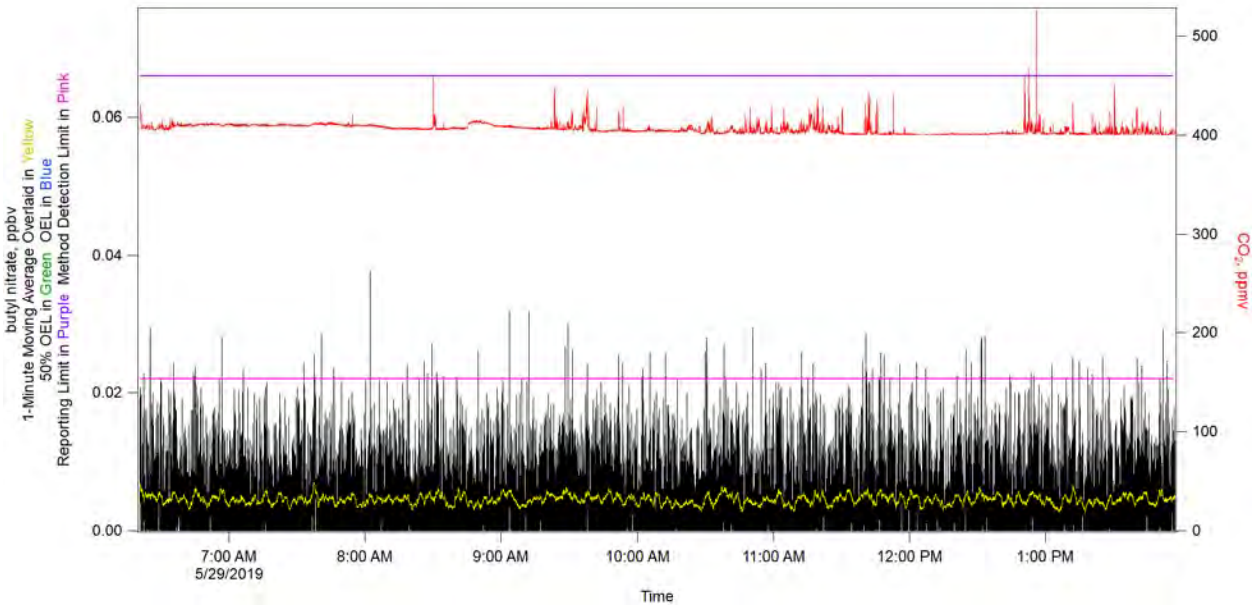

Figure 3-37. Butyl Nitrate.

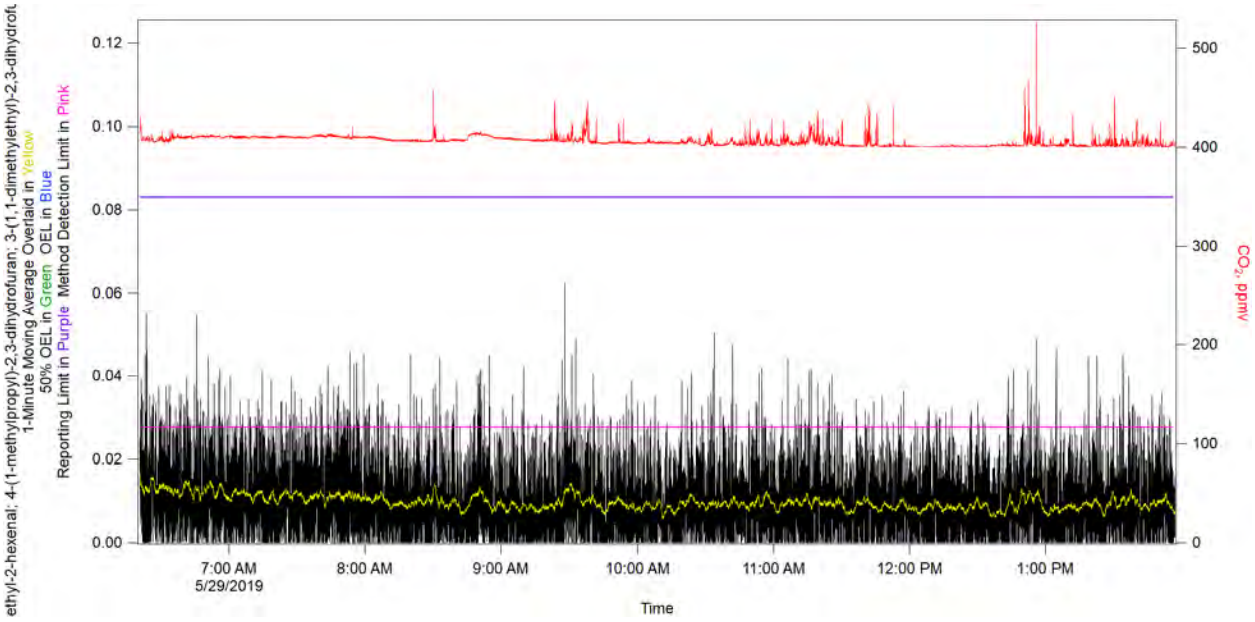

Figure 3-38. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

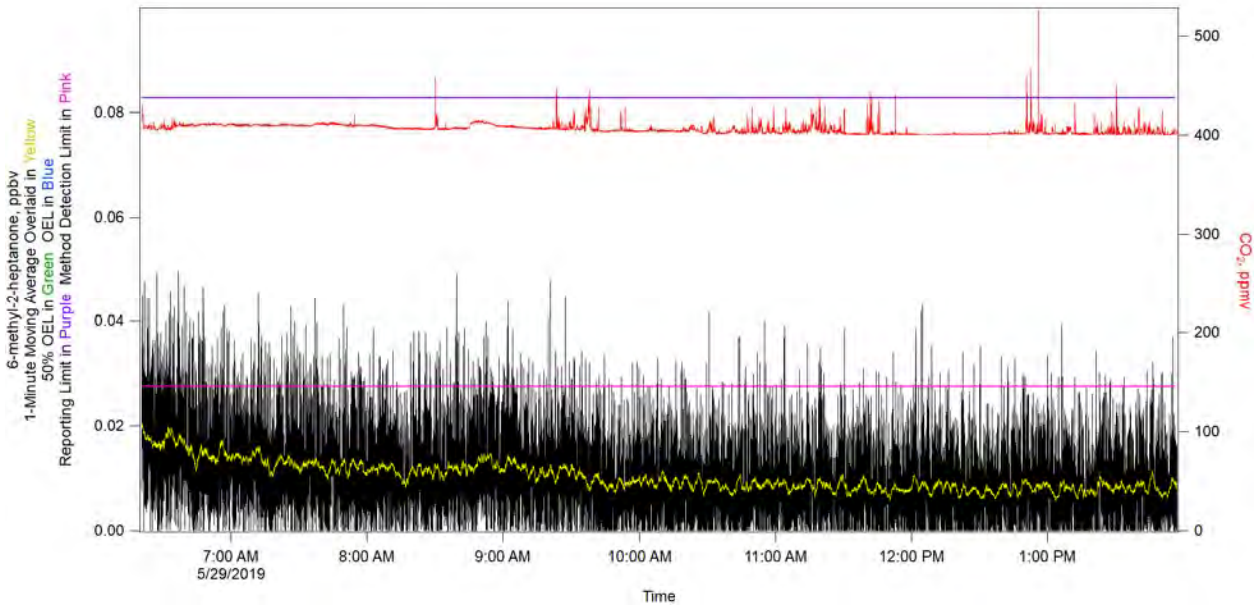

Figure 3-39. 6-methyl-2-heptanone.

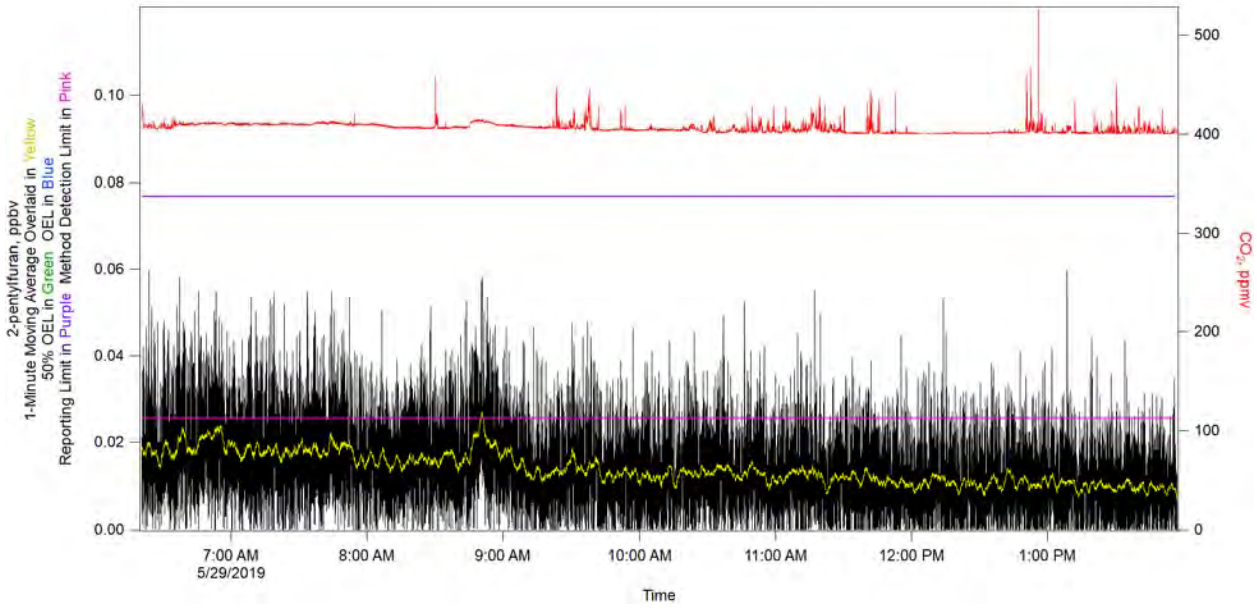

Figure 3-40. 2-pentylfuran.

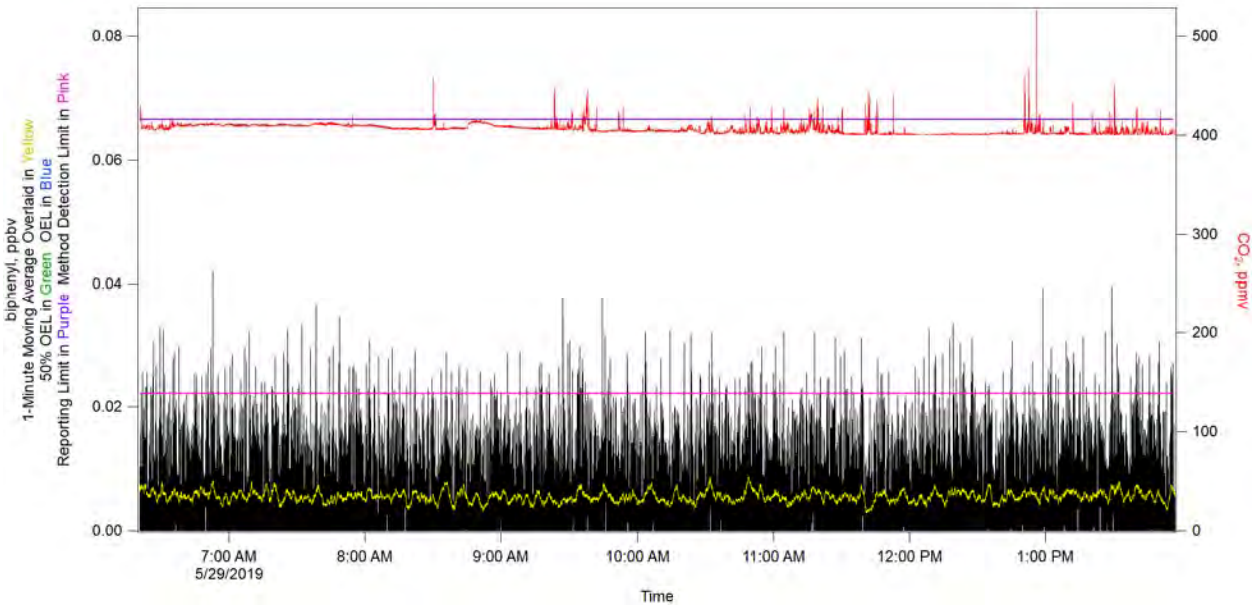

Figure 3-41. Biphenyl.

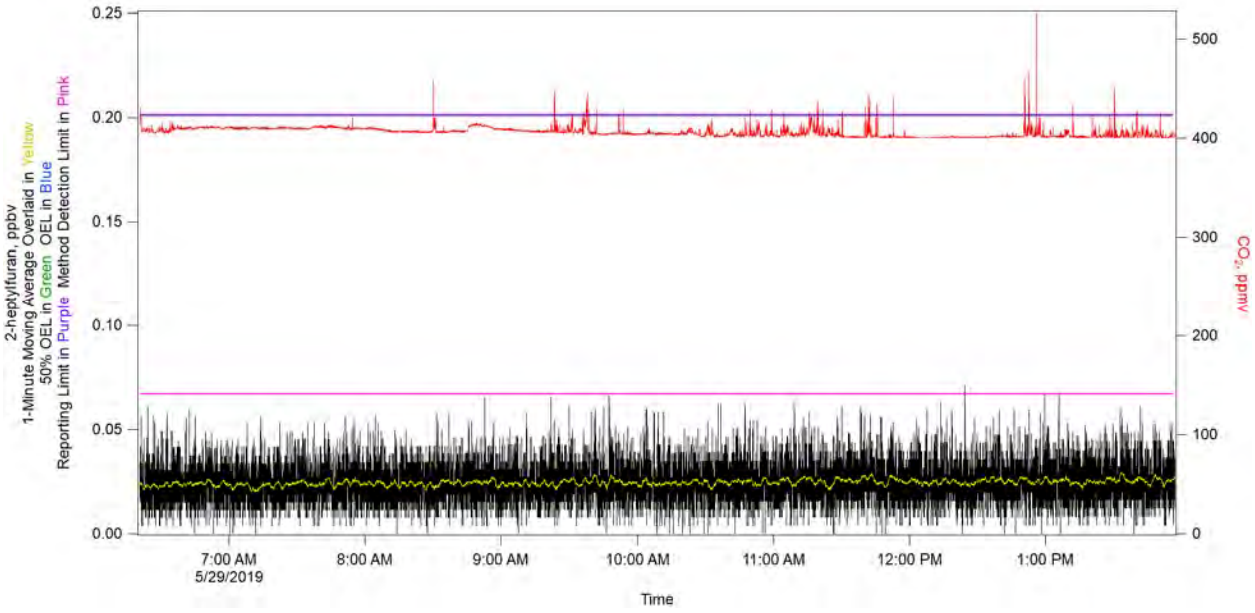

Figure 3-42. 2-heptylfuran.

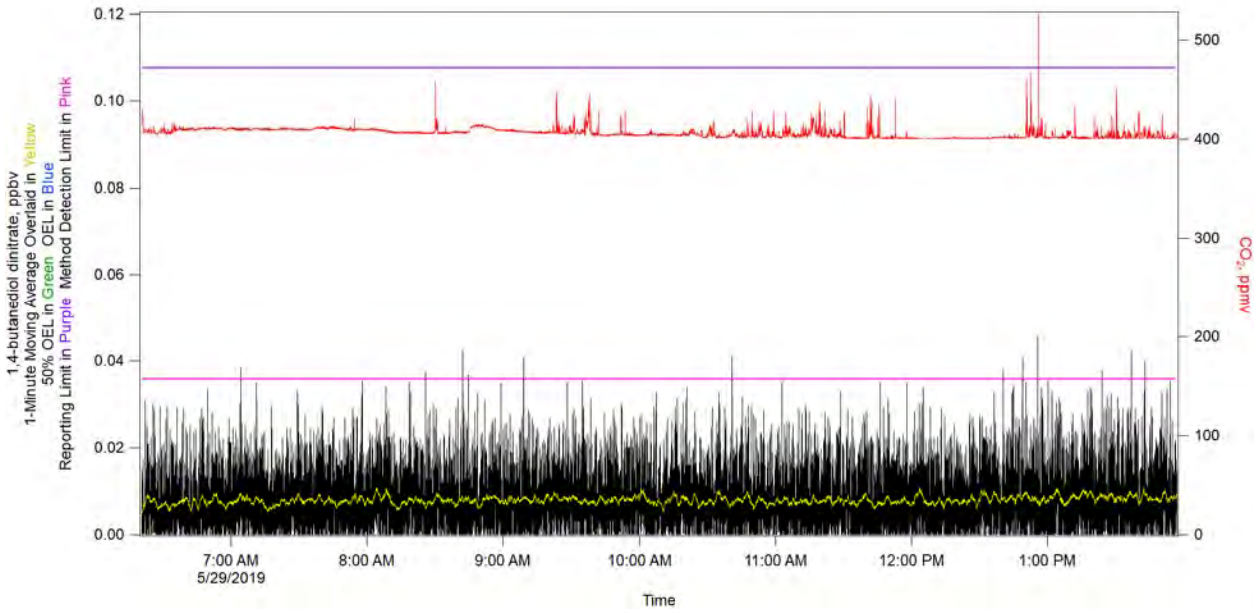

Figure 3-43. 1,4-butanediol Dinitrate.

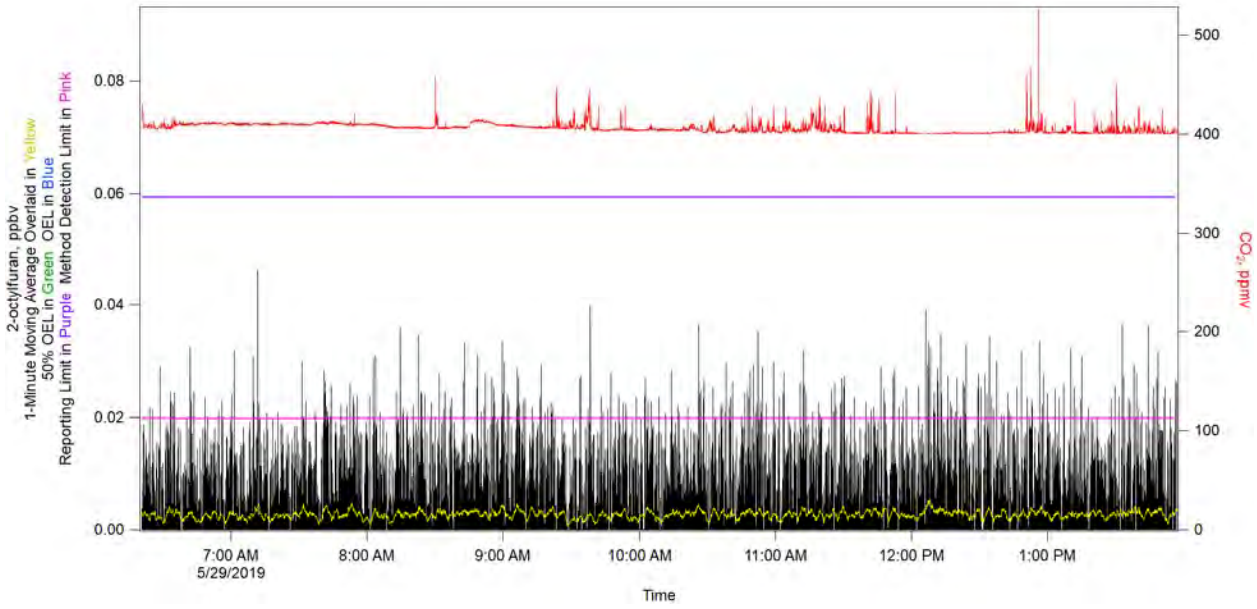

Figure 3-44. 2-octylfuran.

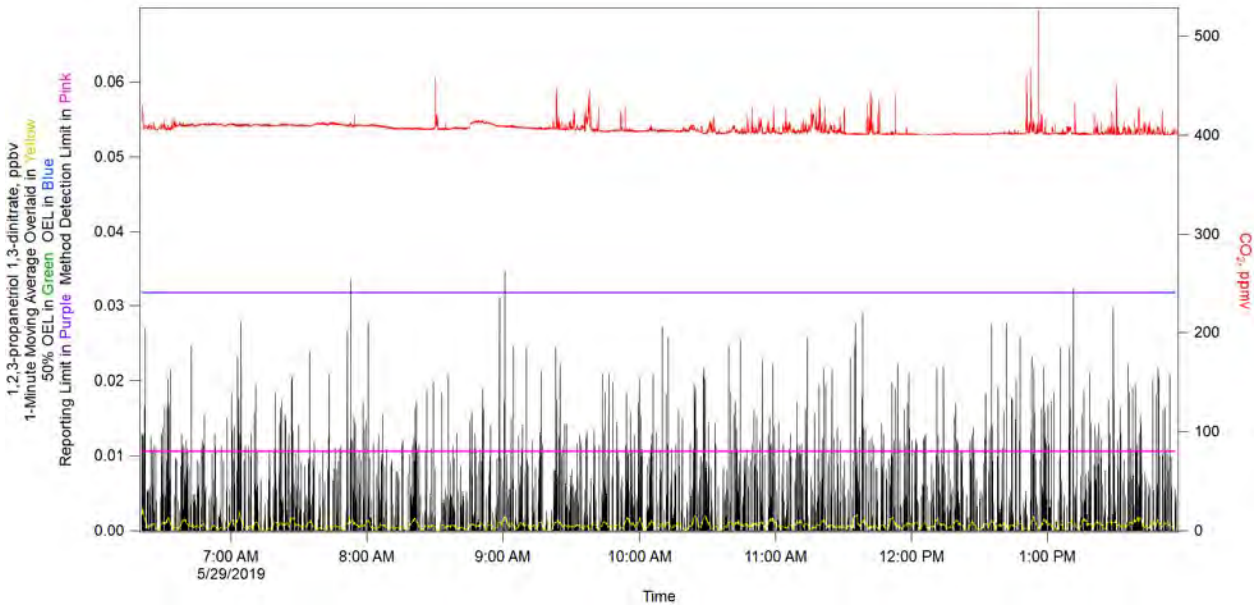

Figure 3-45. 1,2,3-propanetriol 1,3-dinitrate.

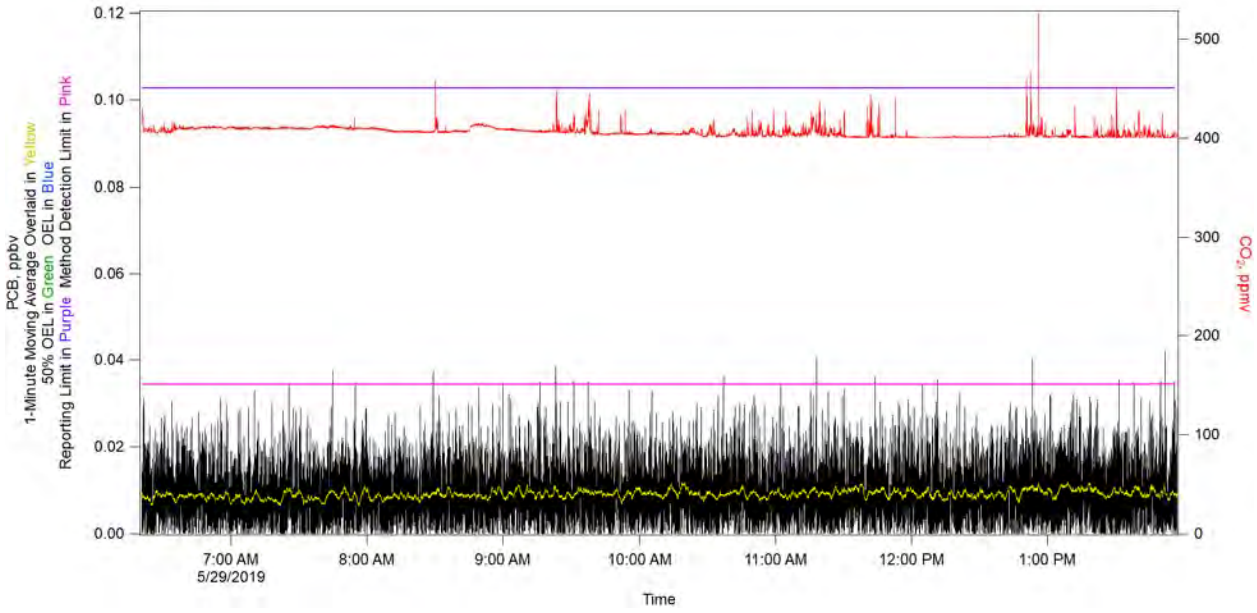

Figure 3-46. PCB.

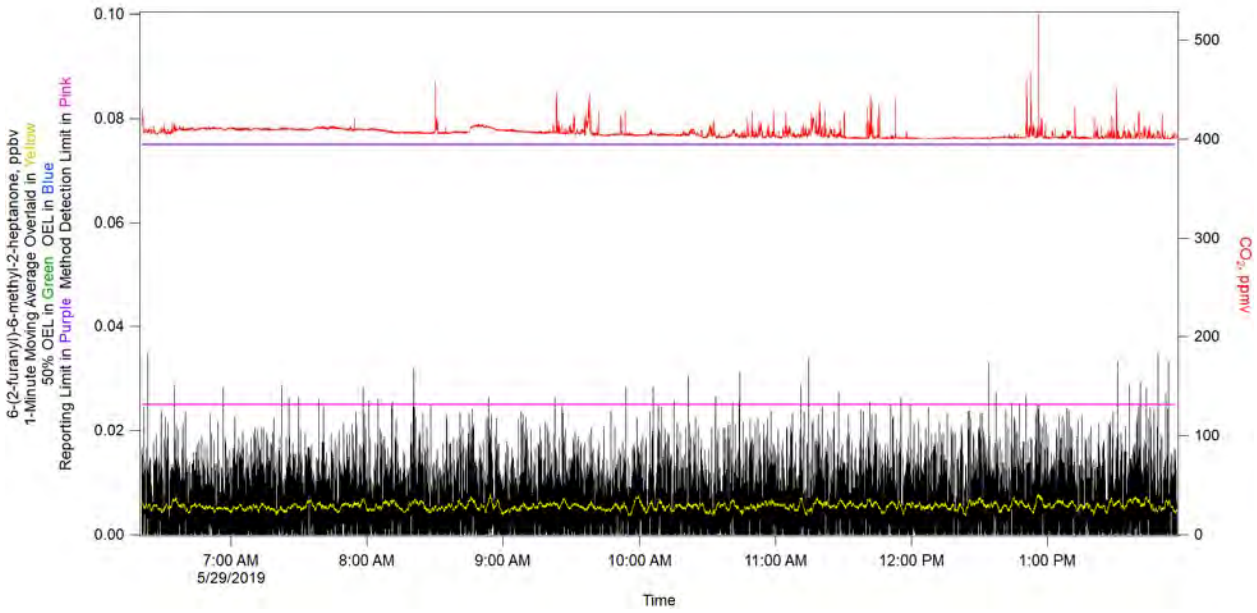

Figure 3-47. 6-(2-furanyl)-6-methyl-2-heptanone.

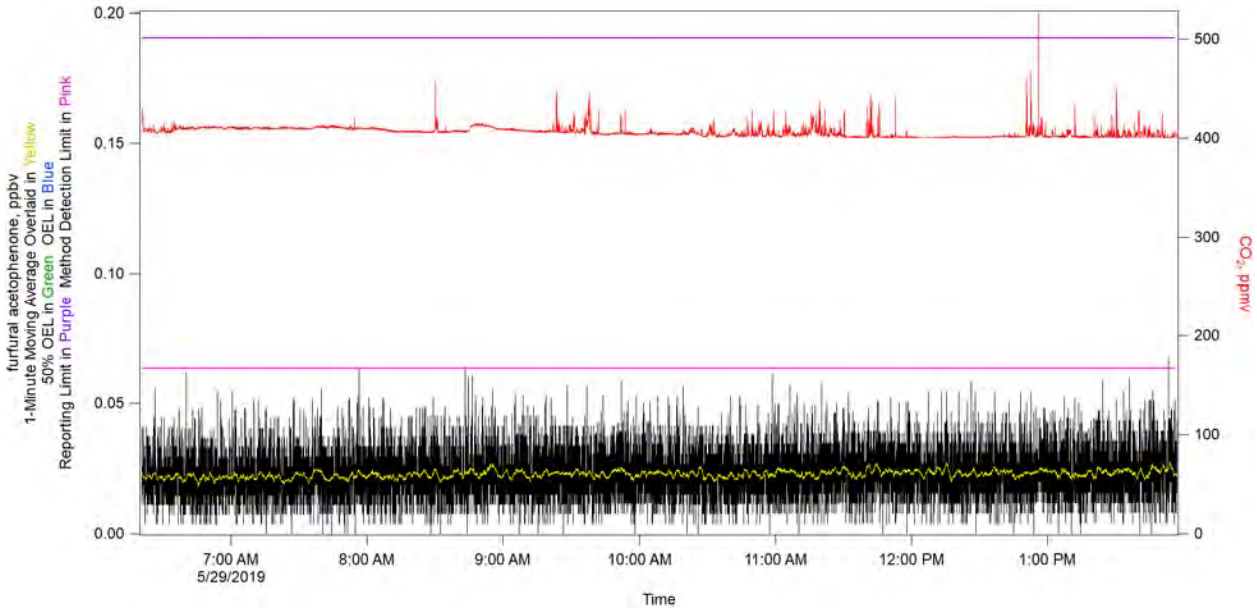

Figure 3-48. Furfural Acetophenone.

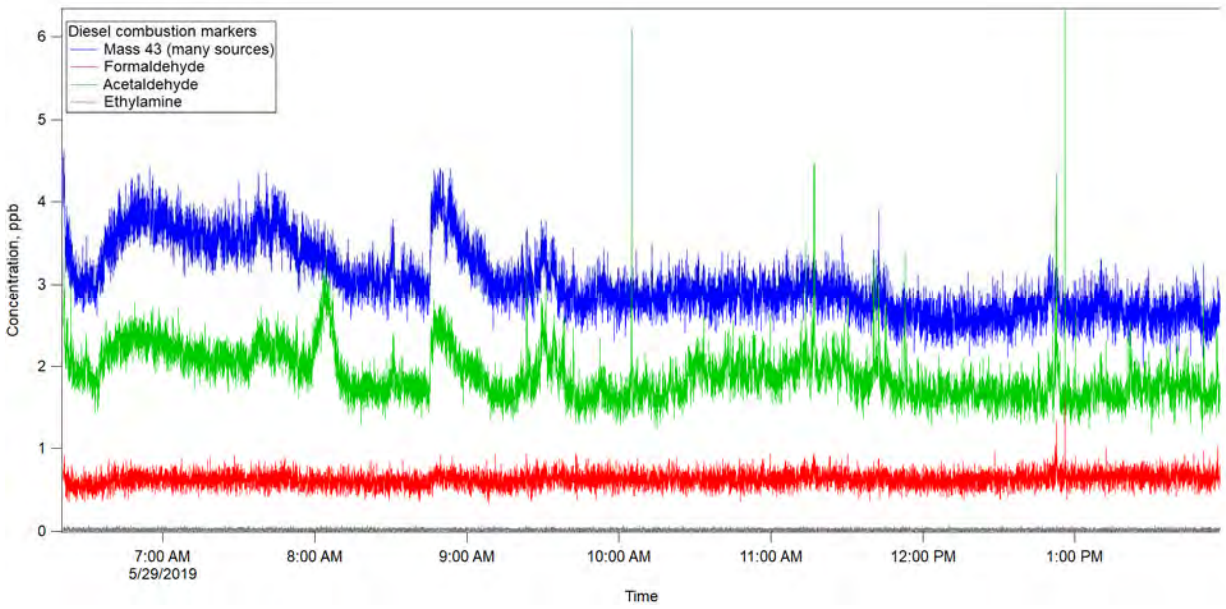

Figure 3-49. Diesel Combustion Markers.

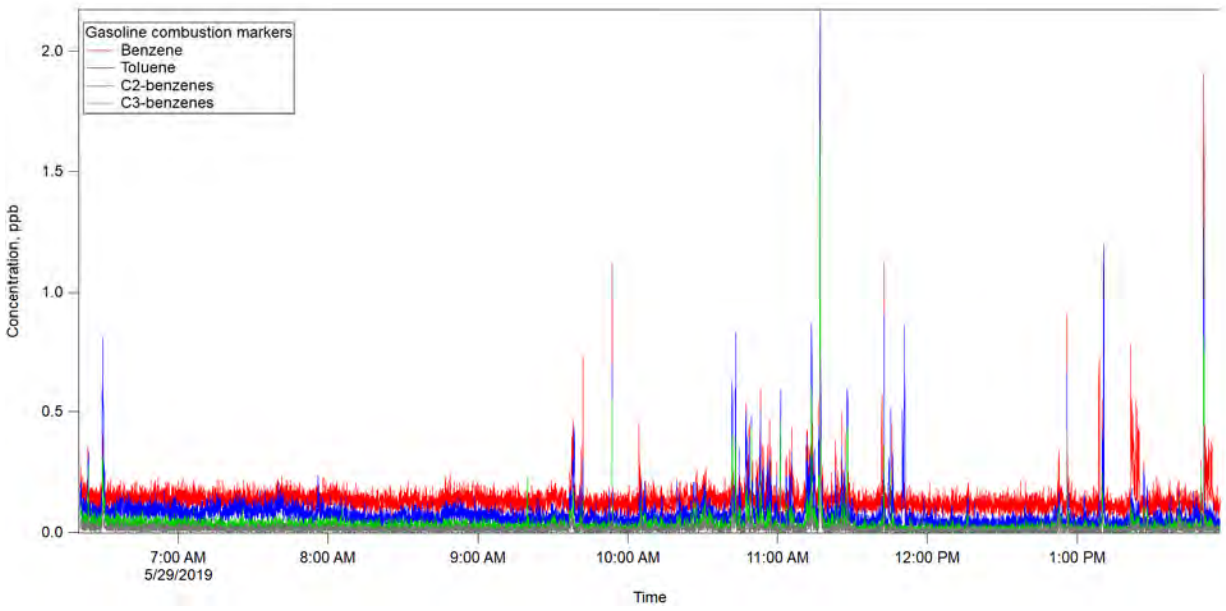

Figure 3-50. Gasoline Combustion Markers.

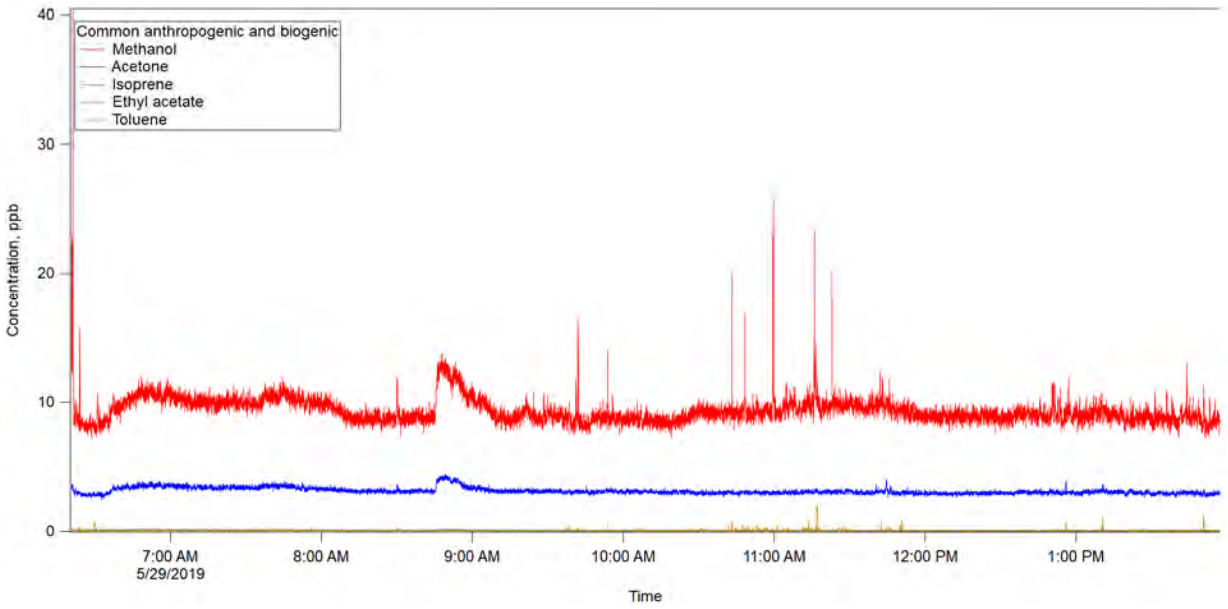

Figure 3-51. Plant and Human Markers.

4.0 MAY 30, 2019 – AREA MONITORING

4.1 Quality Assessment

Data from May 30, 2019, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

4.2 Summary

On May 30, 2019, the ML arrived at the TerraGraphics warehouse at 04:56. The QA/QC zero-air/span check was performed on the PTR-MS beginning at 05:14. The ML Operators stopped for fuel at 05:26 and arrived at the Hanford Site to check in with CSO at 06:26. After leaving the CSO at 06:46, the ML Operators headed to TY/TX Farms for area monitoring. At 07:01, the ML was parked at the east fence line between TY and TX Farms. After an hour of monitoring TX/TY Tank Farms, the ML was driven to U Farm. At 08:05, the ML was parked east of U Farm. After noticing a wind shift, the ML was relocated south of U Farm at 08:20 and completed U Farm monitoring at 09:38. Site survey loops were started at 10:02. At 10:16, the ML was parked east of AP Farm and brief APGEMS training was conducted. At 10:55, the ML was parked west of AZ Farm. A second set of area loops began at 12:03 and upon completion the ML was parked northwest of AW Farm. At 13:30, a final round of site survey loops was conducted. The ML Operators finished the day by checking out with the CSM at 14:04.

Table 4-1 illustrates the times and locations on May 30, 2019, where the ML Operators noted a potential source, or a peak of interest was observed. During morning monitoring of TX/TY Farm, Operators observed an elevated signal of NDMA around 07:12, displayed in Figure 4-19. While monitoring west of AZ Farm, at approximately 11:42, there were elevated signals for acetaldehyde (Figure 4-7), propanenitrile (Figure 4-10), 1-butanol:butenes (Figure 4-16), benzene (Figure 4-20), 2,4-dimethylpyridine (Figure 4-32), and NMOR (Figure 4-36). From 11:00 to 12:00, multiple elevated signals of C_2-benzenes and C_3-benzenes were seen in diesel combustion markers (Figure 4-50).

Table 4-1. Mobile Laboratory Summary of Events.

Time	Activity	Observed
07:12	East of TX/TY Farm	Elevated signal for NDMA
08:18	East of U Farm	Shift in wind direction
11:03	West of AZ Farm	Smell of burnt plastic/rubber
11:15	West of AZ Farm	Elevated signal for C_3-C_4 benzenes
11:42	West of AZ Farm	Elevated signal for acetaldehyde

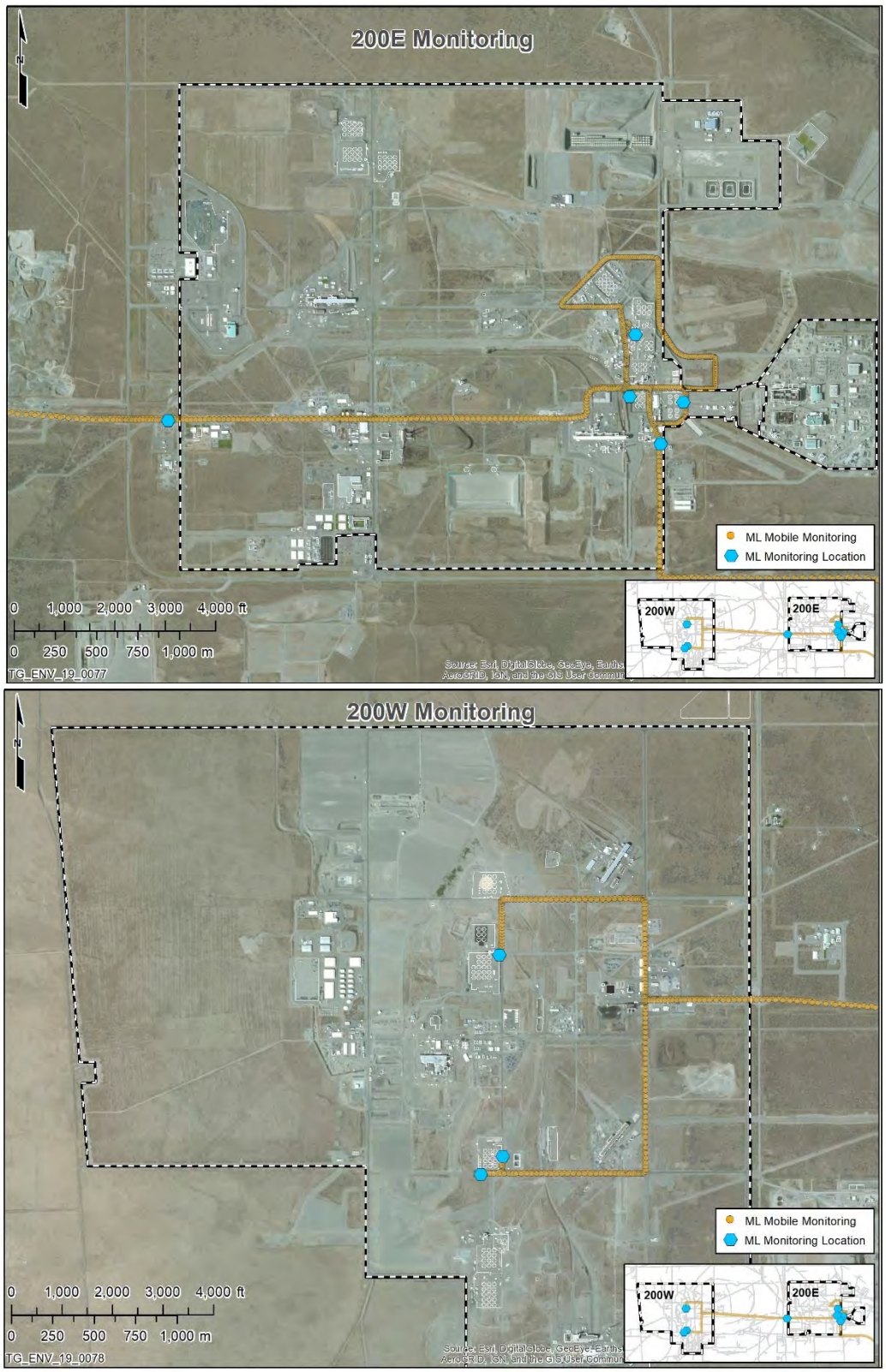

Figure 4-1. Location of the Mobile Laboratory for the Duration of the Monitoring Period.

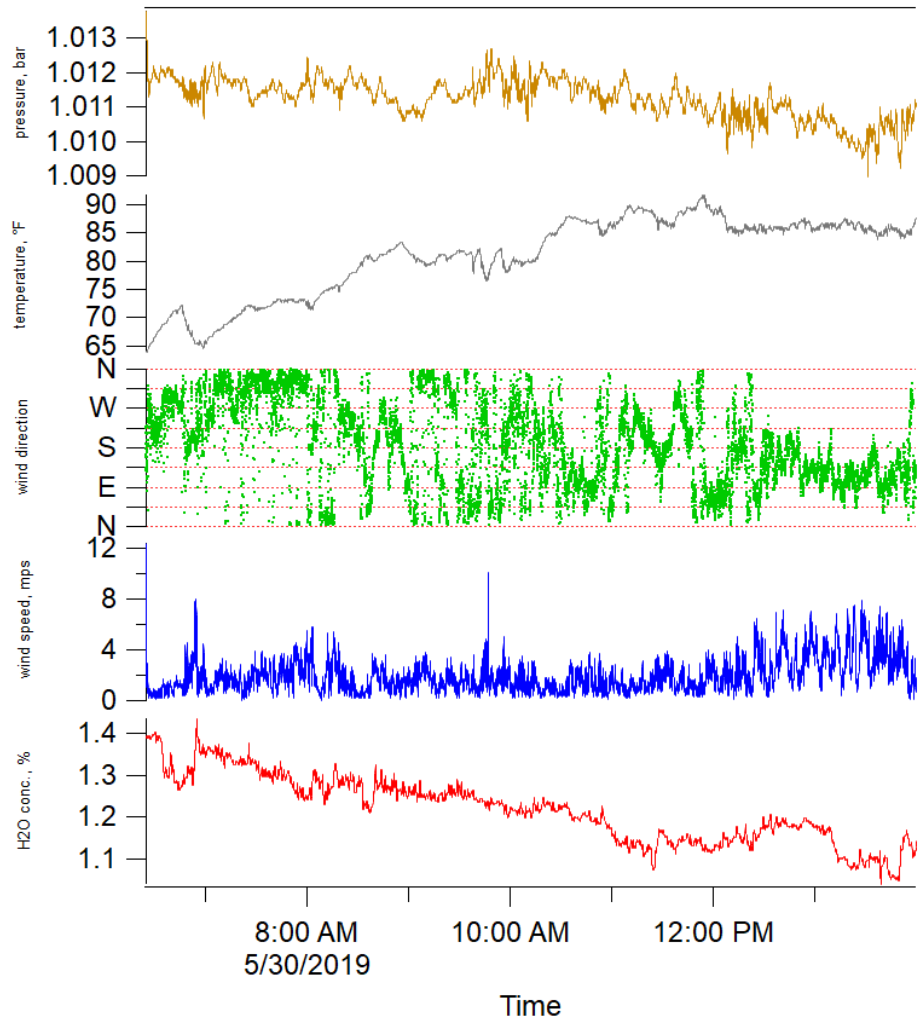

Figure 4-2. Weather Data for the Duration of the Monitoring Period.

