Keystone-Conemaugh Projects, LLC
175 Cornell Road, Suite 1
Blairsville, PA 15717

August 16, 2019

Via Email Delivery - ozone@otcair.org
Ozone Transport Commission
800 Maine Avenue SW, Suite 200
Washington, DC 20024

Re: Keystone and Conemaugh Generating Stations (KEY-CON)
Comments to Clean Air Act Section 184(c) petition submitted by Maryland Department of the Environment (MDE)

Dear Ozone Transport Commission (OTC):

Please find attached comments from KEY-CON and our air dispersion modeling contractor AECOM to the subject petition. The Keystone and Conemaugh stations are located in western Pennsylvania, and are among the facilities identified in the petition. This comments letter is organized as follows:

I. Background Information for KEY-CON

II. Synopsis of KEY-CON's understanding of MDE's petition

III. KEY-CON's request to the OTC

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(1) The petition is unnecessary for areas in Maryland to demonstrate attainment with the 2008 ozone (O_3) National Ambient Air Quality Standard (NAAQS).

(2) The petition is ill-timed as related to the State Implementation Plan (SIP) required for the 2015 O_3 NAAQS.

(3) The petition asserts that daily "excess emissions" from select Pennsylvania (PA) coal plants would not be realized if "the coal-fired EGU operators ran existing control technology consistent with manufacturers' specifications and *past best practices*" (emphasis added). The certified NOx emissions data clearly demonstrate that the KEY-CON units are being operated in accordance with manufacturers' specifications, the applicable requirements and good air pollution control practices – MDE's assertion is inaccurate. Importantly, there is no applicable requirement to operate units in accordance with "*past best practices.*"

(4) A review of hourly NOx emission rate data for the O_3 NAAQS exceedance events included in the petition clearly demonstrates that KEY Units 1 and 2 and CON Units 1 and 2 were operated in accordance with the applicable requirements and good air pollution control practices, and in a manner consistent with all other periods during the ozone season (OS).

(5) The KEY-CON units are subject to NOx emission limits promulgated under the Pennsylvania Department of Environmental Protection (PA DEP) RACT 2 Rule, which became effective on 01-01-2017. Operating units in accordance with "*past best practices*" is not a Clean Air Act term and suggests that Best Available Control Technology (BACT) is required – BACT is not required; Reasonably Achievable Control Technology (RACT) is required. RACT requirements for the units included in the petition were reviewed and established for source categories by PA DEP in the RACT 2 regulation.

(6) The petition is silent on whether the claimed "excess emissions" impacted any of the MDE ozone monitors on days with measured exceedances of the NAAQS. Trajectory analyses generated by AECOM using the HYSPLIT model show that of the total of 28 ozone exceedance days involved over the 2 years, only 10 of the days involved back trajectories that were in the vicinity of KEY-CON, or about 36% of the cases. On those 10 select days, the backward trajectories also traversed either over large metropolitan areas in western Pennsylvania and Midwest states (Ohio, Indiana, Michigan, etc.) or over the Ohio River Valley. These large metropolitan areas and Ohio River Valley include significant sources of NOx emissions from mobile sources and other stationary sources. Consequently, because of the preponderance of southerly wind components occurring during high ozone days recorded at MDE monitoring sites, the majority of the days in 2017 and 2018 with monitored O_3 NAAQS exceedances were not influenced by emissions from KEY-CON.

(7) The petition included the results from a photochemical dispersion model run using CAMx[1] modeling for determining the potential incremental ozone concentration levels associated with the assumed "excess emissions." AECOM's review of the modeling run includes the following findings:

(i) The ratios of non-optimized to optimized NOx emissions (as selected by MDE) for the KEY-CON units used in the CAMx modeling analysis were 2 to 4 times higher than the typical ratios that MDE determined in their 2017-2018 daily emissions analysis. Inflated ratios may also have been used for the other PA coal-fired EGUs as well. It appears that MDE applied this difference of emissions for the KEY-CON and all other PA coal-fired EGUs for every day of the July 2011 CAMx simulation and for all other PA coal-fired EGUs. This configuration is clearly a worst-case situation that is unlikely to happen even on one day, much less for an entire month. Therefore, the modeling results reported for these differences in NOx emissions for the PA coal-fired EGUs represent an extremely improbable outcome.

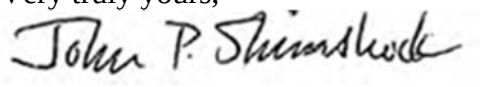
(ii) Even using these exaggerated NOx emission differences, ozone modeling results at three select MDE monitors for each day in July 2011 model run showed that the impacts of the "excess emissions" from the PA coal-fired EGUs are virtually undetectable. Model runs conducted with more representative emission inputs would generate results with even smaller impacts. Thus, based upon the CAMx modeling MDE provided, the MDE-recommended changes to optimize the PA coal-fired EGU NOx emissions have been demonstrated to have a negligible effect on ambient O_3 concentrations monitored at MDE sites.

[1] Comprehensive Air Quality Model with Extensions (CAMx): documentation and model available at http://www.camx.com/.

IV. KEY-CON and AECOM's observation pertaining to O_3 exceedances at MDE monitoring sites

Details and supporting information for each of the above-listed sections follow. If you have any questions or concerns regarding these comments, then please contact me at (724) 235-4596 or john.shimshock@genon.com.

Very truly yours,



John P. Shimshock
Environmental Specialist - Conemaugh Generating Station

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

I. Background Information for KEY-CON

Each station operates two pulverized bituminous coal-fired boilers, each with a steam turbine-driven electric generator. Each electric generating unit (EGU) is equipped with a suite of emissions control devices that include the following:

- Selective catalytic reduction (SCR) system for nitrogen oxide (NOx) emissions control,
- Electrostatic precipitator (ESP) for particulate matter emissions control,
- Hydrated lime sorbent injection system for sulfuric acid mist (H_2SO_4) emissions control, and
- Wet limestone slurry-forced oxidation scrubber for sulfur dioxide (SO_2) emissions control.

These emissions control devices also provide for co-beneficial control for hazardous air pollutants including mercury and other non-mercury metal emissions, acid gases (hydrochloric and hydrofluoric) and volatile organic compounds. Each unit is demonstrating compliance with the following applicable requirements:

- PA DEP's NOx and VOC RACT 2 Rule – compliance with this rule began 01-01-2017 and the rule requirements are applicable year-round,
- U.S. EPA's Transport Rule (CSAPR, 40 CFR 97 Subparts 5A-5C) – compliance with this rule began in CY 2015 (Phase 1) and CY 2017 (Phase 2), and there are separate requirements for the ozone season and calendar year compliance periods; and
- U.S. EPA's Mercury and Air Toxics Rule (MATS, 40 CFR 63 Subpart 5U) – compliance with this rule began in calendar year (CY) 2015 and the rule requirements are applicable year-round. KEY Units 1 and 2 successfully demonstrated low-emitting EGU (LEE) status for non-mercury metals and acid gas (HCl) emissions under the MATS Rule. CON Units 1 and 2 also successfully demonstrated LEE status for non-mercury metals and satisfy presumptive acid gas emissions control via the alternate SO_2 emissions limit standard under the MATS Rule.

The nominal maximum electrical output each for Units 1 and 2 at the Keystone and Conemaugh Generating Stations is about 900-910 MW gross.

II. Synopsis of KEY-CON's understanding of MDE's petition

Daily "excess emissions" from select coal plants located in Pennsylvania are either contributing to O_3 non-attainment or interfering with maintenance of the O_3 NAAQS. "Excess emissions" would not be realized if "the coal-fired EGU operators ran existing control technology consistent with manufacturers' specifications and *past best practices*" (emphasis added).

The "initial straw-man draft of the recommendation" from MDE is to establish new daily / 24-hour (block) average NOx emission limits (equal to those in the PA DEP RACT 2 Rule, 0.12 lb/MMBtu for units with SCR) and revised rolling 30-day average NOx emission limits equal to the lowest historical NOx emission rate for the same averaging period.

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(1) The petition is unnecessary for areas in Maryland to demonstrate attainment with the 2008 O_3 NAAQS.

Per 40 CFR §81.321, all areas in Maryland are designated as attainment with respect to the 2008 O_3 NAAQS except the (i) Baltimore area (moderate non-attainment) and (ii) Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE and Cecil County, MD (marginal non-attainment). Importantly though, clean data determinations were finalized for these two areas effective 07-01-2015 (FR 80 (104) 06-01-2015, pages 30941-30946) and 12-04-2017 (FR 82 (211) 11-02-2017, pages 50814-50820), respectively.

(2) The petition is ill-timed as related to the State Implementation Plan (SIP) required for the 2015 O_3 NAAQS.

Per 40 CFR §81.321, all areas in Maryland are designated as attainment with respect to the 2015 O_3 NAAQS except (i) Baltimore area (marginal non-attainment), (ii) Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE and Cecil County, MD (marginal non-attainment) and (iii) Washington, DC-MD-VA area (marginal non-attainment). The effective date of the non-attainment designation is 08-03-2018. Per 40 CFR §51.1316, the SIP revisions for such areas are due "no later than 24 months after the effective date of designation for a specific ozone NAAQS" (i.e., by August 2020). In addition, "for RACT required pursuant to initial nonattainment area designations, the state shall provide for implementation of RACT as expeditiously as practicable, but no later than January 1 of the fifth year after the effective date of designation" (i.e., by 01-01-2023).

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(3) The petition asserts that daily "excess emissions" from select PA coal plants would not be realized if "the coal-fired EGU operators ran existing control technology consistent with manufacturers' specifications and *past best practices*" (emphasis added). The certified NOx emissions data clearly demonstrate that the KEY-CON units are being operated in accordance with manufacturers' specifications, the applicable requirements and good air pollution control practices – MDE's assertion is inaccurate. Importantly, there is no applicable requirement to operate units in accordance with "*past best practices*" (emphasis added).

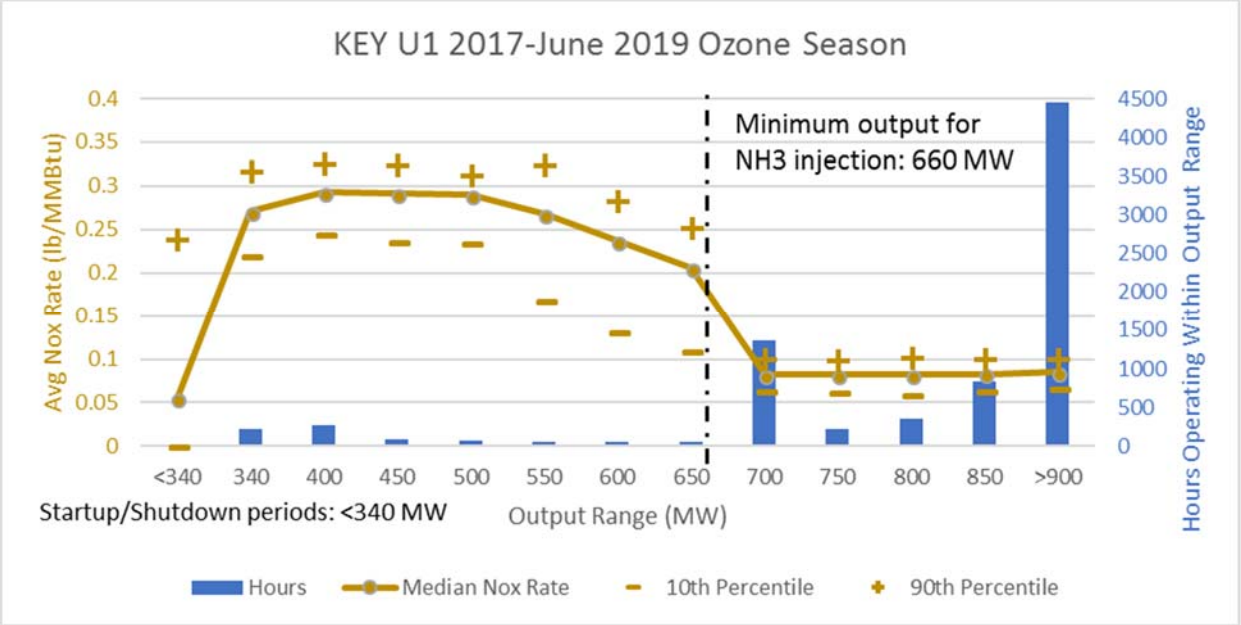
A review of hourly NOx emission rate data for the CY 2017 OS, CY 2018 OS and CY 2019 partial OS (May and June) clearly demonstrates that KEY Units 1 and 2 and CON Units 1 and 2 are being operated in accordance with the manufacturers' specifications, applicable requirements, good air pollution control practices and the PA DEP RACT 2 Rule. Consequently, enacting additional regulations is unnecessary and will not provide control of "excess emissions" from the KEY-CON units sought by MDE.

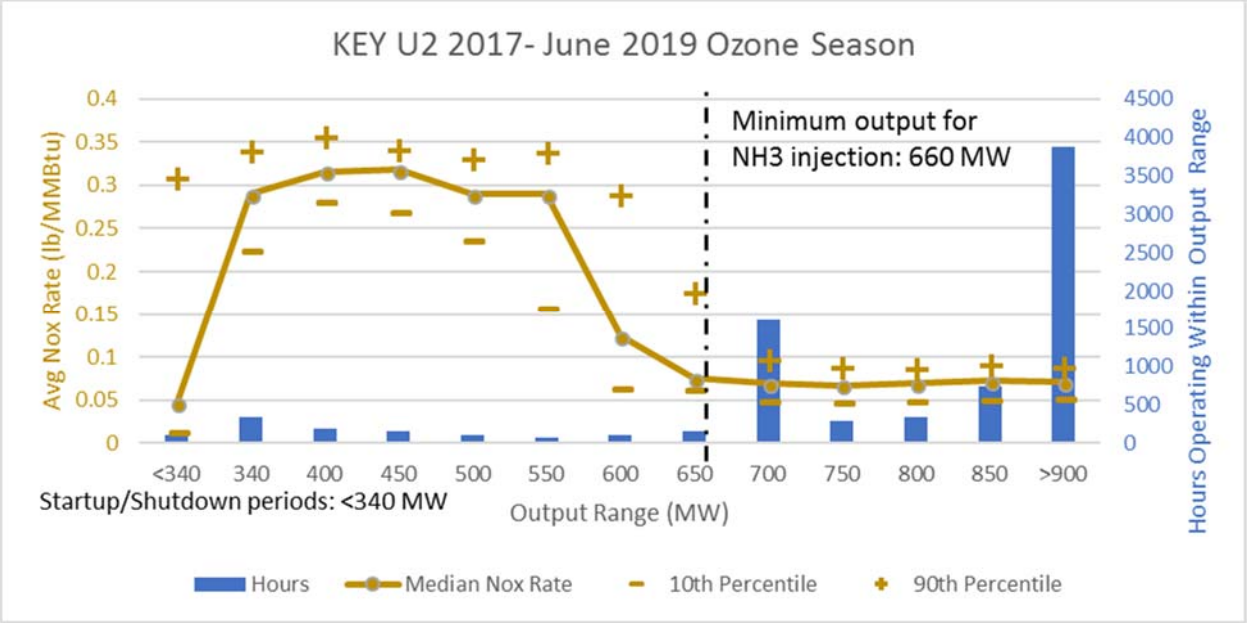
(a) These data have been summarized in the attached histograms (the data were downloaded from EPA's Air Markets Program, link: https://ampd.epa.gov/ampd/). The target NOx emission rate is dependent on daily unit operating conditions (e.g., mechanical maintenance concerns, coal quality) and KEY-CON's obligations under the PA DEP RACT 2 Rule and CSAPR.