Figure 4-2 illustrates the summary of meteorological for the monitoring period on May 30, 2019. The temperature rose slowly from 63˚F to reach a high of 91˚F then settled down near 85˚F for the afternoon. The wind was moderate and heading west/northwest in the morning and shifted to east/southeast with moderate gusts in the afternoon.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Airmar Weather Station.

Confirmatory air samples were not collected during this period.

4.4 Area Monitoring

The ML Operators performed area monitoring from approximately 06:46 to14:04. The table below displays the COPC statistical results during that monitoring period.

Table 4-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 30, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
1	ammonia	25000	6.225	15.527†	2.955	19.029	25.992	14.866†
2	formaldehyde	300	1.721	<1.721	0.108	16.386	2.203	<1.721
3	methanol	200000	5.758	10.385†	4.778	46.005	164.949	9.680†
4	acetonitrile	20000	0.085	0.212†	0.033	15.791	0.628	0.211†
5	acetaldehyde	25000	1.027	2.200†	0.717	32.600	13.231	2.079†
6	ethylamine	5000	0.069	<0.069	0.014	59.359	0.086	<0.069
7	1,3-butadiene	1000	0.183	<0.183	0.101	61.124	3.981	<0.183
8	propanenitrile	6000	0.107	<0.107	0.020	40.869	0.354	<0.107
9	2-propenal	100	0.340	<0.340	0.188	76.797	1.665	<0.340
10	1-butanol + butenes	20000	0.214	<0.214	0.121	85.523	4.455	<0.214
11	methyl isocyanate	20	0.069	<0.069	0.023	47.875	0.180	<0.069
12	methyl nitrite	100	0.098	0.119†	0.038	31.917	0.414	0.114†
13	furan	1	0.062	<0.062	0.017	48.551	0.194	<0.062
14	Butanenitrile	8000	0.039	<0.039	0.014	59.960	0.284	<0.039
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	200, 1, 1	0.041	0.079†	0.049	61.598	N/A*	N/A*
16	butanal	25000	0.061	0.229	0.075	32.974	0.611	0.215
17	NDMA**	0.3	0.082	<0.082	0.021	197.720	0.214	<0.082
18	benzene	500	0.236	<0.236	0.118	87.139	4.088	<0.236
19	2,4-pentadienenitrile + pyridine	300, 1000	0.085	<0.085	0.016	43.767	0.278	<0.085
20	2-methylene butanenitrile	300	0.036	<0.036	0.008	68.695	0.184	<0.036
21	2-methylfuran	1	0.043	0.048†	0.025	52.241	0.196	0.044†
22	pentanenitrile	6000	0.036	<0.036	0.011	68.778	0.164	<0.036
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.043	0.053†	0.032	60.130	0.230	0.046†
24	NEMA**	0.3	0.058	<0.058	0.018	170.862	0.156	<0.058
25	2,5-dimethylfuran	1	0.032	<0.032	0.017	63.326	0.127	<0.032
26	hexanenitrile	6000	0.031	<0.031	0.007	89.950	0.112	<0.031
27	2-hexanone (MBK)	5000	0.036	<0.036	0.014	87.605	0.114	<0.036
28	NDEA**	0.1	0.034	<0.034	0.010	153.585	0.075	<0.034

Table 4-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 30, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
29	butyl nitrite + 2-nitro-2-methylpropane	100, 300	0.058	<0.058	0.011	40.975	0.085	<0.058
30	2,4-dimethylpyridine	500	0.036	<0.036	0.027	235.330	1.515	<0.036
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.027	<0.027	0.012	84.546	0.087	<0.027
32	heptanenitrile	6000	0.027	<0.027	0.006	91.449	0.096	<0.027
33	4-methyl-2-hexanone	500	0.033	<0.033	0.009	91.556	0.054	<0.033
34	NMOR**	0.6	0.021	<0.021	0.008	177.270	0.133	<0.021
35	butyl nitrate	2500	0.022	<0.022	0.005	112.335	0.037	<0.022
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.028	<0.028	0.009	80.683	0.076	<0.028
37	6-methyl-2-heptanone	8000	0.028	<0.028	0.009	77.776	0.063	<0.028
38	2-pentylfuran	1	0.026	<0.026	0.009	70.626	0.068	<0.026
39	biphenyl	200	0.022	<0.022	0.007	114.865	0.047	<0.022
40	2-heptylfuran	1	0.067	<0.067	0.010	39.358	0.068	<0.067
41	1,4-butanediol dinitrate	50	0.036	<0.036	0.007	84.620	0.053	<0.036
42	2-octylfuran	1	0.020	<0.020	0.005	202.682	0.049	<0.020
43	1,2,3-propanetriol 1,3-dinitrate	50	0.011	<0.011	0.003	388.291	0.043	<0.011
44	PCB	1000	0.034	<0.034	0.006	68.361	0.043	<0.034
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.025	<0.025	0.005	96.025	0.042	<0.025
46	furfural acetophenone	1	0.064	<0.064	0.009	39.860	0.063	<0.064
N/A*	The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.317 ppb and the median value was 0.064† ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 200, which provide widely variant bases for these numbers.							
**	Nitrosamine results are suspect due to isobaric interferants causing positive bias that have been encountered during previous background [53005-81-RPT-007, *PTR-MS Mobile Laboratory Vapor Monitoring Background Study, (3/18/2018 – 4/20/2018)*, and *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, RJ Lee Group, Inc.].							
<	COPC Averages below the MDL.							
†	COPC Averages between the RL and the MDL.							
	COPC Averages >100% of the OEL.							
	COPC Averages 50-100% of the OEL.							
	COPC Averages 10-50% of the OEL.							

Figure 4-3 through Figure 4-51 display 46 COPC signals, overlaid with the same signal smoothed using a 1-minute moving average (in cases where a moving average assist with data visualization), and CO_2, for the monitoring period May 30, 2019. If within range of the plot's left axis, a green horizontal line representing 50% of the COPC's OEL, a blue horizontal line representing the COPC's OEL, a horizontal purple line representing the RL, and a pink horizontal line representing the MDL are shown.

Figure 4-5 shows the signal for methanol over the monitoring period and the plume at approximately 12:40 PST exceeded 100 ppbv. The data analyst adjusted the axis for this plot to avoid skewing the data set for the remainder of the day.

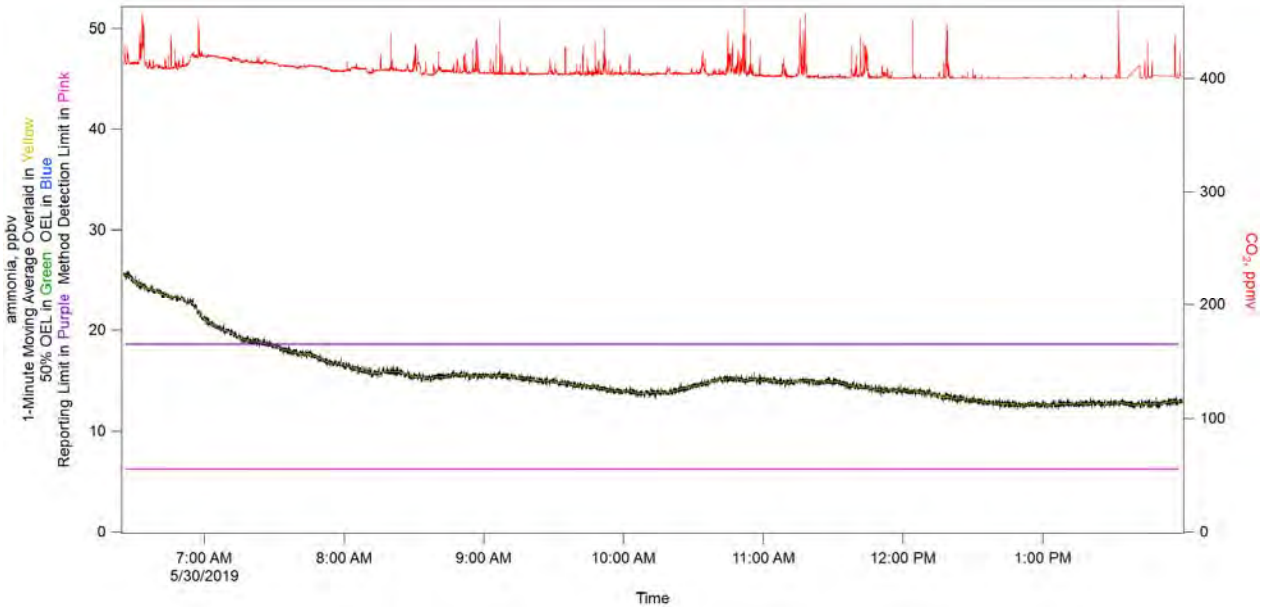

Figure 4-3. Ammonia.

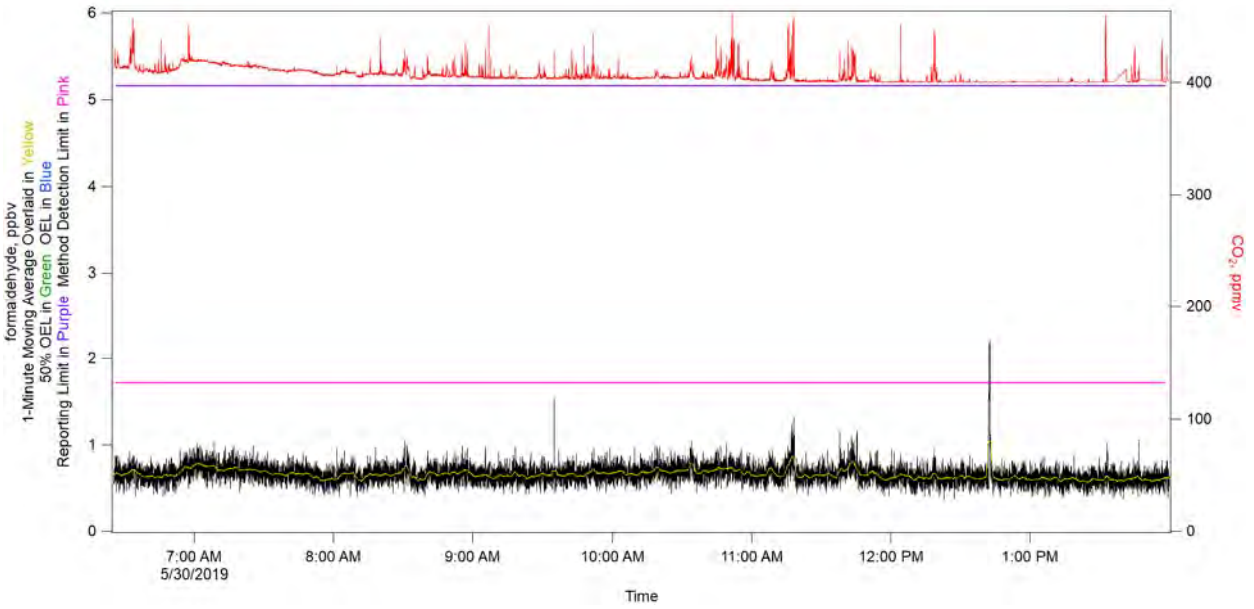

Figure 4-4. Formaldehyde.

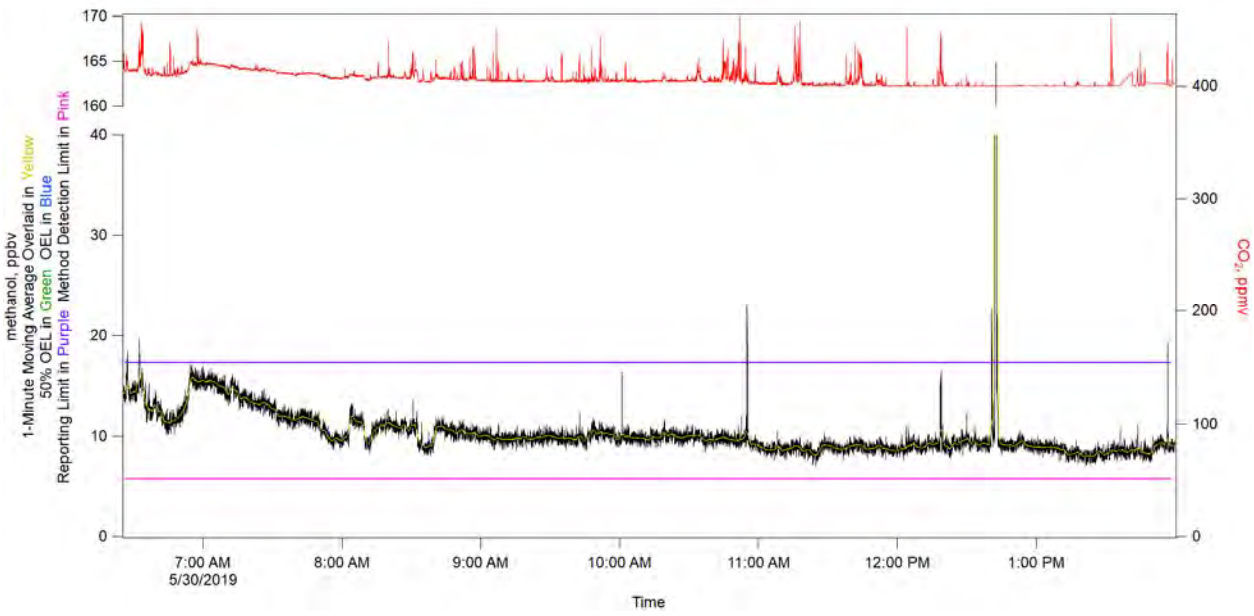

Figure 4-5. Methanol.

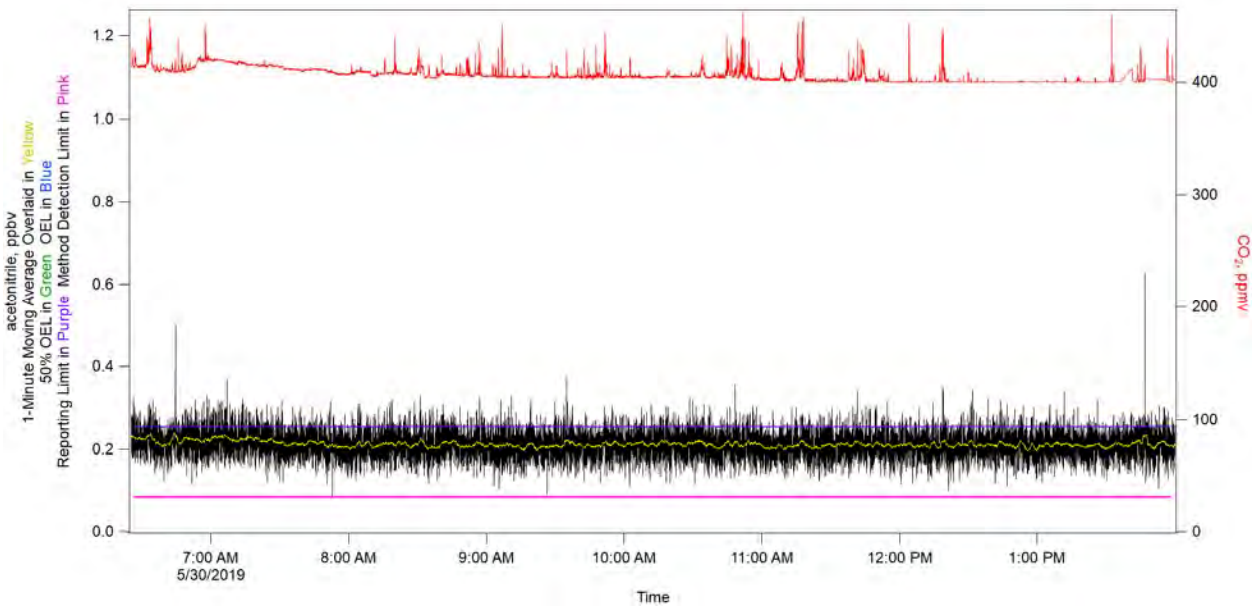

Figure 4-6. Acetonitrile.

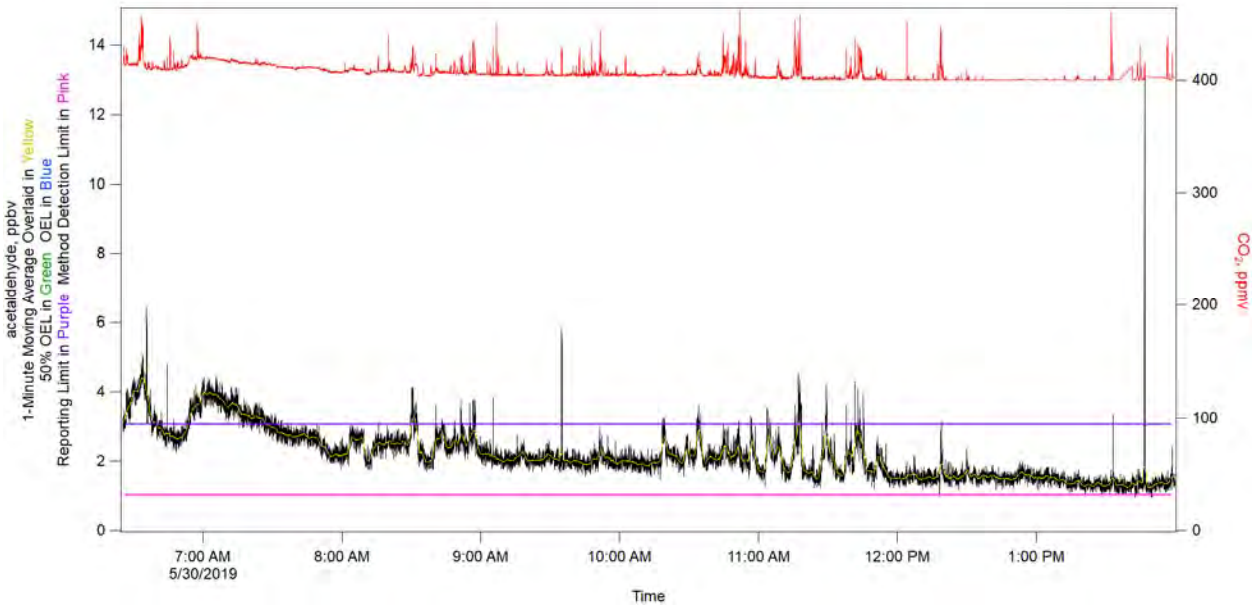

Figure 4-7. Acetaldehyde.

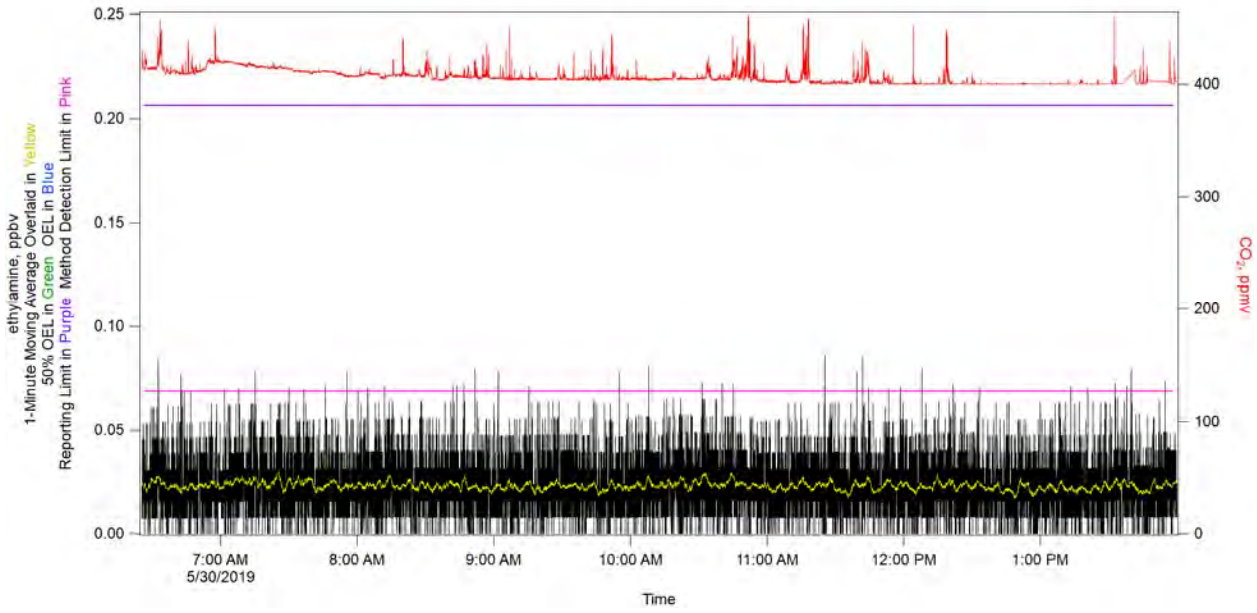

Figure 4-8. Ethylamine.

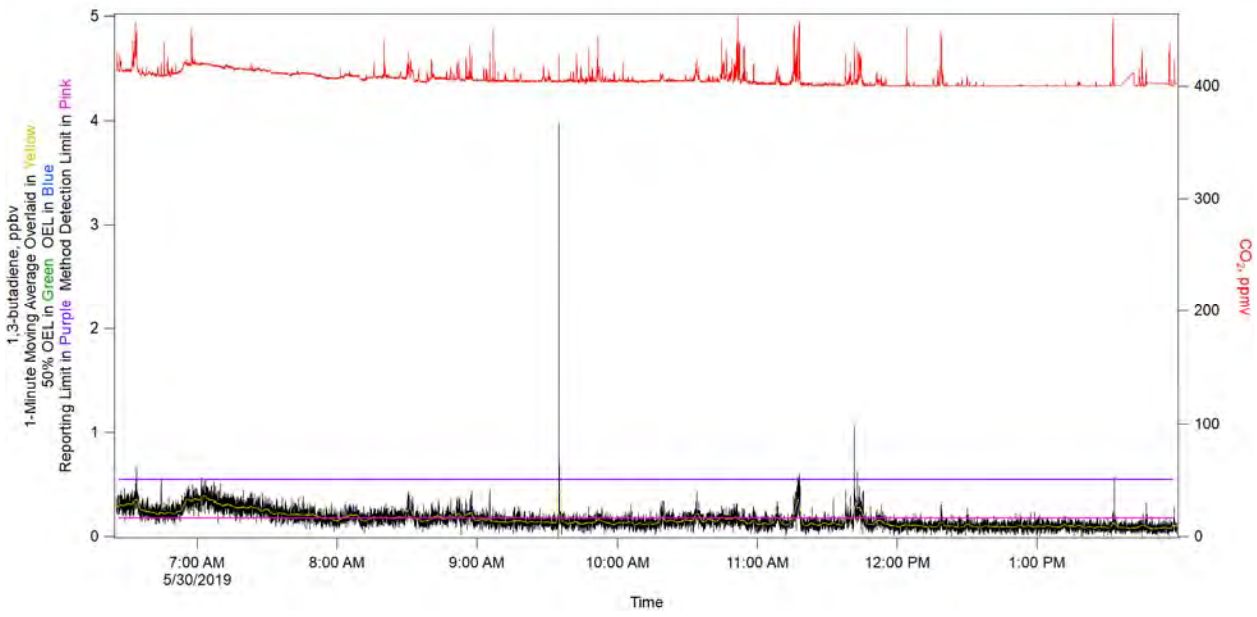

Figure 4-9. 1,3-butadiene.

Figure 4-10. Propanenitrile.

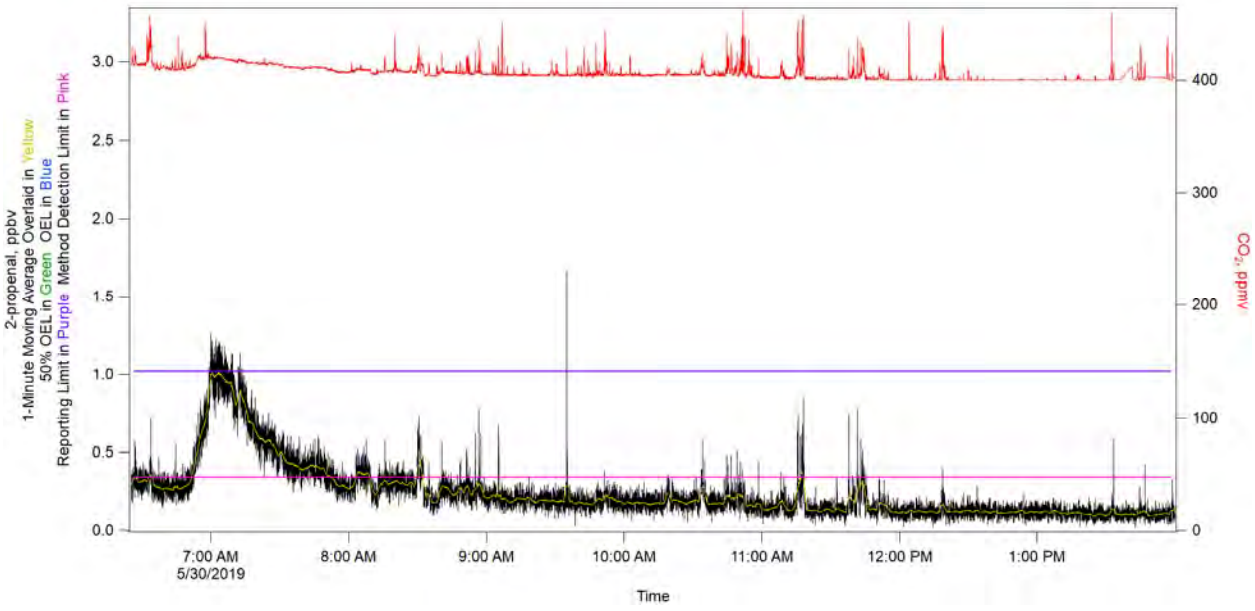

Figure 4-11. 2-propenal.

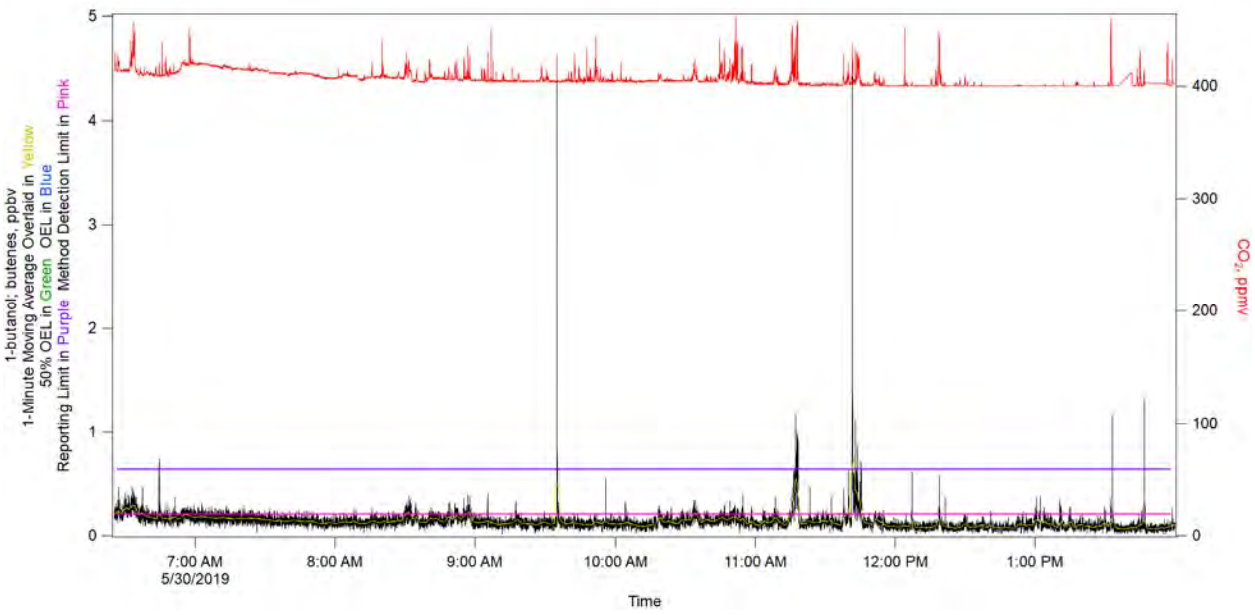

Figure 4-12. 1-butanol; Butenes.

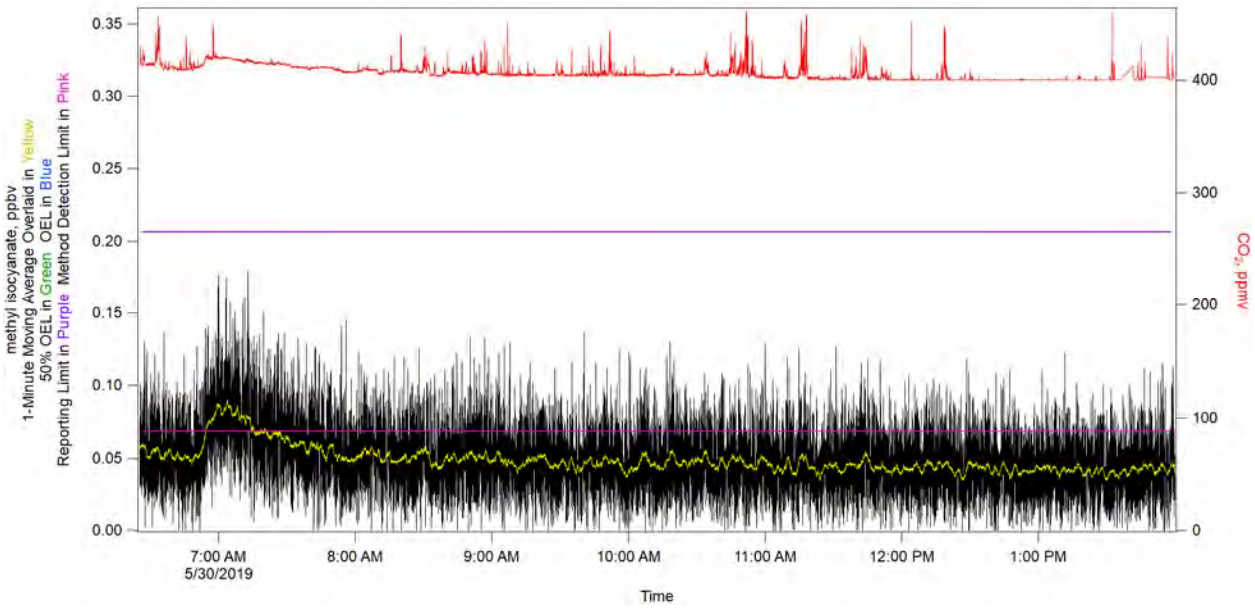

Figure 4-13. Methyl Isocyanate.

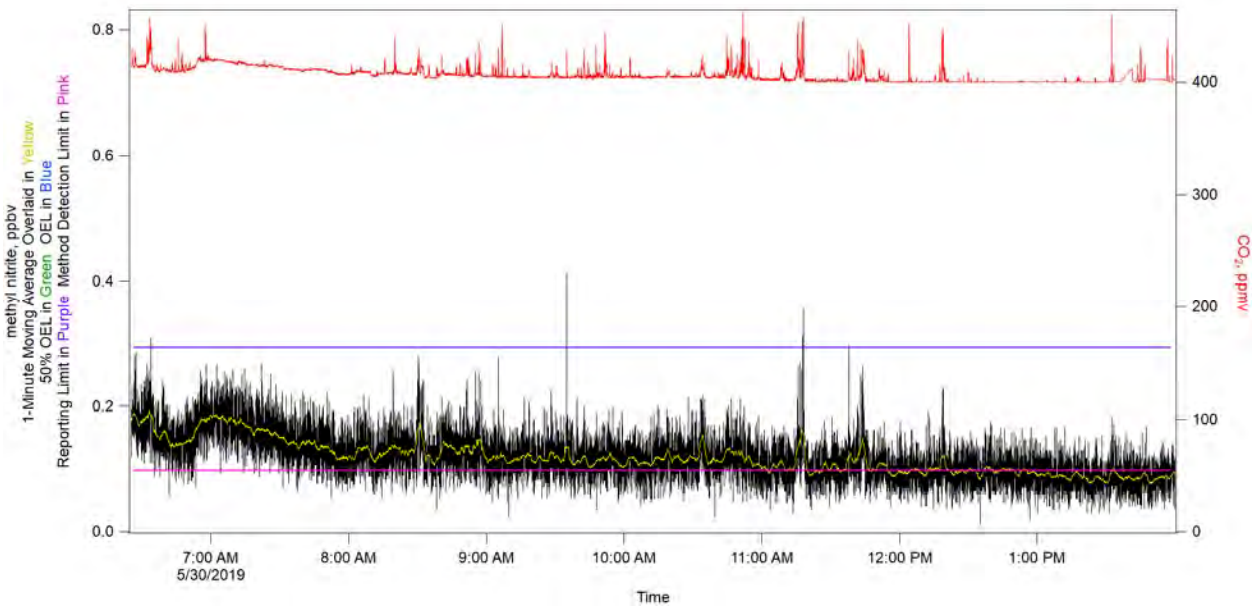

Figure 4-14. Methyl Nitrite.

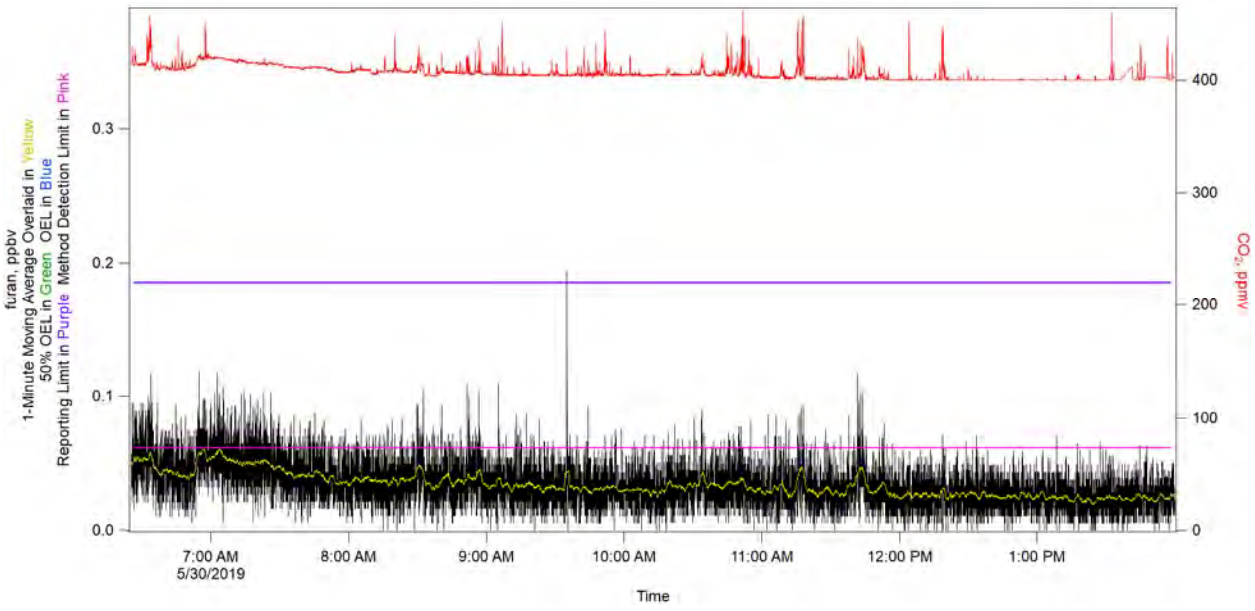

Figure 4-15. Furan.

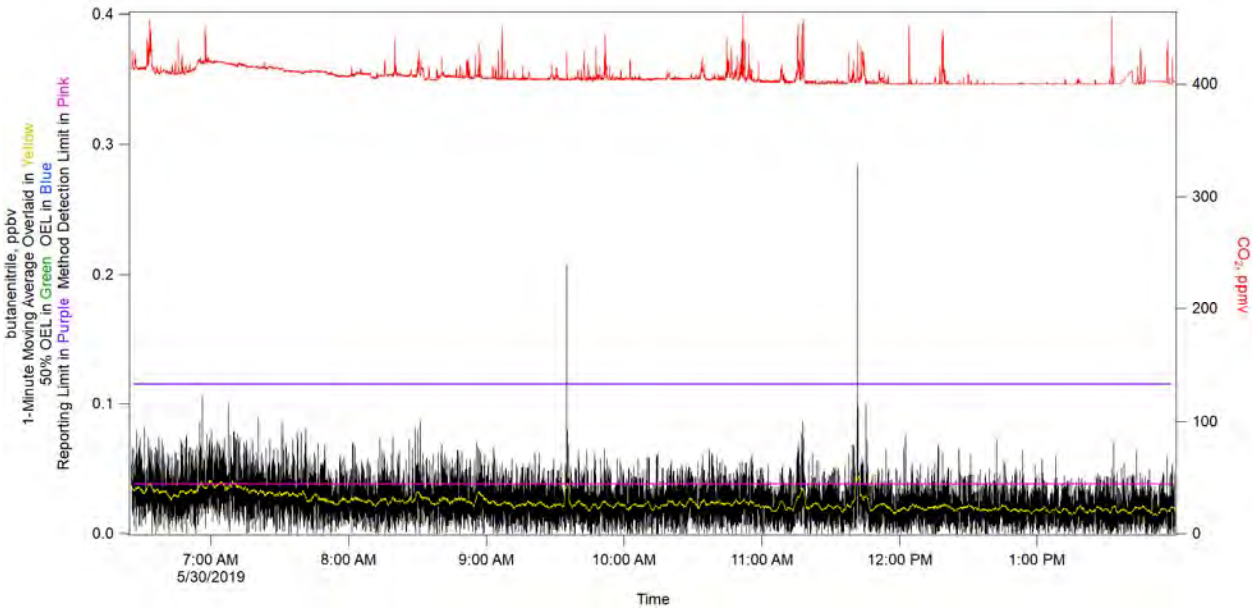

Figure 4-16. Butanenitrile.

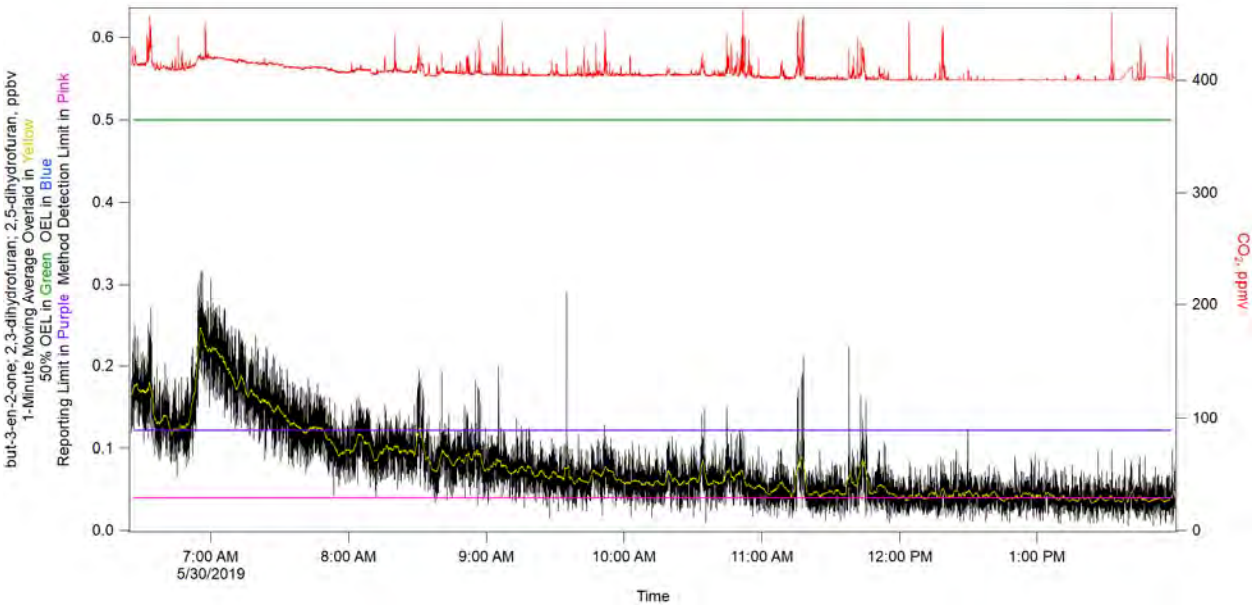

Figure 4-17. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

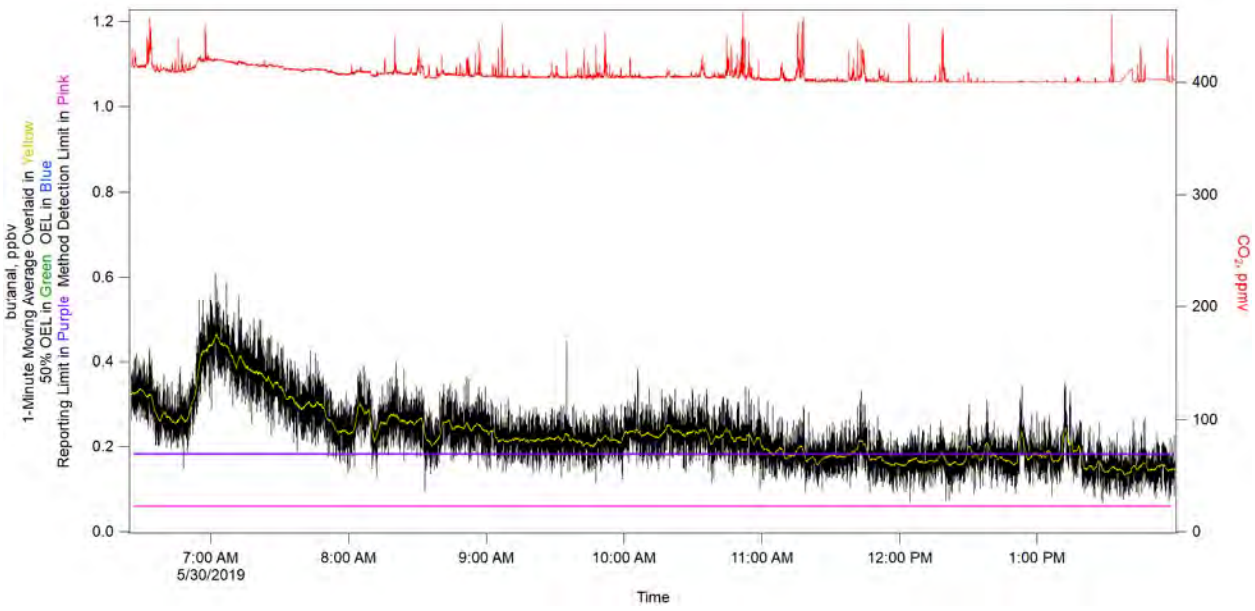

Figure 4-18. Butanal.

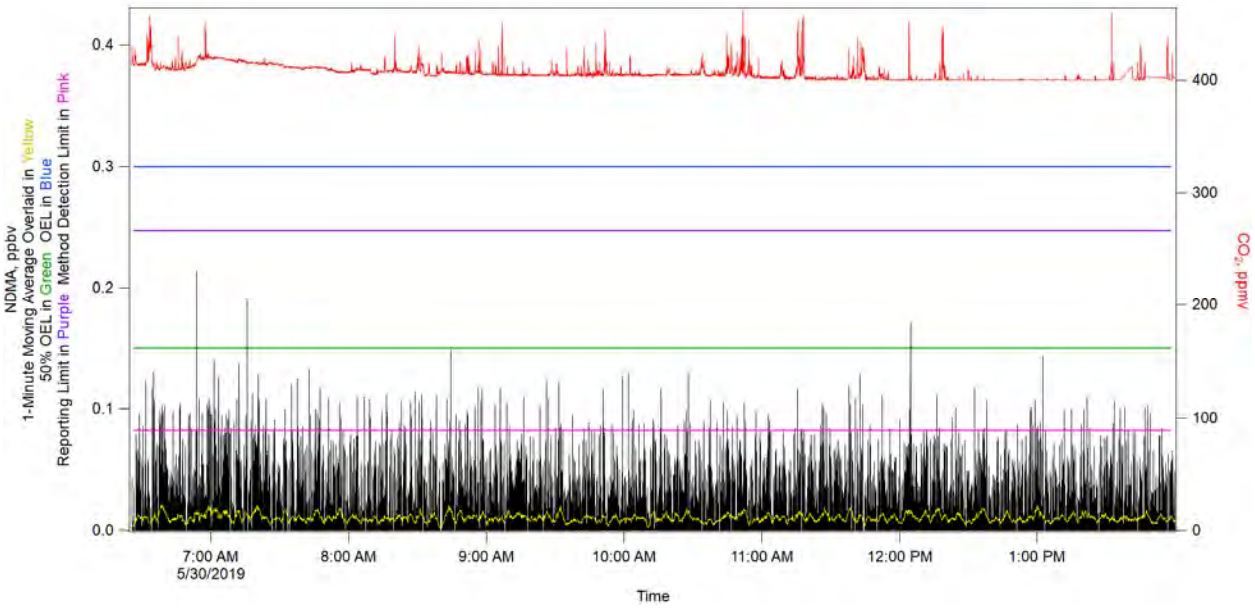

Figure 4-19. N-nitrosodimethylamine (NDMA).