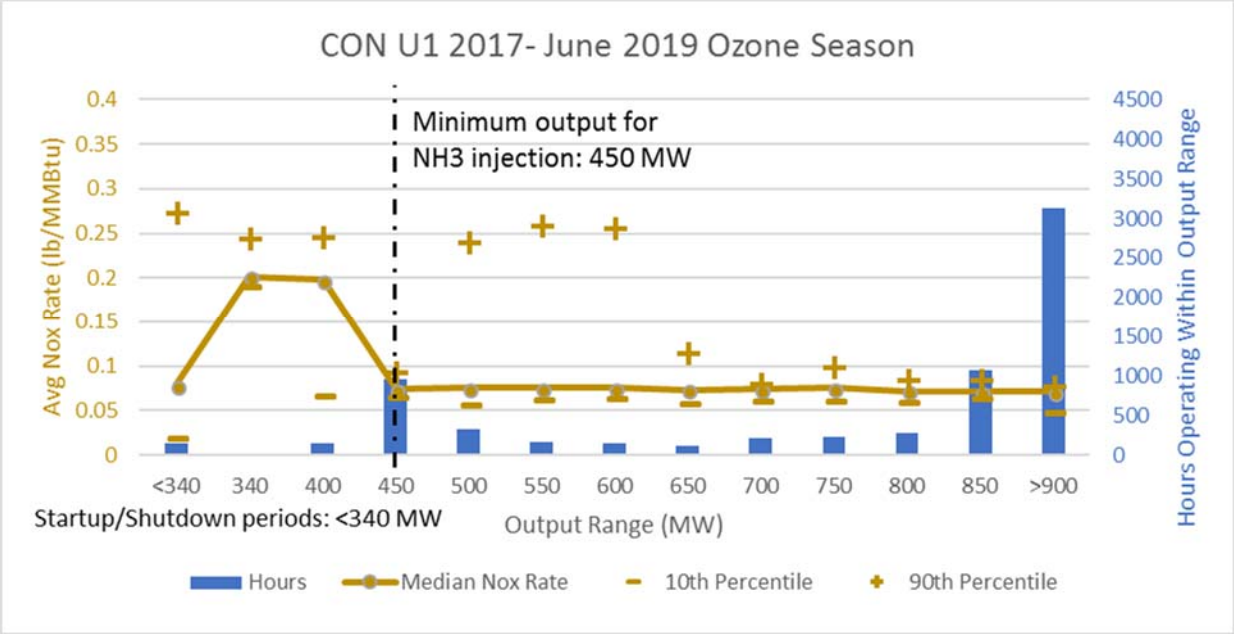
(b) It is important to understand that conditions that allow for aqueous ammonia (NH_3 aq.) injection in the SCR (and expected reduction in NOx concentrations) are realized under limited operating conditions only (function of the flue gas temperature at the SCR inlet, require > 600 degrees F). Injecting NH_3 aq. during conditions that are outside the established SCR operating parameters will result in significant ammonia slip, consequential ammonium bisulfite formation in the flue gas stream and detrimental deposits on the air pre-heaters and ESPs.

(c) In these histograms, gross MW is used as a surrogate indicator for flue gas temperature at the inlet to the SCR device (a flue gas temperature of 600 degrees F at the SCR inlet is realized with an electrical output of about 450 gross MW for the Conemaugh units, 660 gross MW for the Keystone units).

(d) As shown in the histograms, a majority of the operating hours were at 90 percent or more of the nominal maximum electrical output of 900-910 MW. For these hours, the actual NOx emission rate was between 0.05 and 0.10 lb/MMBtu (the range represents the 10^{th} and 90^{th} percentile values), which is consistent with a well-performing large EGU equipped with an SCR.


KEY U1 2017-June 2019 Ozone Season
Minimum output for
NH3 injection: 660 MW
Avg Nox Rate (lb/MMBtu)
Hours Operating Within Output Range
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
<340 340 400 450 500 550 600 650 700 750 800 850 >900
Startup/Shutdown periods: <340 MW
Output Range (MW)
Hours
Median Nox Rate
10th Percentile
90th Percentile


KEY U2 2017- June 2019 Ozone Season
Minimum output for
NH3 injection: 660 MW
Avg Nox Rate (lb/MMBtu)
Hours Operating Within Output Range
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
<340 340 400 450 500 550 600 650 700 750 800 850 >900
Startup/Shutdown periods: <340 MW
Output Range (MW)
Hours
Median Nox Rate
10th Percentile
90th Percentile


CON U1 2017- June 2019 Ozone Season
Minimum output for
NH3 injection: 450 MW
Avg Nox Rate (lb/MMBtu)
Hours Operating Within Output Range
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4500
4000
3500
3000
2500
2000
1500
1000
500
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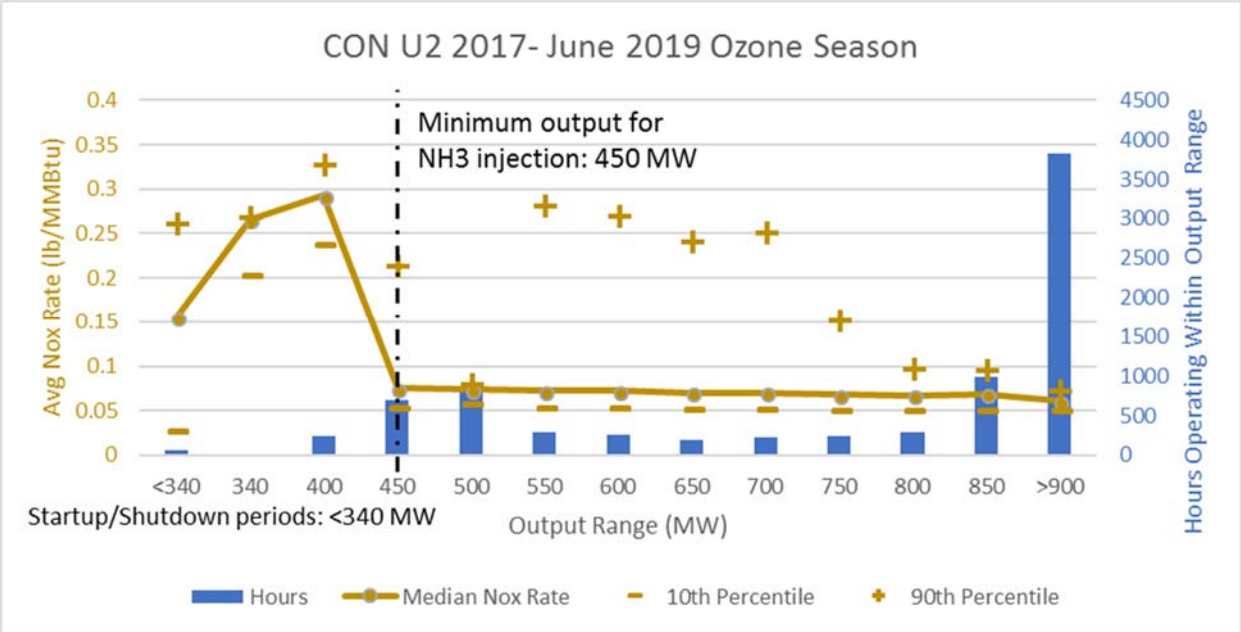
<340 340 400 450 500 550 600 650 700 750 800 850 >900
Startup/Shutdown periods: <340 MW
Output Range (MW)
Hours
Median Nox Rate
10th Percentile
90th Percentile


CON U2 2017- June 2019 Ozone Season
Minimum output for
NH3 injection: 450 MW
Avg Nox Rate (lb/MMBtu)
Hours Operating Within Output Range
0.4
0.35
0.3
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<340 340 400 450 500 550 600 650 700 750 800 850 >900
Startup/Shutdown periods: <340 MW
Output Range (MW)
Hours
Median Nox Rate
10th Percentile
90th Percentile

Additionally, there is no applicable requirement to operate units in accordance with "*past best practices*" – the applicable requirements are copied below.

40 CFR §60.11 Compliance with standards and maintenance requirements.

(d) At all times, including periods of startup, shutdown, and malfunction, owners and operators shall, to the extent practicable, maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Administrator which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source.

25 Pa. Code § 127.444. Compliance requirements.

A person may not cause or permit the operation of a source subject to this article unless the source and air cleaning devices identified in the application for the plan approval and operating permit and the plan approval issued to the source are operated and maintained in accordance with specifications in the application and conditions in the plan approval and operating permit issued by the Department. A person may not cause or permit the operation of an air contamination source subject to this chapter in a manner inconsistent with good operating practices.

The concept of requiring future performance to meet "*past best practices*" is completely contrary to the regulatory rulemaking process because this concept essentially bypasses the applicable requirements. Comparing historic NOx emission rates from 14 years ago (e.g., KEY Units 1 and 2) with recent NOx emission rates and then calculating the amount of "excess emissions" is analogous to comparing federal tax returns for the year in which the filer had the highest combined taxes and charitable contributions with those from another year, calculating the shortfall, and then expecting the filer to assess the highest taxes and charitable contributions on itself in all future years irrespective of the circumstances. Performing the comparison without a thorough understanding of the historical context (e.g., applicable or expected future regulations, age of the emissions control device, fuel quality, etc.) will yield misleading or erroneous conclusions. For the above-mentioned KEY Units 1 and 2, CY 2005 was the first full year with the SCRs in-service, and station management elected to operate the units at the highest NOx emissions reduction achievable during that OS in an attempt to gauge the maximum performance of the SCRs. Importantly, when this decision was made, U.S. EPA's CAIR Rule was just promulgated, and the availability of NOx allowances in the trading market was unknown (CAIR Phase I caps were implemented beginning in CY 2009). NOx emissions were indeed reduced significantly at KEY Units 1 and 2 during the 2005 OS by injecting very large amounts of NH_3 aq., but doing so yielded significant and deleterious ammonia slip in the flue gas streams and consequential ammonium bisulfite formation and deposits / fouling on the air pre-heaters, which resulted in the air pre-heaters requiring frequent maintenance. The air pre-heaters were ultimately non-serviceable by the end of that OS, thus necessitating the station to schedule a maintenance outage – lesson learned. Air pre-heater fouling reduces the efficiency of the boiler (increased heat rate, Btu/KWh) and results in a consequential increase in the NOx emission rate on an output basis (lb/MWh). Lastly, requiring "*past best practices*" also ignores the premise of market-based trading programs established to incentivize investment in emissions controls and yield the low-cost solution to regional emissions reduction goals. SCRs at these existing units were installed to take advantage of economic drivers and were not installed to comply with state or federal NOx regulations.

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(4) A review of hourly NOx emission rate data for the O_3 NAAQS exceedance events included in the petition clearly demonstrates that KEY Units 1 and 2 and CON Units 1 and 2 were operated in accordance with the applicable requirements and good air pollution control practices, and in a manner consistent with all other periods during the OS.

(a) These data have been summarized in the time series plots included as Appendix A to this letter. Example time series plots are presented in Figure 1. The events are those included in Attachment 3 of the petition. The x-axis in these figures denotes the cumulative hours beginning at 12:01 AM on the listed event date through 24 hours after the last day among those included for that particular event. For example, the time series plot for the 7/2/2017 event includes 7/2 (no monitored O_3 exceedances), 7/3 and 7/4 (monitored O_3 exceedances) and 7/5 (no monitored O_3 exceedance).

(i) The time series plot for the 7/2/2017 event shows that the Keystone units operated at sufficient electrical output to allow NH_3 aq. injection for all hours. NOx emission rates were between 0.05 and 0.10 lb/MMBtu.

(ii) The time series plot for the 8/9/2017 event shows that the Keystone units operated at sufficient electrical output to allow NH_3 aq. injection for all hours, with the exception of Unit 2 which operated at a lower output for several hours. These lower outputs were insufficient to allow NH_3 aq. injection.

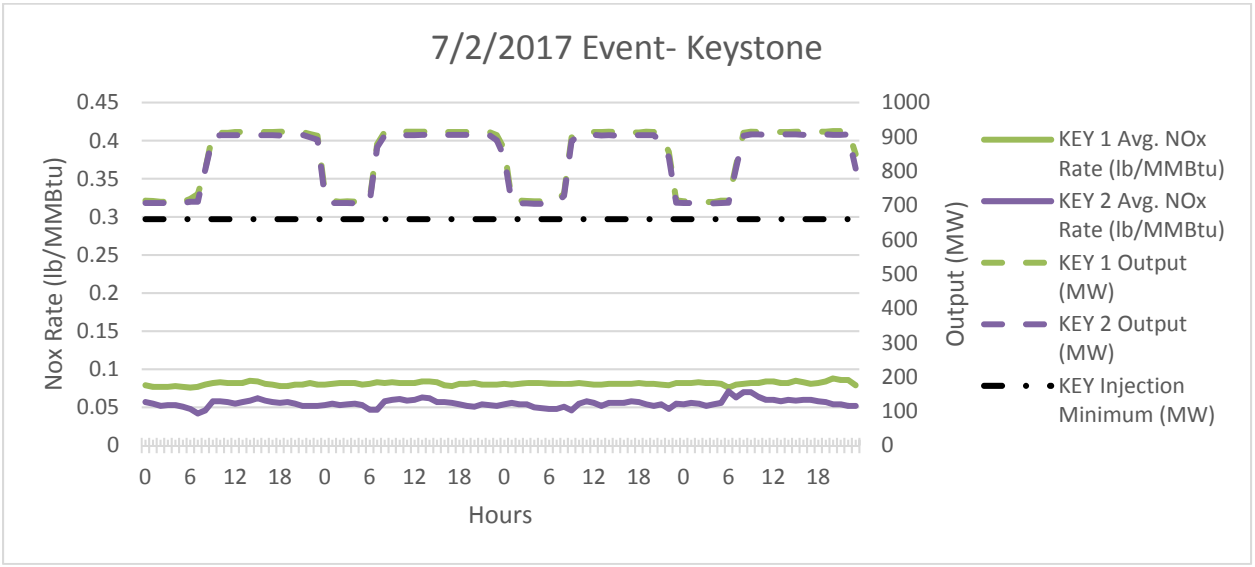
(iii) The time series plot for the 5/1/2018 event shows a start-up for Conemaugh Unit 1. NH_3 aq. injection occurred for all hours in which sufficient electrical output was realized.

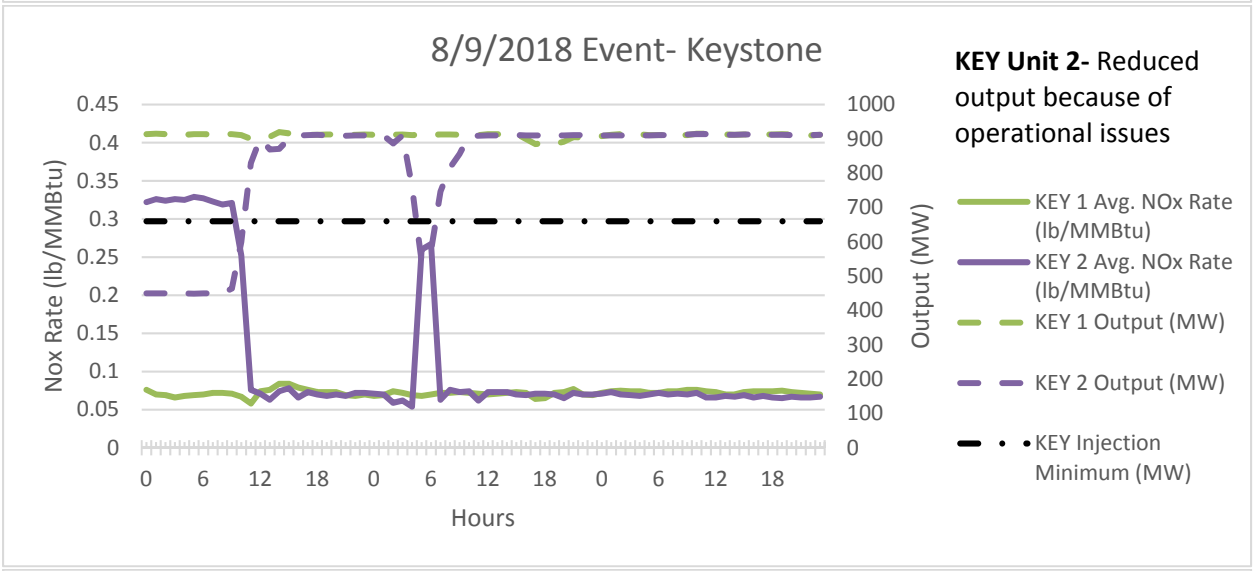
(b) In time series plots, operating log entries noted that periodic NOx emission rate spiking was caused by either temporary malfunctions of the NH_3 aq. injection system or automatic shut-off of the injection system in response to operating conditions that were outside of the established SCR operating parameters.