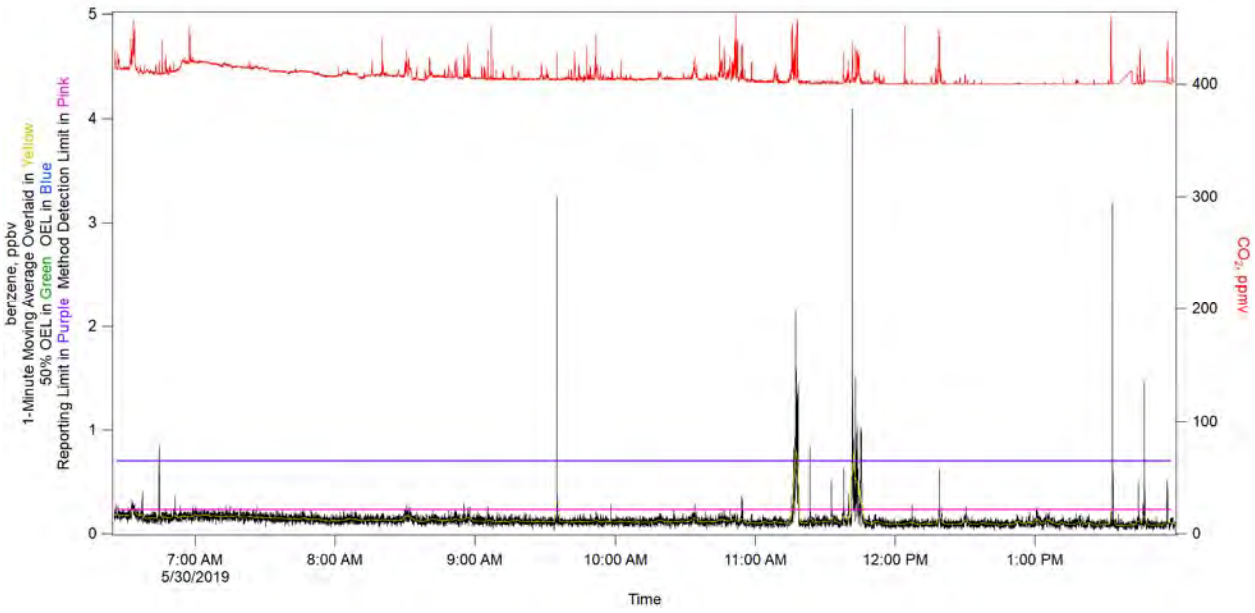

Figure 4-20. Benzene.

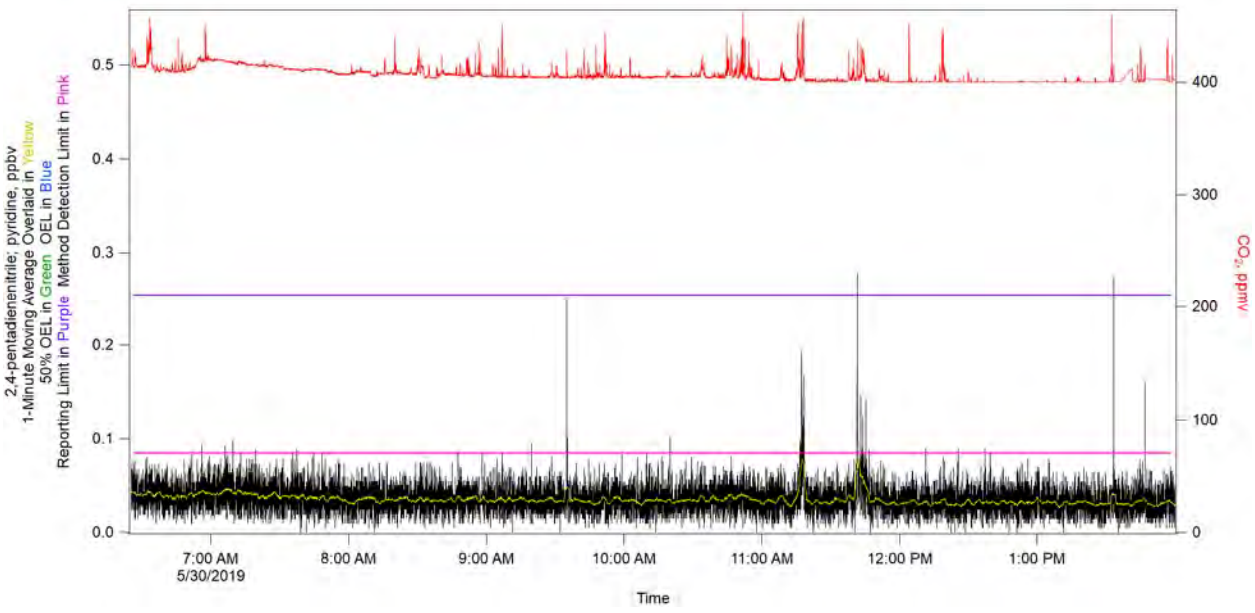

Figure 4-21. 2,4-pentadienenitrile; Pyridine.

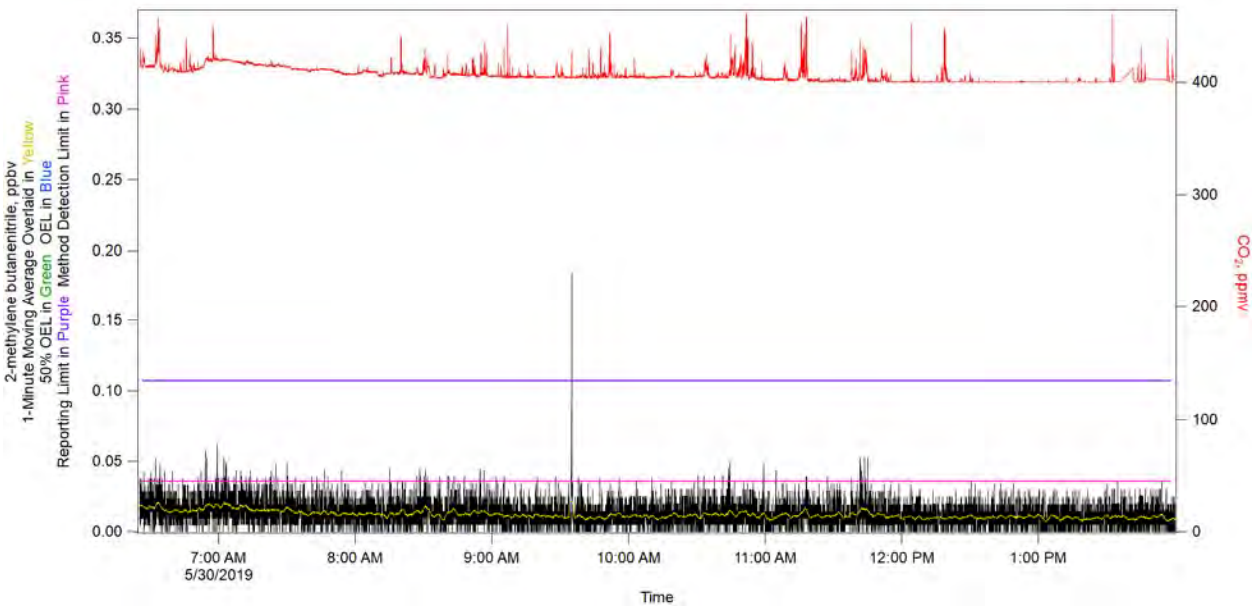

Figure 4-22. 2-methylene Butanenitrile.

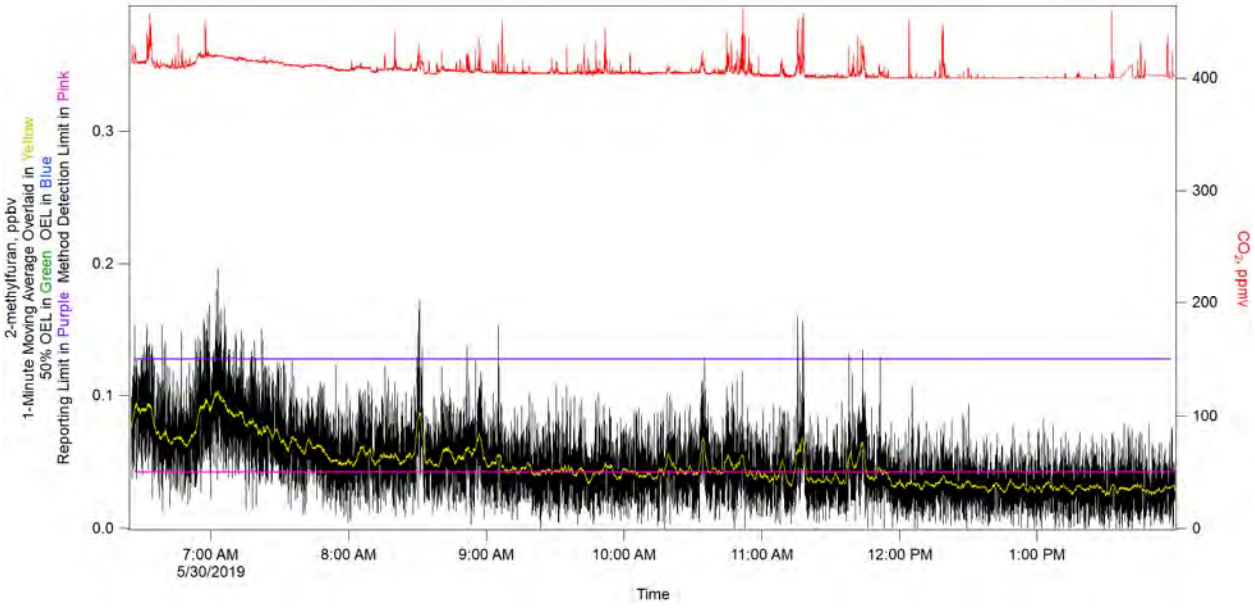

Figure 4-23. 2-methylfuran.

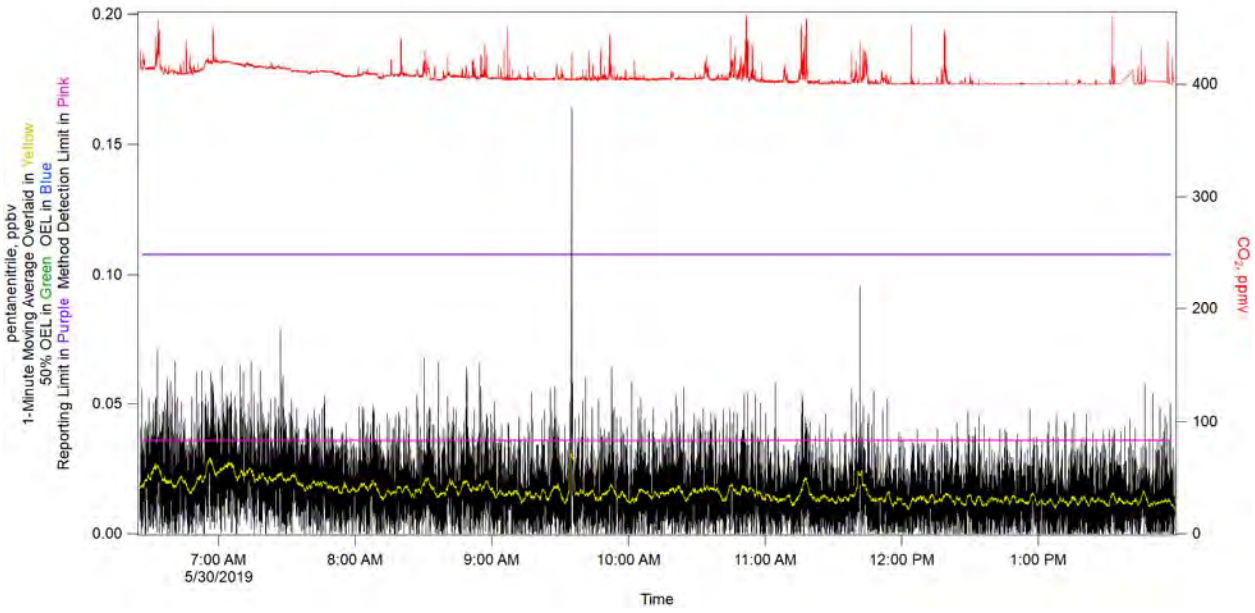

Figure 4-24. Pentanenitrile.

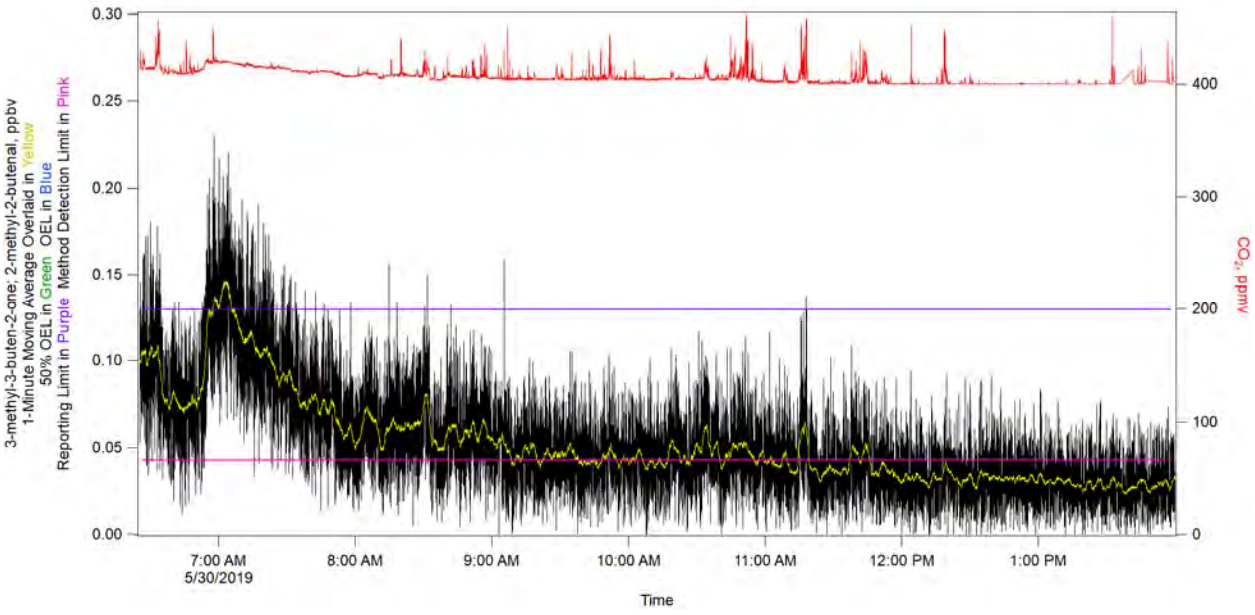

Figure 4-25. 3-methyl-3-buten-2-one; 2-methyl-2-butenal.

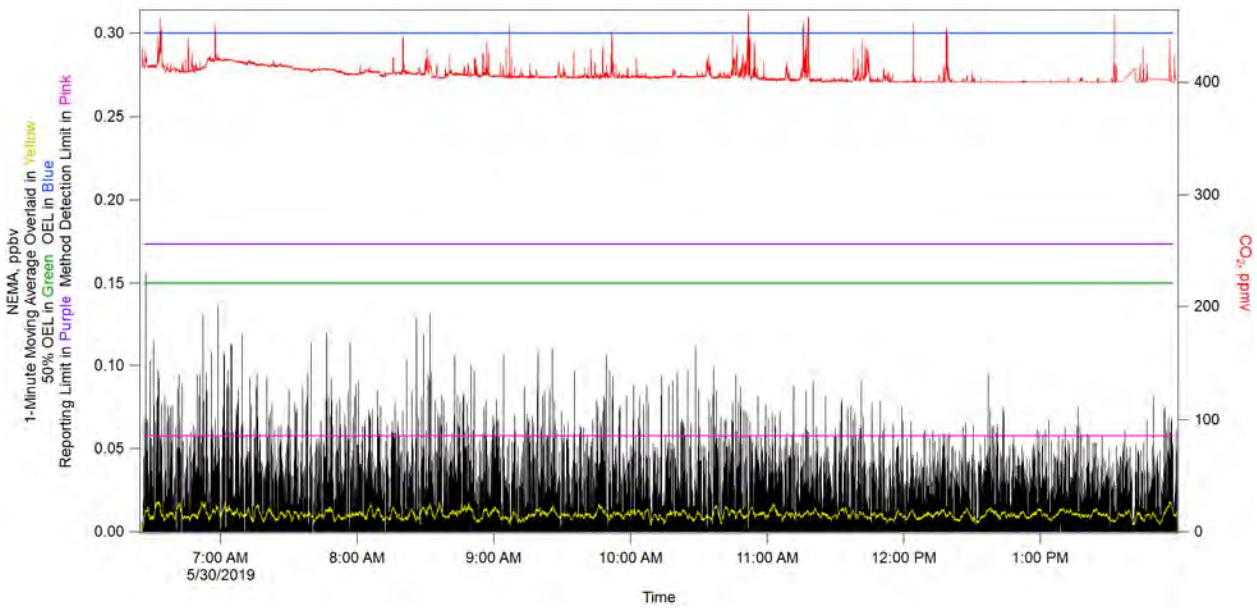

Figure 4-26. N-nitrosomethylethylamine (NEMA).

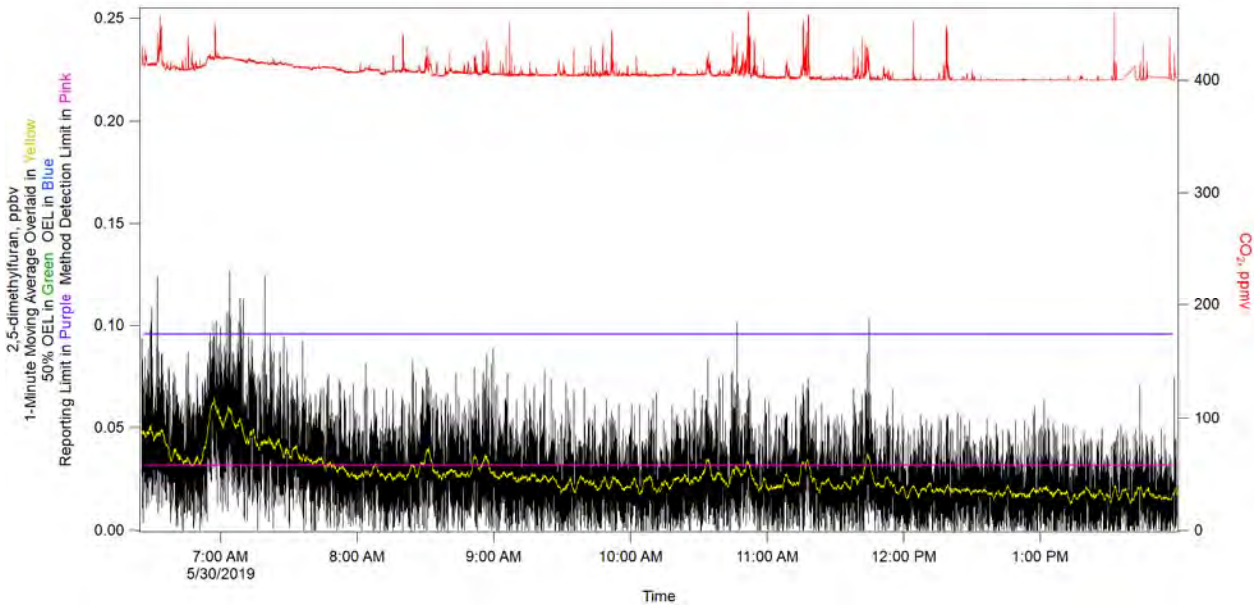

Figure 4-27. 2,5-dimethylfuran.

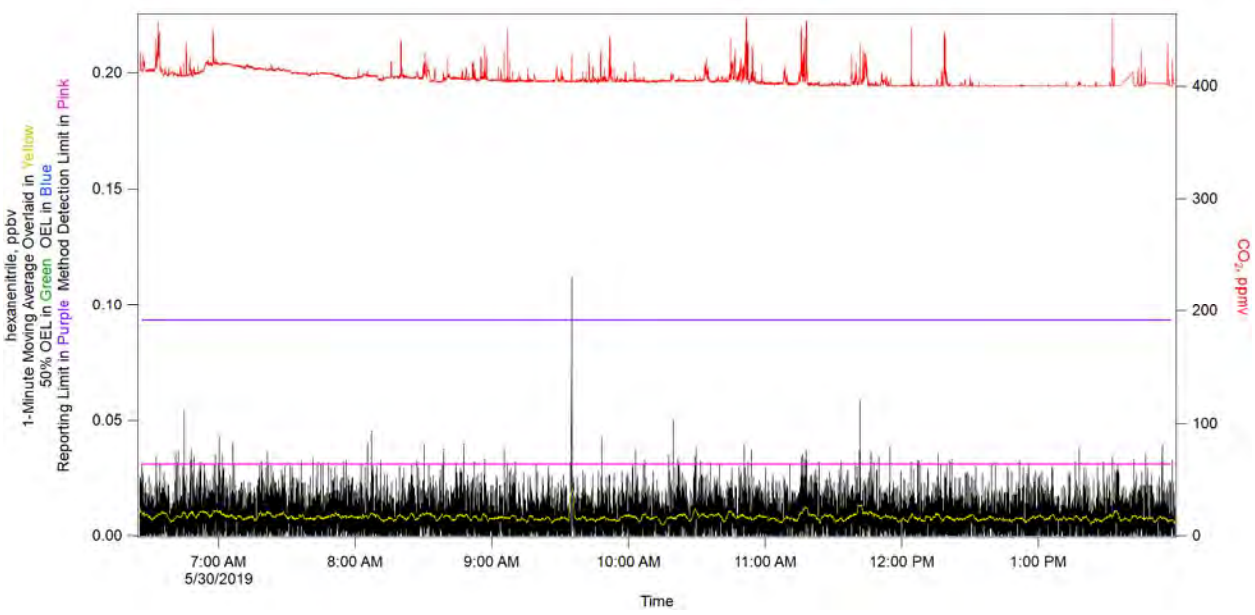

Figure 4-28. Hexanenitrile.

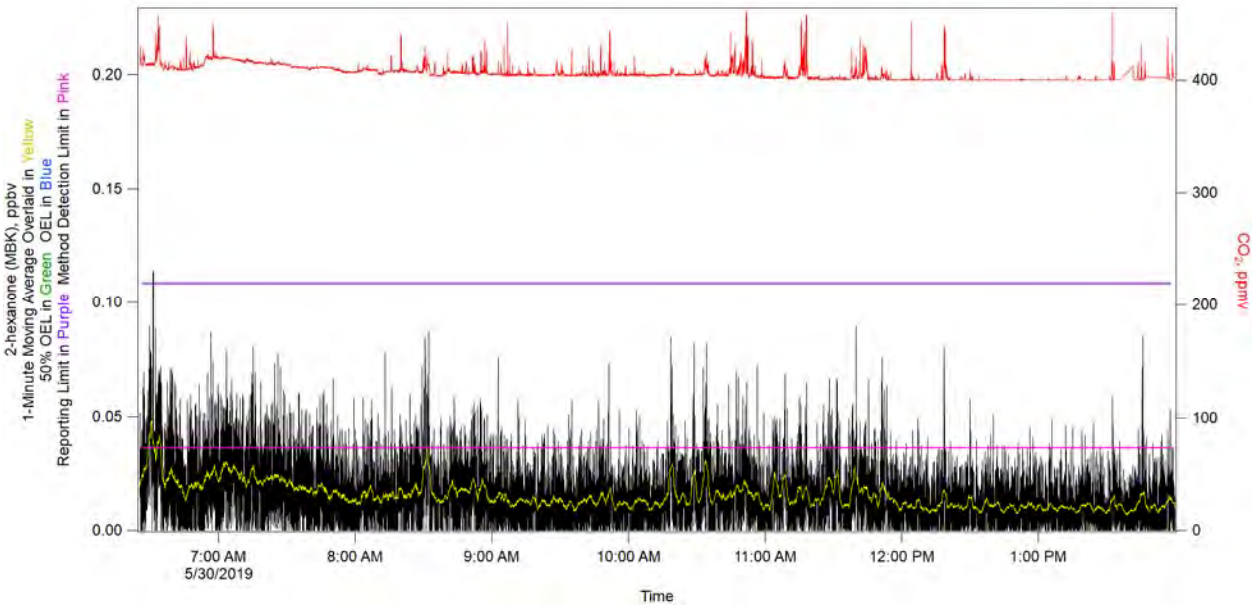

Figure 4-29. 2-hexanone (MBK).

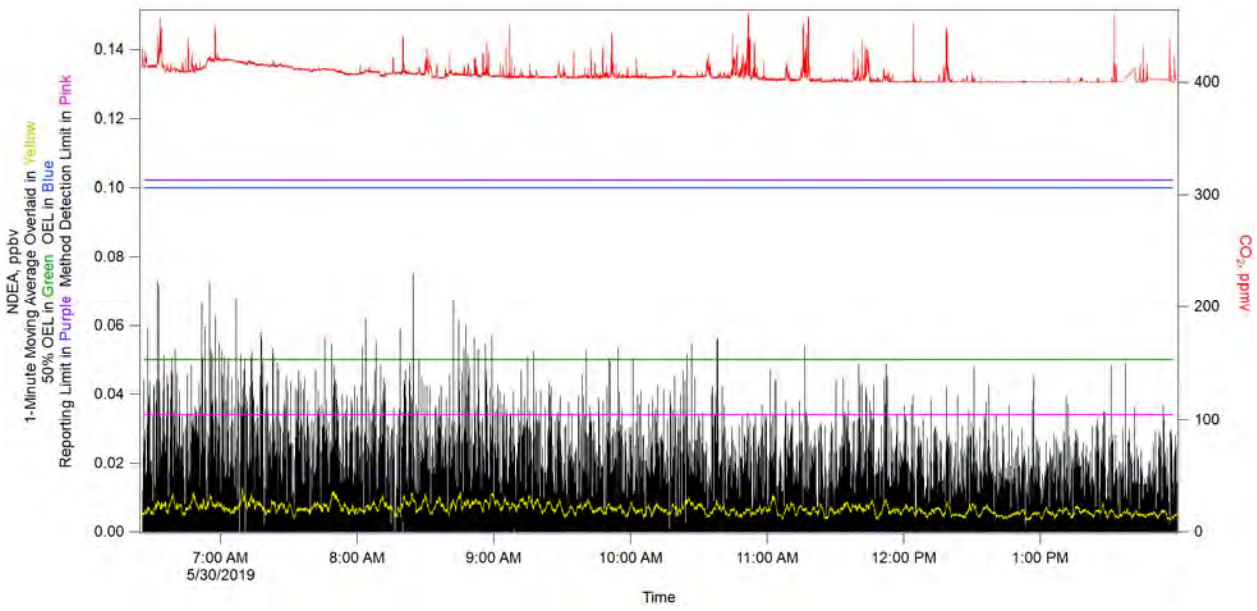

Figure 4-30. N-nitrosodiethylamine (NDEA).

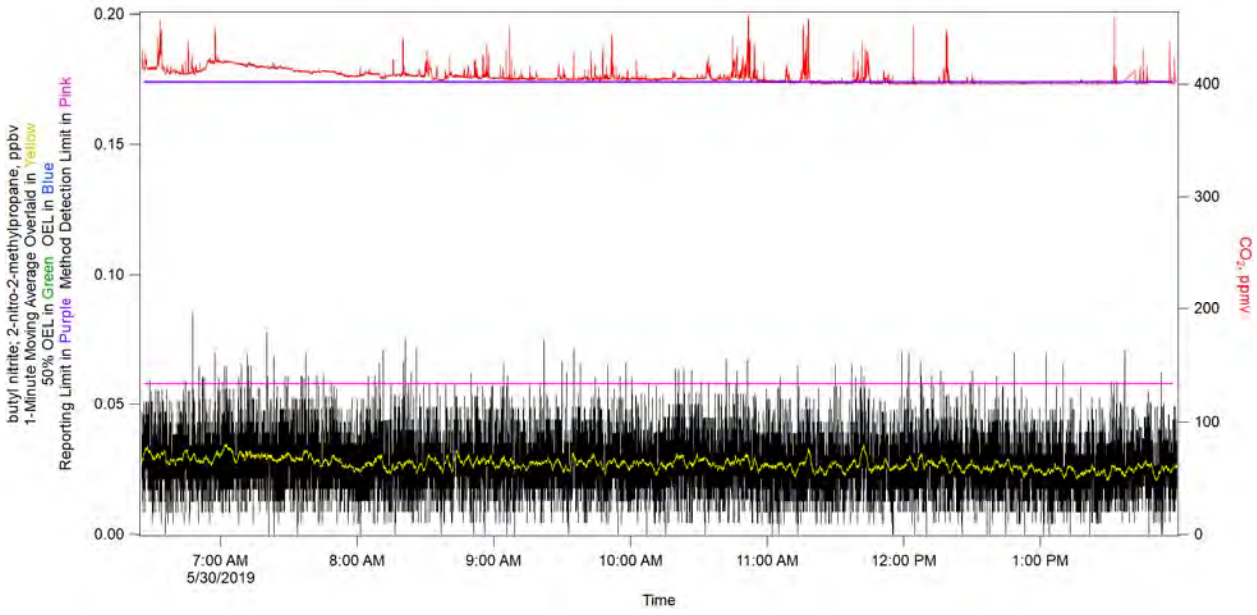

Figure 4-31. Butyl Nitrite; 2-nitro-2-methylpropane.

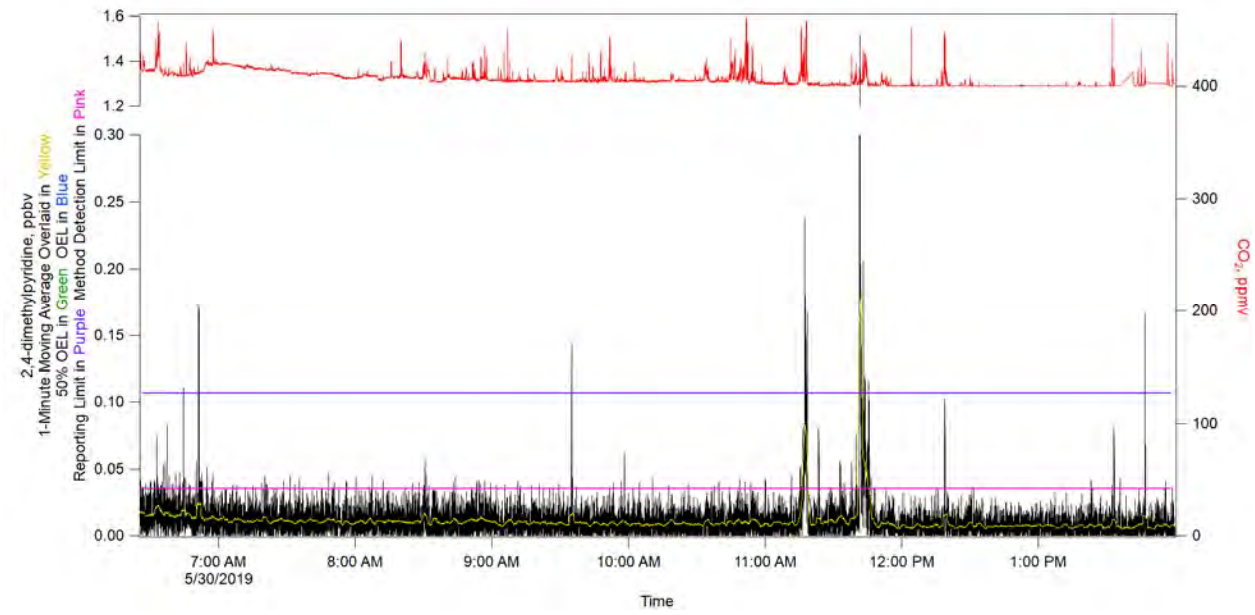

Figure 4-32. 2,4-dimethylpyridine.

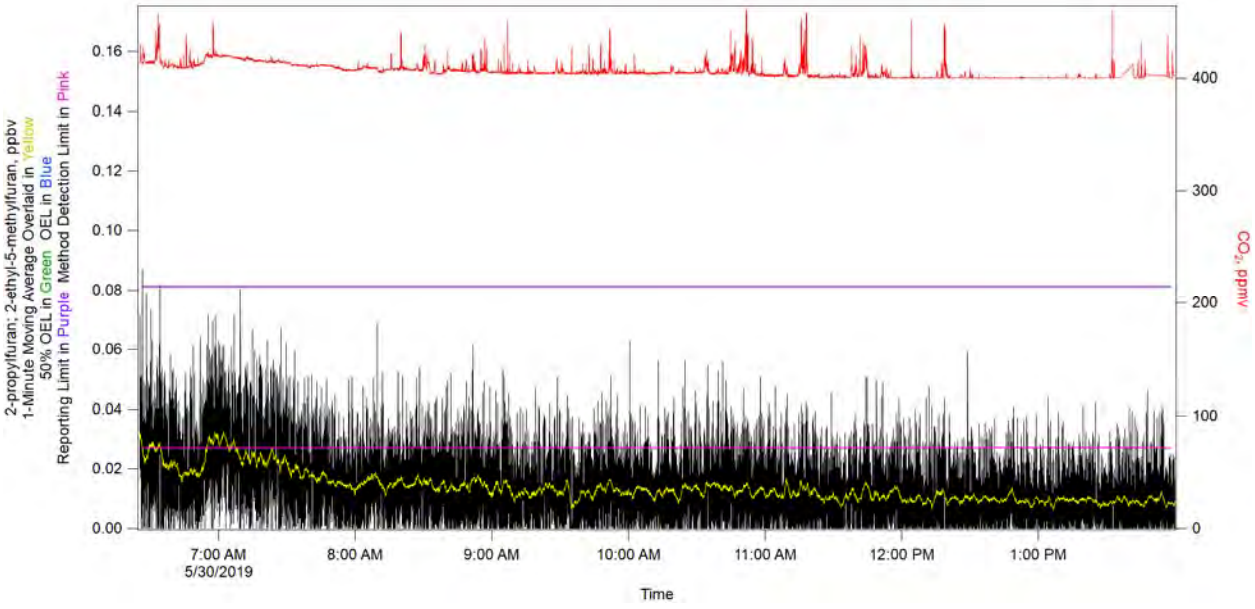

Figure 4-33. 2-propylfuran; 2-ethyl-5-methylfuran.

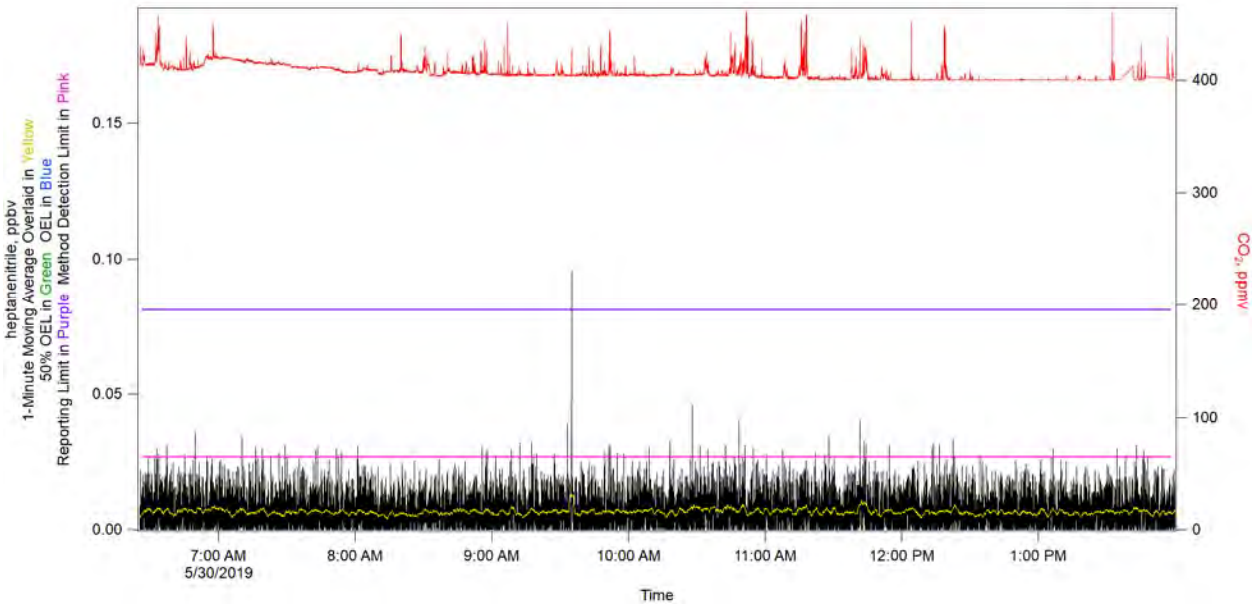

Figure 4-34. Heptanenitrile.

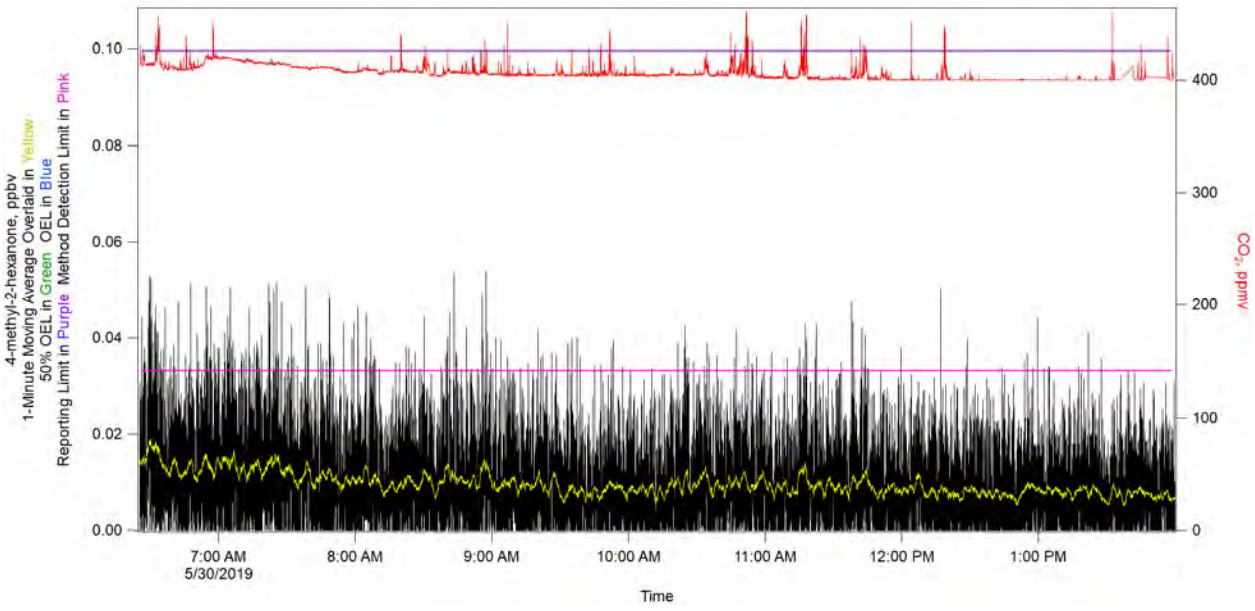

Figure 4-35. 4-methyl-2-hexanone.

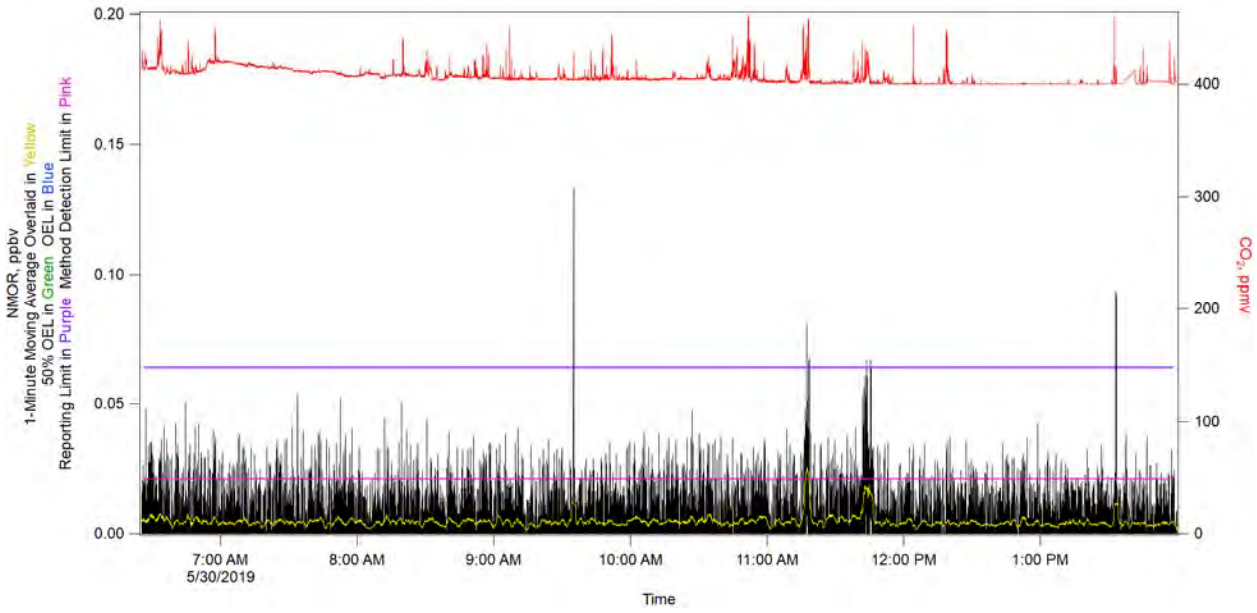

Figure 4-36. N-nitrosomorpholine (NMOR).

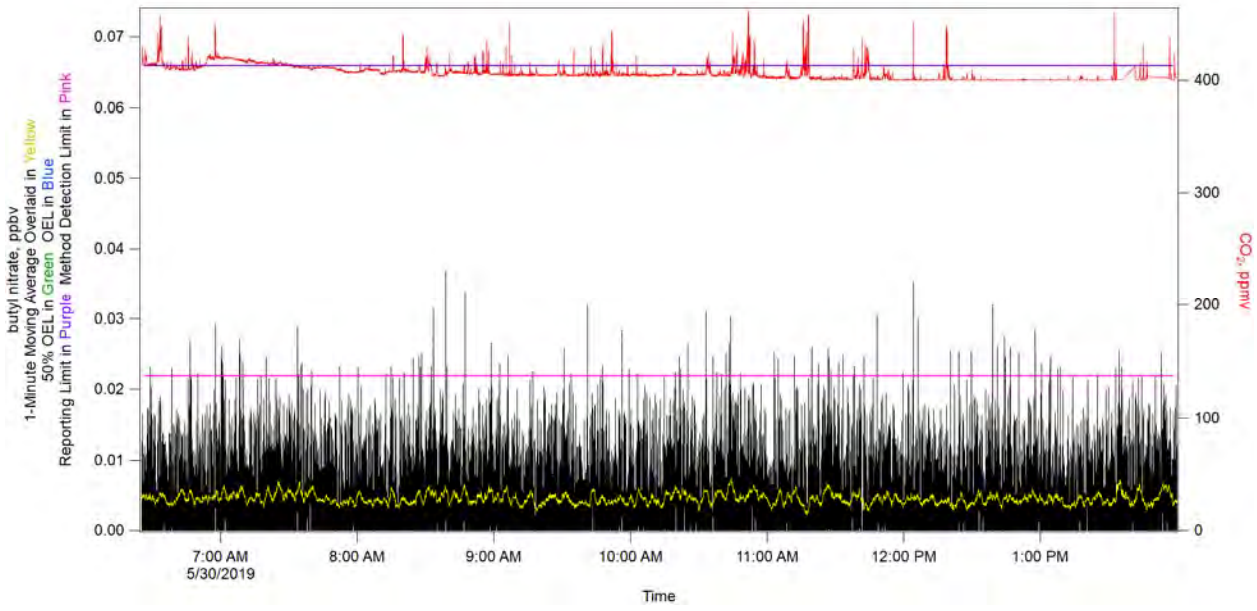

Figure 4-37. Butyl Nitrate.

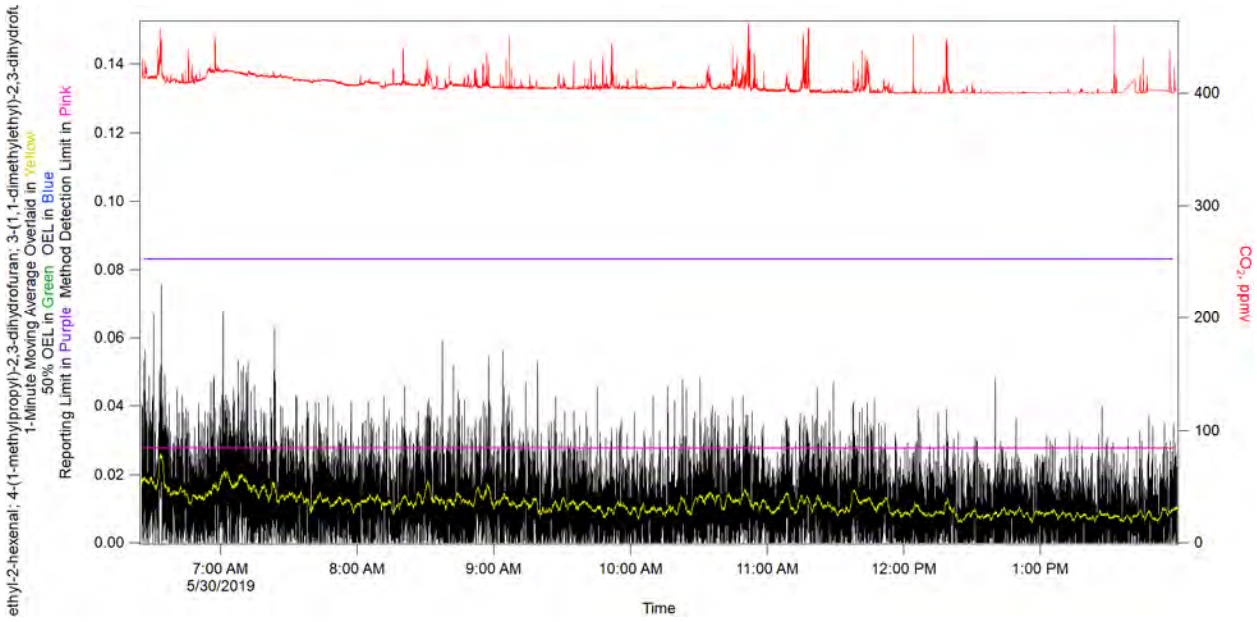

Figure 4-38. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

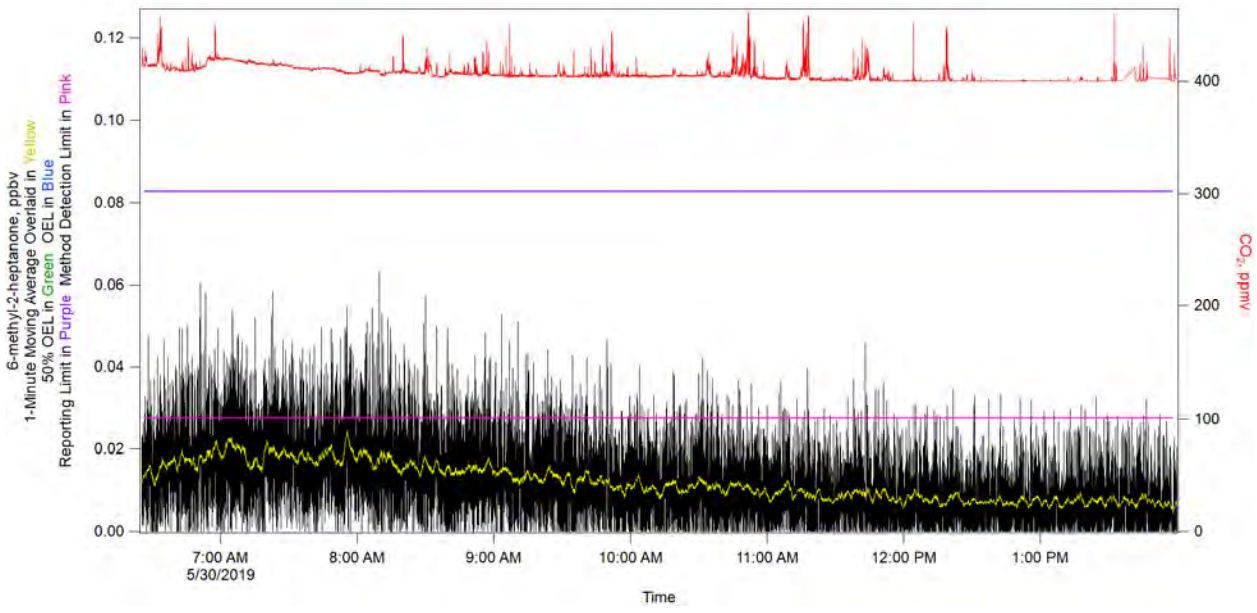

Figure 4-39. 6-methyl-2-heptanone.

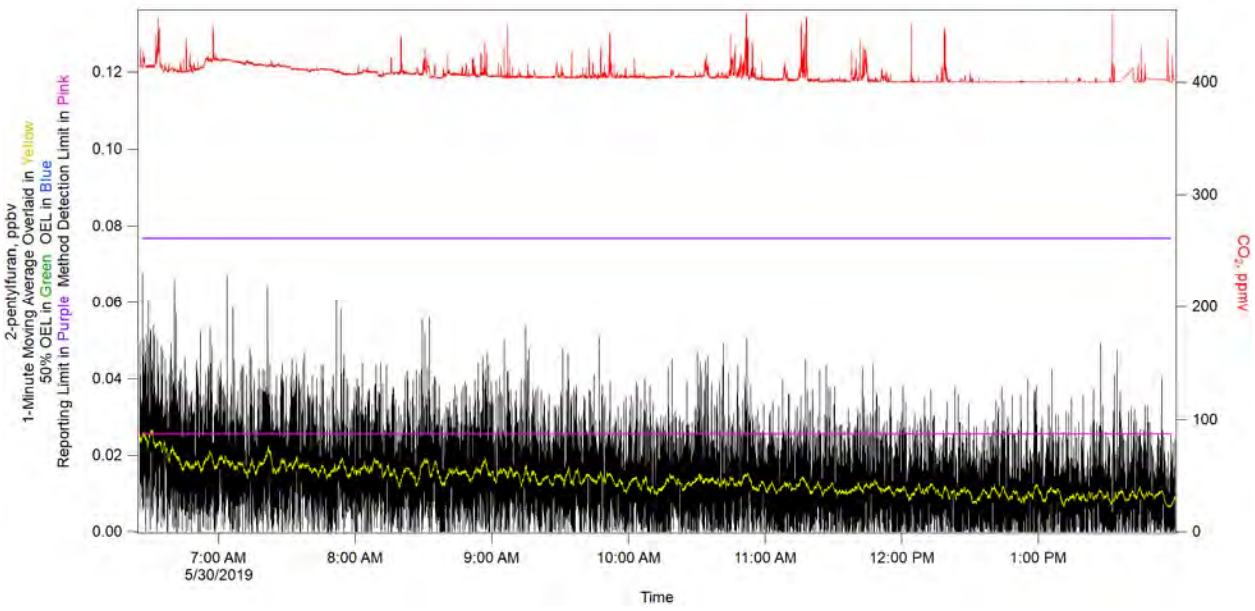

Figure 4-40. 2-pentylfuran.

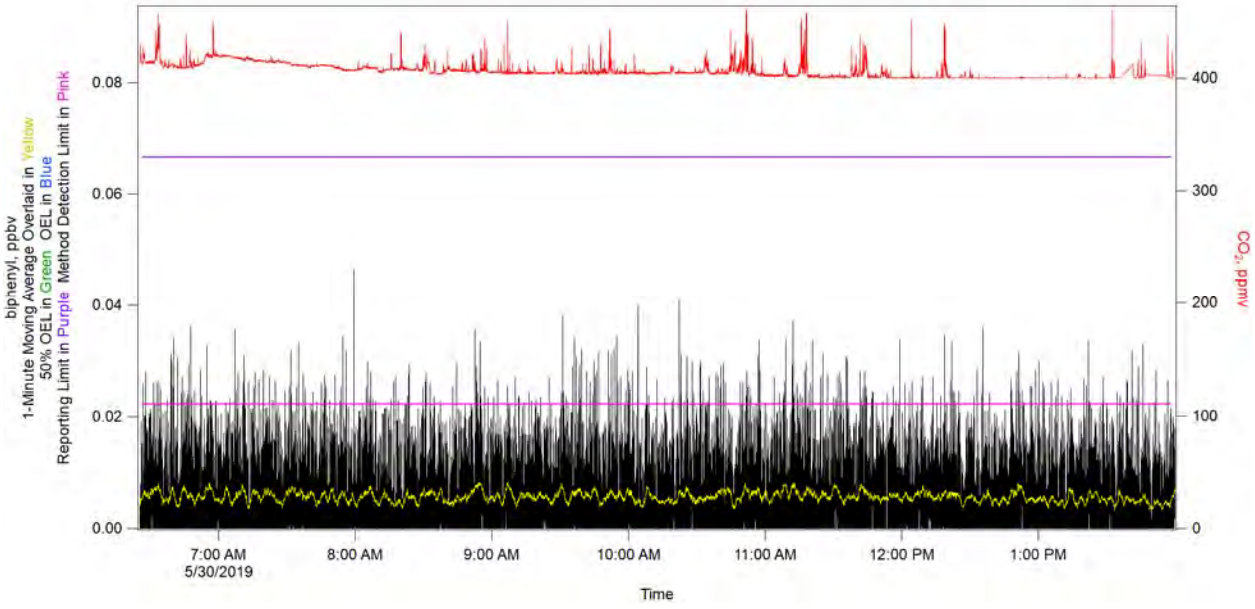

Figure 4-41. Biphenyl.

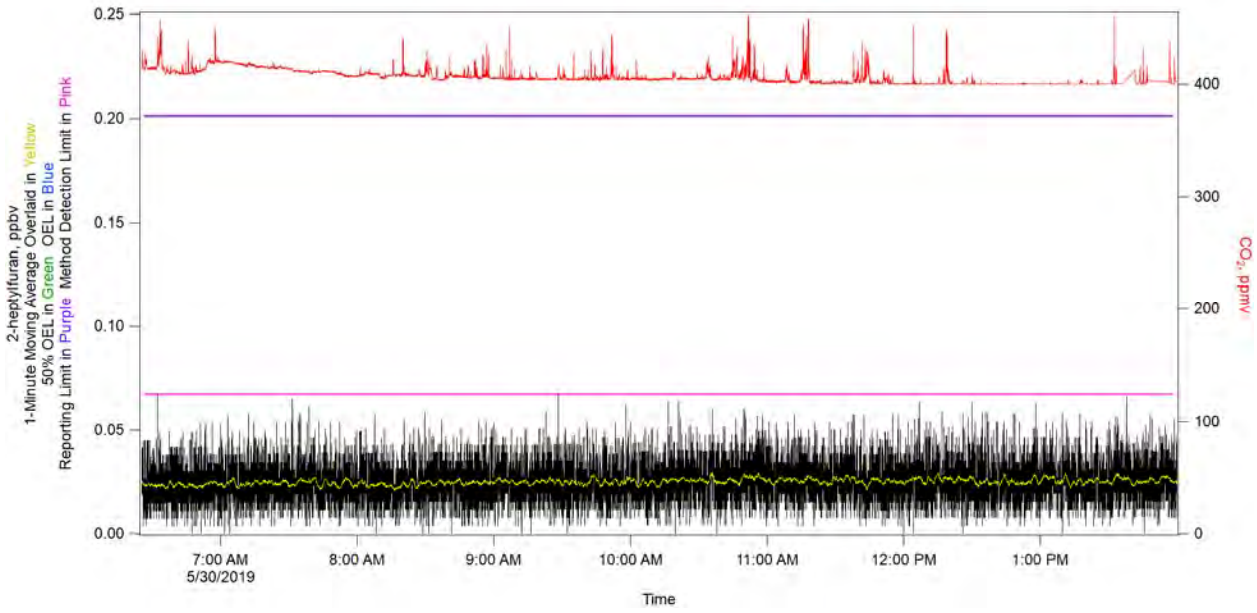

Figure 4-42. 2-heptylfuran.

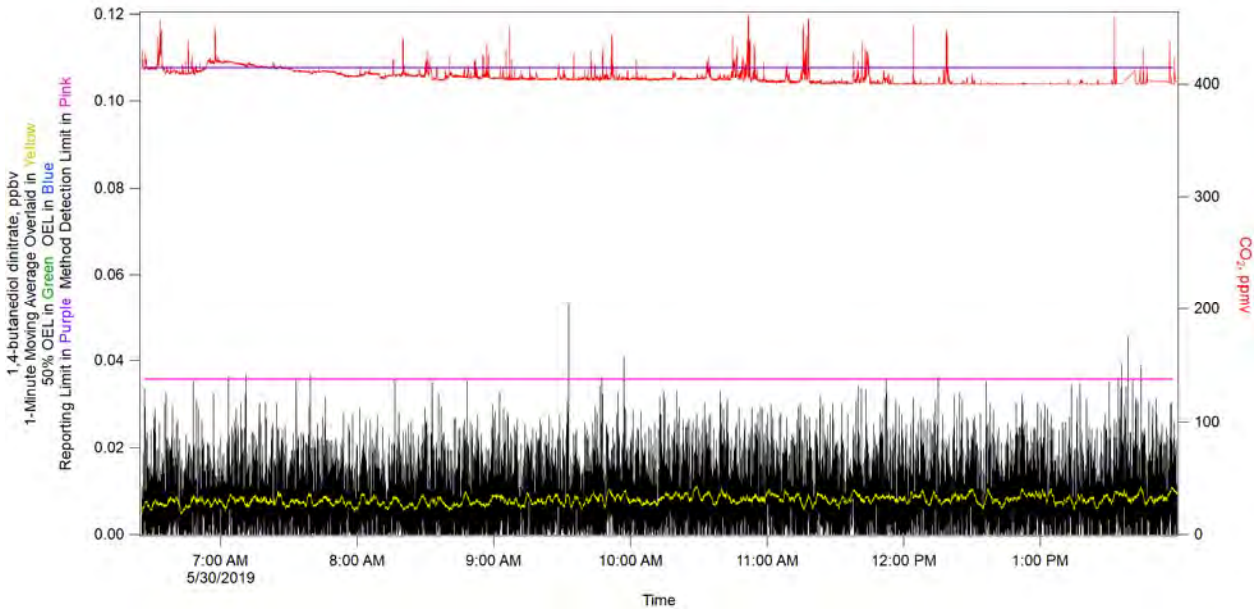

Figure 4-43. 1,4-butanediol Dinitrate.

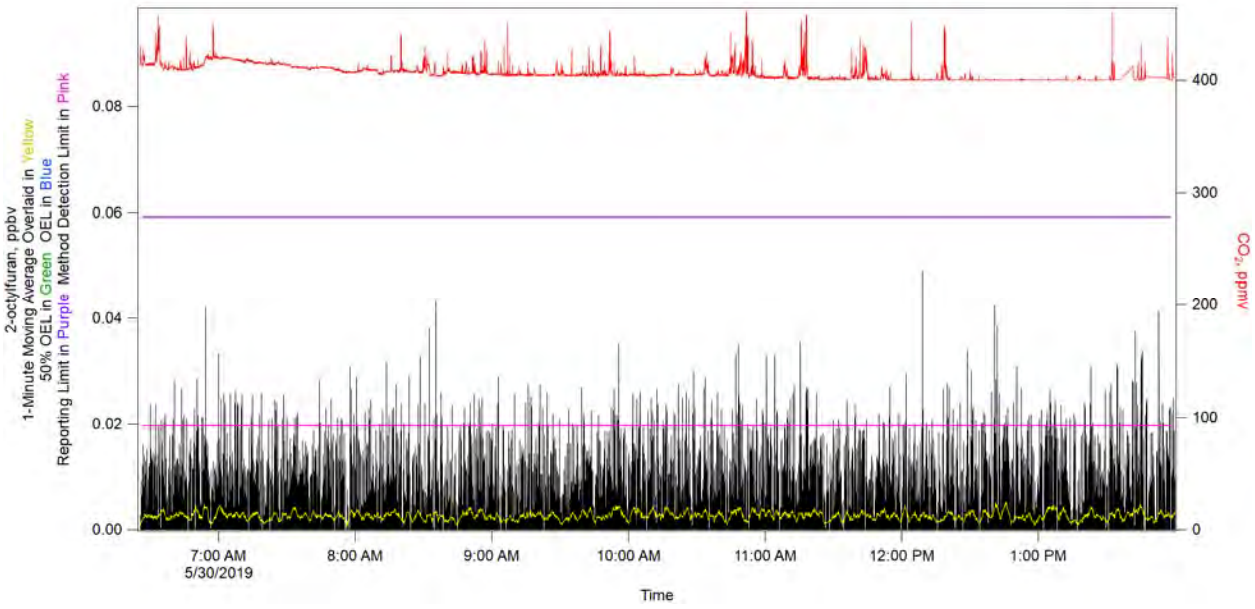

Figure 4-44. 2-octylfuran.

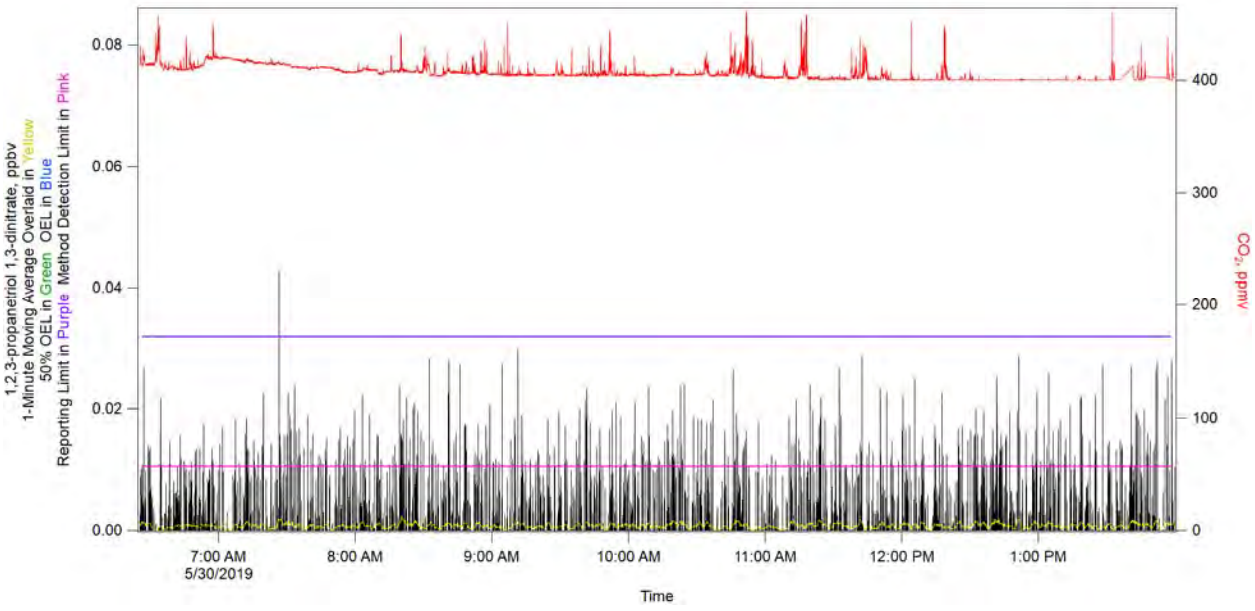

Figure 4-45. 1,2,3-propanetriol 1,3-dinitrate.

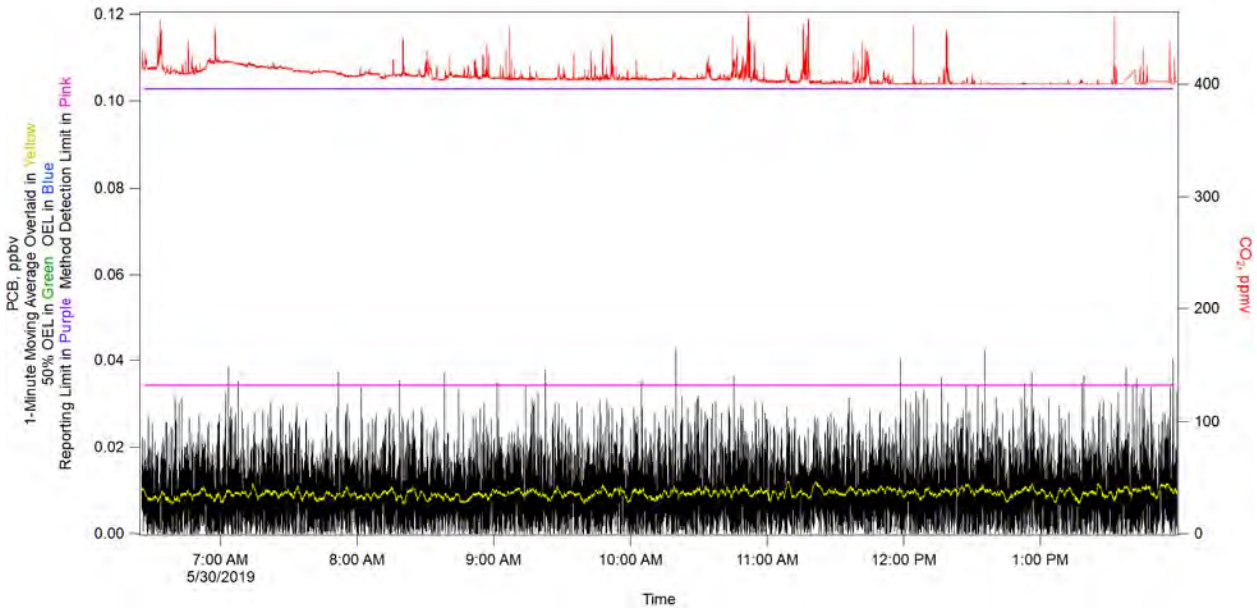

Figure 4-46. PCB.

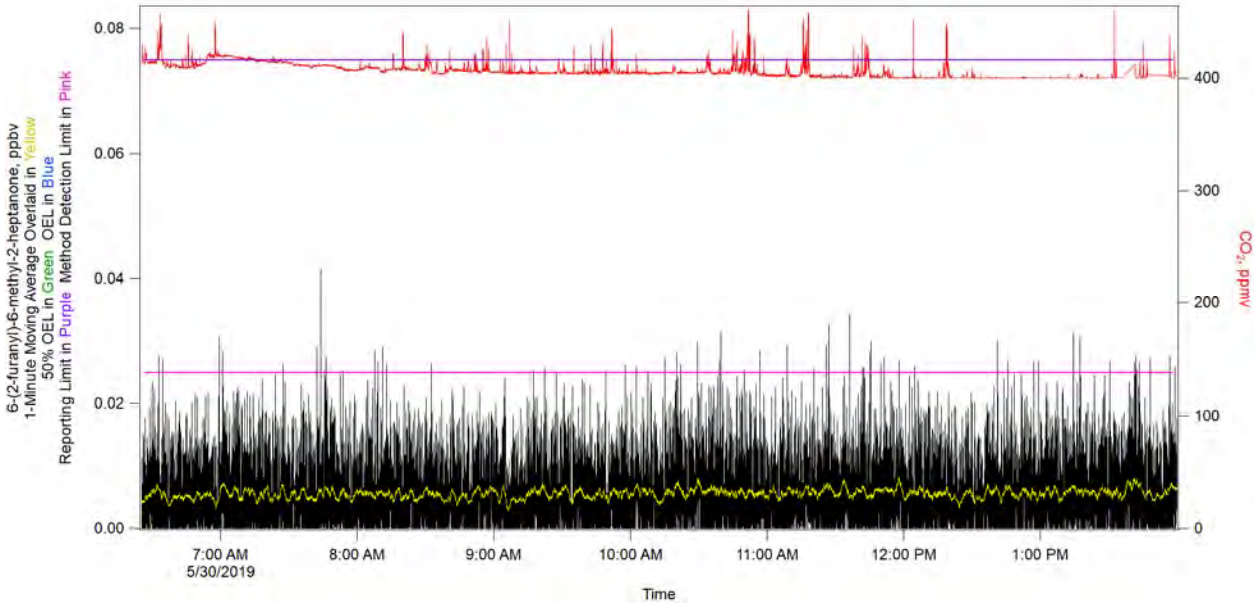

Figure 4-47. 6-(2-furanyl)-6-methyl-2-heptanone.

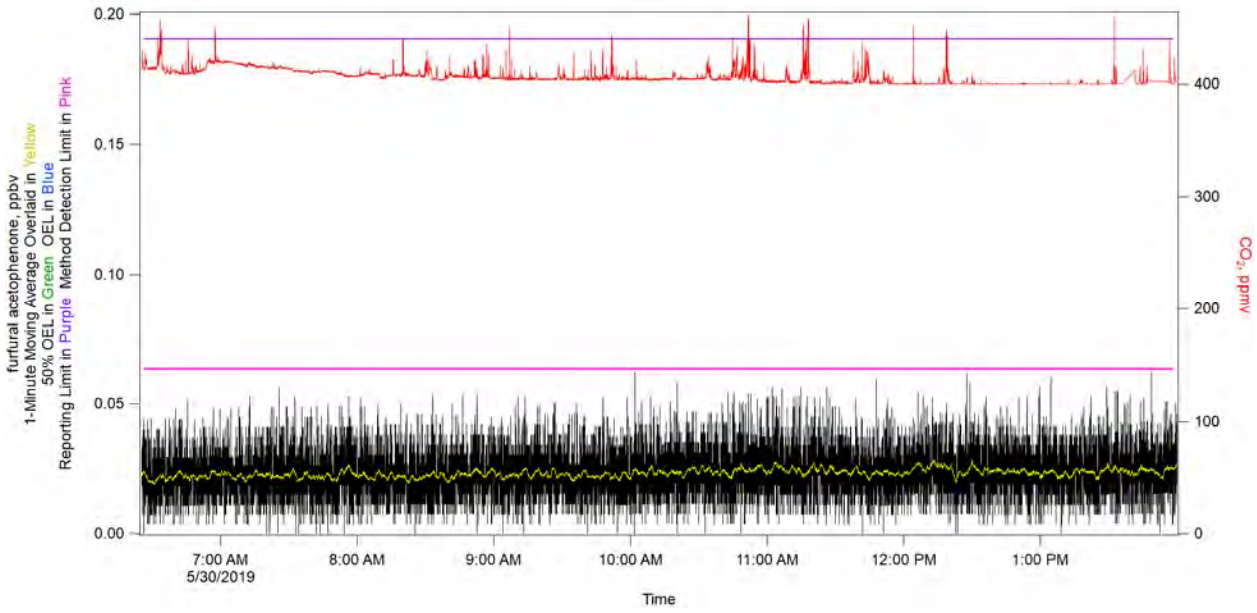

Figure 4-48. Furfural Acetophenone.

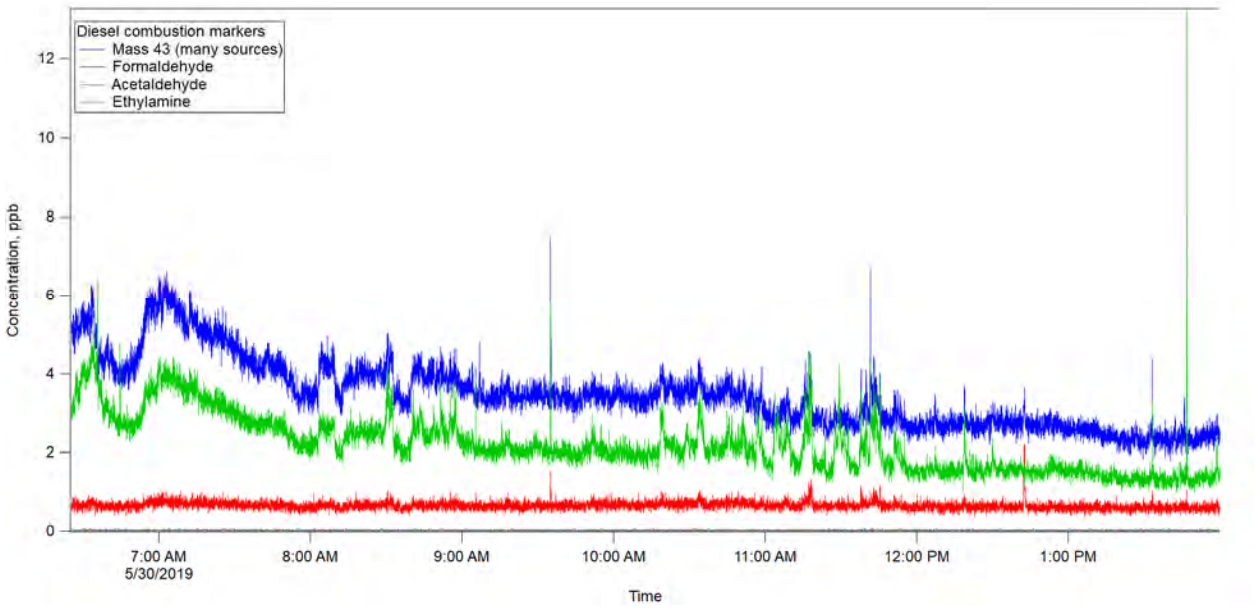

Figure 4-49. Diesel Combustion Markers.

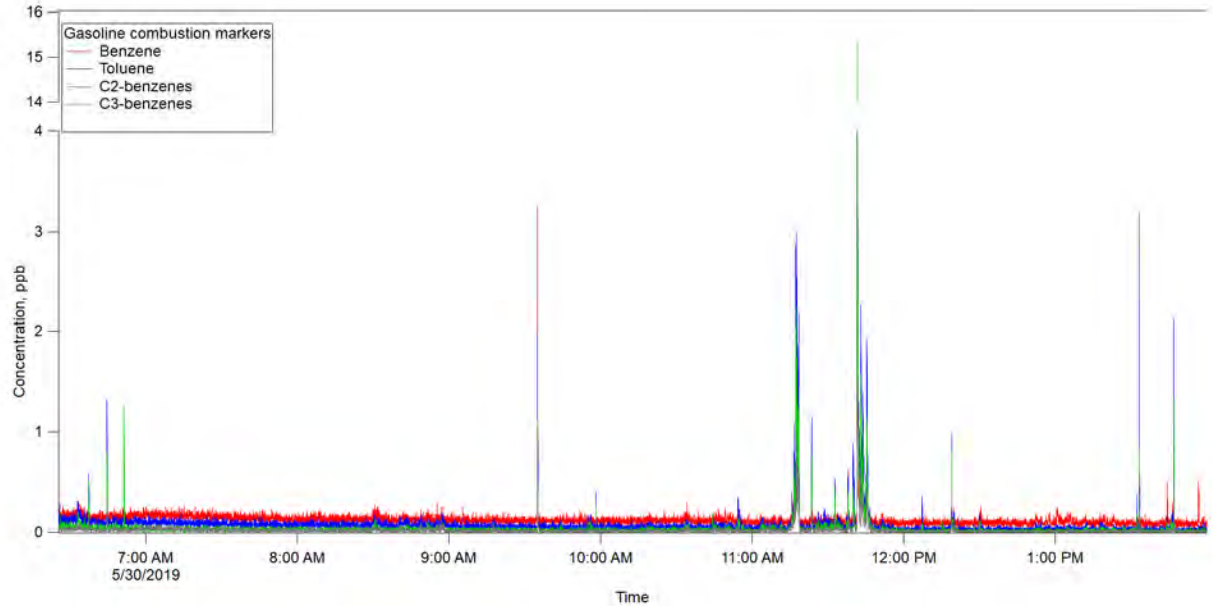

Figure 4-50. Gasoline Combustion Markers.

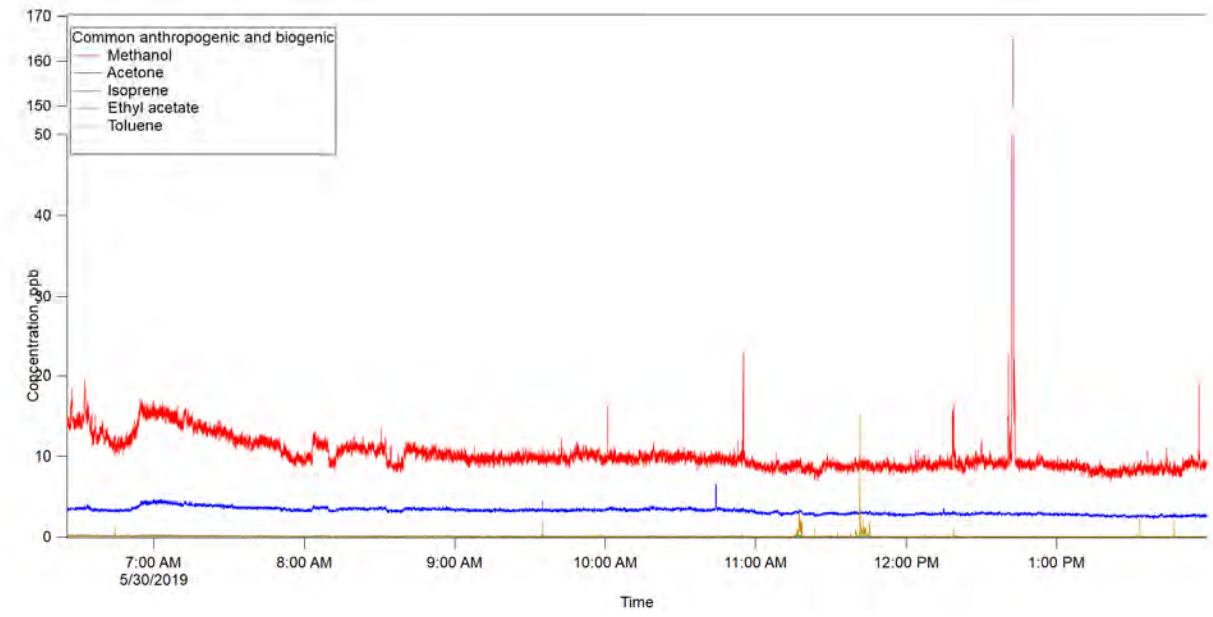

Figure 4-51. Plant and Human Markers.

5.0 MAY 31, 2019 AND JUNE 1, 2019 – AZ-102 TO AN-106 WASTE TRANSFER

5.1 Quality Assessment

Data from May 31, 2019, and June 1, 2019, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

5.2 Summary

On May 31, 2019, the ML arrived at the TerraGraphics warehouse at 04:04 to prepare for monitoring activities of AZ-102 to AN-106 Waste Transfer. The QA/QC zero-air/span check was performed on the PTR-MS beginning at 04:15. The ML Operators arrived at the Hanford Site to check in with the CSO and configure the ML into mobile monitoring mode at 05:12. The ML Operators attended a waste transfer pre-job briefing from 05:51 to 06:50. After leaving the CSO, the ML Operators headed to what appeared to be downwind of waste transfer activities. After parking the ML, the Operators logged into APGEMS to determine the exact position for further monitoring. APGEMS software showed the best accessible position for monitoring to be 50 yards southeast of their current location and Operators proceeded to move the ML to that location at 07:36. At 07:48, ML Operators received a text notification that stated the transfer was about to begin. At 08:40, Operators noted that they had heard over the radio of a failed reading from a tank level indicator in AN Farm. At 10:01 the ML Operators arrived at the CSO to check the status of transfer activities. After speaking with the CSM, Operators discovered that the failed reading at 08:40 caused transfer activities to pause for troubleshooting to occur. At 11:22, the CSM announced for all transfer workers to return to their stations and ML Operators relocated to a downwind position shortly after. At 12:07, the ML Operators moved positions due to a change in wind direction and relocated to the west entrance of AZ Tank Farm by 12:12. The waste transfer began at 12:10. Wind changed direction yet again, validation from the APGEMS modeling called for the ML to move, and by 12:31, the ML was parked on the southeast side of AZ Tank Farm. Wind direction shifted often between 12:56 to 14:36, requiring two additional location changes. At 15:24, the subject matter expert (SME) performed a remote check to ensure all instrumentation was running ideally for overnight data collection. After checking out with the CSM and returning the radio, Operators left the Hanford Site at 15:40.

On June 1, 2019, the ML arrived at the TerraGraphics Office at 04:05 and departed for the Hanford Site by 04:10. At 05:05, Operators arrived at the CSO and checked in with the CSM. Shortly after leaving the CSO, Operators ran APGEMS to determine the best location for ML monitoring of the ongoing transfer activities. At 05:58, the ML was parked about 50 yards northeast of the AN Tank Farm. Due to changing winds, the ML relocated to the east of AZ/AN Tank Farms, at 06:27. At 06:56, the ML was parked east of AZ Farm. At 07:57, Operators noted in the logbook that wind was continuing to shift, and this might potentially cause exhaust hits to be seen. At 09:11, the ML was moved to the north of AN Farm. At 14:32, the ML was parked to the east of AZ and AN Farms. The tank transfer was completed at 17:31 and Operators prepared the ML to head back to the TerraGraphics warehouse. The QA/QC zero air/span check was performed on the PTR-MS beginning at 18:53.

Table 5-1 illustrates the times and locations on May 31, 2019, through June 1, 2019, where the ML Operators noted a potential source, or a peak of interest was observed. On May 31, 2019, at approximately 11:00, ML Operators located a generator near the fence line of 241-AY and 241-A Farms that the SME requested be monitored. During this time, there were elevated signals for methanol (Figure 5-6), acetonitrile (Figure 5-7), and benzene (Figure 5-21). On June 1, 2019, at approximately 06:00, while monitoring northeast of 241-AN Farm, there were elevated signals for formaldehyde (Figure 5-5), methanol (Figure 5-6), benzene (Figure 5-21), and 3-methyl-3-buten-2-one; 2 methyl-2-butenal (Figure 5-26).

Table 5-1. Mobile Laboratory Summary of Events.

Date	Time	Activity	Observed
05/31/19	08:31	Downwind of 241-AN/AZ Farms	Shift in wind direction
	10:52 - 11:20	Fence line of 241-AN/AZ Farms	Pictures of generator taken for SME
	12:10	West entrance of 241-AZ Farm	Waste transfer started
06/01/19	06:38	East side of 241-AZ/AN Farms	Shift in wind direction
	09:11	North side of AN Farm	Shift in wind direction
	17:31	East side of AZ/AN Farm	Transfer complete

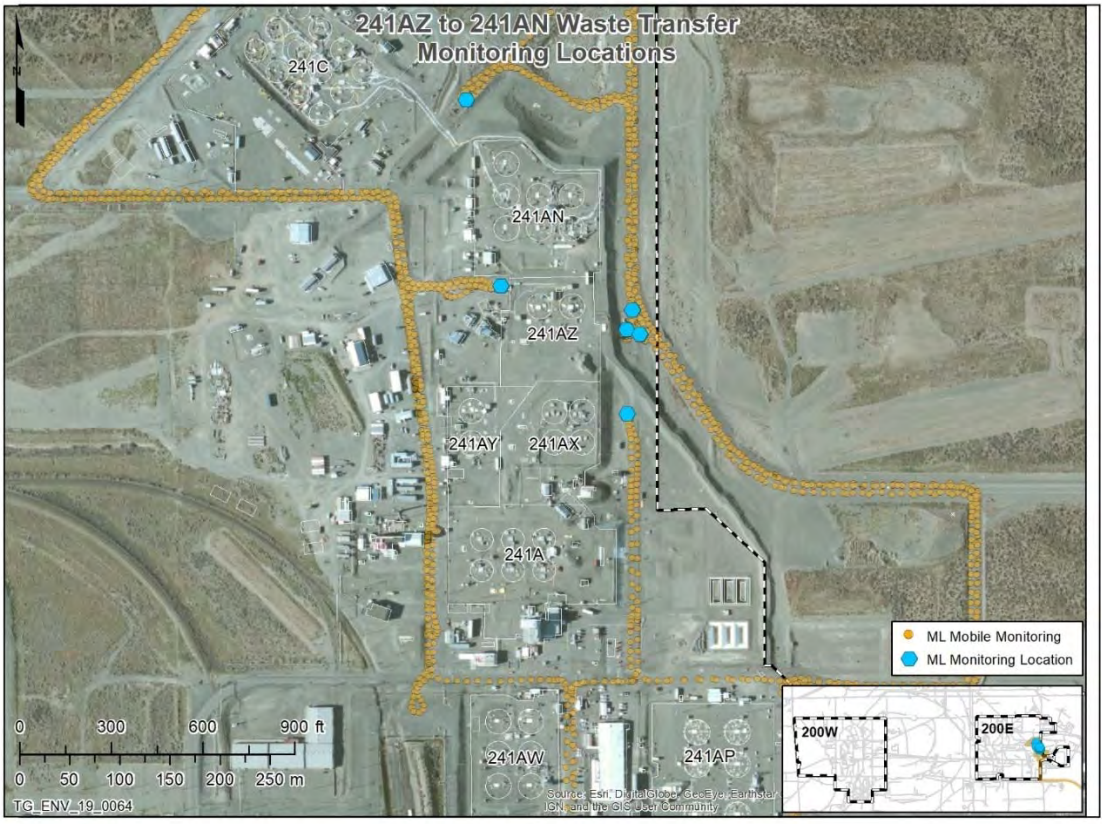

Figure 5-1. Location of the Mobile Laboratory for the Duration of the Monitoring Period of May 31, 2019.

Figure 5-2. Location of the Mobile Laboratory for the Duration of the Monitoring Period of June 1, 2019.

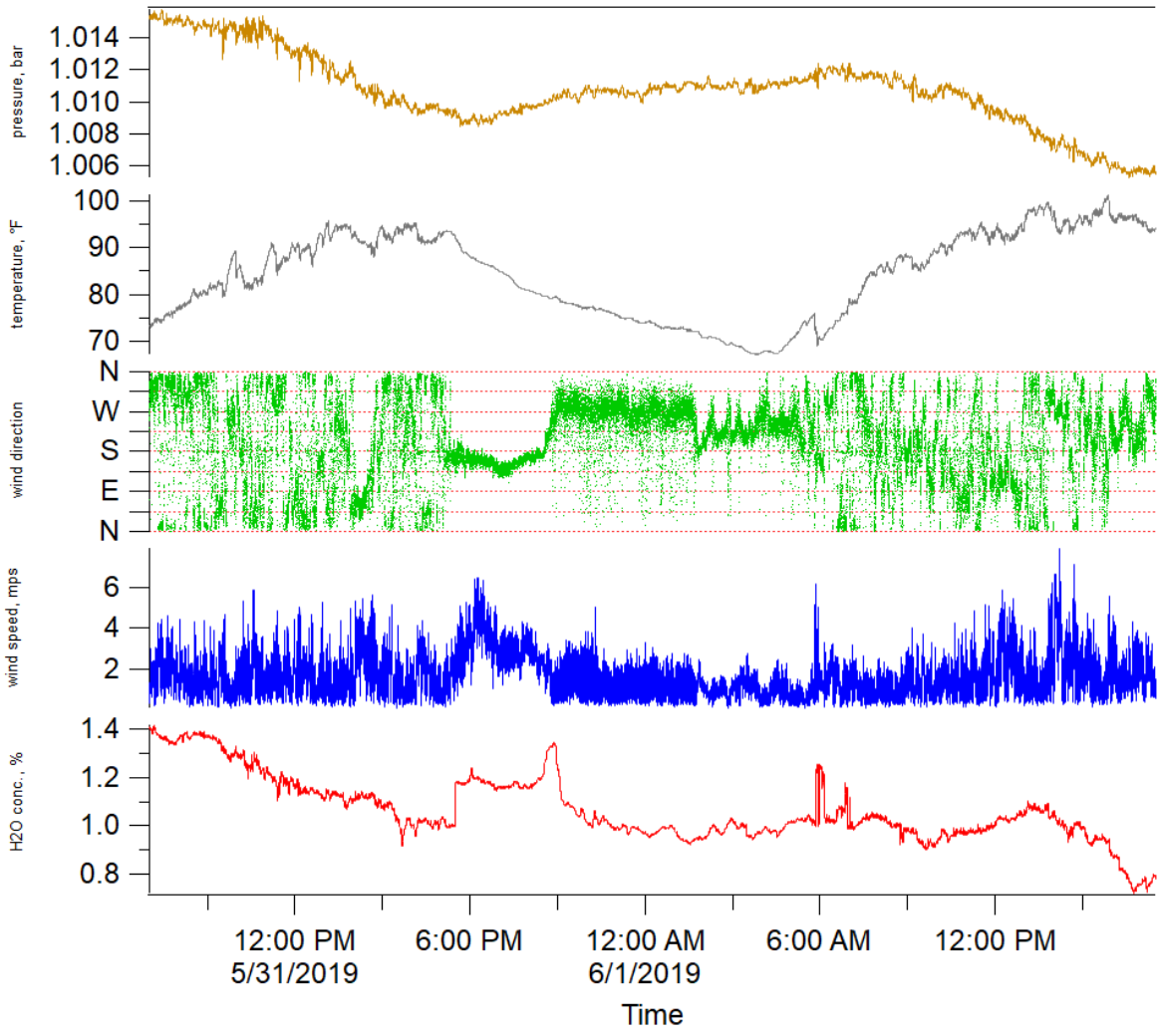

Figure 5-3. Weather Data for the Duration of the Monitoring Period.

5.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Airmar Weather Station.

Confirmatory air samples were not collected during this period.

5.4 Area Monitoring

Table 5-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 31, 2019 through June 1, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
1	ammonia	25000	6.225	11.200†	2.490	22.232	19.088	10.728†
2	formaldehyde	300	1.721	<1.721	0.155	21.698	22.782	<1.721
3	methanol	200000	5.758	10.499†	10.572	100.697	2063.530	9.916†
4	acetonitrile	20000	0.085	0.227†	0.039	17.152	0.540	0.225†
5	acetaldehyde	25000	1.027	1.776†	0.479	26.965	7.287	1.665†
6	ethylamine	5000	0.069	<0.069	0.014	61.194	0.097	<0.069
7	1,3-butadiene	1000	0.183	0.185†	0.065	34.859	0.853	0.179†
8	propanenitrile	6000	0.107	<0.107	0.018	39.806	0.157	<0.107
9	2-propenal	100	0.340	<0.340	0.062	44.480	1.341	<0.340
10	1-butanol + butenes	20000	0.214	<0.214	0.040	44.353	0.928	<0.214
11	methyl isocyanate	20	0.069	<0.069	0.022	46.566	0.166	<0.069
12	methyl nitrite	100	0.098	0.112†	0.034	30.043	0.433	0.108†
13	furan	1	0.062	<0.062	0.015	48.801	0.170	<0.062
14	butanenitrile	8000	0.039	<0.039	0.013	61.522	0.094	<0.039
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	200, 1, 1	0.041	0.087†	0.053	61.421	N/A*	N/A*
16	butanal	25000	0.061	0.190	0.051	26.564	0.568	0.185
17	NDMA**	0.3	0.082	<0.082	0.021	198.194	0.186	<0.082
18	benzene	500	0.236	<0.236	0.034	31.056	1.004	<0.236
19	2,4-pentadienenitrile + pyridine	300, 1000	0.085	<0.085	0.014	39.482	0.127	<0.085
20	2-methylene butanenitrile	300	0.036	<0.036	0.008	68.956	0.059	<0.036
21	2-methylfuran	1	0.043	0.043†	0.021	49.291	0.249	0.040†
22	pentanenitrile	6000	0.036	<0.036	0.010	68.822	0.076	<0.036
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.043	<0.043	0.021	52.097	0.199	<0.043
24	NEMA**	0.3	0.058	<0.058	0.017	164.052	0.131	<0.058
25	2,5-dimethylfuran	1	0.032	<0.032	0.014	64.020	0.155	<0.032
26	hexanenitrile	6000	0.031	<0.031	0.007	89.335	0.055	<0.031
27	2-hexanone (MBK)	5000	0.036	<0.036	0.012	86.972	0.124	<0.036
28	NDEA**	0.1	0.034	<0.034	0.009	145.781	0.073	<0.034

Table 5-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of May 31, 2019 through June 1, 2019. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
29	butyl nitrite + 2-nitro-2-methylpropane	100, 300	0.058	<0.058	0.011	42.322	0.100	<0.058
30	2,4-dimethylpyridine	500	0.036	<0.036	0.008	94.269	0.228	<0.036
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.027	<0.027	0.010	87.229	0.078	<0.027
32	heptanenitrile	6000	0.027	<0.027	0.006	92.245	0.045	<0.027
33	4-methyl-2-hexanone	500	0.033	<0.033	0.008	92.166	0.062	<0.033
34	NMOR**	0.6	0.021	<0.021	0.007	168.568	0.058	<0.021
35	butyl nitrate	2500	0.022	<0.022	0.005	114.286	0.050	<0.022
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.028	<0.028	0.008	87.325	0.064	<0.028
37	6-methyl-2-heptanone	8000	0.028	<0.028	0.007	84.438	0.052	<0.028
38	2-pentylfuran	1	0.026	<0.026	0.009	76.313	0.066	<0.026
39	biphenyl	200	0.022	<0.022	0.007	119.023	0.050	<0.022
40	2-heptylfuran	1	0.067	<0.067	0.011	40.150	0.084	<0.067
41	1,4-butanediol dinitrate	50	0.036	<0.036	0.007	84.387	0.052	<0.036
42	2-octylfuran	1	0.020	<0.020	0.006	203.809	0.055	<0.020
43	1,2,3-propanetriol 1,3-dinitrate	50	0.011	<0.011	0.003	387.894	0.043	<0.011
44	PCB	1000	0.034	<0.034	0.007	67.763	0.049	<0.034
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.025	<0.025	0.006	96.377	0.046	<0.025
46	furfural acetophenone	1	0.064	<0.064	0.010	40.738	0.084	<0.064

N/A*	The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.348 ppb and the median value was 0.074†ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 200, which provide widely variant bases for these numbers.
**	Nitrosamine results are suspect due to isobaric interferants causing positive bias that have been encountered during previous background [53005-81-RPT-007, *PTR-MS Mobile Laboratory Vapor Monitoring Background Study, (3/18/2018 – 4/20/2018)*, and *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, RJ Lee Group, Inc.].
<	COPC Averages below the MDL.
†	COPC Averages between the RL and the MDL.
	COPC Averages >100% of the OEL.
	COPC Averages 50-100% of the OEL.
	COPC Averages 10-50% of the OEL.