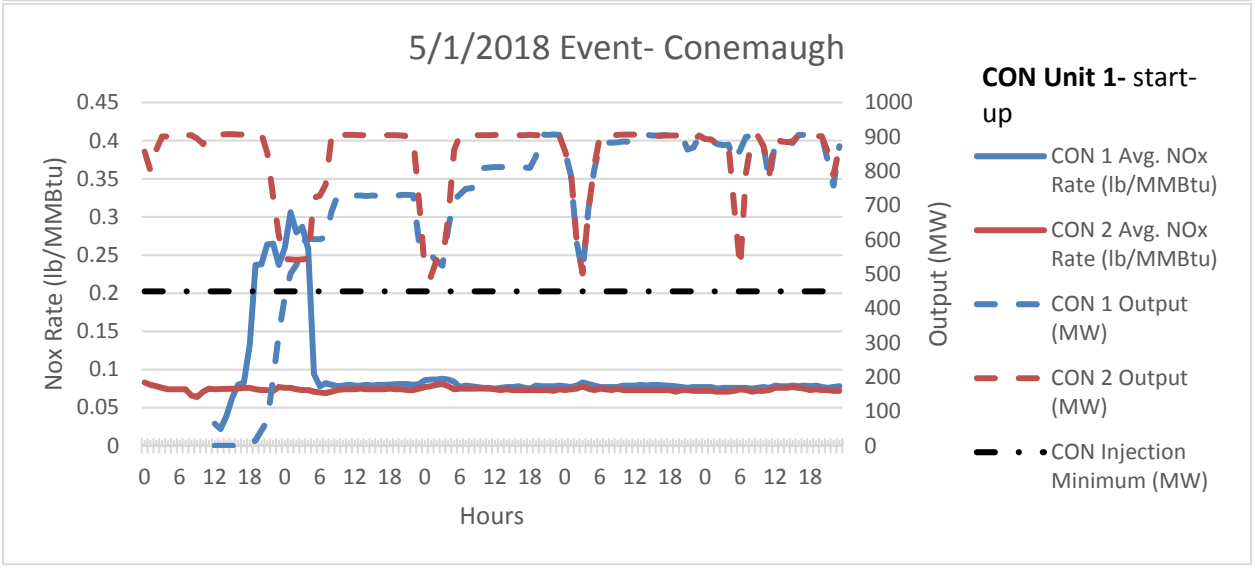
(c) Imposition of a stringent daily NOx emission rate limit could easily result in forced shutdowns and restarts of the unit in response to temporary unit upset conditions. Because operations during start-up periods, shutdown periods and other low-output periods do not allow for SCR operations, such periods could actually result in greater daily NOx mass emissions (lb/day) than what might be intended initially by a more stringent daily limit.

(d) The PA DEP RACT 2 Rule inherently requires general compliance with the specified NOx emission limit on a daily basis. Because compliance is determined on a rolling 30-day basis, emissions higher than the 30-day average would need to be offset by emissions lower than the 30-day average with each passing day. The time series plots demonstrate that there was no deliberate effort to operate the KEY-CON SCR systems in an abnormal manner before or during days in which an O3 NAAQS exceedance was realized.

Figure 1: Example time series plots for the KEY-CON units during O_3 NAAQS exceedance events at MDE monitors







III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(5) The KEY-CON units are subject to NOx emission limits promulgated under the PA DEP RACT 2 Rule, which became effective on 01-01-2017. Operating units in accordance with "*past best practices*" is not a Clean Air Act term and suggests that BACT is required – BACT is not required; RACT is required. RACT requirements for the units included in the petition were reviewed and established for source categories by PA DEP in the RACT 2 regulation.

Where required, RACT is applicable to existing emission units, whereas BACT is applicable to new, "modified" (as defined in 40 CFR §52.21) and reconstructed units.

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(6) The petition is silent on whether the claimed "excess emissions" impacted any of the MDE ozone monitors (presented in Figure 2) on days with measured exceedances of the NAAQS. Trajectory analyses generated by AECOM using the HYSPLIT model show that of the total of 28 ozone exceedance days involved over the 2 years, only 10 of the days involved back trajectories that were in the vicinity of KEY-CON, or about 36% of the cases. On those 10 select days, the backward trajectories also traversed either over large metropolitan areas in western Pennsylvania and Midwest states (Ohio, Indiana, Michigan, etc.) or over the Ohio River Valley. These large metropolitan areas and Ohio River Valley include significant sources of NOx emissions from mobile sources and other stationary sources. Consequently, because of the preponderance of southerly wind components occurring during high ozone days recorded at MDE monitoring sites, the majority of the days in 2017 and 2018 with monitored O_3 NAAQS exceedances were not influenced by emissions from KEY-CON.

To determine the likelihood for emissions from KEY-CON, AECOM conducted back-trajectory analyses using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model[2] for days in 2017 and 2018 for which there were 8-hour ozone concentrations at any MDE monitor above the 70 ppb NAAQS. The features of the HYSPLIT model were discussed[3] at the 9th Modeling Conference of the Environmental Protection Agency (EPA) as a useful tool for back-trajectory analyses of plume transport. HYSPLIT is also being used by the Western Regional Air Partnership[4] for determining source regions of regional haze. As noted in the Stein et al. (2015) journal article[5], the HYSPLIT model, developed by NOAA's Air Resources Laboratory, is one of the most widely used models for atmospheric trajectory and dispersion calculations.

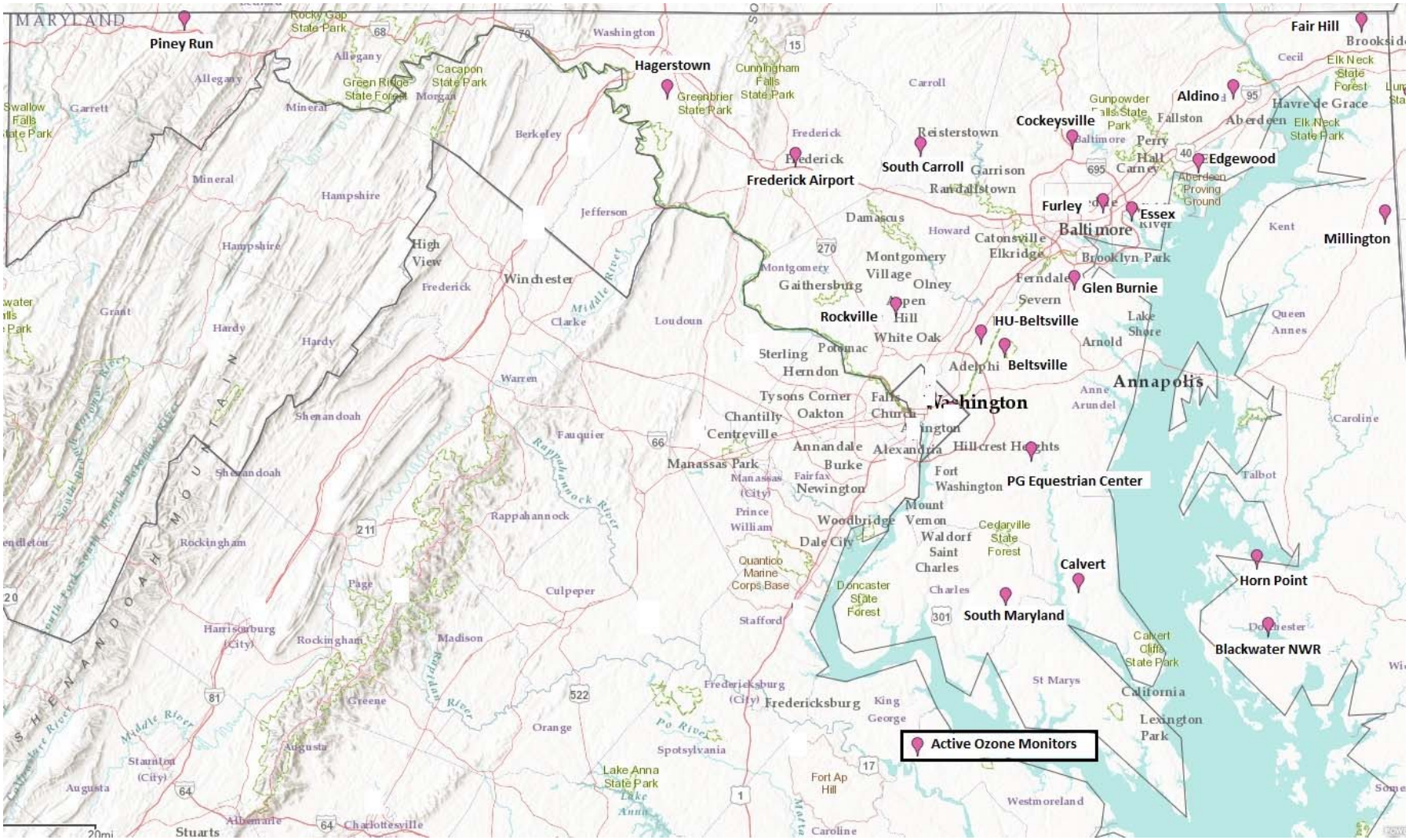
[2] National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory: https://www.ready.noaa.gov/HYSPLIT.php.