Figure 5-4 through Figure 5-52 display 46 COPC signals, overlaid with the same signal smoothed using a 1-minute moving average (in cases where a moving average assist with data visualization), and CO_2, for the monitoring period May 31, 2019. If within range of the plot's left axis, a green horizontal line representing 50% of the COPC's OEL, a blue horizontal line representing the COPC's OEL, a horizontal purple line representing the RL, and a pink horizontal line representing the MDL are shown.

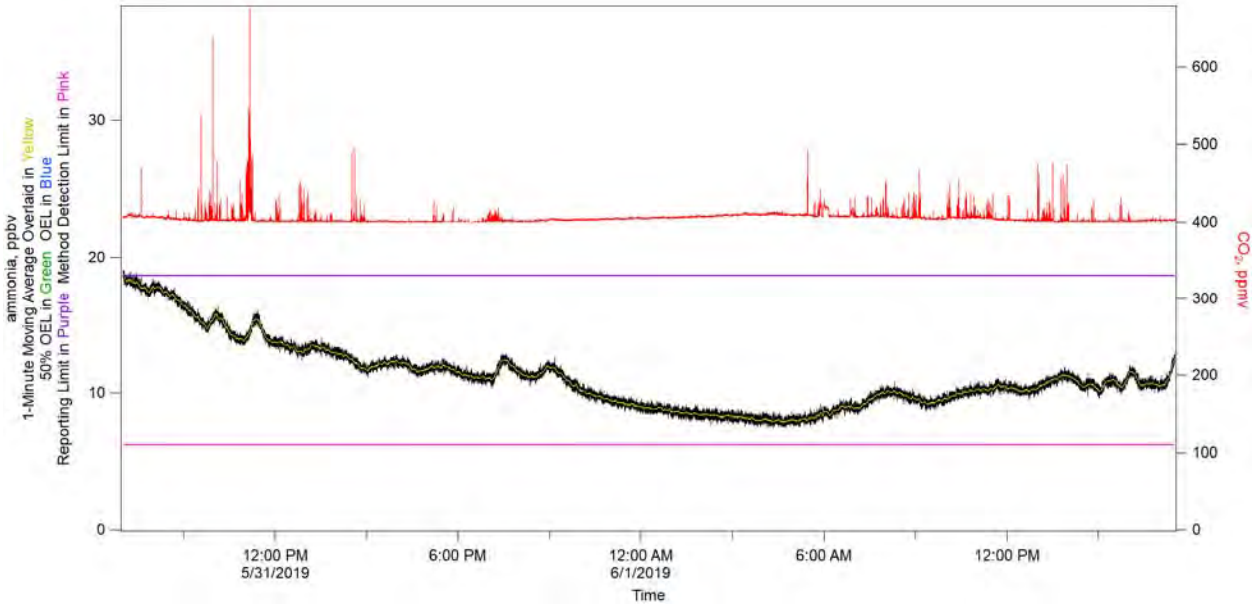

Figure 5-4. Ammonia.

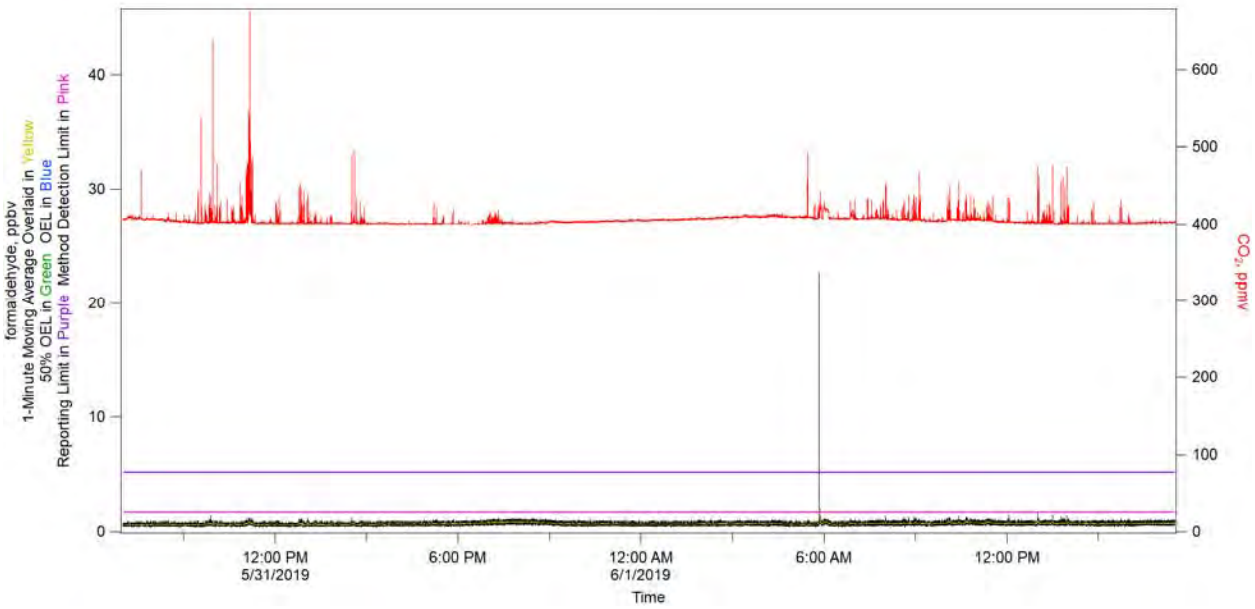

Figure 5-5. Formaldehyde.

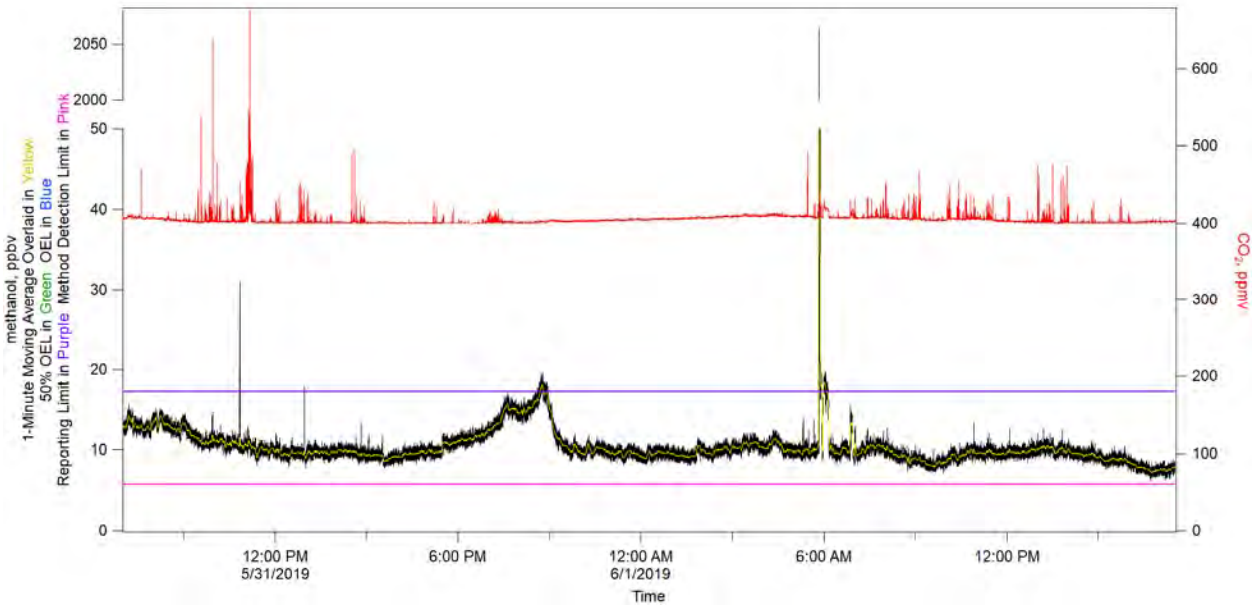

Figure 5-6. Methanol.

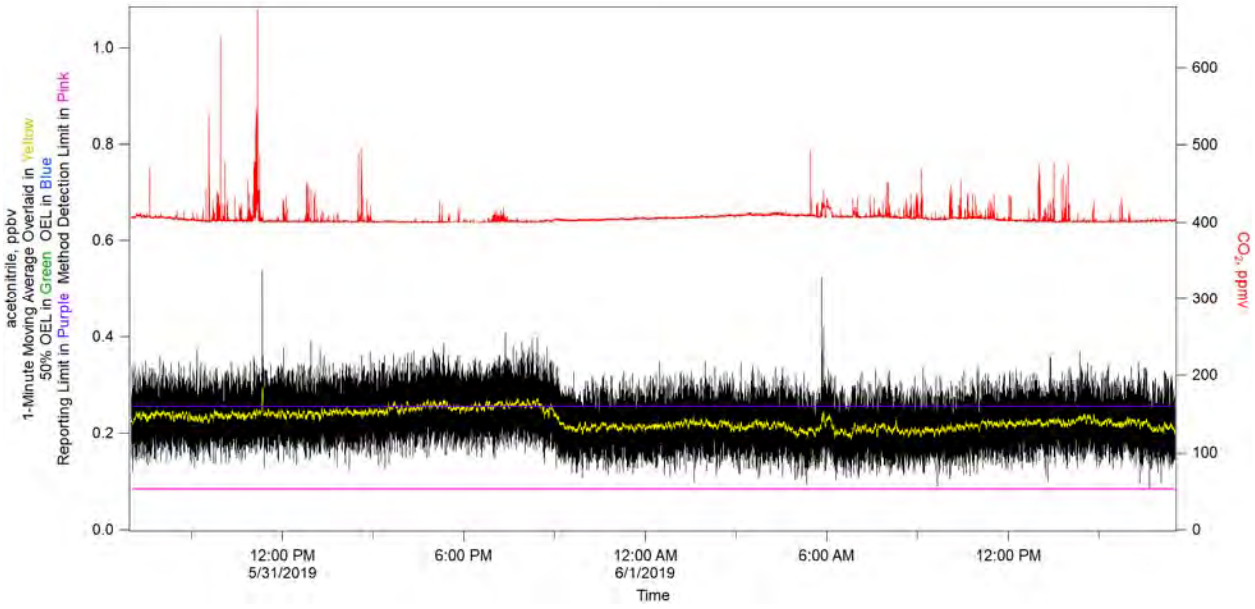

Figure 5-7. Acetonitrile.

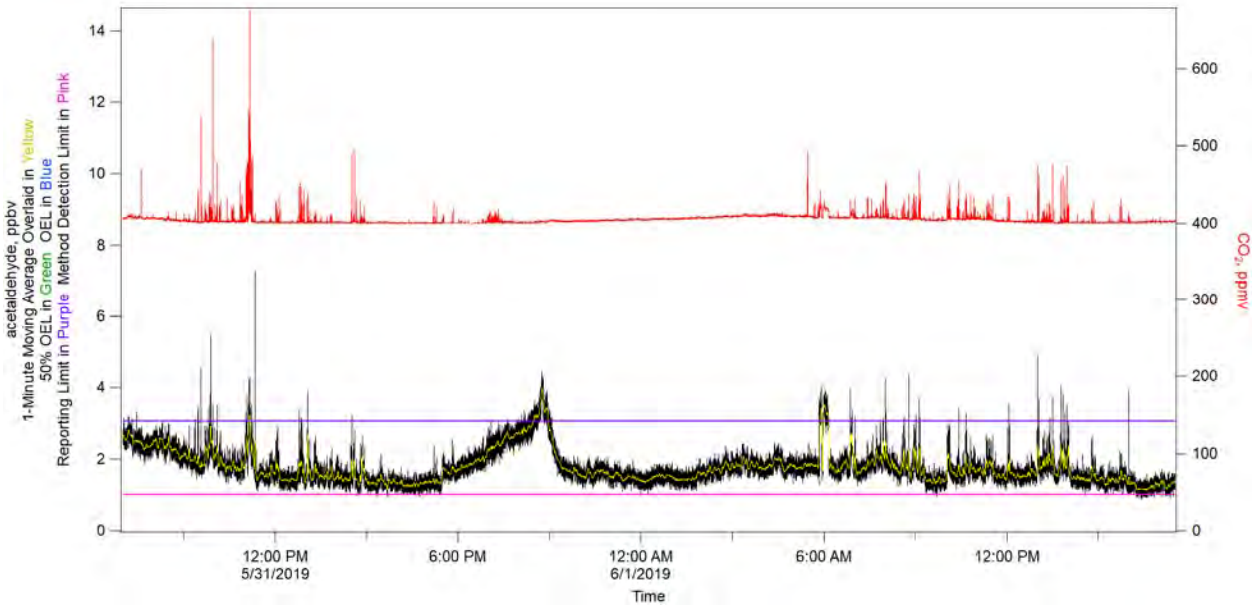

Figure 5-8. Acetaldehyde.

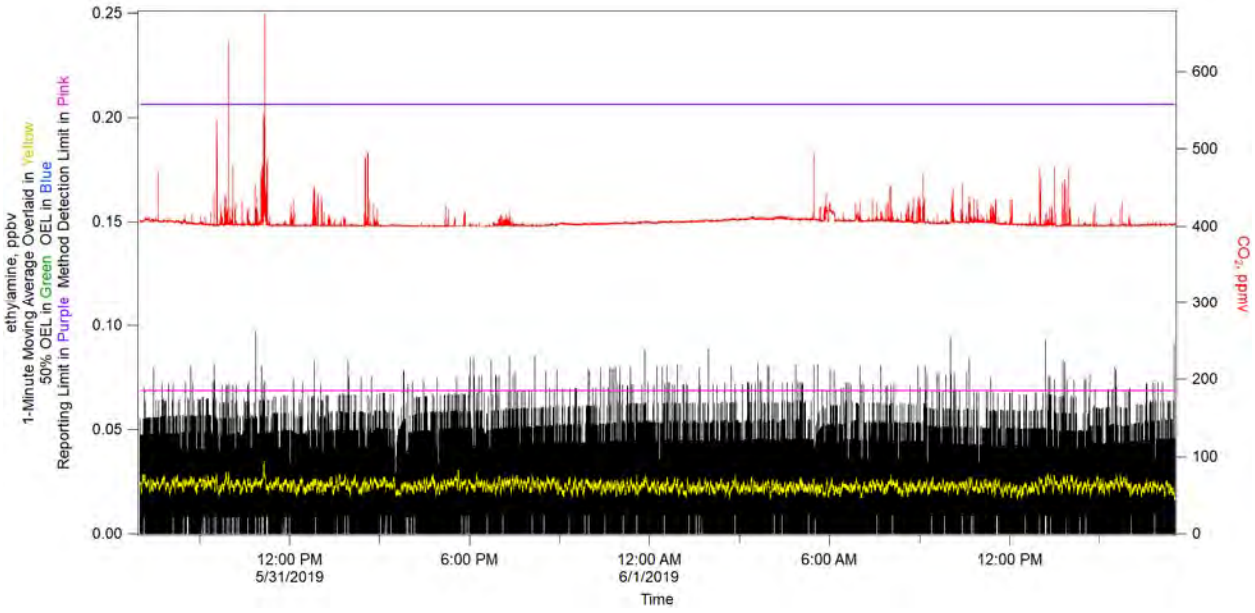

Figure 5-9. Ethylamine.

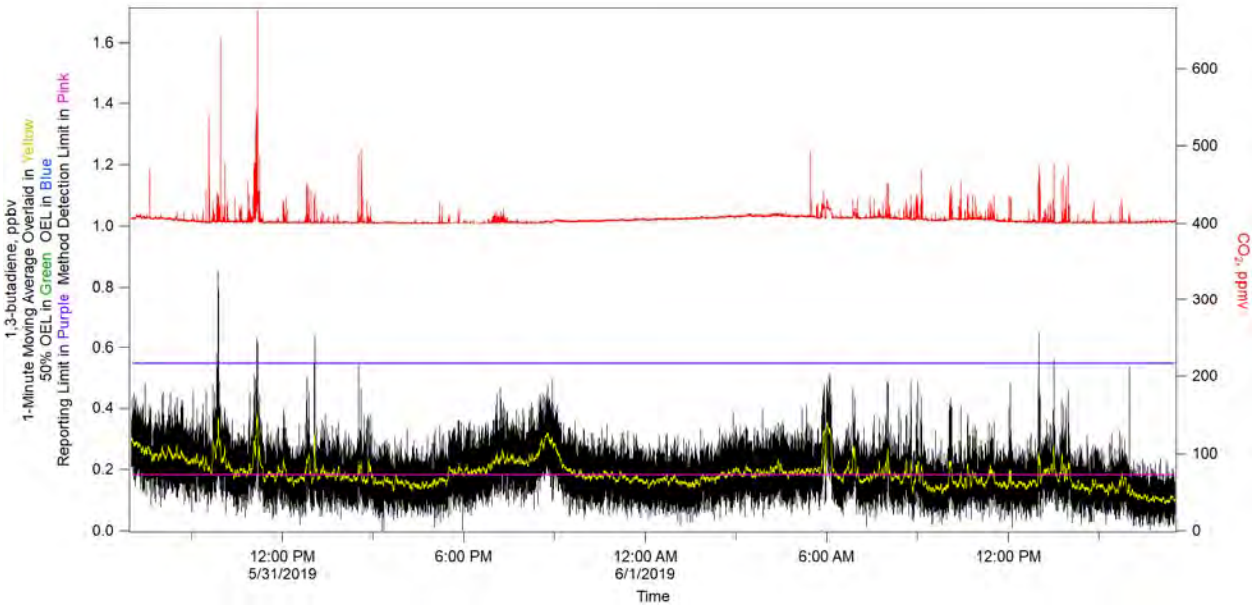

Figure 5-10. 1,3-butadiene.

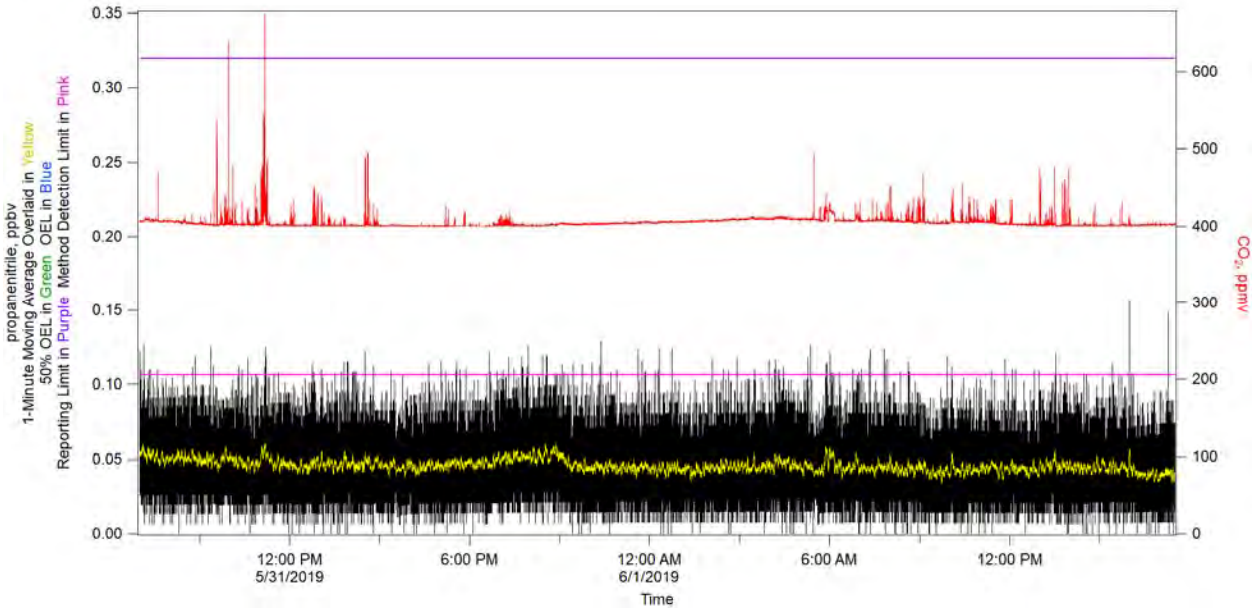

Figure 5-11. Propanenitrile.

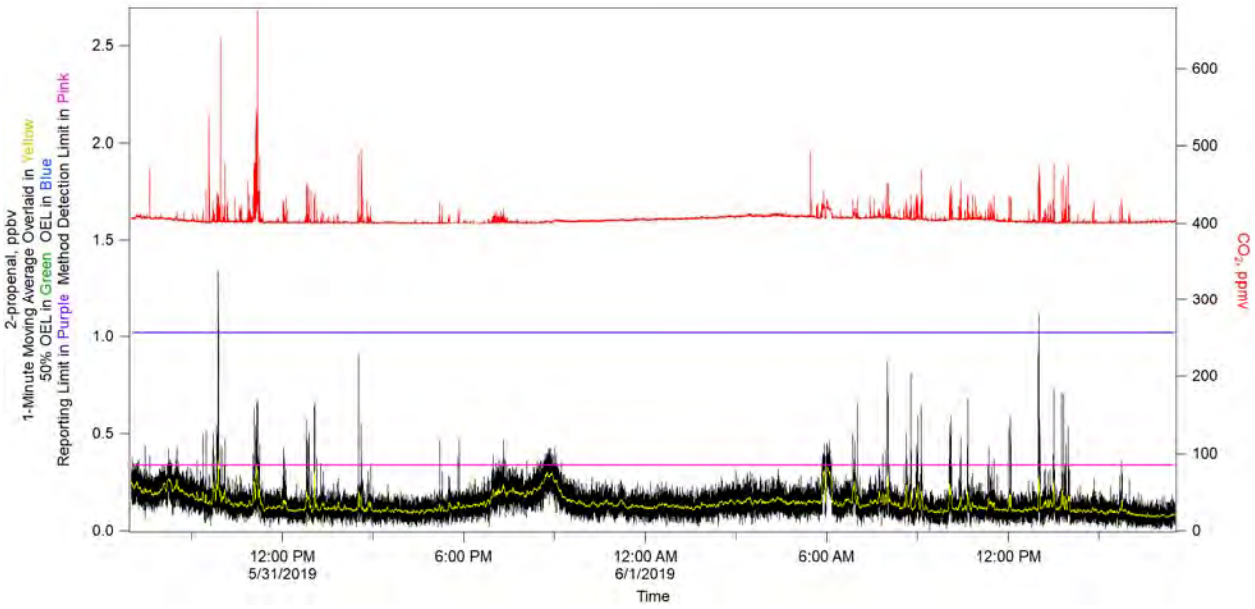

Figure 5-12. 2-propenal.

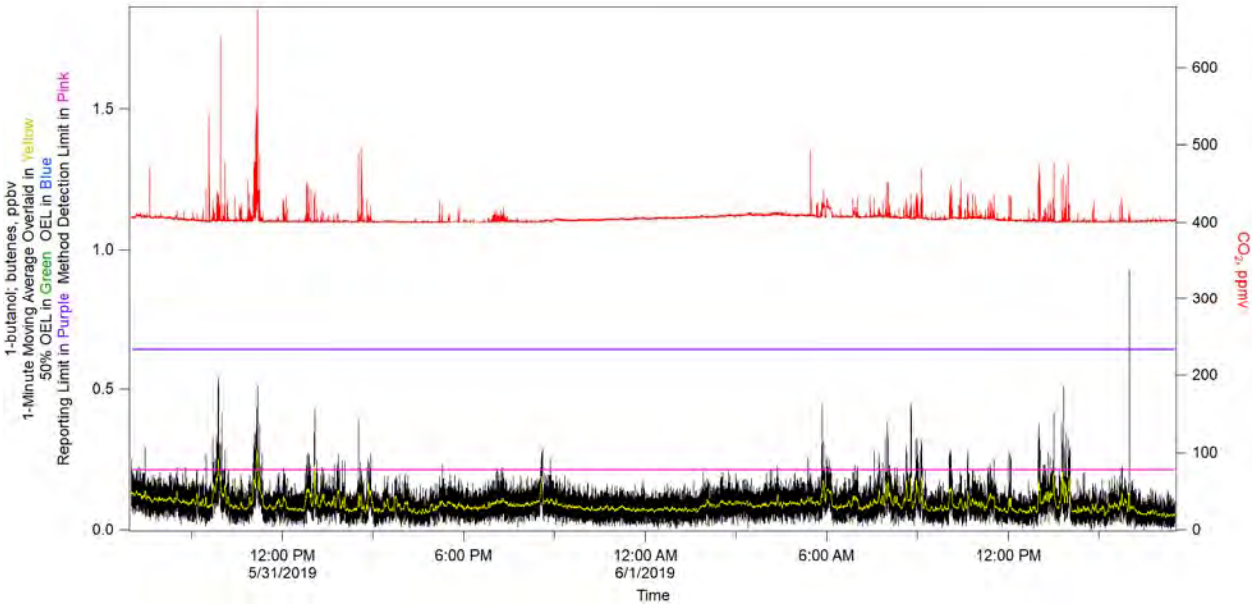

Figure 5-13. 1-butanol; Butenes.

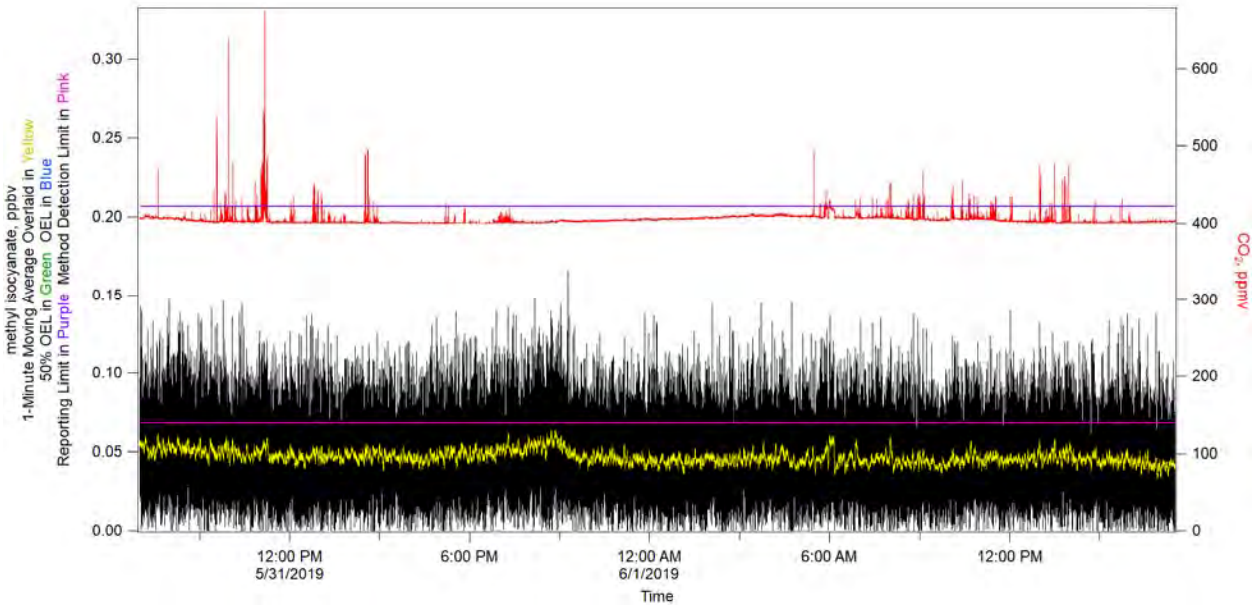

Figure 5-14. Methyl Isocyanate.

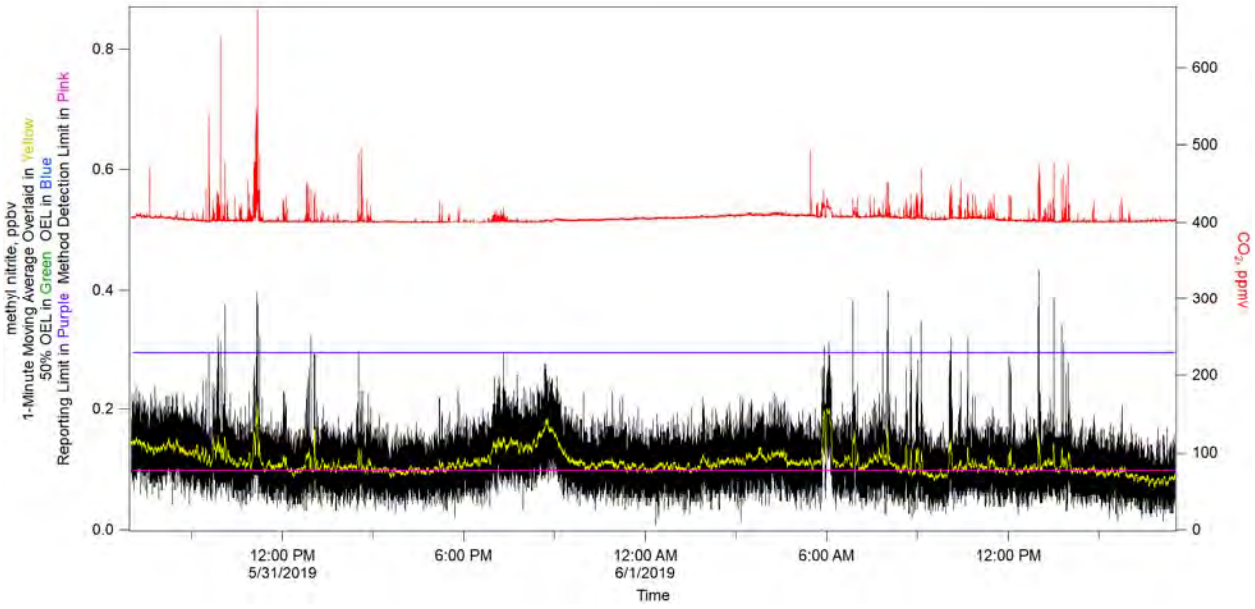

Figure 5-15. Methyl Nitrite.

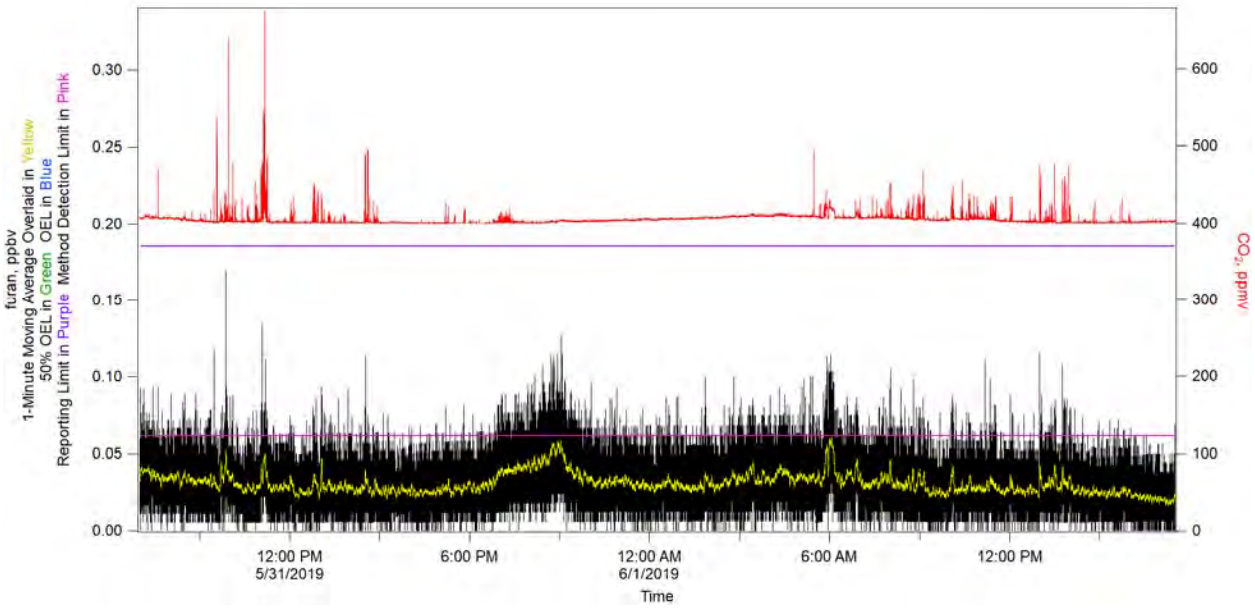

Figure 5-16. Furan.

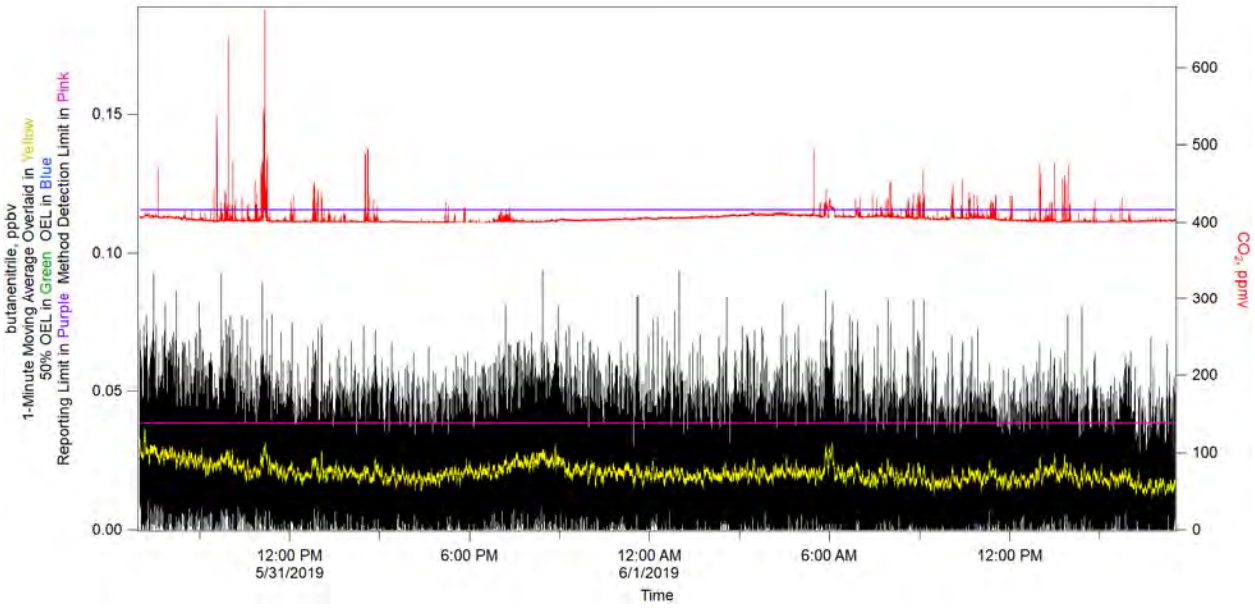

Figure 5-17. Butanenitrile.

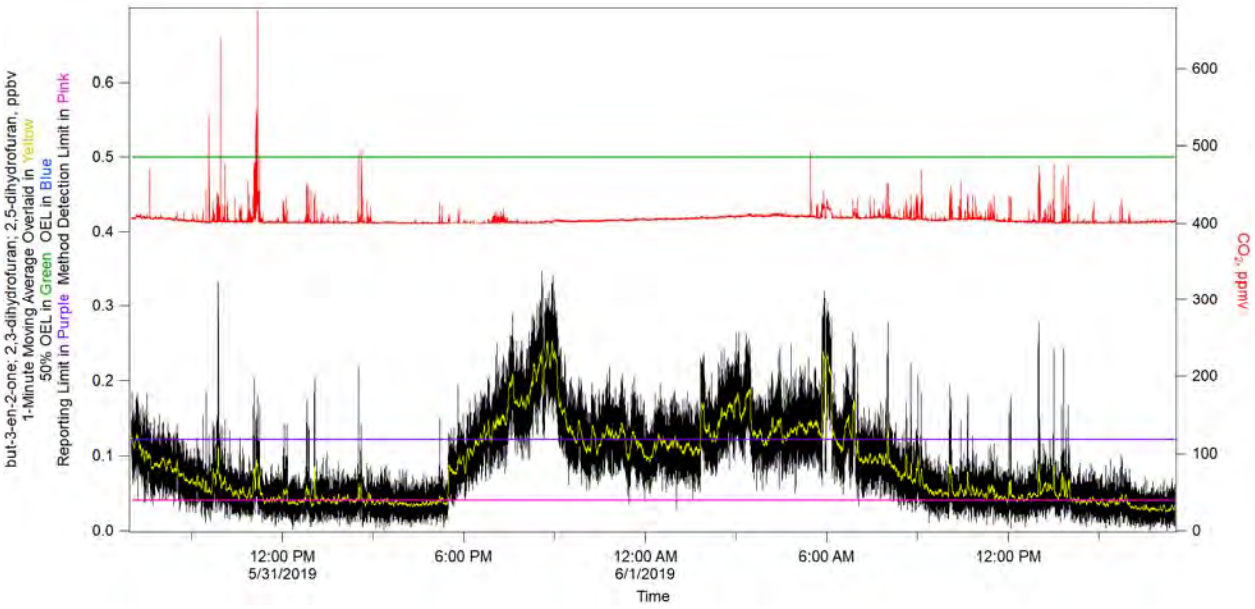

Figure 5-18. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

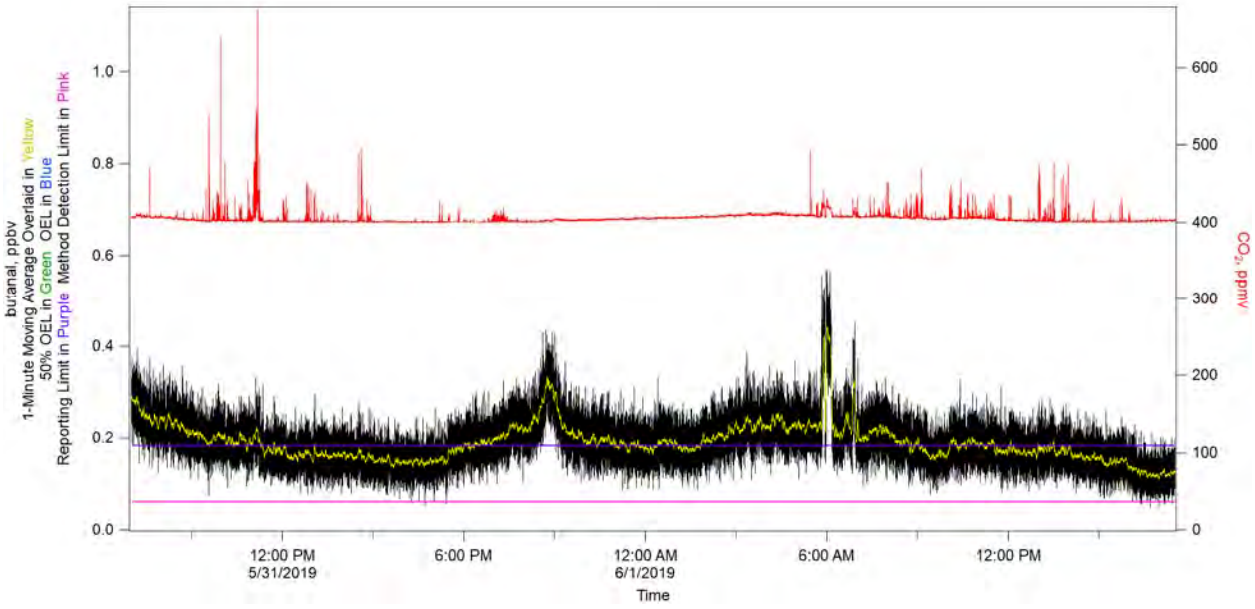

Figure 5-19. Butanal.

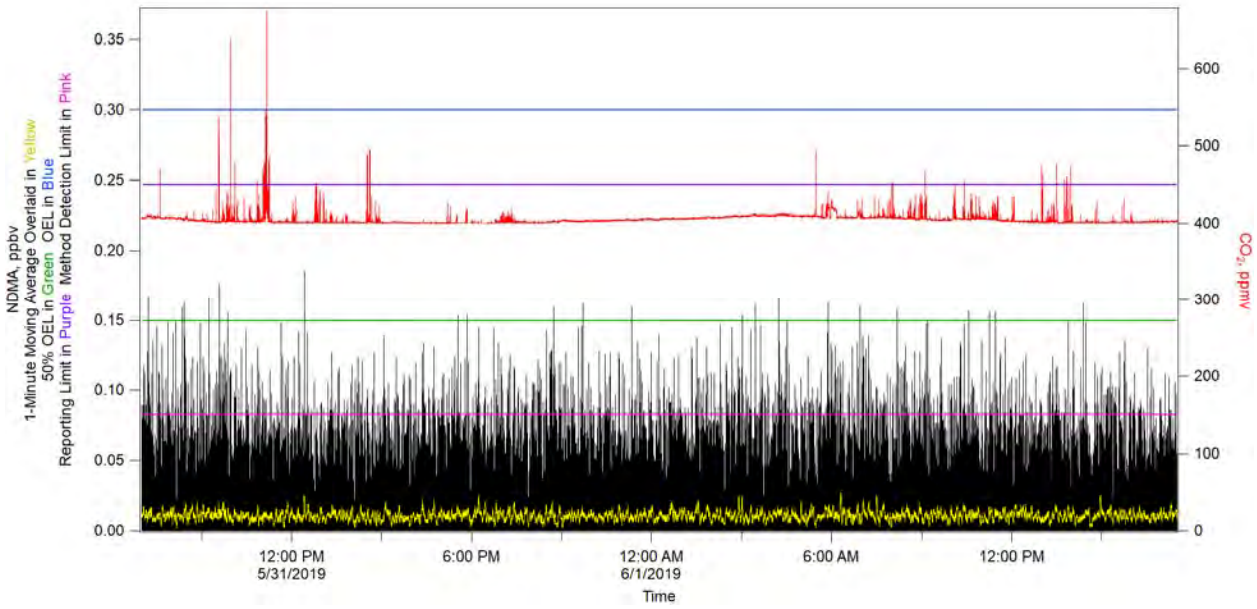

Figure 5-20. N-nitrosodimethylamine (NDMA).

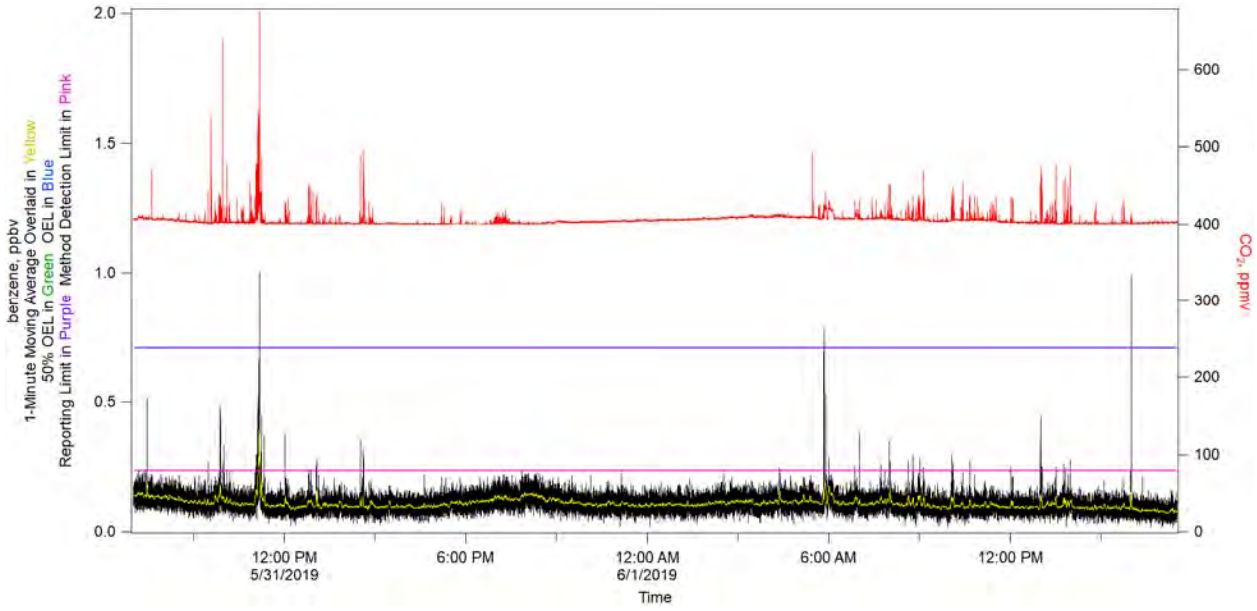

Figure 5-21. Benzene.

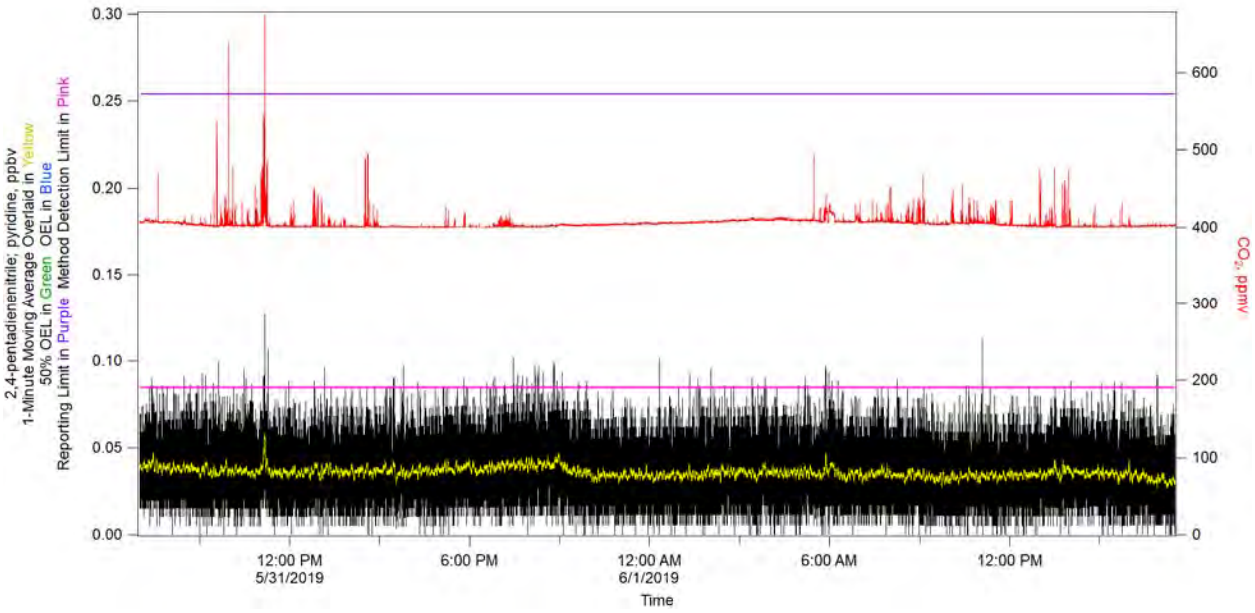

Figure 5-22. 2,4-pentadienenitrile; Pyridine.

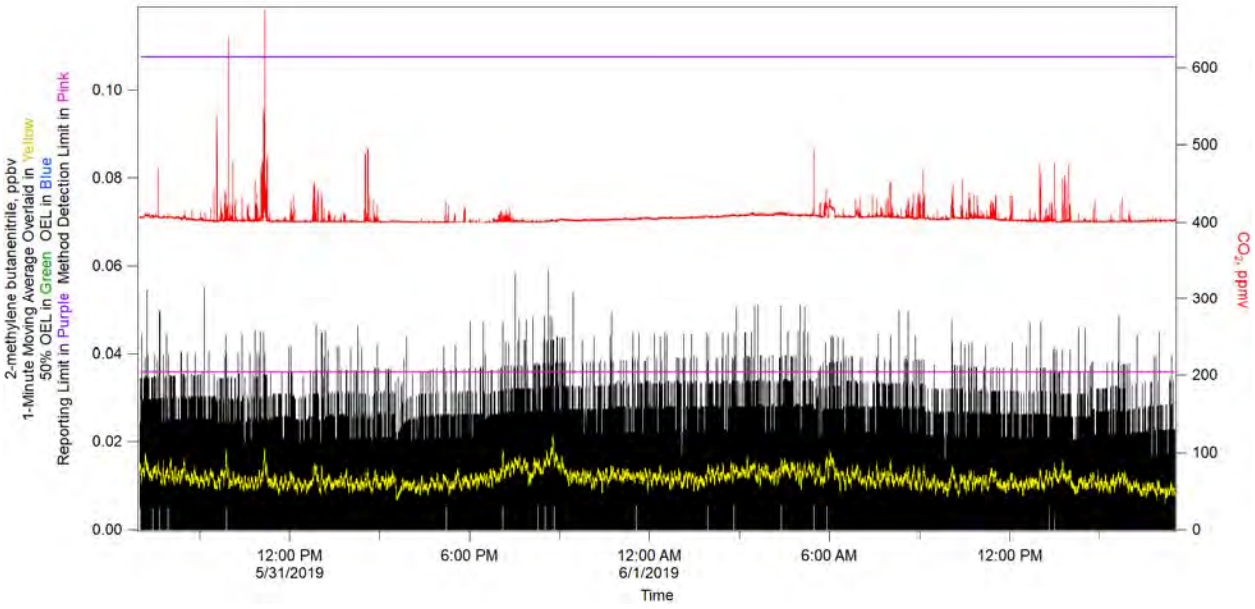

Figure 5-23. 2-methylene Butanenitrile.

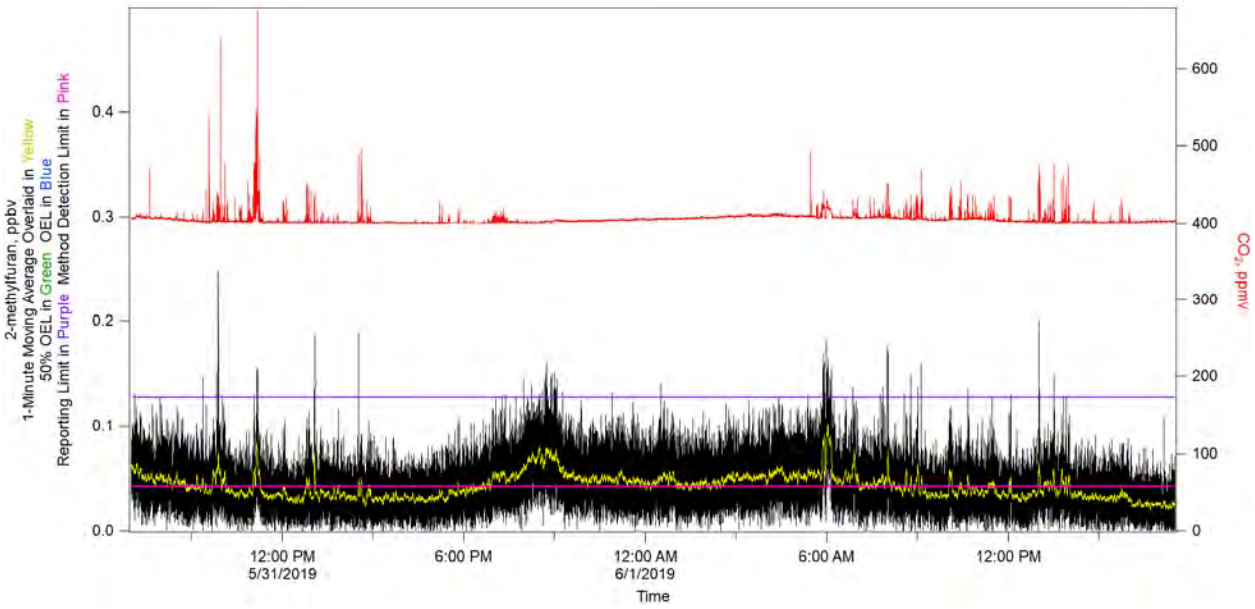

Figure 5-24. 2-methylfuran.

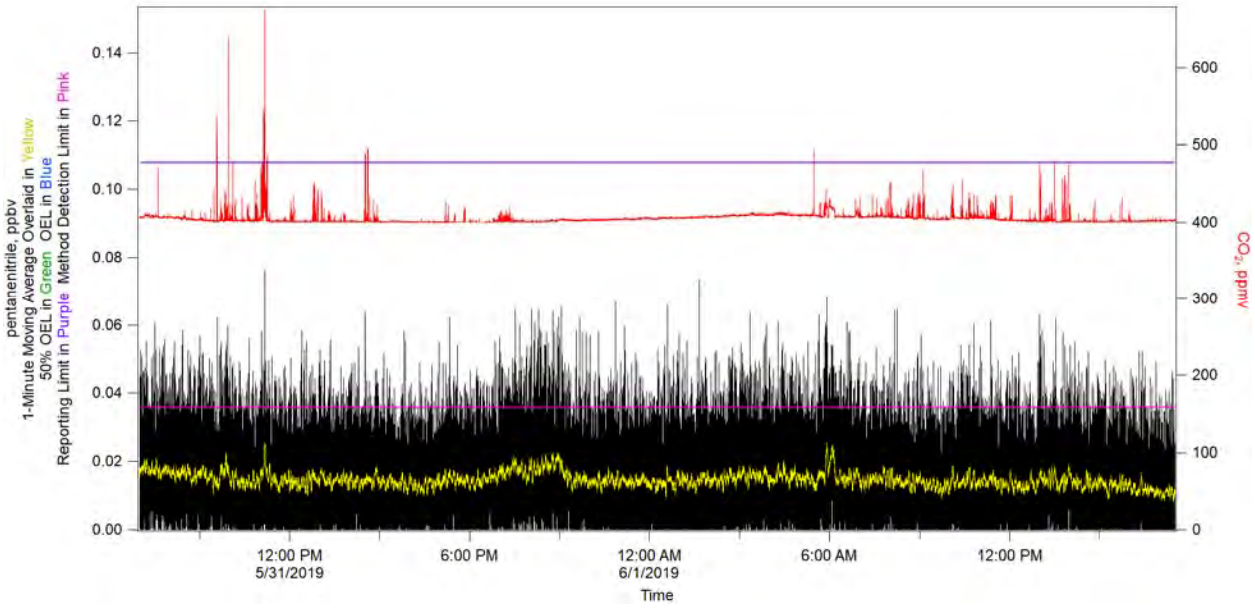

Figure 5-25. Pentanenitrile.

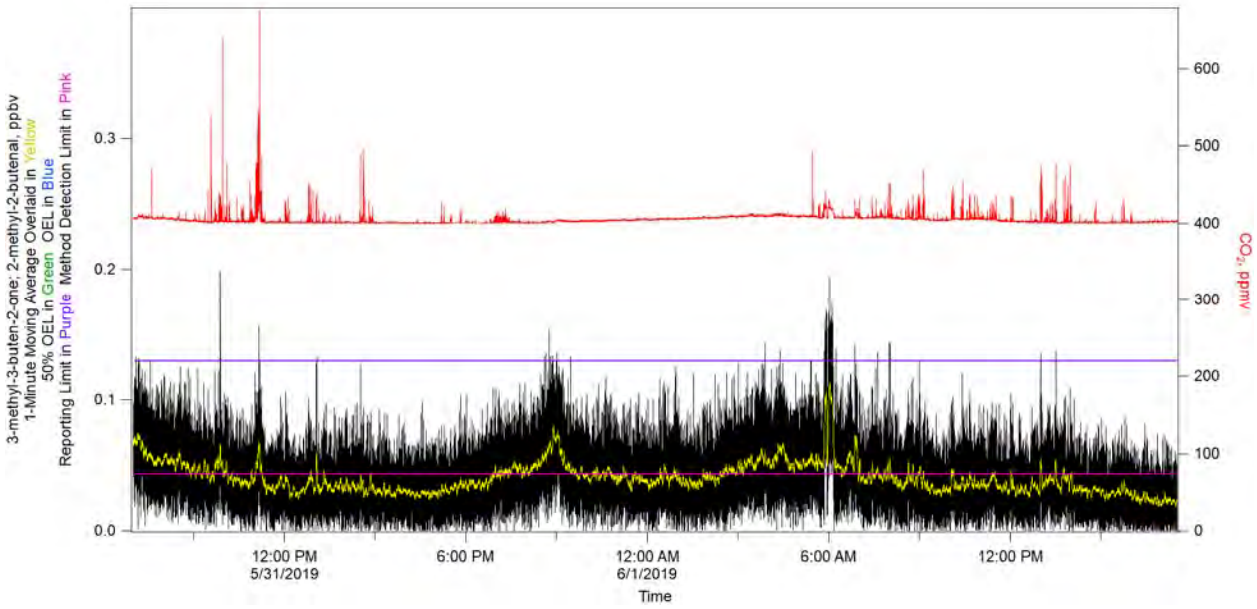

Figure 5-26. 3-methyl-3-buten-2-one; 2-methyl-2-butenal.

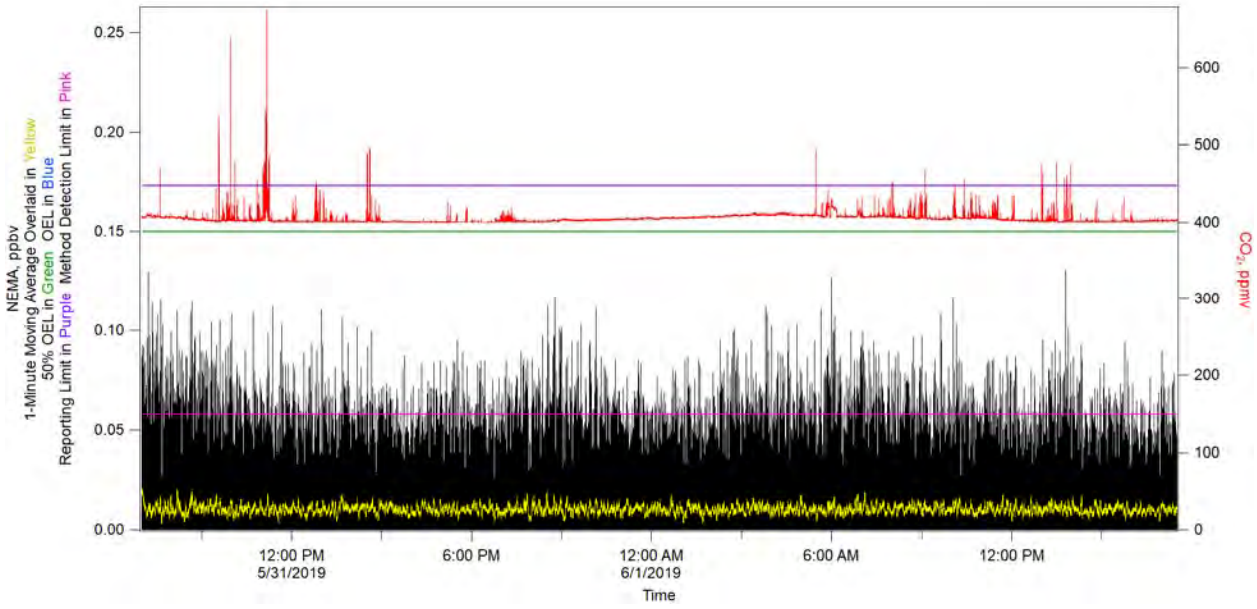

Figure 5-27. N-nitrosomethylethylamine (NEMA).

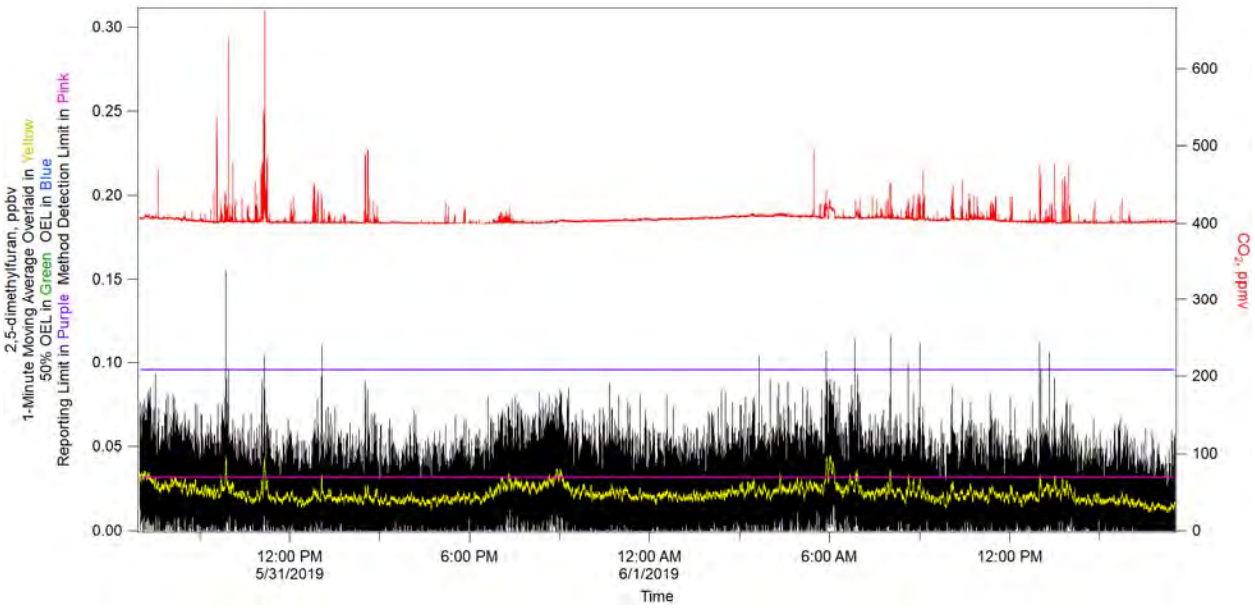

Figure 5-28. 2,5-dimethylfuran.

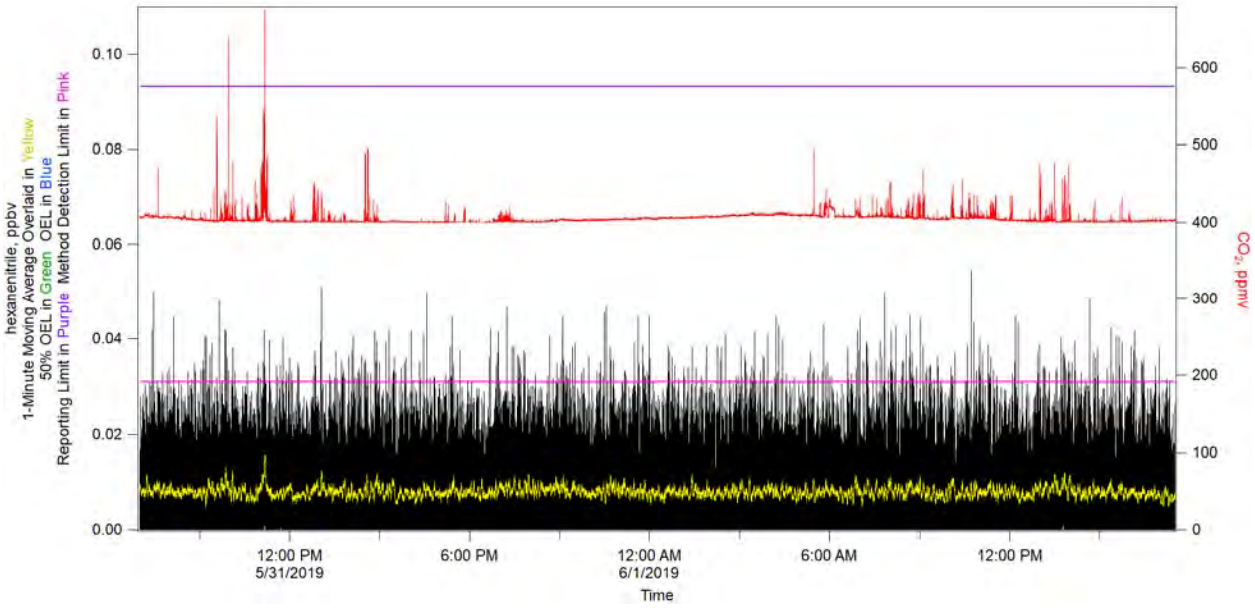

Figure 5-29. Hexanenitrile.

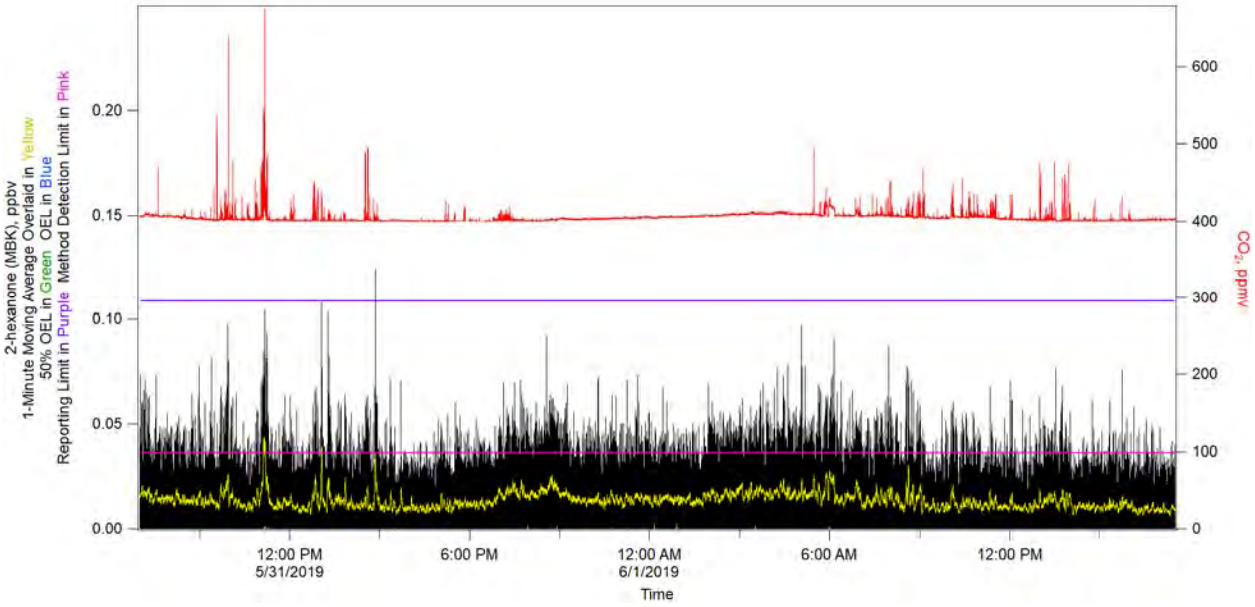

Figure 5-30. 2-hexanone (MBK).

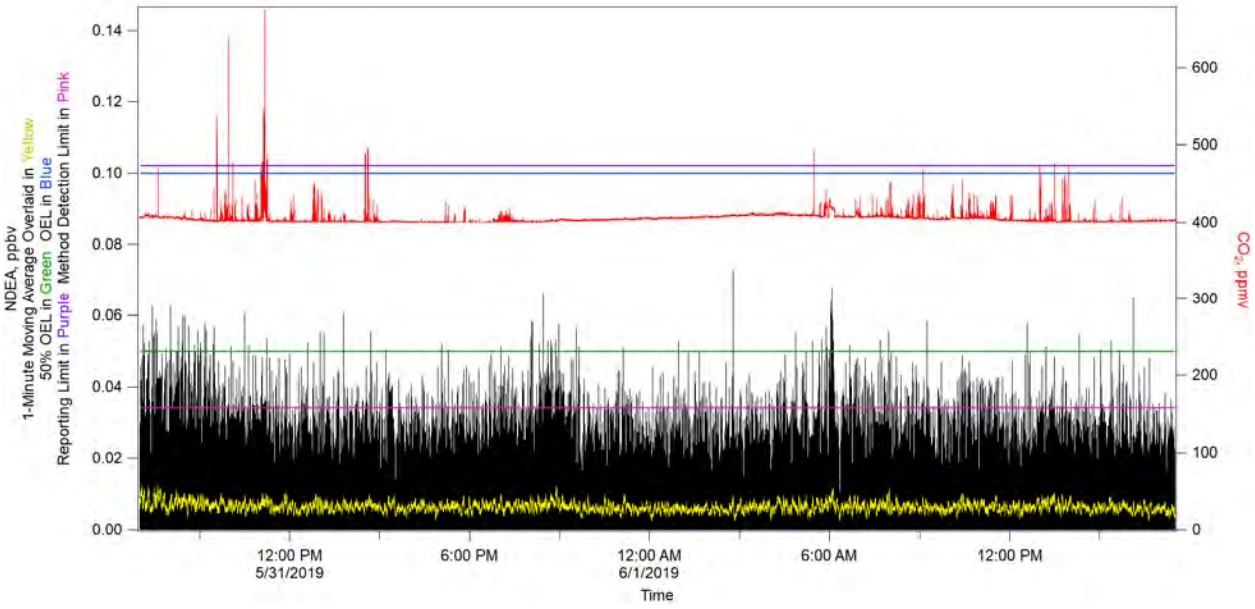

Figure 5-31. N-nitrosodiethylamine (NDEA).

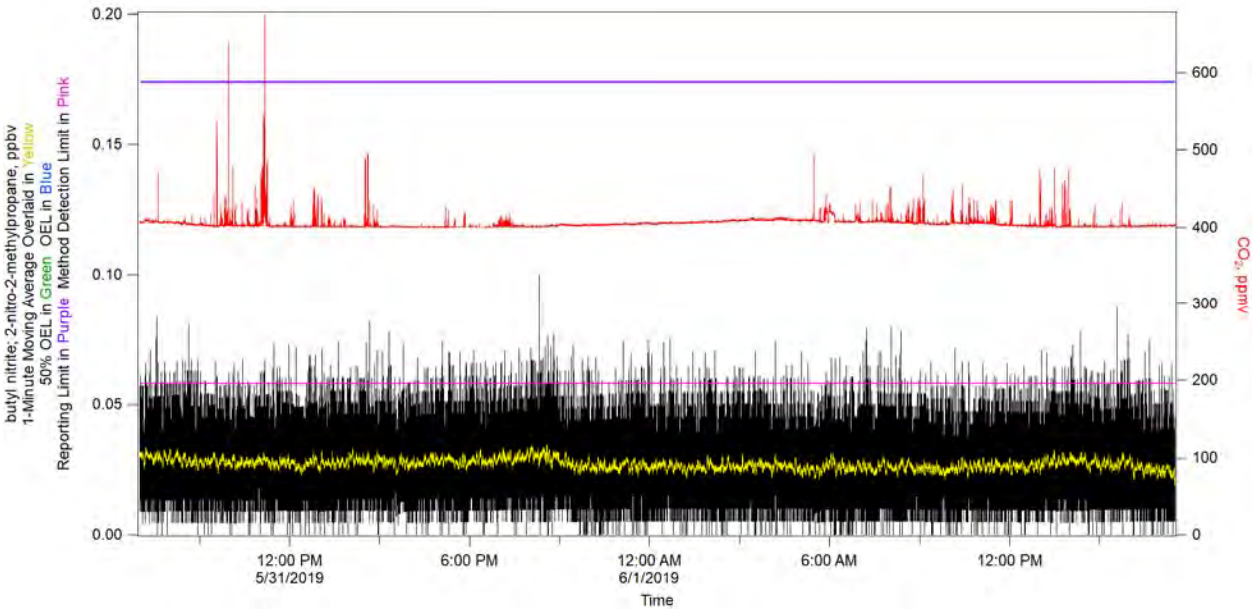

Figure 5-32. Butyl Nitrite; 2-nitro-2-methylpropane.

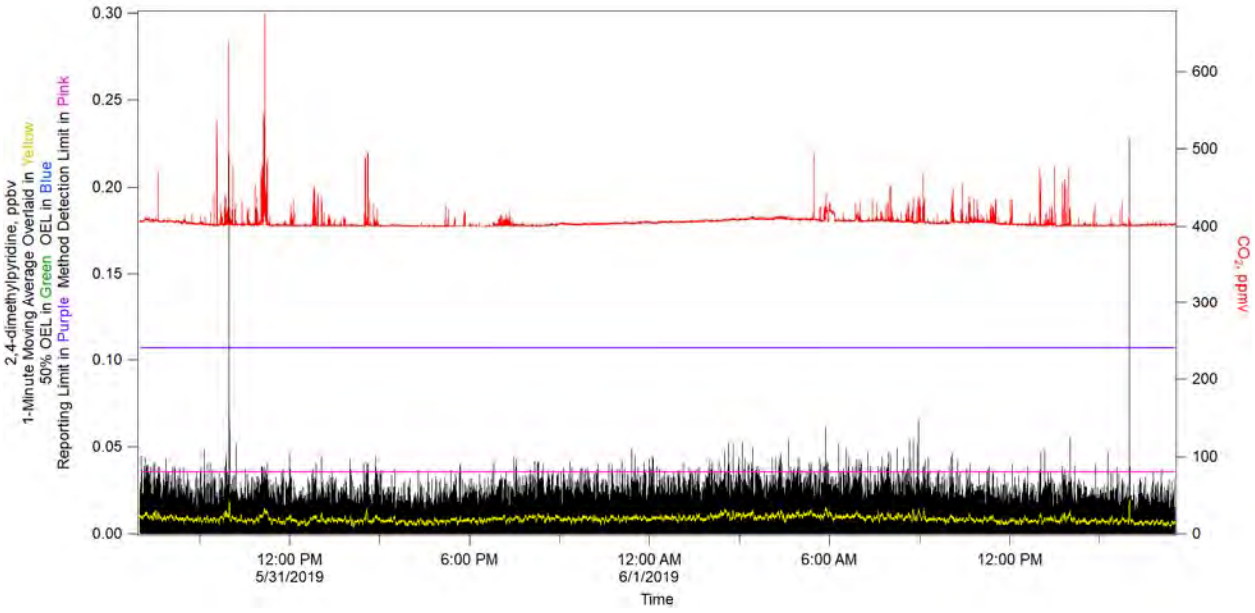

Figure 5-33. 2,4-dimethylpyridine.

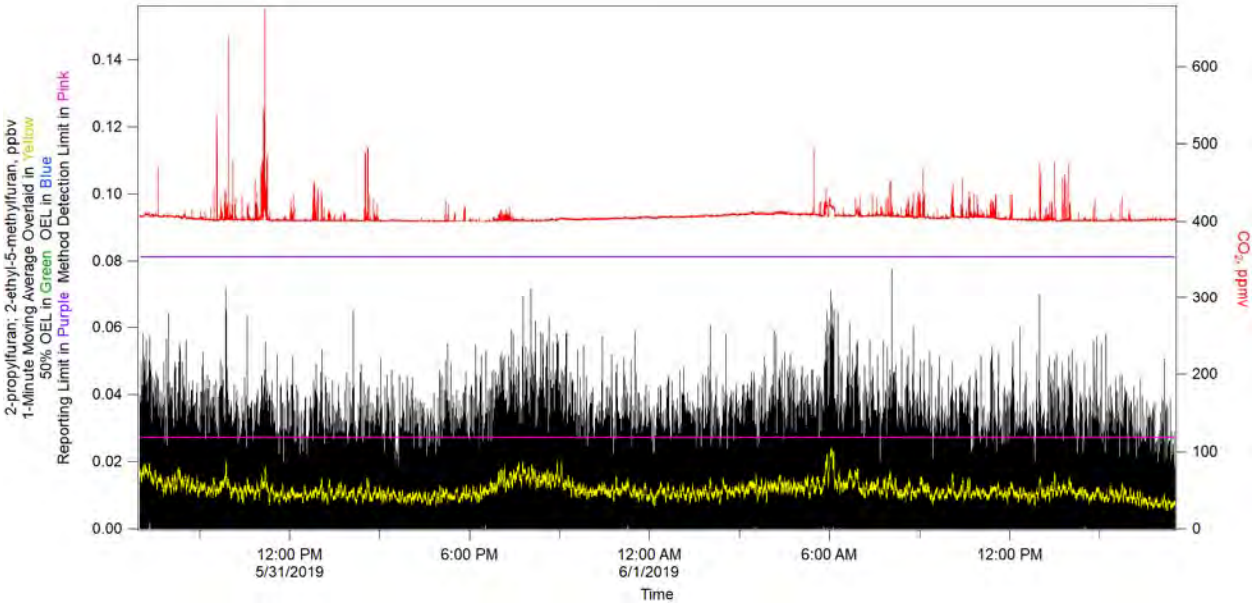

Figure 5-34. 2-propylfuran; 2-ethyl-5-methylfuran.

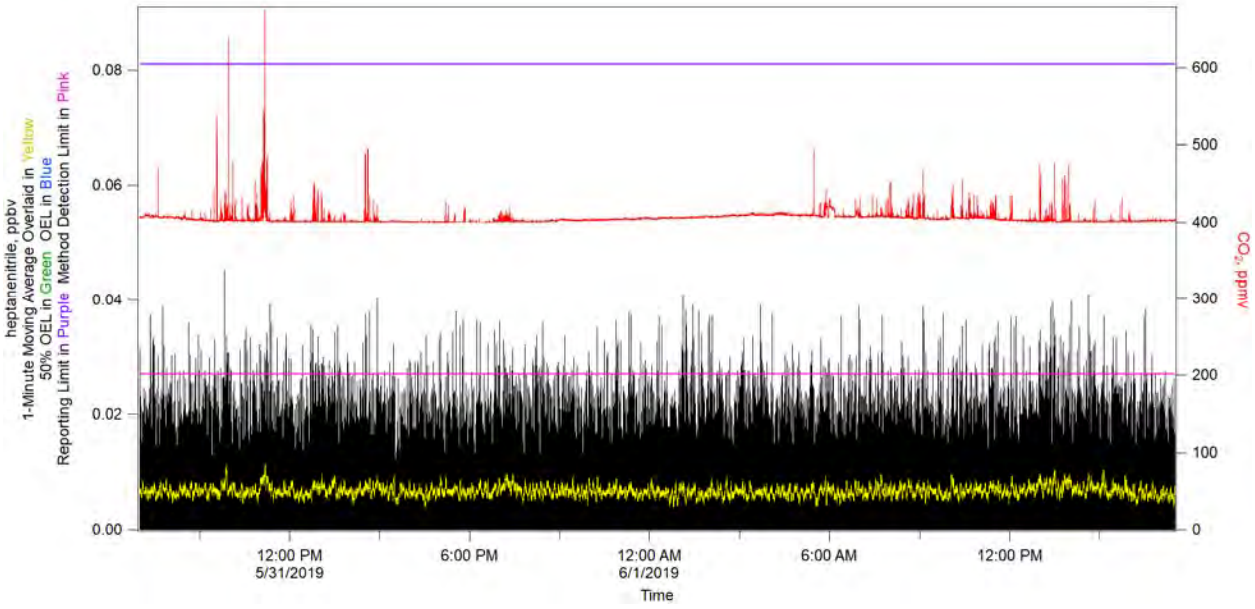

Figure 5-35. Heptanenitrile.

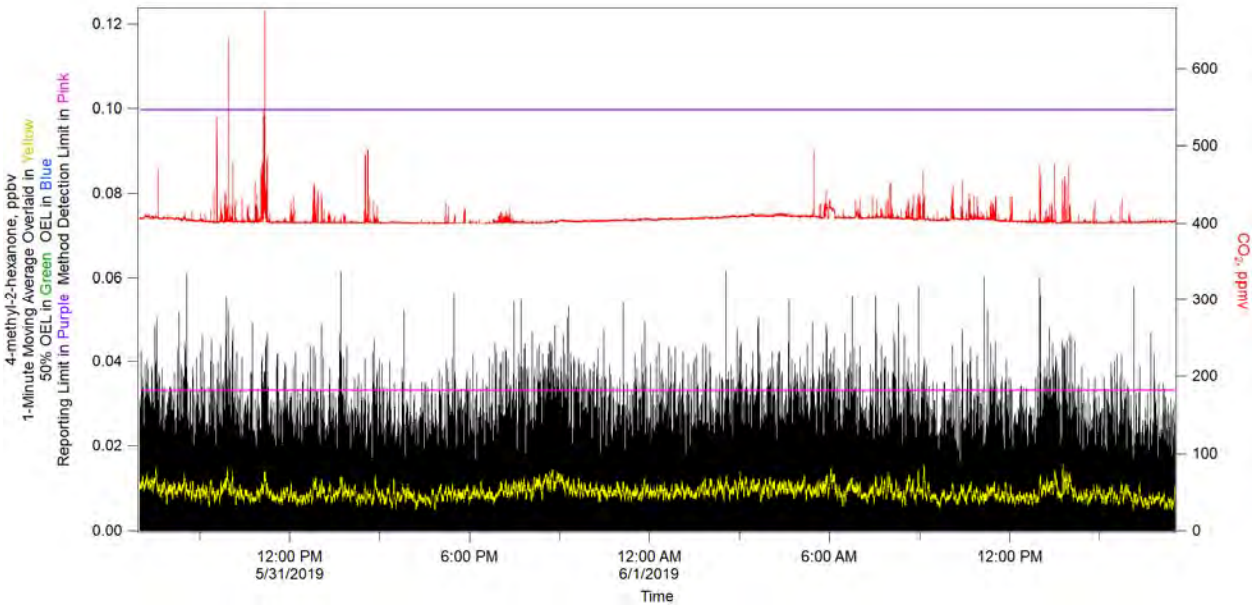

Figure 5-36. 4-methyl-2-hexanone.

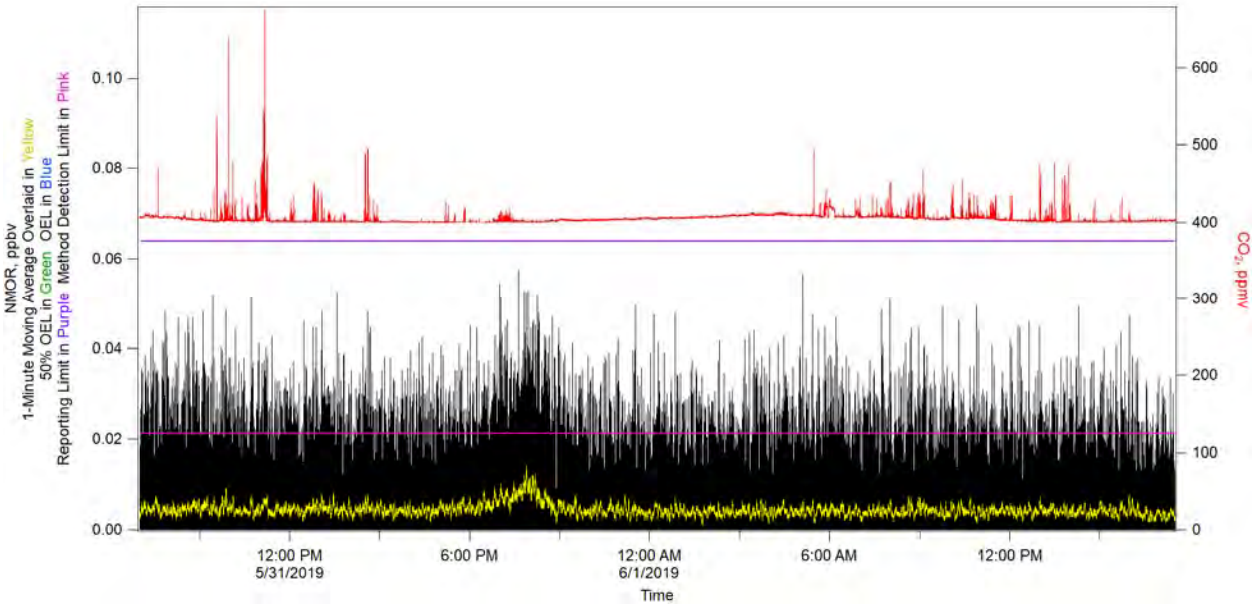

Figure 5-37. N-nitrosomorpholine (NMOR).

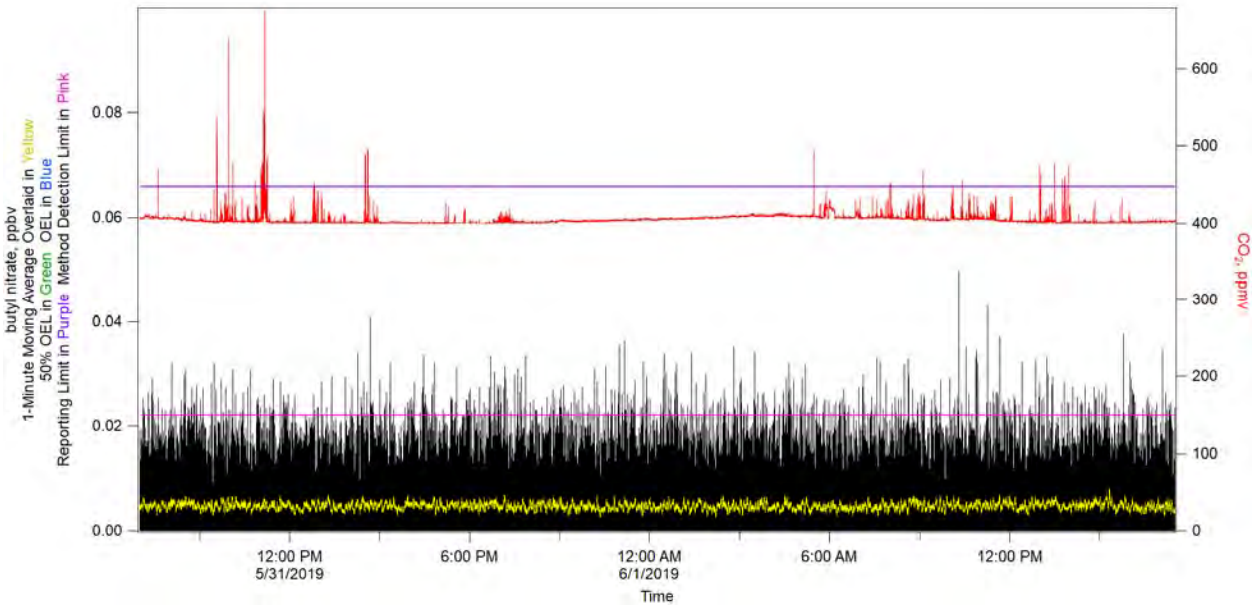

Figure 5-38. Butyl Nitrate.

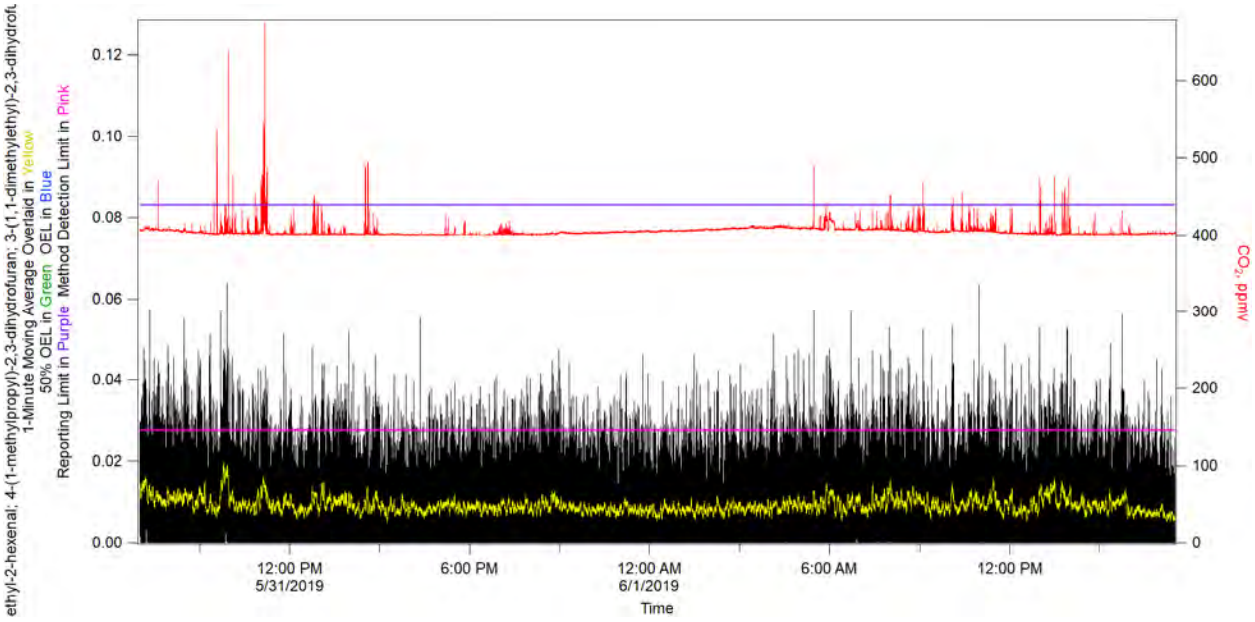

Figure 5-39. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

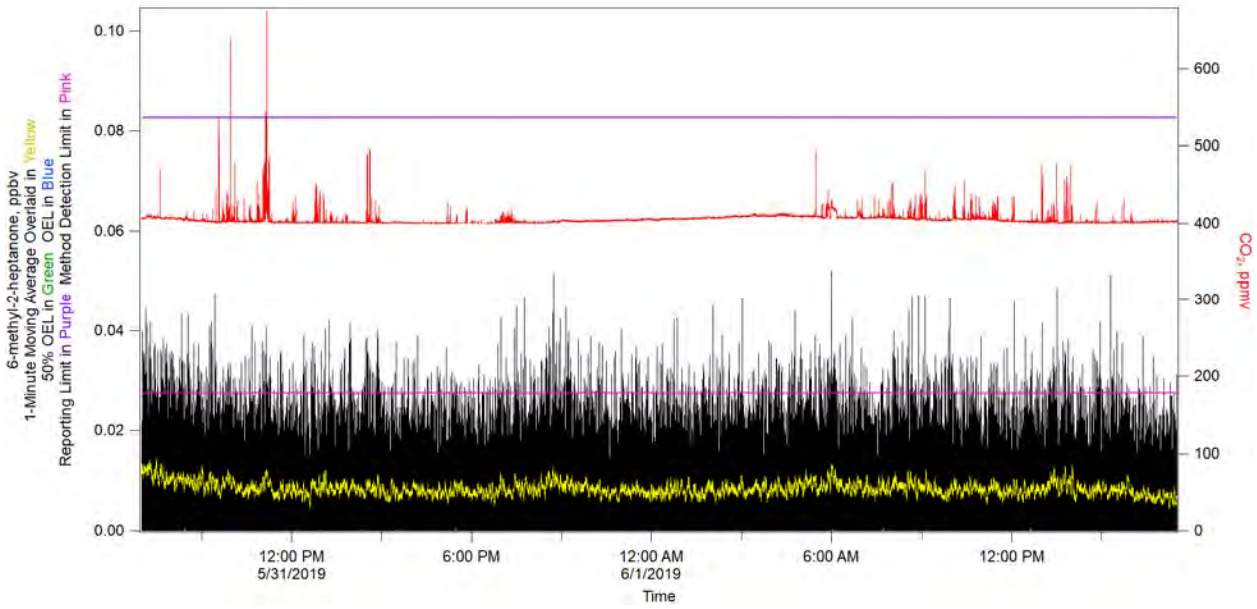

Figure 5-40. 6-methyl-2-heptanone.