[3] https://www3.epa.gov/scram001/9thmodconf/draxler.pdf.

[4] See the presentation at https://www.wrapair2.org/RHPWG.aspx associated with the WRAP Regional Haze Planning Workgroup Control Measures Subcommittee.

[5] Stein, A. F., R. Draxler, G. Rolph, B. Stunder, M. Cohen, and F. Ngan, 2015. NOAA's HYSPLIT Atmospheric Transport and Dispersion Modeling System. *Bulletin of the American Meteorological Society*, vol. 96, issue 12, pp. 2059-2077. https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-14-00110.1.

Figure 2: Map Showing the Location of Active MDE Ozone Monitors



KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

Continuation of Item #6

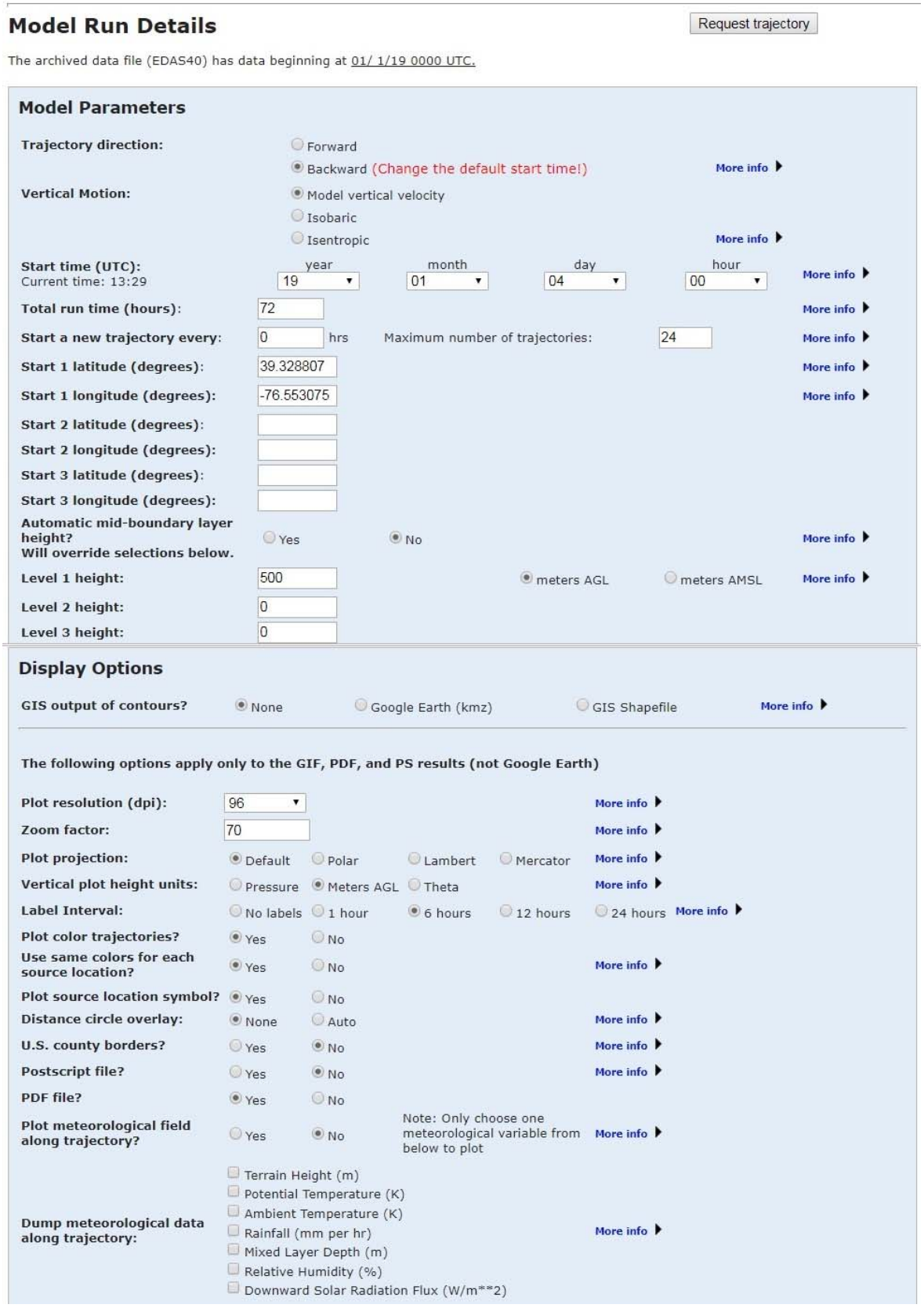
AECOM used HYSPLIT's default modeling approach for computing back trajectories. The trajectories were designed to end at the location of the peak monitoring site for each day analyzed in 2017 and 2018. The computed trajectories were designed to start at the monitor site at the default height of 500 meters above ground level and going backwards in time for a 72-hour period. Trajectories were computed for arrival at the monitoring site for 4 times each day, separated by 6 hours: 2 A.M. local time (06 UTC), 8 A.M. local time (12 UTC), 2 P.M. local time (18 UTC), and at 8 P.M. local time (00 UTC the next day). The Eta Data Assimilation System (EDAS[6]) 40 km resolution meteorological data which covers the continental United States from 2004 to the present was used within HYSPLIT to compute the back trajectories. The EDAS 40 km meteorological data has the highest horizontal resolution and one of the highest temporal resolutions of the North American meteorological data sets available. HYSPLIT was run with the default vertical motion option which uses modeled vertical velocity. The default settings that were used in the running the HYSPLIT model are shown in Figure 3.

In 2017, there were 12 days with ozone peak 8-hour averages above the level of the NAAQS at one or more MDE monitors. Figures showing the four 6-hour HYSPLIT figures are presented in Appendix B. In 2018, there were 16 days that met this criterion; the HYSPLIT figures are presented in Appendix C. An example back trajectory is presented in Figure 4.

AECOM's analysis of the HYSPLIT back trajectories for 2017 and 2018 is summarized in Tables 1 and 2, respectively. Of the total of 28 days involved over the 2 years, only 10 of the days involved back trajectories that were in the vicinity of the Conemaugh and Keystone Generating Stations, or about 36% of the cases. Therefore, on the majority of the high ozone days, KEY-CON played no role in the high ozone concentrations being monitored at the MDE monitors.