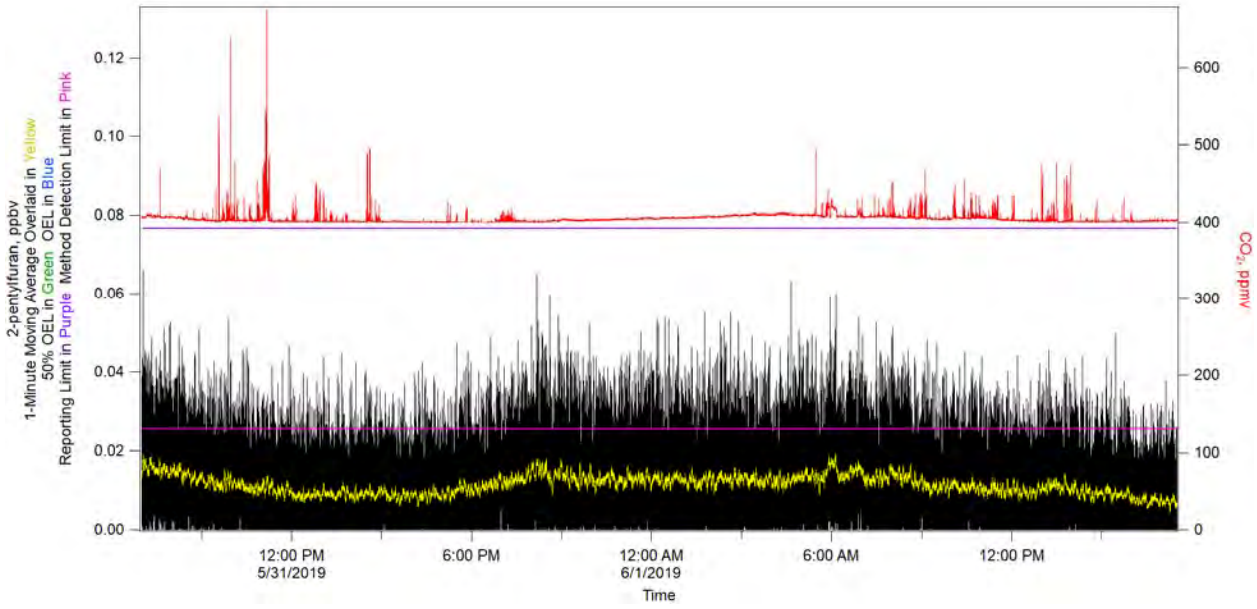

Figure 5-41. 2-pentylfuran.

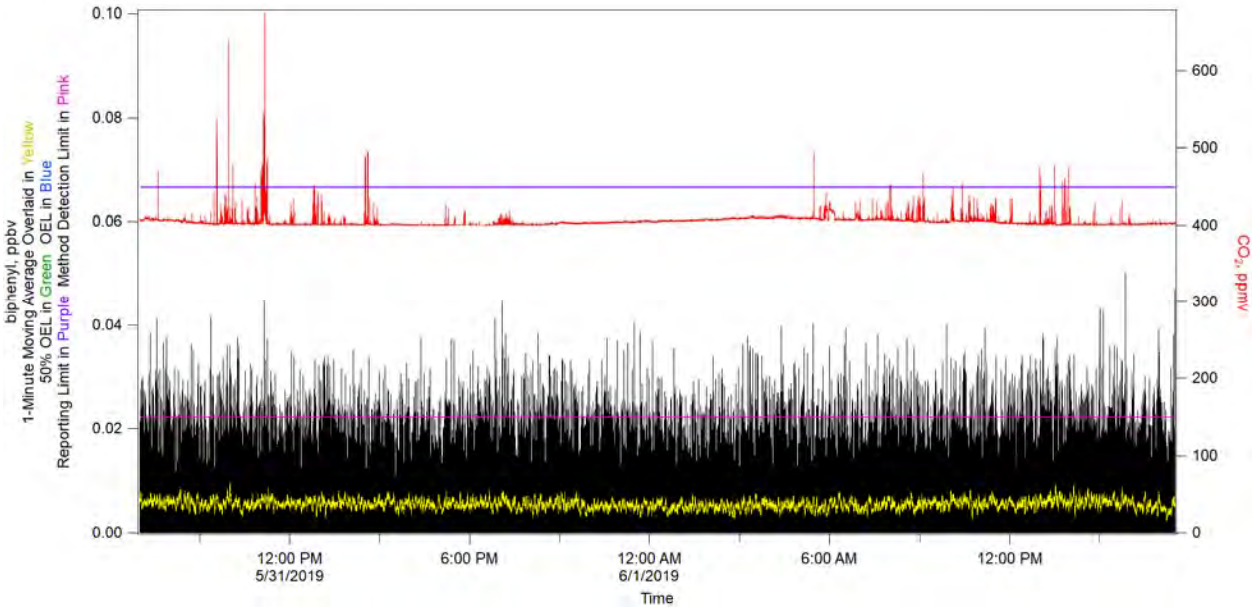

Figure 5-42. Biphenyl.

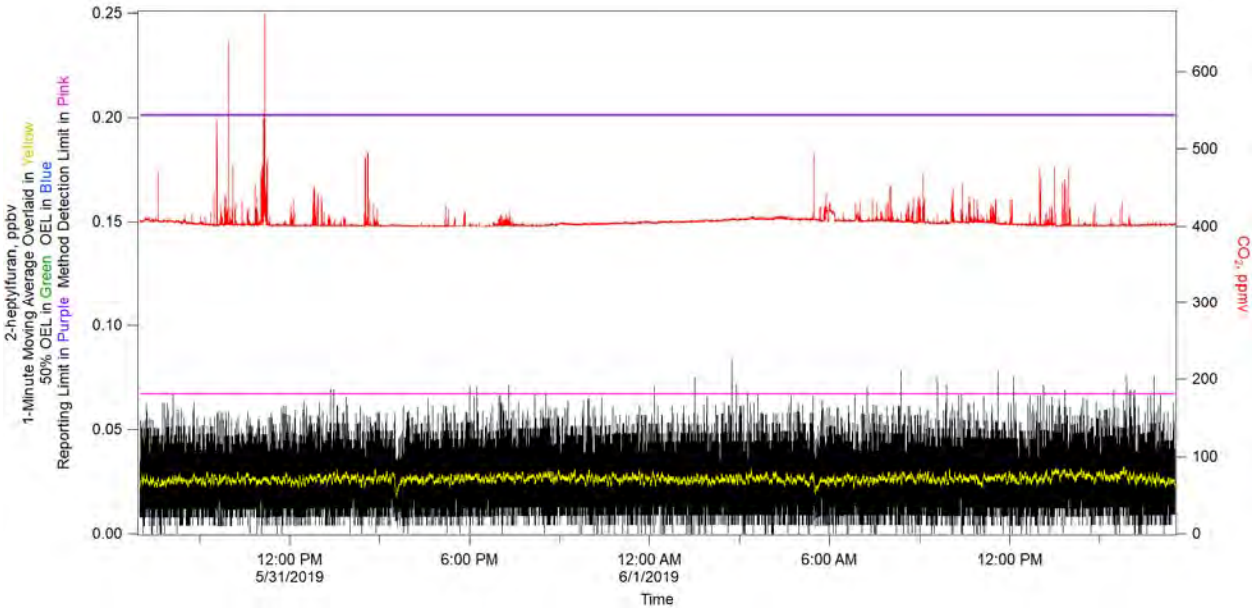

Figure 5-43. 2-heptylfuran.

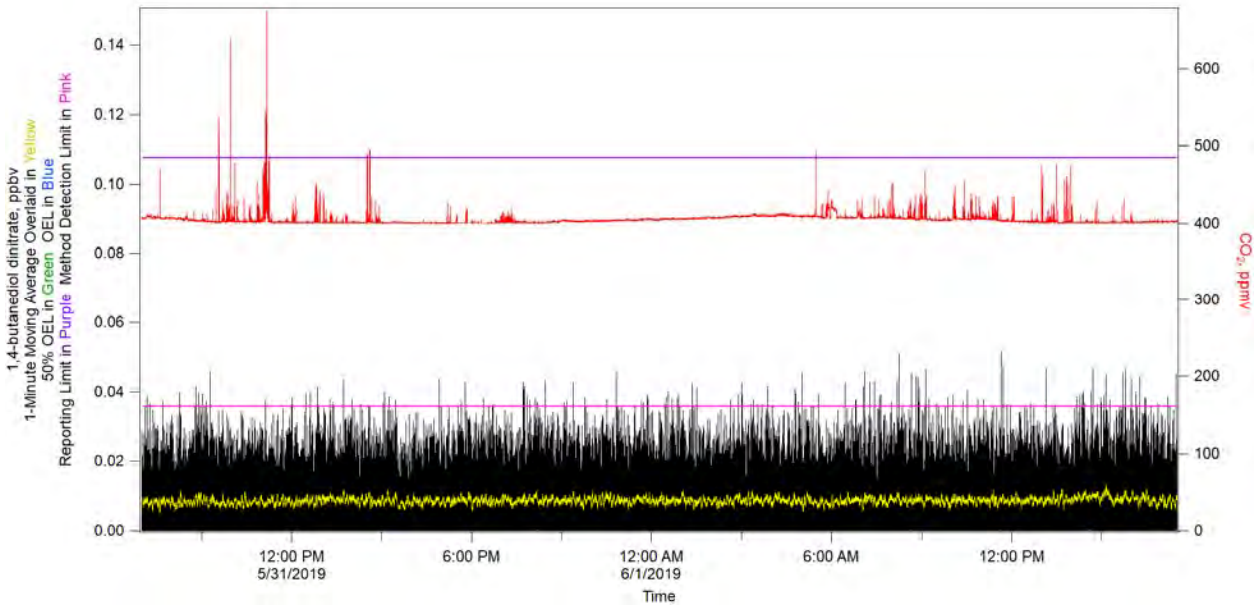

Figure 5-44. 1,4-butanediol Dinitrate.

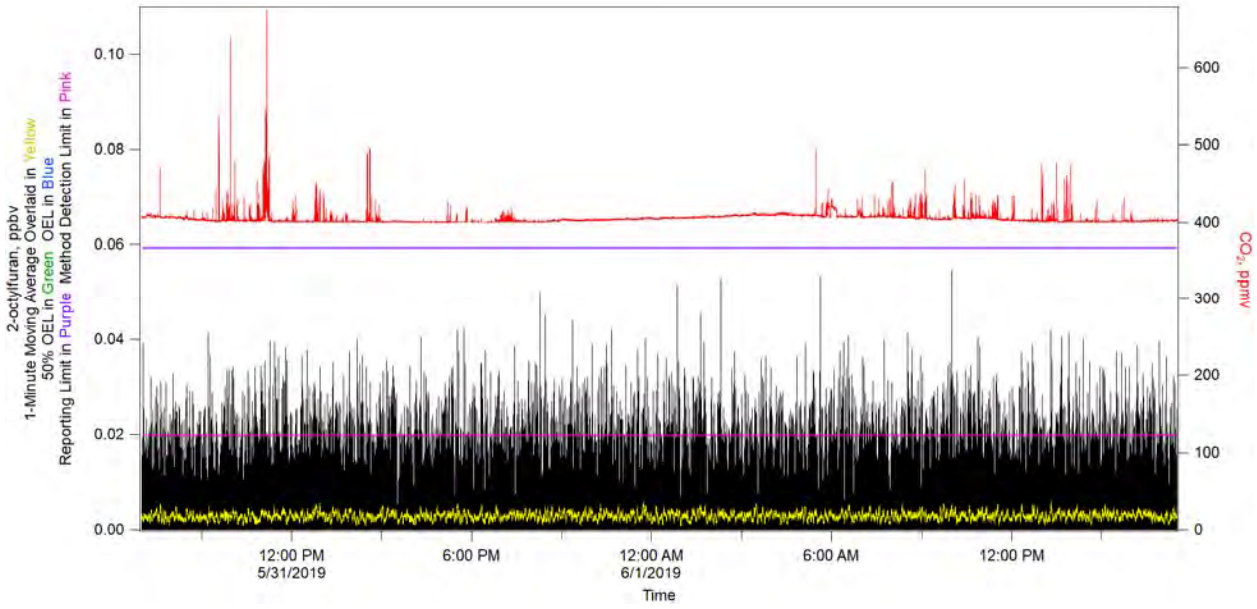

Figure 5-45. 2-octylfuran.

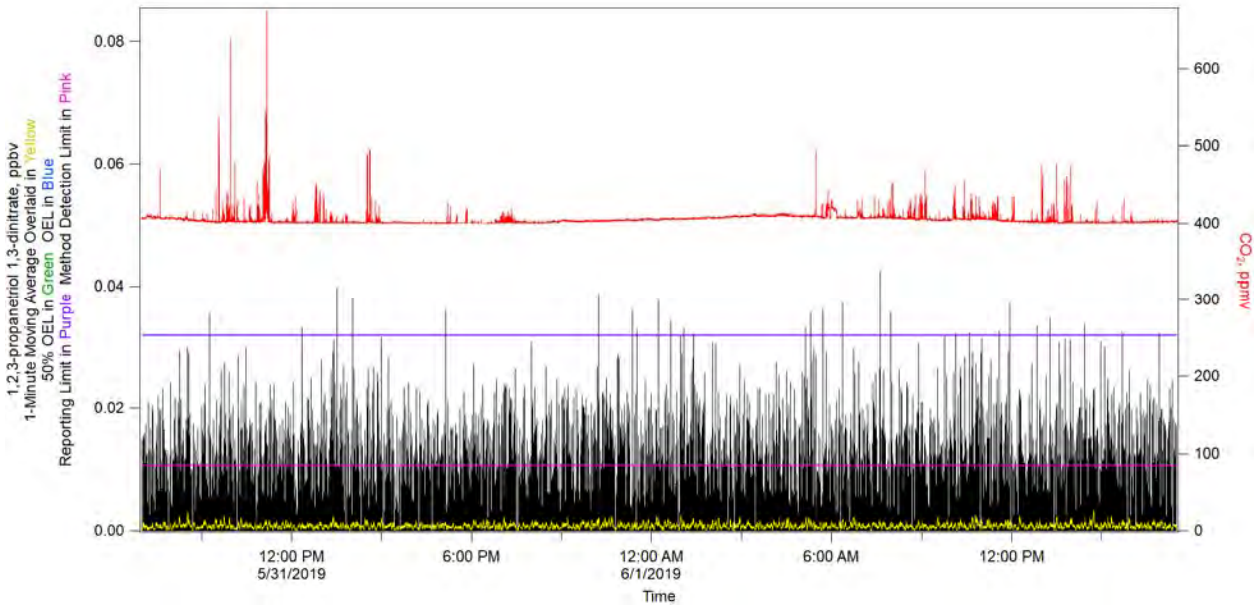

Figure 5-46. 1,2,3-propanetriol 1,3-dinitrate.

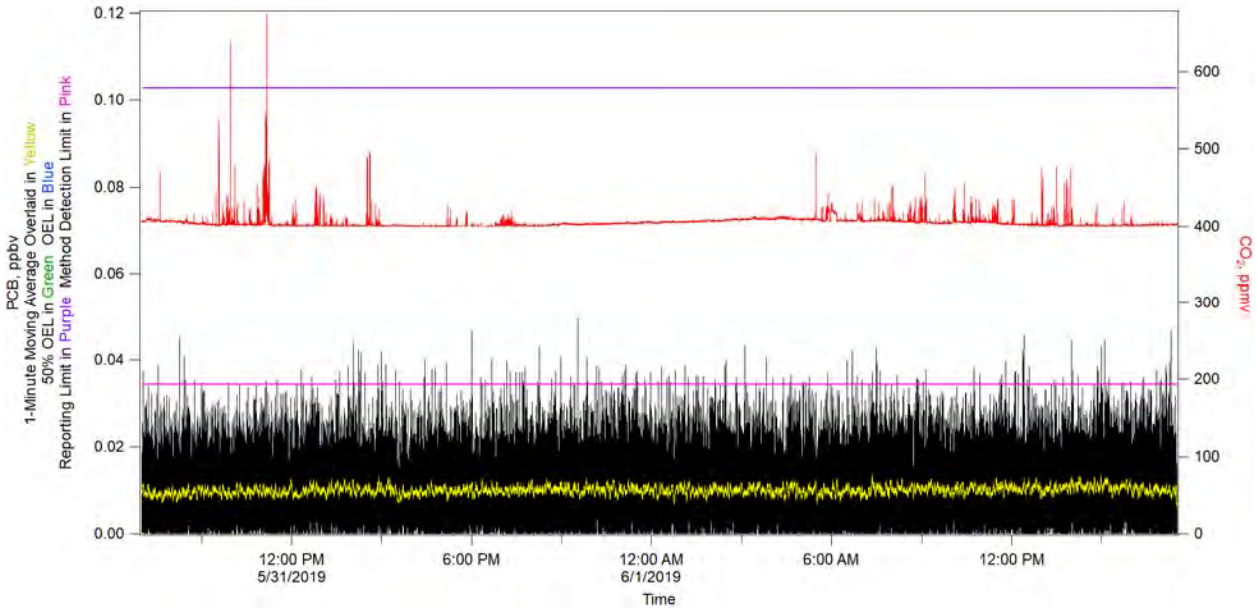

Figure 5-47. PCB.

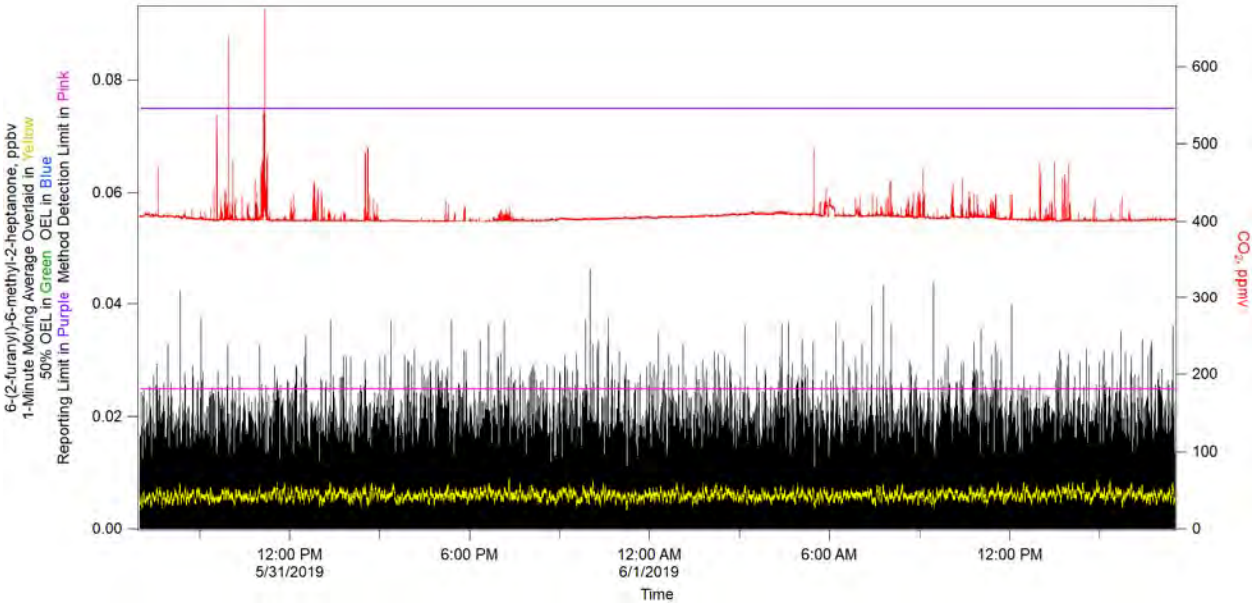

Figure 5-48. 6-(2-furanyl)-6-methyl-2-heptanone.

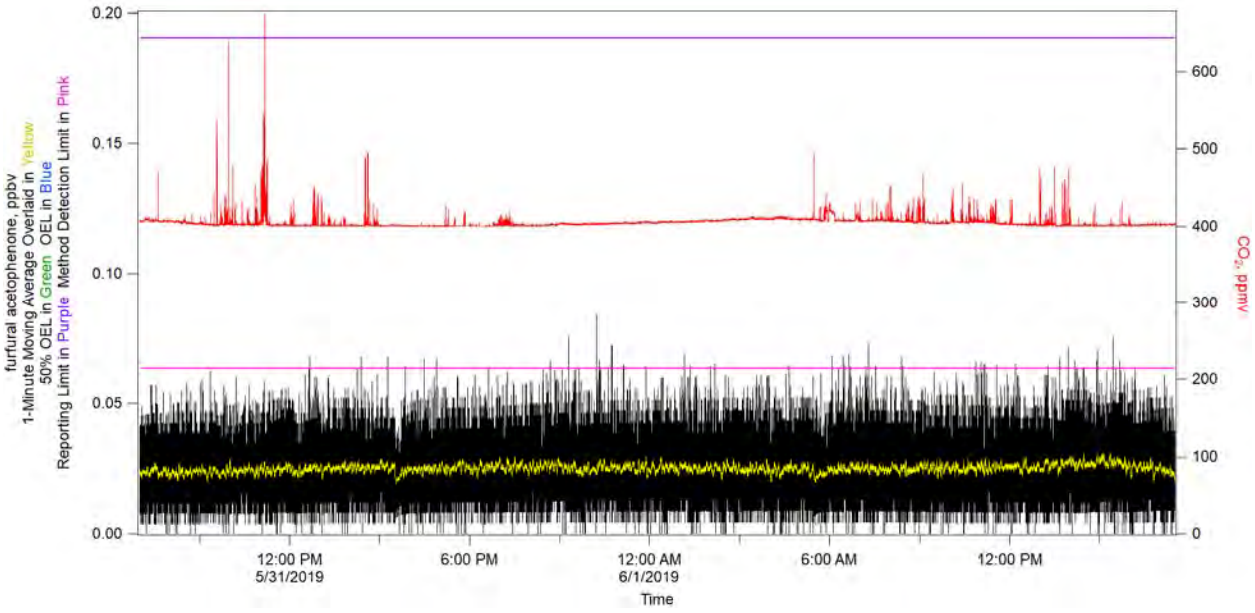

Figure 5-49. Furfural Acetophenone.

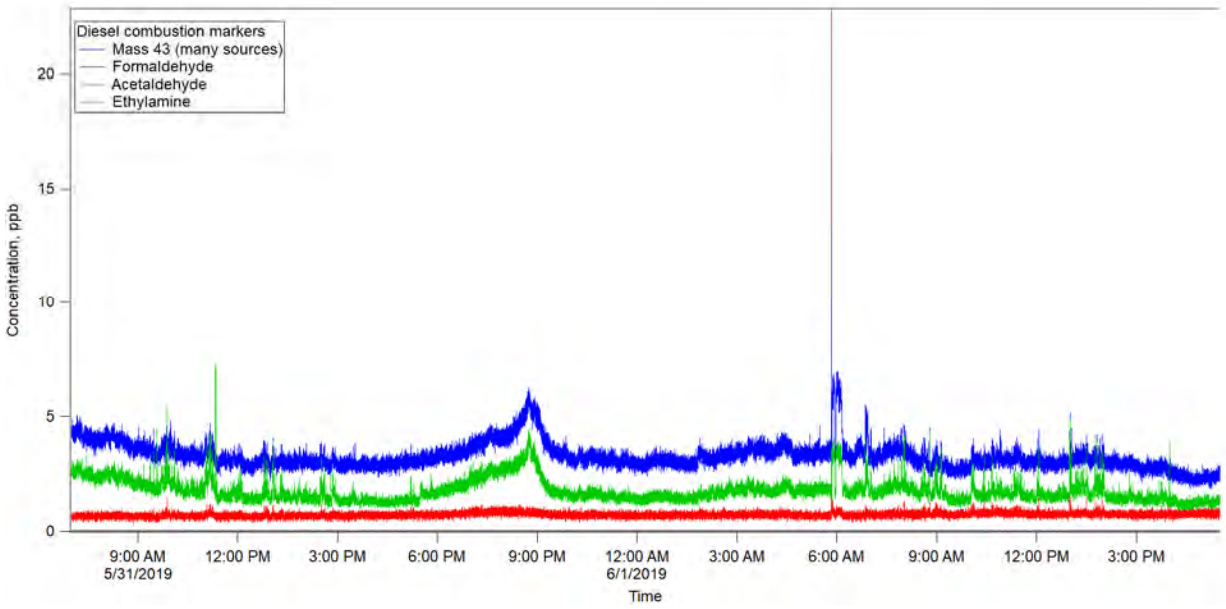

Figure 5-50. Diesel Combustion Markers.

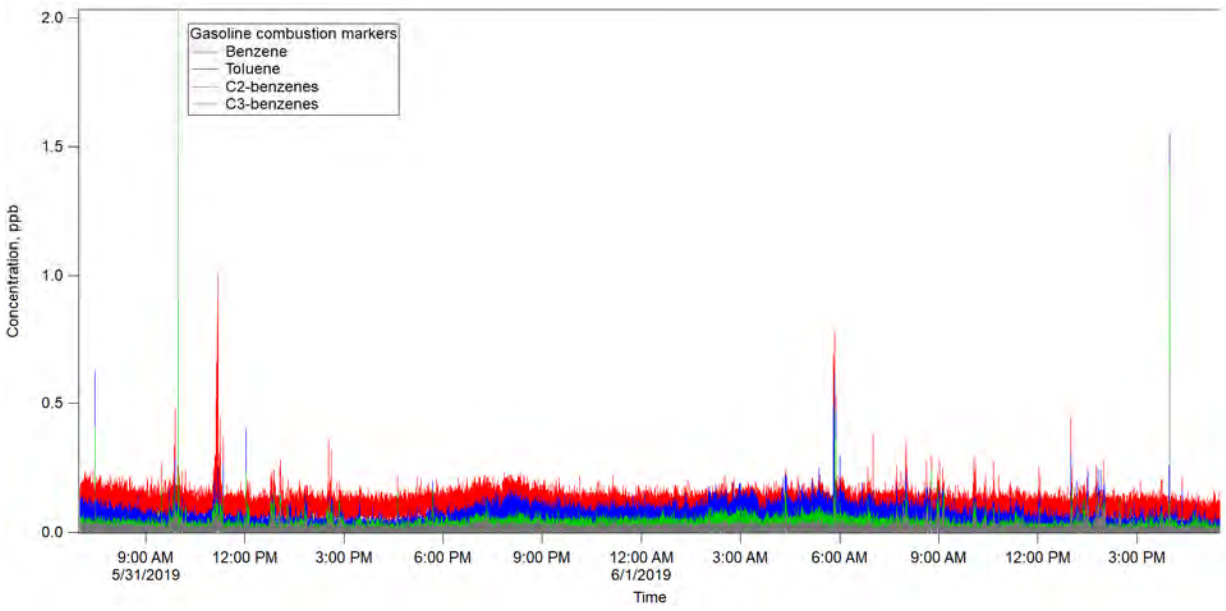

Figure 5-51. Gasoline Combustion Markers.

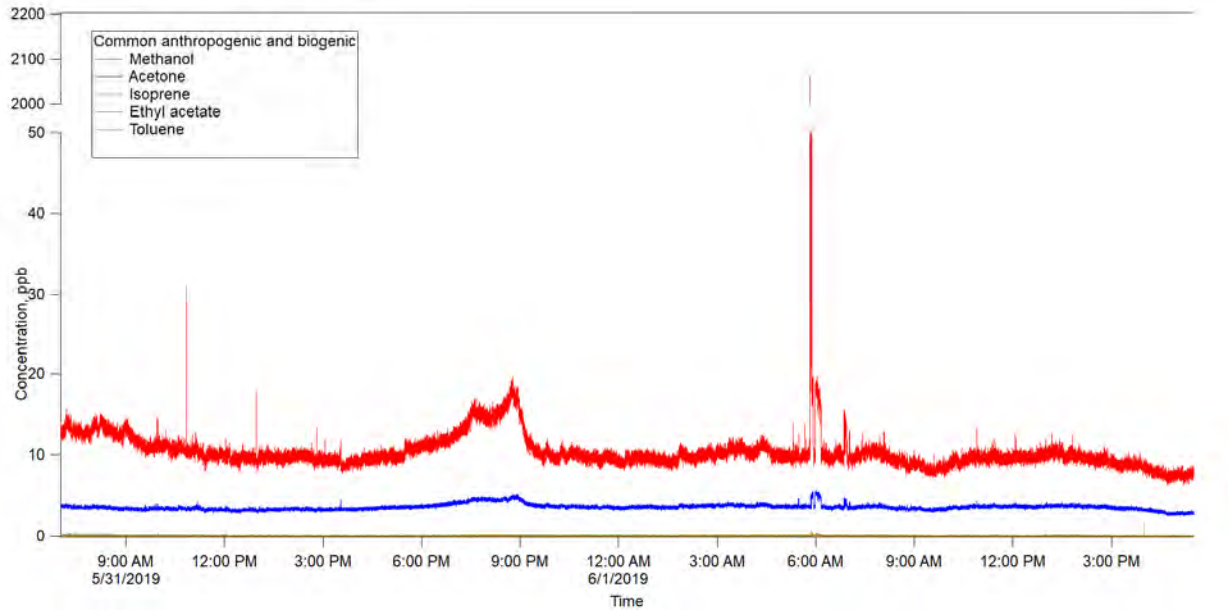

Figure 5-52. Plant and Human Markers.

5.5 Odor Compounds

The ML Operators monitored tank waste transfer on May 31, 2019, from approximately 13:10 until June 1, 2019, at 17:31. The following table represents the odor-causing compounds that were observed during this period.

Table 5-3. Odor Statistical Information for the Source Characterization Monitoring period on May 31, 2019 through June 1, 2019.

Odor #	Odor Compound Name	MDL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max. (ppb)	Median (ppb)
1	Hydrogen sulfide	2.801	<2.801	0.094	12.674	4.613	<2.801
2	methyl mercaptan	0.147	<0.147	0.026	33.403	0.204	<0.147
3	Dimethylsulfide + ethanethiol	0.088	<0.088	0.027	31.880	0.236	<0.088
4	allyl mercaptan	0.033	<0.033	0.005	305.304	0.065	<0.033
5	1-propanethiol + isopropyl mercaptan	0.041	<0.041	0.014	114.822	0.109	<0.041
6	2-butene-1-thiol	0.062	<0.062	0.011	177.102	0.085	<0.062
7	diethyl sulfide + 2-methylpropane-2-thiol	0.281	<0.281	0.024	33.779	0.254	<0.281
8	thiopropanal sulfuroxide	0.024	<0.024	0.007	152.285	0.060	<0.024
9	dimethyl disulfide	0.027	<0.027	0.008	95.052	0.067	<0.027
10	1-pentanethiol + 2,2-dimethylpropane-1-thiol	0.046	<0.046	0.013	156.899	0.209	<0.046
11	benzenethiol	0.028	<0.028	0.006	182.113	0.047	<0.028
12	diallyl sulfide	0.022	<0.022	0.009	186.389	0.075	<0.022
13	methyl propyl disulfide	0.016	<0.016	0.006	226.920	0.059	<0.016
14	methylbenzenethiol	0.027	<0.027	0.007	116.140	0.056	<0.027
15	dimethyl trisulfide	0.020	0.024†	0.013	52.149	0.095	0.023†
16	(1-oxoethyl) thiophene	0.040	<0.040	0.007	113.331	0.062	<0.040
17	(1-oxopropyl) thiophene	0.029	<0.029	0.008	105.790	0.054	<0.029
18	dipropyl disulfide	0.024	<0.024	0.006	111.156	0.053	<0.024
19	methyl propyl trisulfide	0.019	<0.019	0.005	139.425	0.045	<0.019
20	dimethyl tetrasulfide	0.021	<0.021	0.005	97.405	0.034	<0.021
21	dipropyl trisulfide	0.022	<0.022	0.006	180.392	0.050	<0.022
22	diphenyl sulfide	0.026	<0.026	0.007	139.503	0.062	<0.026
<	COPC Average/Median Below the MDL.						
†	Average/Median Between the RL and the MDL.						

Figure 5-53 through Figure 5-74 display potential odor-causing compounds, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of May 31, 2019 through June 1, 2019. If within range of the plot's left axis, a horizontal purple line representing the RL, and a pink horizontal line representing the MDL are shown.

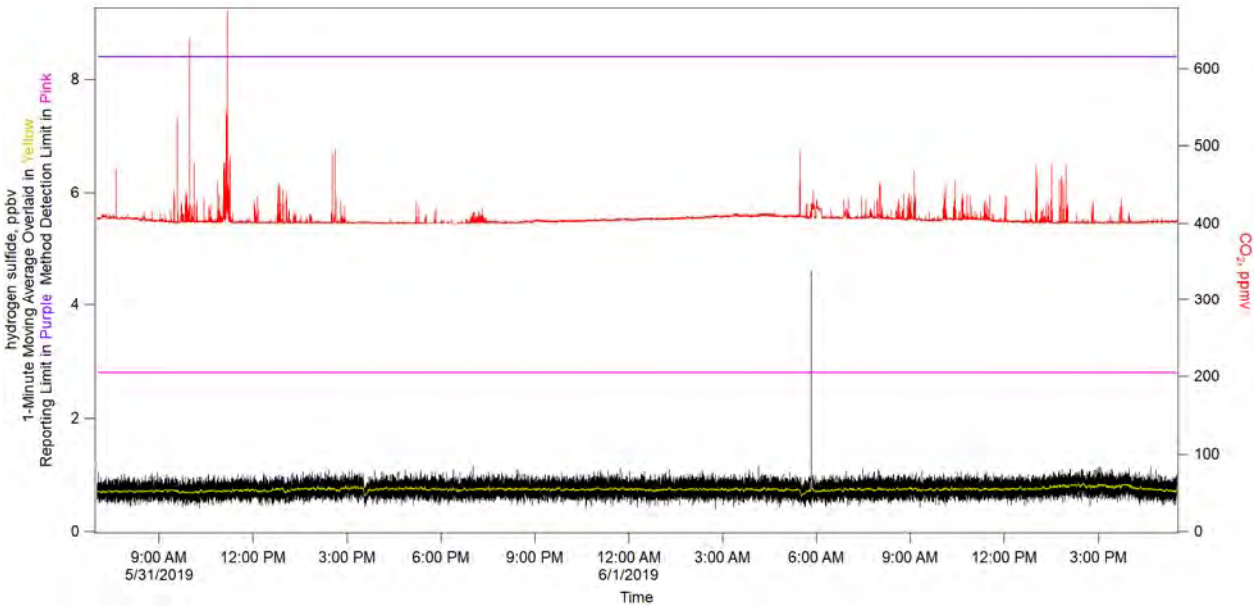

Figure 5-53. Hydrogen Sulfide.

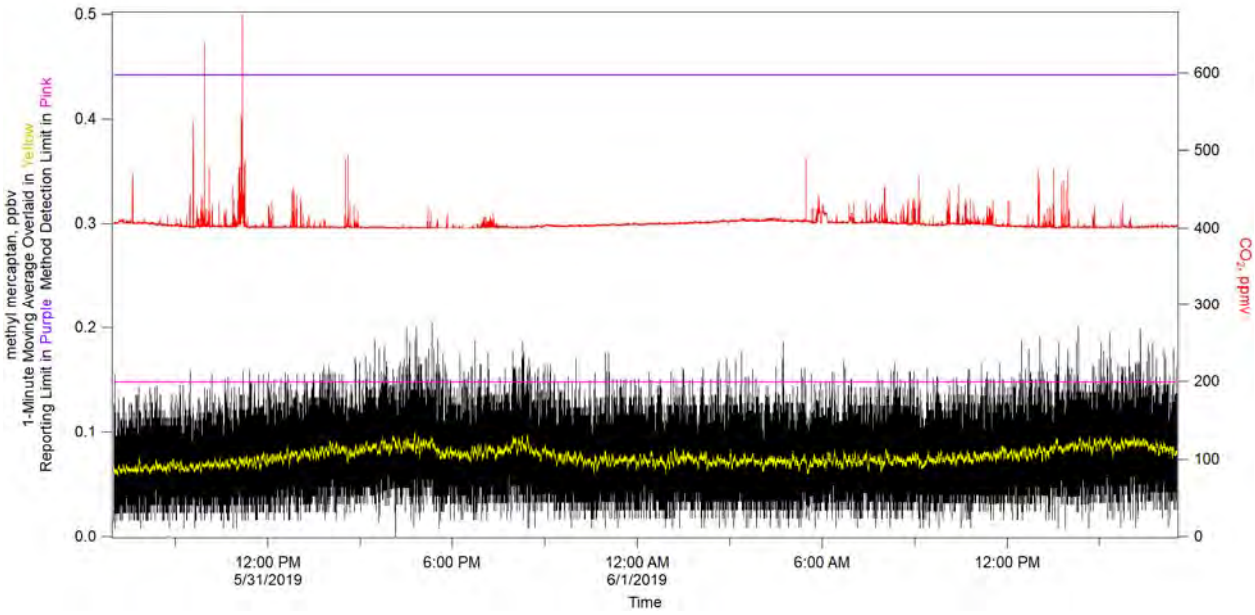

Figure 5-54. Methyl Mercaptan.

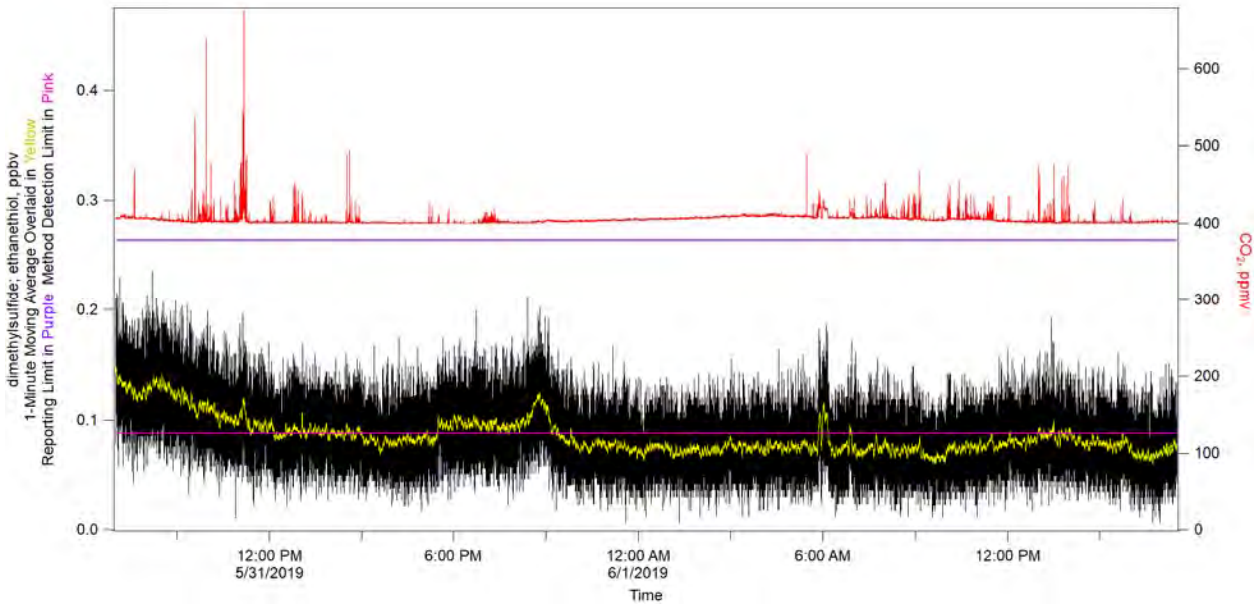

Figure 5-55. Dimethyl Sulfide; Ethanethiol.

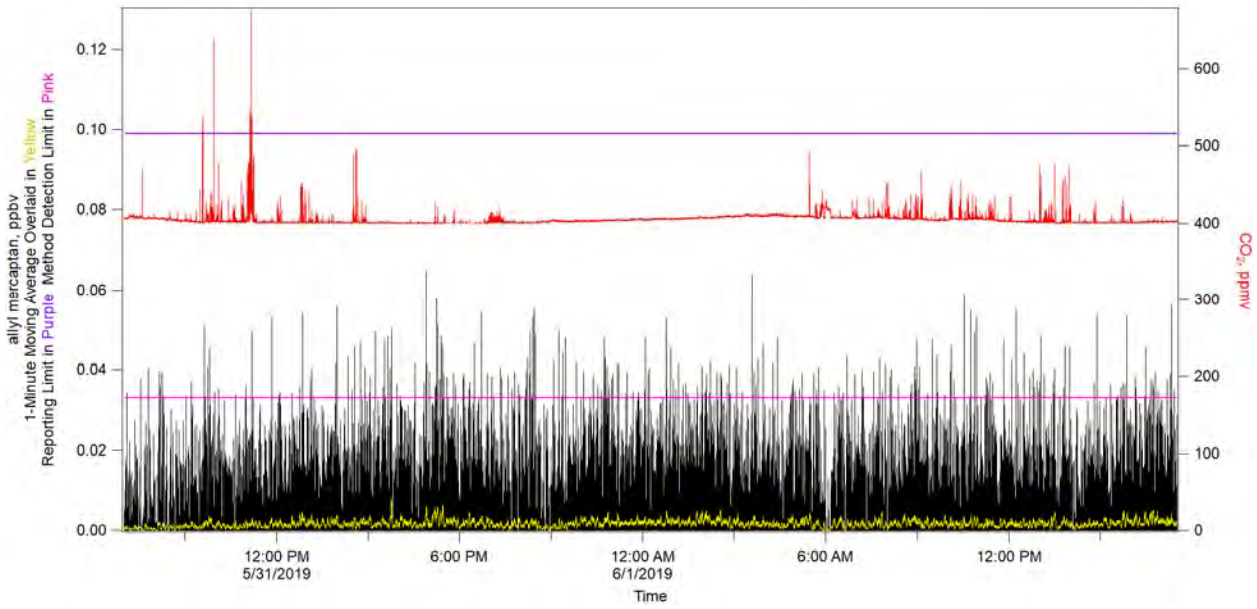

Figure 5-56. Allyl Mercaptan.

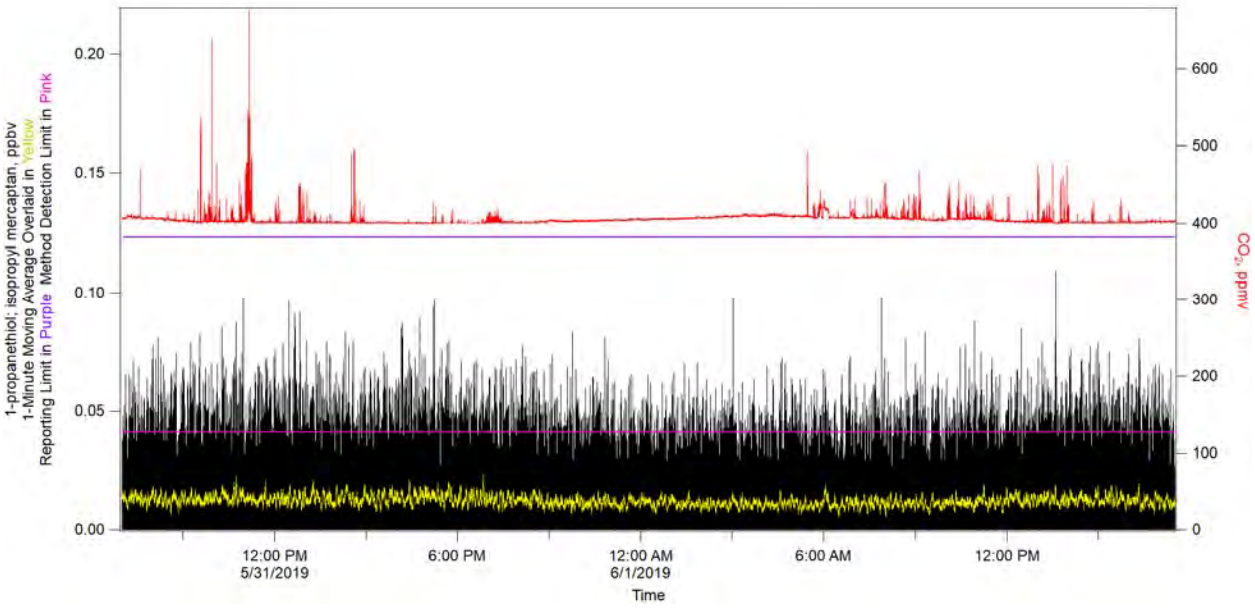

Figure 5-57. 1-propanethiol; Isopropyl Mercaptan.