[6] https://www.ready.noaa.gov/edas40.php.

Figure 3: HYSPLIT Model Run Example



Model Run Details

Request trajectory

The archived data file (EDAS40) has data beginning at 01/ 1/19 0000 UTC.

Model Parameters

Trajectory direction: ○ Forward ◉ Backward (Change the default start time!) More info

Vertical Motion: ◉ Model vertical velocity ○ Isobaric ○ Isentropic More info

Start time (UTC): Current time: 13:29 — year 19 | month 01 | day 04 | hour 00 More info

Total run time (hours): 72 More info

Start a new trajectory every: 0 hrs Maximum number of trajectories: 24 More info

Start 1 latitude (degrees): 39.328807 More info

Start 1 longitude (degrees): -76.553075 More info

Start 2 latitude (degrees):

Start 2 longitude (degrees):

Start 3 latitude (degrees):

Start 3 longitude (degrees):

Automatic mid-boundary layer height? Will override selections below. ○ Yes ◉ No More info

Level 1 height: 500 ◉ meters AGL ○ meters AMSL More info

Level 2 height: 0

Level 3 height: 0

Display Options

GIS output of contours? ◉ None ○ Google Earth (kmz) ○ GIS Shapefile More info

The following options apply only to the GIF, PDF, and PS results (not Google Earth)

Plot resolution (dpi): 96 More info

Zoom factor: 70 More info

Plot projection: ◉ Default ○ Polar ○ Lambert ○ Mercator More info

Vertical plot height units: ○ Pressure ◉ Meters AGL ○ Theta More info

Label Interval: ○ No labels ○ 1 hour ◉ 6 hours ○ 12 hours ○ 24 hours More info

Plot color trajectories? ◉ Yes ○ No

Use same colors for each source location? ◉ Yes ○ No More info

Plot source location symbol? ◉ Yes ○ No

Distance circle overlay: ◉ None ○ Auto More info

U.S. county borders? ○ Yes ◉ No More info

Postscript file? ○ Yes ◉ No More info

PDF file? ◉ Yes ○ No

Plot meteorological field along trajectory? ○ Yes ◉ No Note: Only choose one meteorological variable from below to plot More info

Dump meteorological data along trajectory: More info

- ☐ Terrain Height (m)
- ☐ Potential Temperature (K)
- ☐ Ambient Temperature (K)
- ☐ Rainfall (mm per hr)
- ☐ Mixed Layer Depth (m)
- ☐ Relative Humidity (%)
- ☐ Downward Solar Radiation Flux (W/m**2)

Figure 4: HYSPLIT Back Trajectory for 8 PM, May 2, 2018 (dots showing the locations of the Keystone and Conemaugh Stations are included)

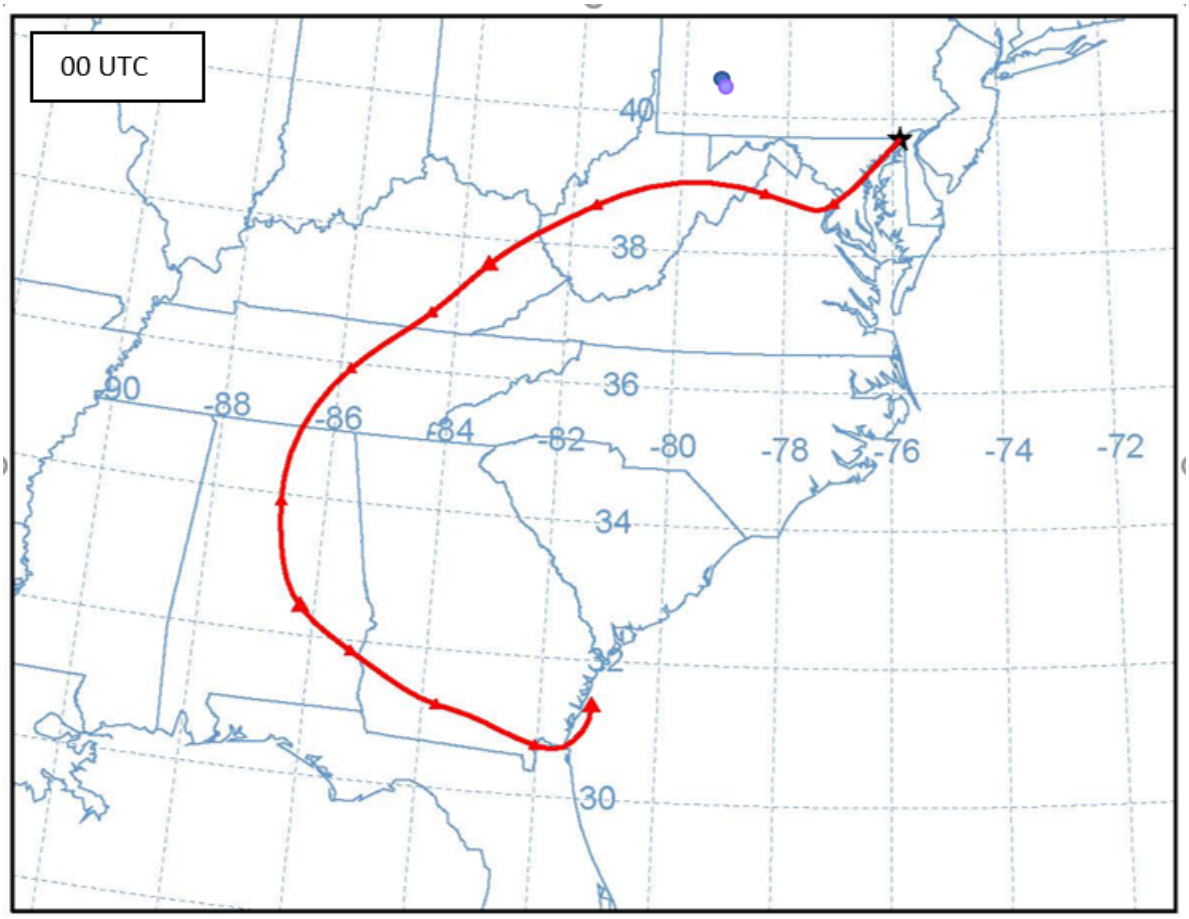


Table 1: Analysis of HYSPLIT Back Trajectories for 2017 High Ozone Days for MDE Monitors (from MDE Attachment 3)

Dates from MDE Attachment 3	Max 8-hour Ozone Concentration Over the 20 Monitors (ppm)		Notes on Back Trajectories for Conemaugh and Keystone Involvement
4/11/2017	0.073	**Fair Hill**	Air parcels come from south of PA.
5/17/2017	0.084	**Aldino**	Air parcels come from south of PA.
5/18/2017	0.090	**Fair Hill**	Air parcels from the south and east of PA.
6/10/2017	0.073	**Glen Burnie**	Most air parcels miss western PA.
6/11/2017	0.070	**Edgewood**	No NAAQS exceedance; back trajectory not done.
6/12/2017	0.077	**Edgewood**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/13/2017	0.088	**Edgewood**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/15/2017	0.071	**Hagerstown**	Air parcels do not come near the plants.
6/22/2017	0.071	**Fair Hill**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/3/2017	0.067	**Essex**	No NAAQS exceedance; back trajectory not done
7/4/2017	0.066	**Fair Hill**	No NAAQS exceedance; back trajectory not done
7/19/2017	0.075	**Glen Burnie**	Air parcels come from south of PA.
7/20/2017	0.086	**Edgewood**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/21/2017	0.073	**Glen Burnie**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
8/1/2017	0.063	**PG Equestrian Center**	No NAAQS exceedance; back trajectory not done
8/16/2017	0.069	**PG Equestrian Center**	No NAAQS exceedance; back trajectory not done
9/25/2017	0.075	**Fair Hill**	Air parcels from north and east of PA.