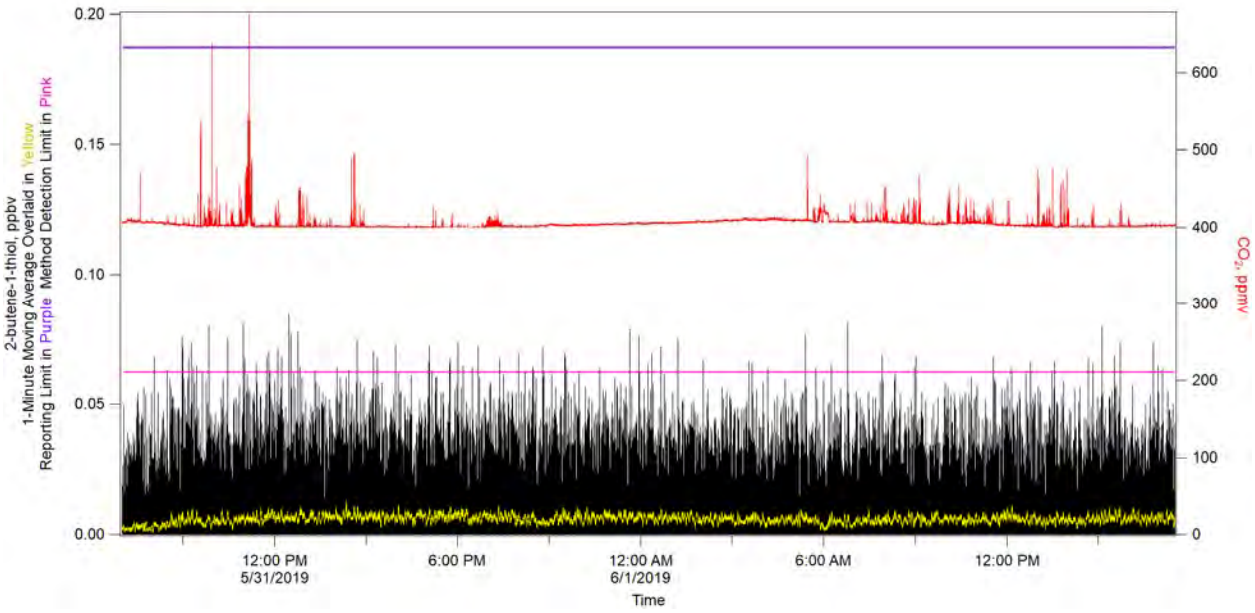

Figure 5-58. 2-butene-1-thiol.

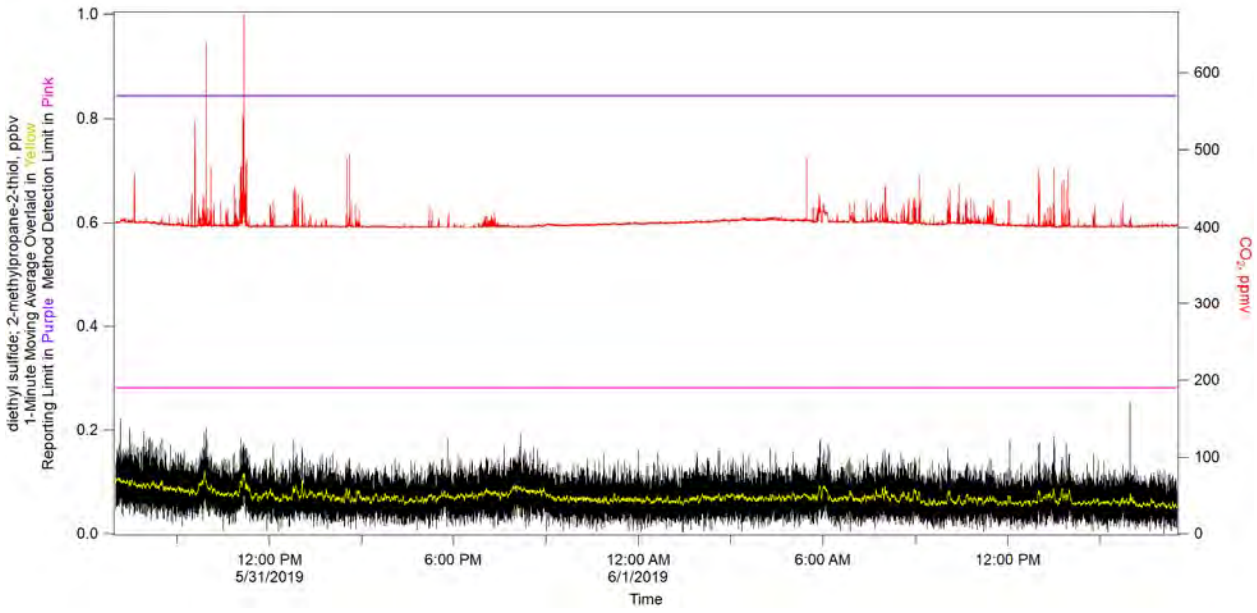

Figure 5-59. Diethyl Sulfide; 2-methylpropane-2-thiol.

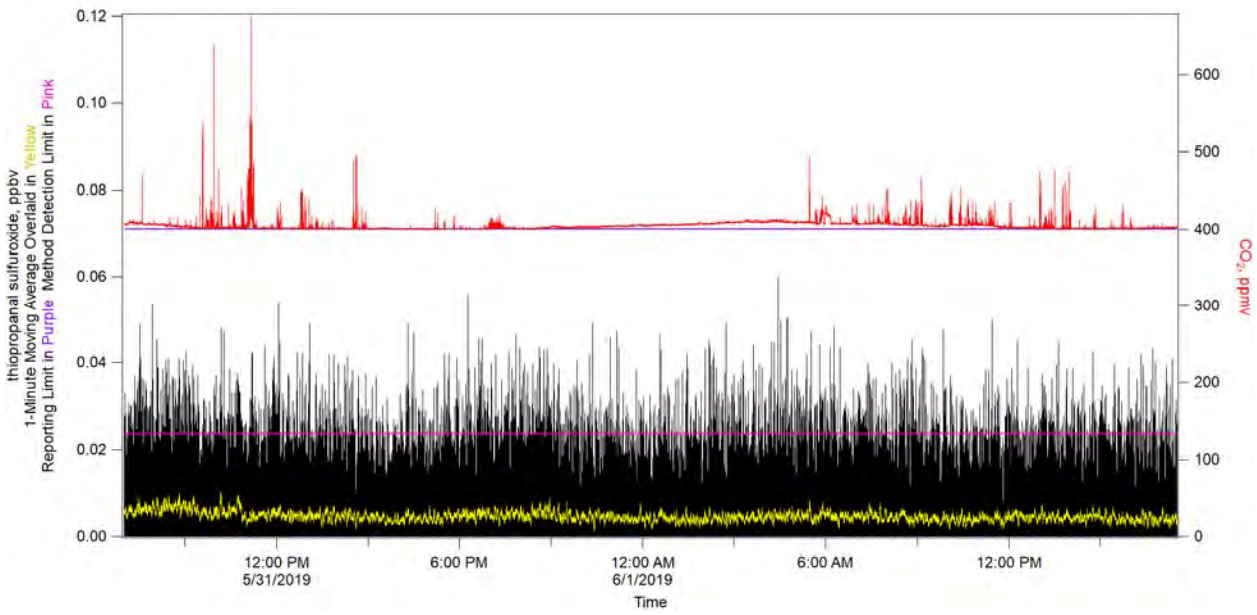

Figure 5-60. Thiopropanal Sulfuroxide.

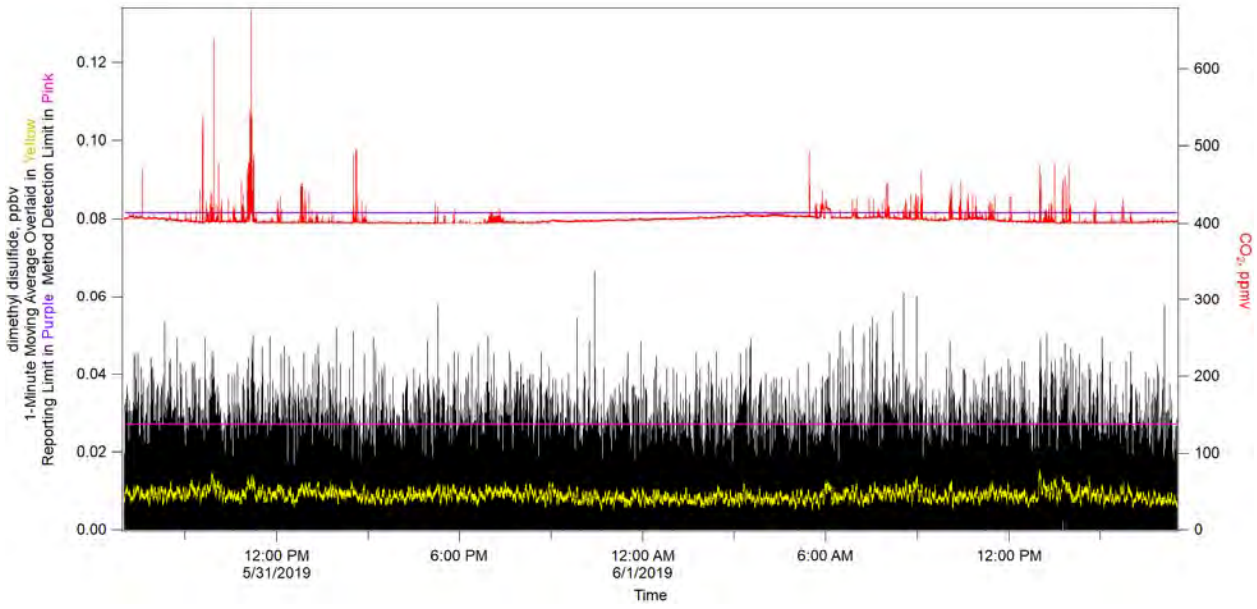

Figure 5-61. Dimethyl Disulfide.

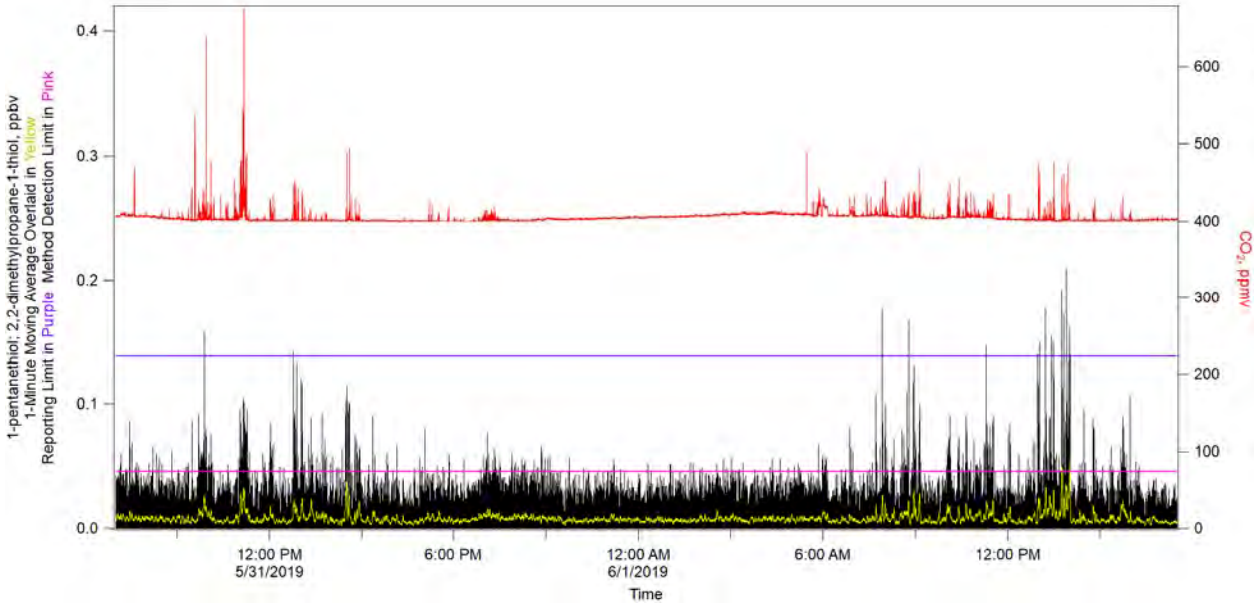

Figure 5-62. 1-pentanethiol; 2,2-dimethylpropane-1-thiol.

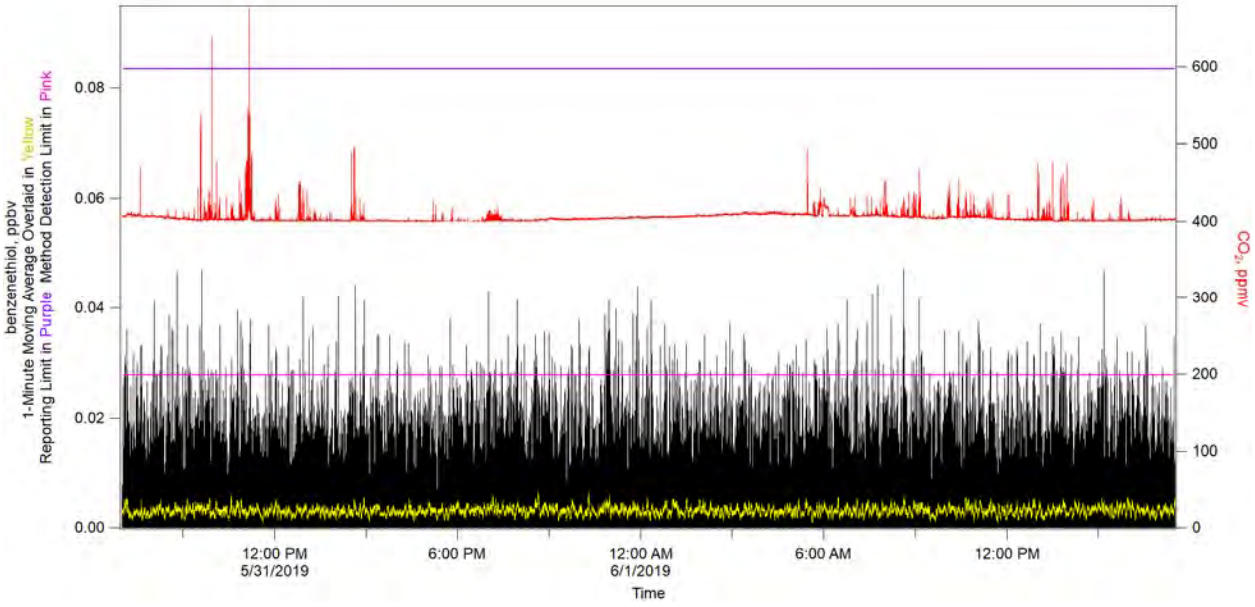

Figure 5-63. Benzenethiol.

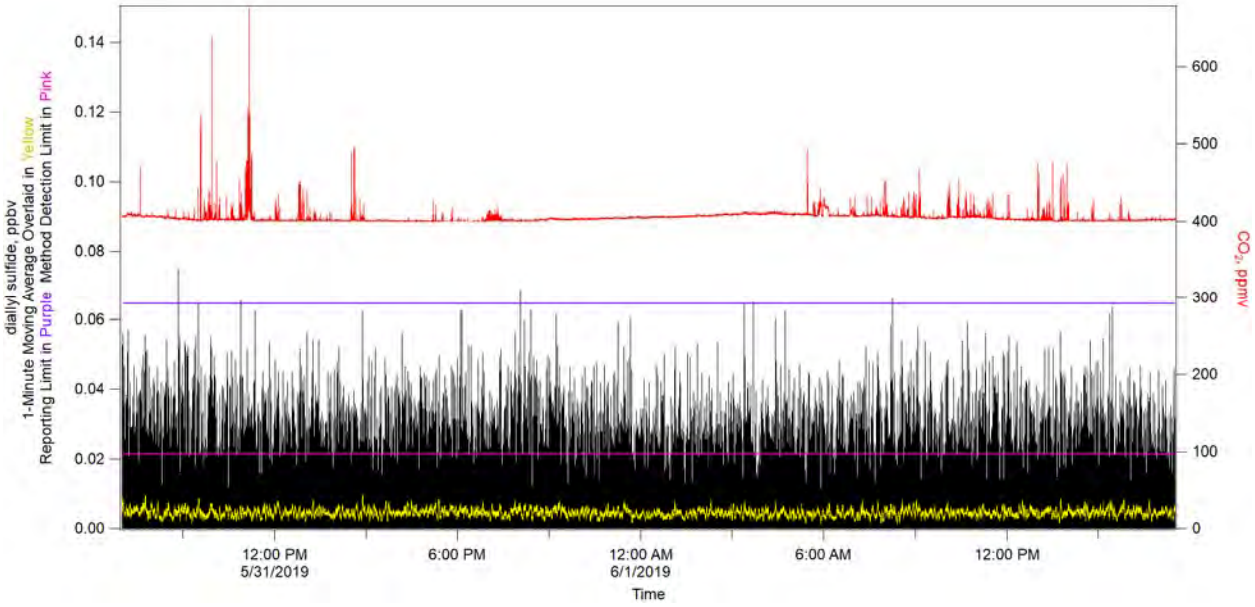

Figure 5-64. Diallyl Sulfide.

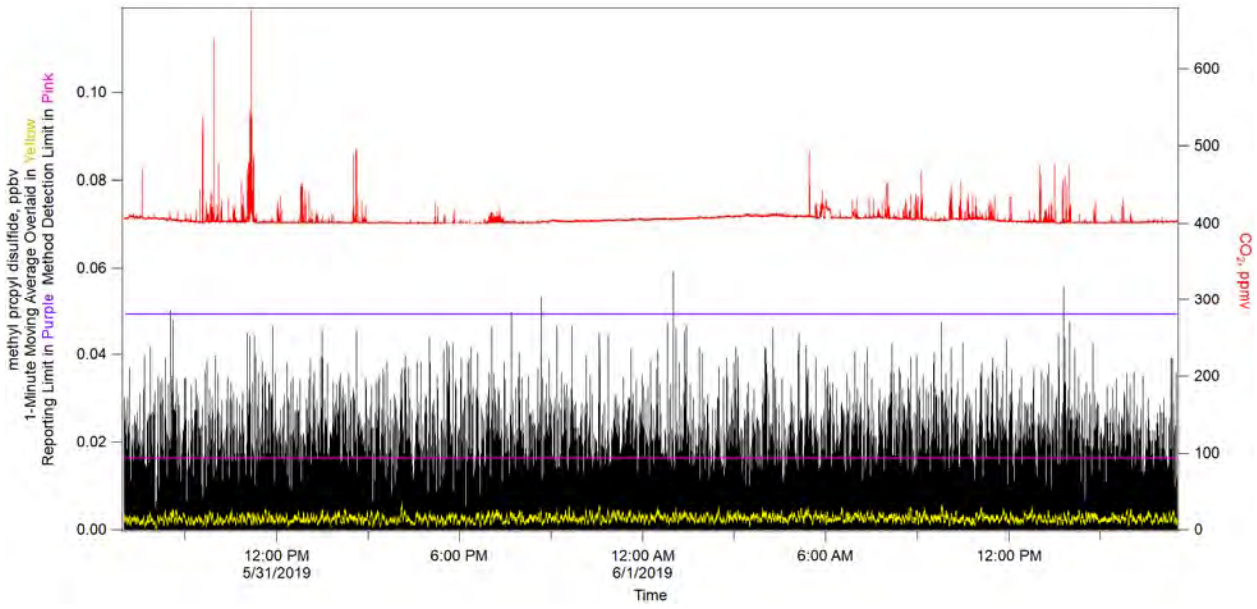

Figure 5-65. Methyl Propyl Disulfide.

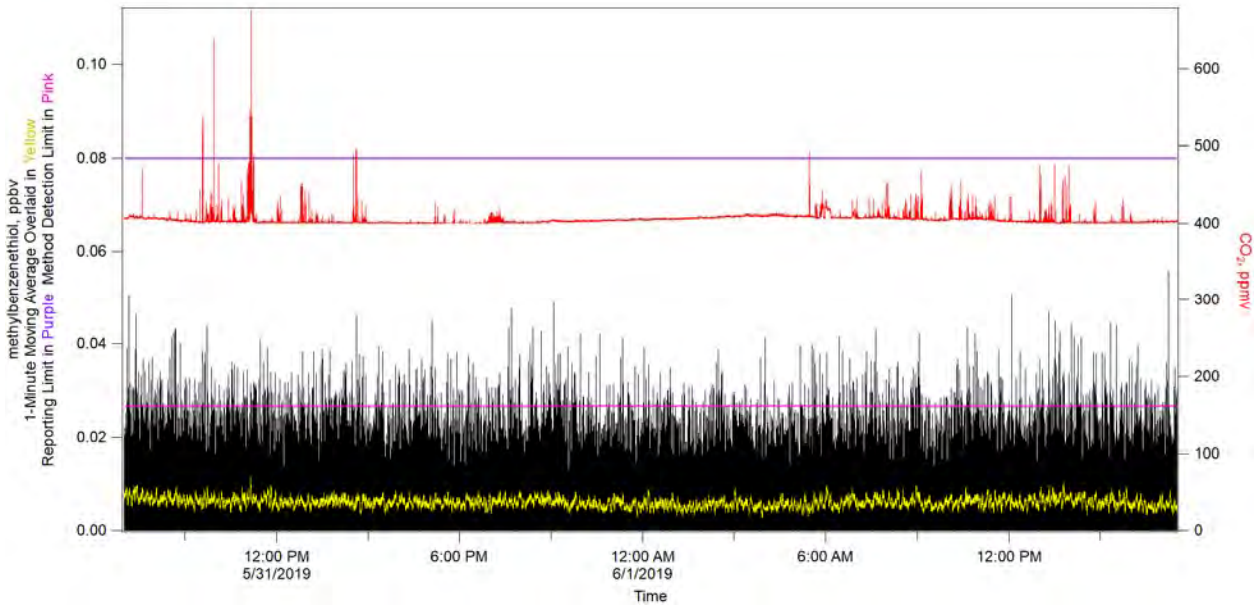

Figure 5-66. Methylbenzenethiol.

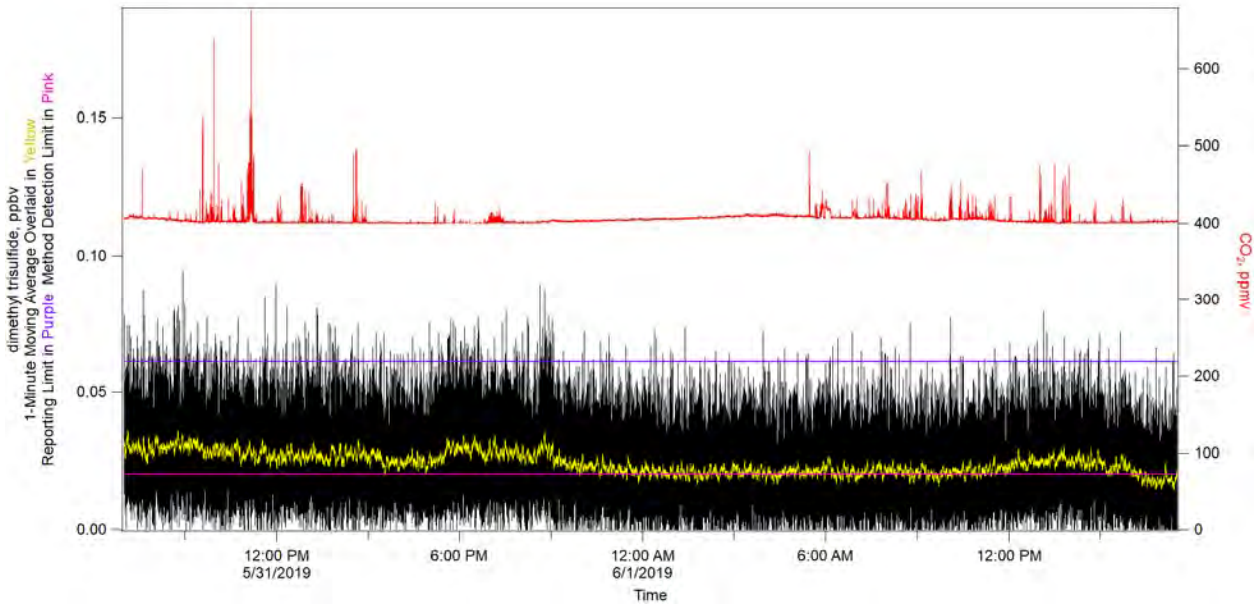

Figure 5-67. Dimethyl Trisulfide.

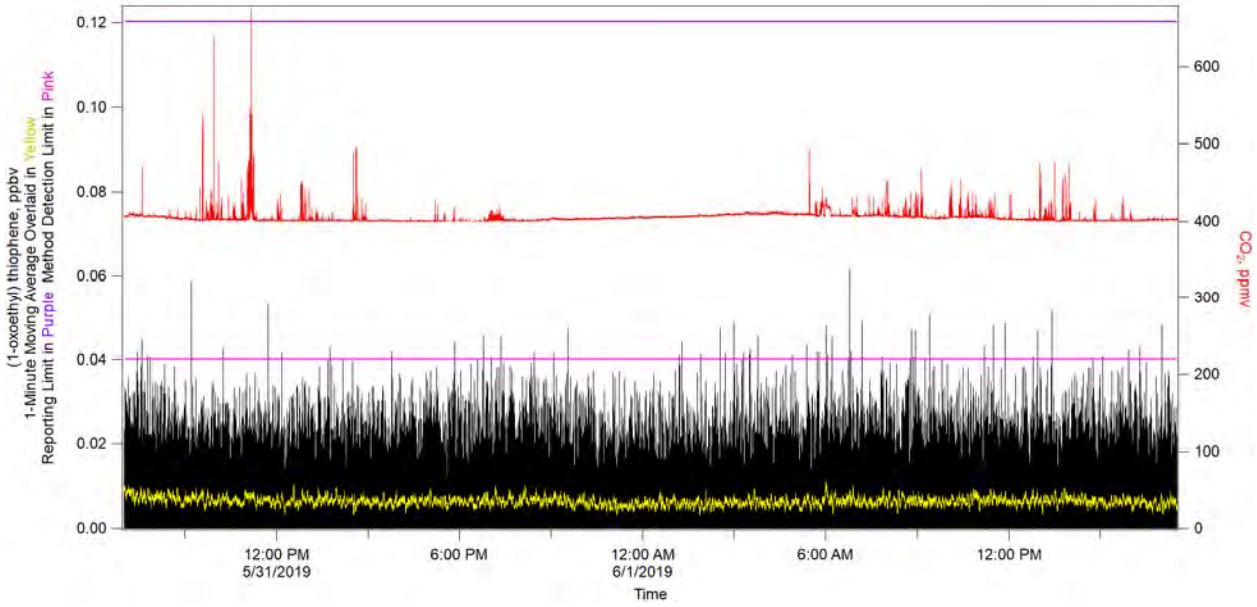

Figure 5-68. (1-oxoethyl) Thiophene.

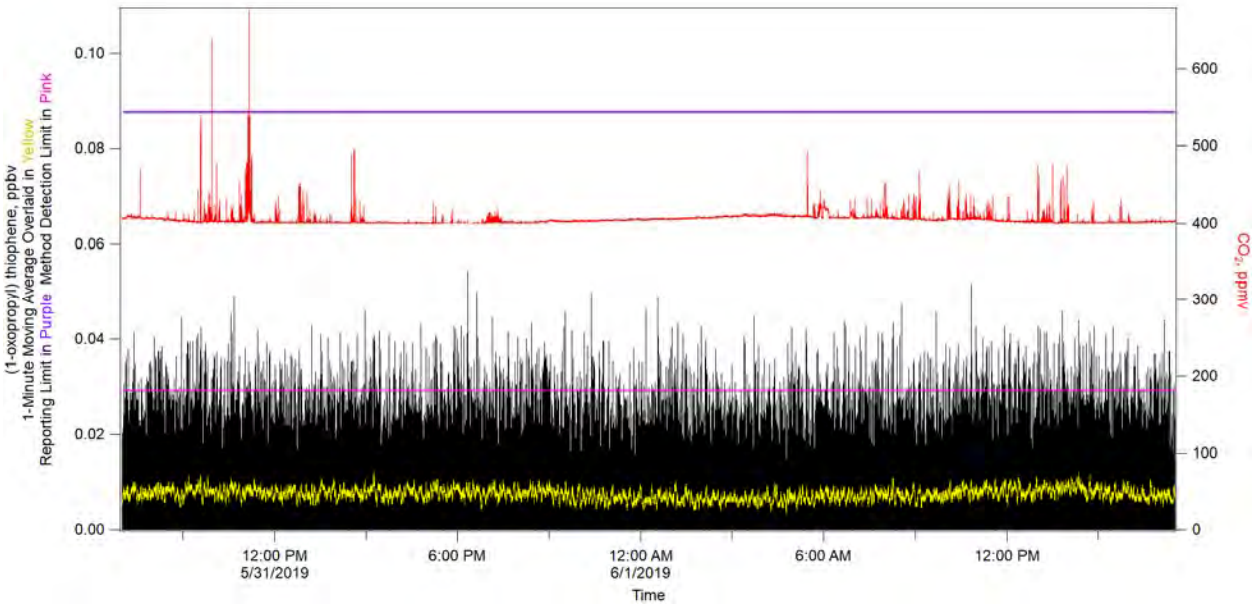

Figure 5-69. (1-oxopropyl) Thiophene.

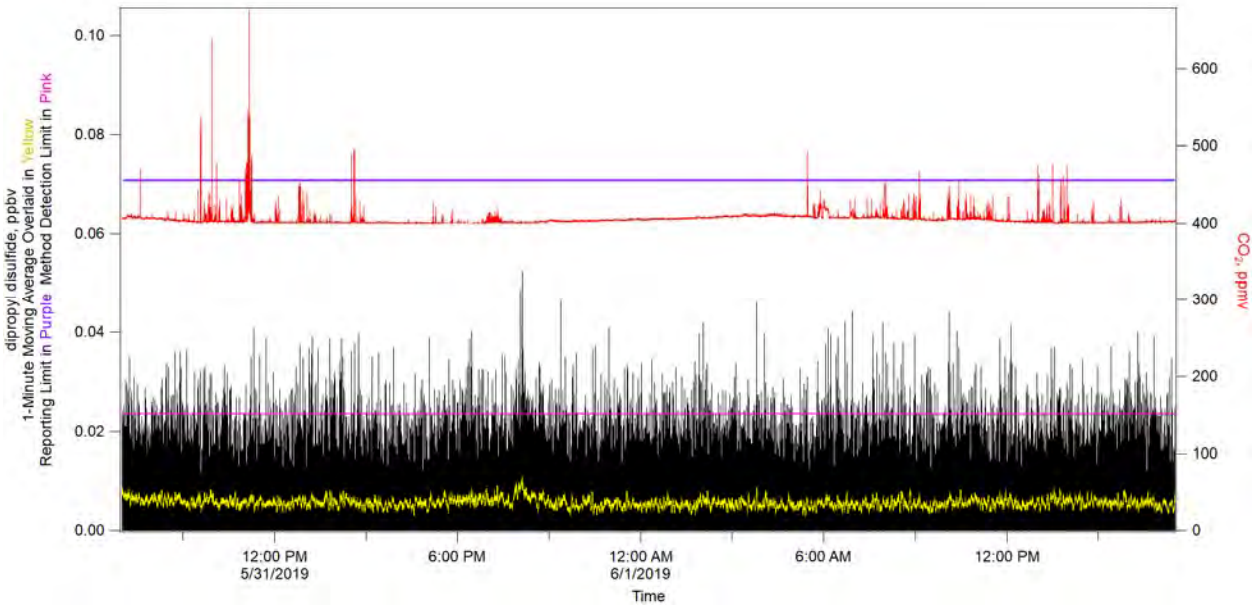

Figure 5-70. Dipropyl Disulfide.

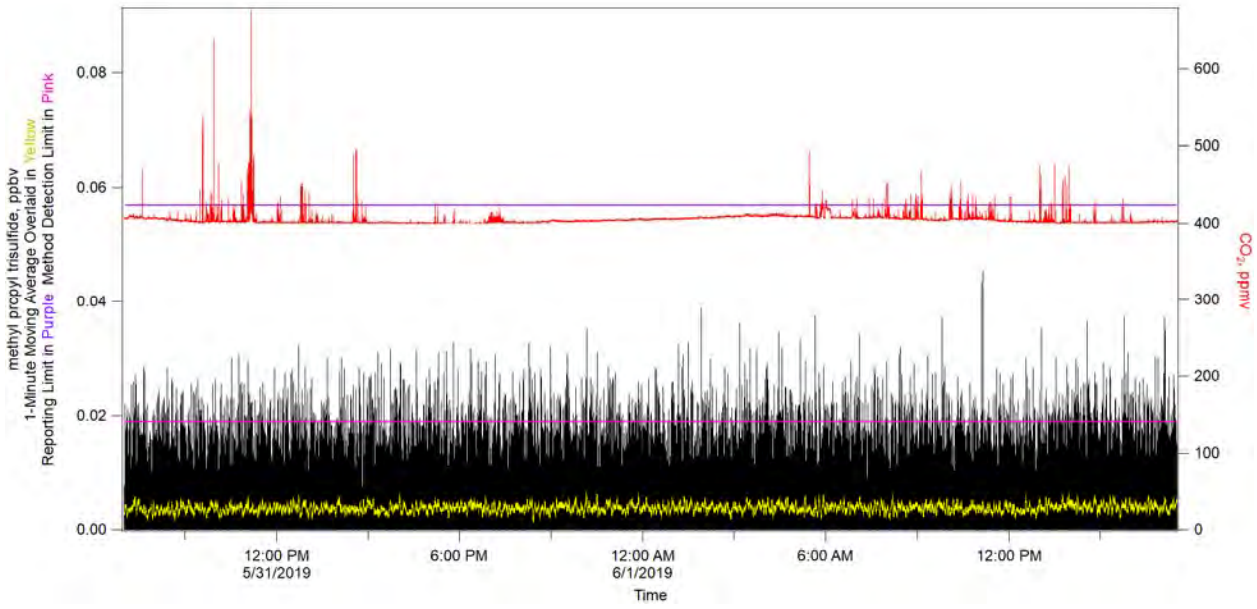

Figure 5-71. Methyl Propyl Trisulfide.

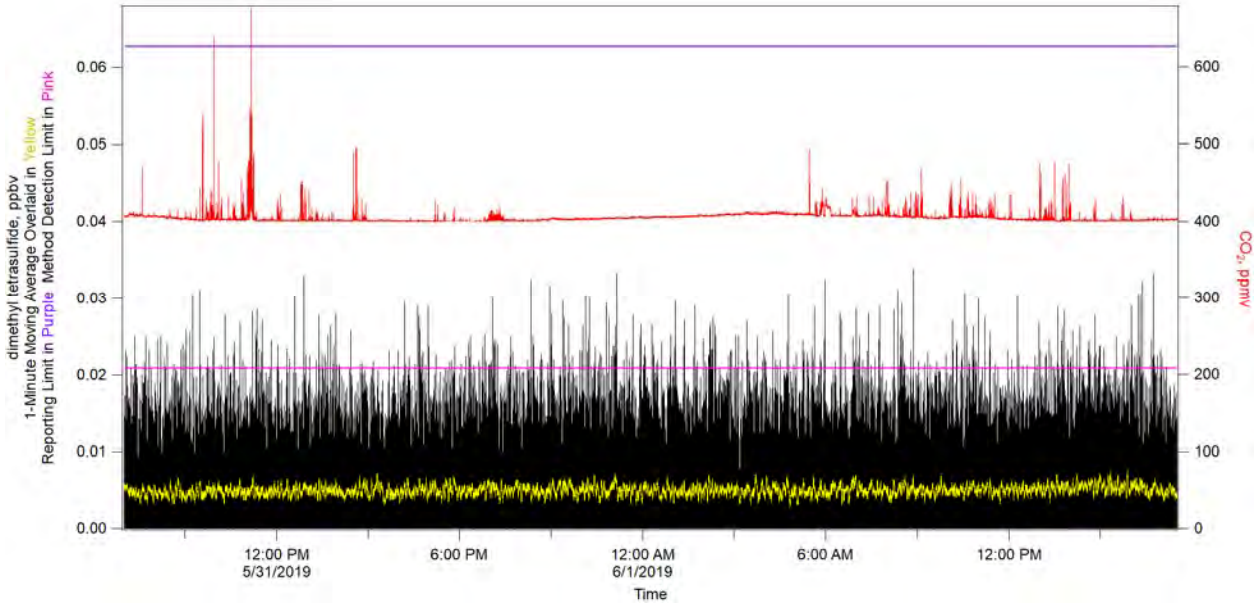

Figure 5-72. Dimethyl Tetrasulfide.

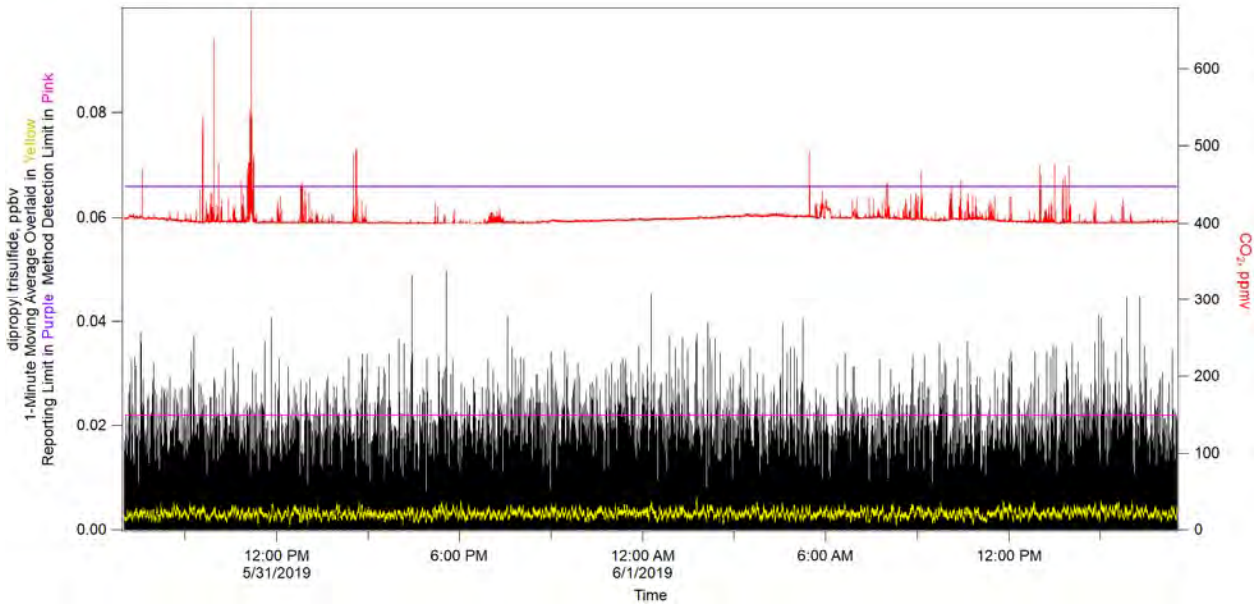

Figure 5-73. Dipropyl Trisulfide.

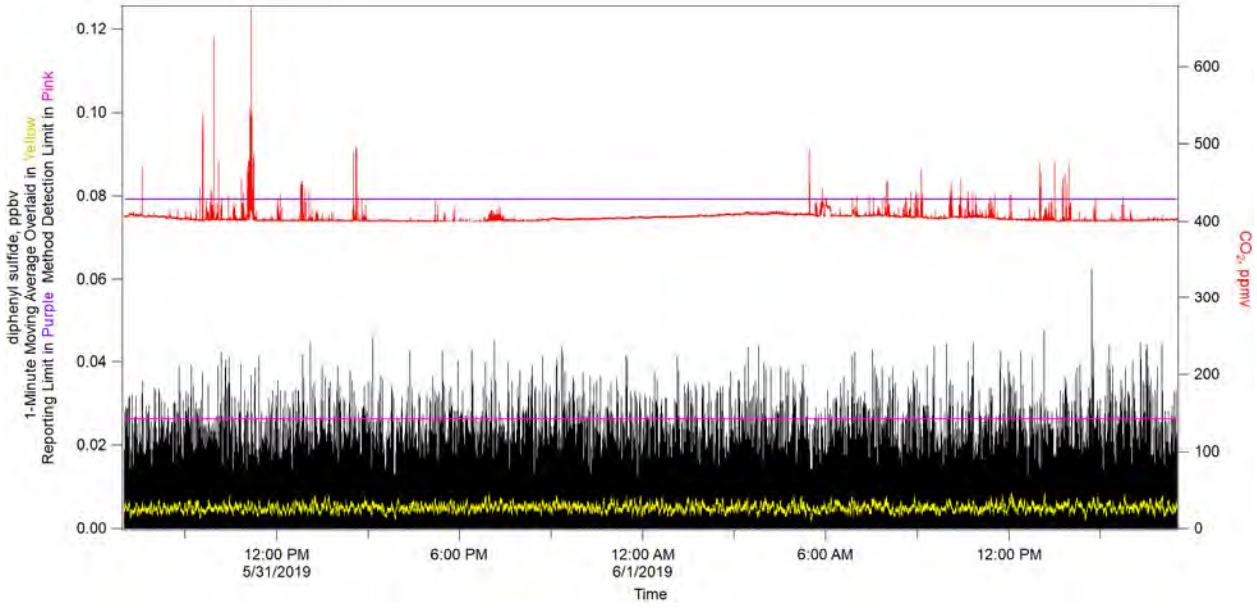

Figure 5-74. Diphenyl Sulfide.

6.0 ZERO-AIR AND SPAN VERIFICATION

Tables 6-1 through 6-6 display the zero-air and span checks.

Table 6-1. Zero-air Checks for the LI-COR CO_2 Monitor.

Date	Time	Instrument Check	Observed Result (ppm)	Expected Result (ppm)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	05:46	Zero	-2.471	<50	N/A	N/A	Pass
05/29/19	05:51	Zero	-1.722	<50	N/A	N/A	Pass
05/30/19	06:38	Zero	1.741	<50	N/A	N/A	Pass
05/31/19	04:47	Zero	-1.754	<50	N/A	N/A	Pass
06/01/19	18:53	Zero	1.8	<50	N/A	N/A	Pass

Table 6-2. Span Checks for the LI-COR CO_2 Monitor.

Date	Time	Instrument Check	Observed Result (ppm)	Expected Result (ppm)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	05:48	Span	348	384	9.6	20	Pass
05/29/19	05:53	Span	358	384	6.9	20	Pass
05/30/19	06:38	Span	361	385.4	6.4	20	Pass
05/31/19	04:49	Span	361	385	6.2	20	Pass
06/01/19	18:53	Span	360	384.9	6.5	20	Pass

Table 6-3. Zero-air Checks for the Proton Transfer Reaction – Time-of-Flight.

Date	Time	Instrument Check	Observed Result (ppb)	Expected Result (ppb)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	05:59	Zero	0.075	<0.5 ppb	N/A	N/A	Pass
05/29/19	06:04	Zero	0.07	<0.5 ppb	N/A	N/A	Pass
05/30/19	06:43	Zero	0.09	<0.5 ppb	N/A	N/A	Pass
05/31/19	04:55	Zero	0.07	<0.5 ppb	N/A	N/A	Pass
06/01/19	18:54	Zero	0.06	<0.5 ppb	N/A	N/A	Pass

Table 6-4. Span Checks for the Proton Transfer Reaction – Time-of-Flight .

Date	Time	Instrument Check	Observed Result (ppb)	Expected Result (ppb)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	06:09	Span	8.6	10.8	20	30	Pass
05/29/19	06:14	Span	8.75	10.8	18.9	30	Pass
05/30/19	06:43	Span	8.57	10.8	20.6	30	Pass
05/31/19	05:10	Span	8.7	10.8	19.4	30	Pass
06/01/19	18:55	Span	8.0	10.8	26	30	Pass

Table 6-5. Zero-air Checks for the Picarro.

Date	Time	Instrument Check	Observed Result (ppb)	Expected Result (ppb)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	05:30	Zero	7.757	< 20 ppb	N/A	N/A	Pass
05/29/19	05:34	Zero	7.143	< 20 ppb	N/A	N/A	Pass
05/30/19	06:42	Zero	7	< 20 ppb	N/A	N/A	Pass
05/31/19	04:30	Zero	6.648	< 20 ppb	N/A	N/A	Pass
06/01/19	18:55	Zero	7.122	< 20 ppb	N/A	N/A	Pass

Table 6-6. Span Checks for the Picarro.

Date	Time	Instrument Check	Observed Result (ppb)	Expected Result (ppb)	% Difference	Acceptance Criteria (%)	Pass/Fail
05/28/19	05:45	Span	3632	3284	10.6	20	Pass
05/29/19	05:47	Span	3547	3292	7.7	20	Pass
05/30/19	06:42	Span	3445	3250	6	20	Pass
05/31/19	04:41	Span	3626	3292	10.1	20	Pass
06/01/19	18:55	Span	3524	3283	7.3	20	Pass

7.0 DATA PROCESSING AND REPORTING

During the Week of May 26, 2019, through June 1, 2019, the data processing team continued processing data from the previous week and current week. The reporting team worked towards the completion of reports for Weeks 39 through Week 42, and Months 6 through Month 9. The reporting team submitted the draft weekly summary reports for Week 39 through Week 41 and Month 6 Report.

8.0 REFERENCES

17124-DOE-HS-102, 2018, "Mobile Laboratory Data Processing - Analysis," Revision 2, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

53005-81-RPT-007, 2018, *PTR-MS Mobile Laboratory Vapor Monitoring Background Study, (3/18/2018 – 4/20/2018)*, Revision 0, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

66409-RPT-004, 2019, *Mobile Laboratory Operational Procedure*, Revision 11, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study, 2017, RJ Lee Group, Inc., Pasco, Washington.