Table 2: Analysis of HYSPLIT Back

Dates from MDE Attachment 3	Max 8-hour Ozone Concentration Over the 20 Monitors (ppm)		Notes on Back Trajectories for Conemaugh and Keystone Involvement
5/1/2018	0.074	**Edgewood**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
5/2/2018	0.075	**Fair Hill**	Air parcels do not come near the plants.
5/3/2018	0.071	**Aldino**	Air parcels do not come near the plants.
5/4/2018	0.071	**Glen Burnie**	Air parcels do not come near the plants.
6/1/2018	0.071	**Glen Burnie**	Air parcels from southern U.S.
6/17/2018	0.074	**Cockeysville**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/18/2018	0.085	**Beltsville**	Most back trajectories miss to the south of PA.
6/30/2018	0.080	**Beltsville**	Back trajectories are east of the PA power plants.
7/2/2018	0.074	**Furley**	Back trajectories are generally from the south.
7/3/2018	0.072	**Furley**	Back trajectories are generally from the south.
7/9/2018	0.092	**HU-Beltsville**	Back trajectories are generally from the north and east.
7/10/2018	0.086	**Horn Point**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/16/2018	0.073	**Beltsville**	Back trajectories are generally from the southwest.
8/10/2018	0.073	**PG Equestrian Center**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
8/27/2018	0.074	**Edgewood**	**Some back trajectories pass over/close to Conemaugh and Keystone.**
9/6/2018	0.072	**Fair Hill**	Back trajectories from the SW and then from east and north of the power plants.

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

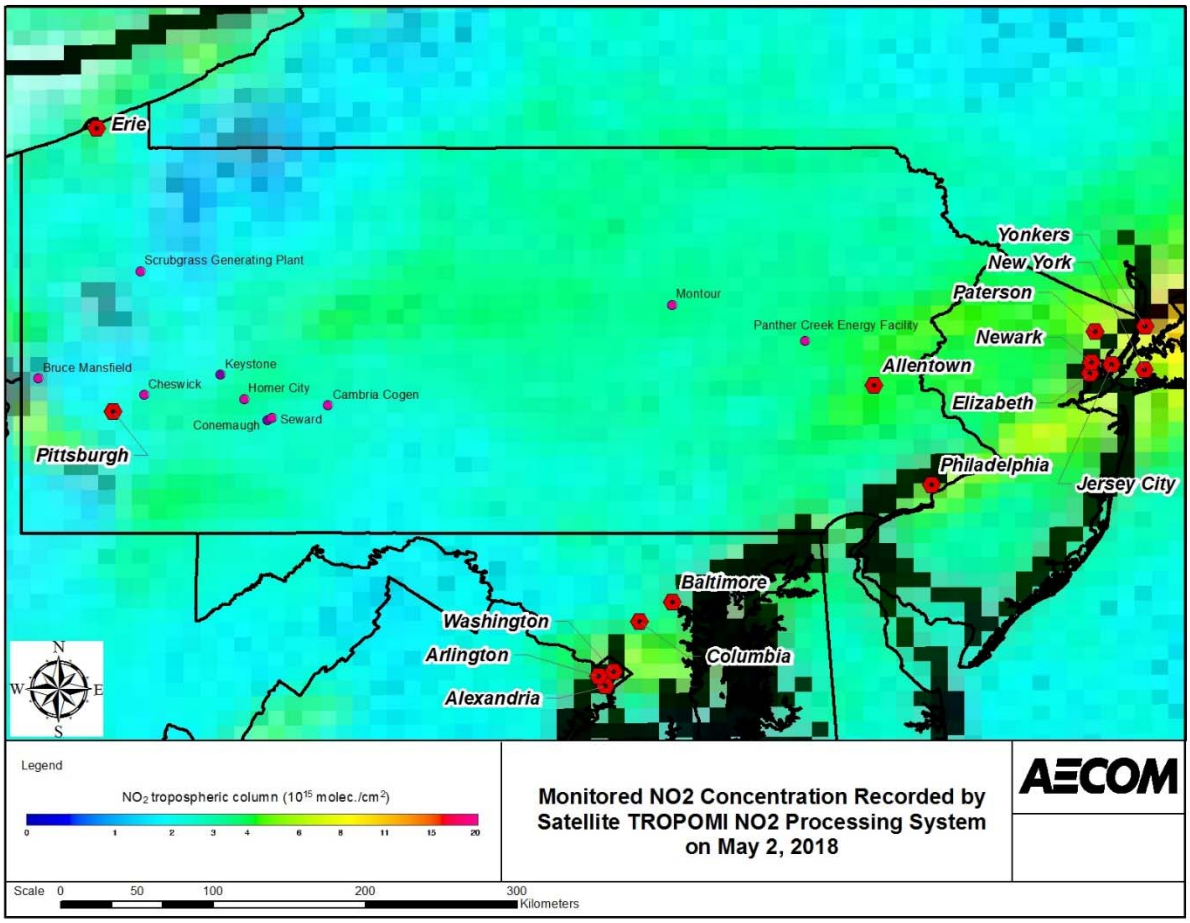
In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

Continuation of Item #6

A review of the total NO_2 atmospheric loading from the satellite-based Tropospheric Monitoring Instrument (TROPOMI) provides some insight as to observed distribution of NO_2 in the atmosphere on selected ozone high days. TROPOMI is the satellite instrument on board the Copernicus Sentinel-5 Precursor satellite. This satellite is the first of the atmospheric composition Sentinels, launched on 13 October 2017, planned for a mission of seven years. The daily tropospheric NO_2 columns are derived from satellite observations based on slant column NO_2 retrievals with the Differential Optical Absorption Spectroscopy (DOAS) technique, and the Royal Netherlands Meteorological Institute (KNMI) combined modeling/retrieval/assimilation approach, as documented at http://www.temis.nl/airpollution/no2.html. The TROPOMI instrument has a spatial resolution of 3.5 x 7 km, compared to the resolution of 24 × 13 km that was available from the Ozone Monitoring Instrument on NASA's previous Aura mission. The satellite maps the entire globe once per day, such that the imagery represents a midday snapshot of the pollutant being detected (in this case, NO_2).

When there are clouds obscuring the surface, the return from the satellite is not available in the affected areas, and due to its launch in 2017, only images starting in 2018 are available. Two of these satellite maps obtained during the 2018 ozone season are worthy of discussion. Along with one of the HYSPLIT back trajectories for May 2, 2018, Figure 5 presents the TROPOMI image for that day for tropospheric NO_2 (total molecules in a vertical column). Note that the heaviest NO_2 atmospheric loading is over the major metropolitan areas ranging from Washington, DC through New York City. During portions of May 2, air parcels arriving at MDE monitors passed over these metropolitan areas, which were likely the principal cause of the high ozone readings. On this day, the KEY-CON units were not involved in air trajectories reaching MDE ozone monitors.

Figure 5: TROPOMI Image for May 2, 2018 Overlaid on Base Map with PA Coal-Fired EGUs and Major Cities Indicated



Another example of a tropospheric NO_2 distribution is shown for June 17, 2018, a day on which air parcel trajectories passed near the KEY-CON units, then over areas with low tropospheric NO_2 in south-central Pennsylvania, western Maryland and eastern West Virginia (opportunity for lower NO_2 concentration within the air parcel as a results of mixing with the local air), and finally over the Washington, DC metropolitan areas toward the end of its travel (see Figure 6 for a HYSPLIT back trajectory). As shown in Figure 7, the NO_2 loading in the metropolitan areas was comparable to the levels over the PA EGUs. Again note the very high NO_2 loading in the New York City area in Figure 7.

In general, we find that only about one-third of the ozone days with at least one MDE monitor that measured an O_3 NAAQS level exceedance in 2017 and 2018 involved air parcel trajectories over the KEY-CON units. Even for those days, the trajectories also likely involved travel over large metropolitan areas with equal or in many cases higher NO_2 atmospheric loading. Therefore, the role of the KEY-CON units for exacerbating the ozone concentrations at MDE monitors is present on a minority of the affected days only, with likely a secondary role. The discussion of the CAMx ozone modeling results in the next section further explores this issue.

Figure 6: HYSPLIT Back Trajectory for 8 AM, June 17, 2018

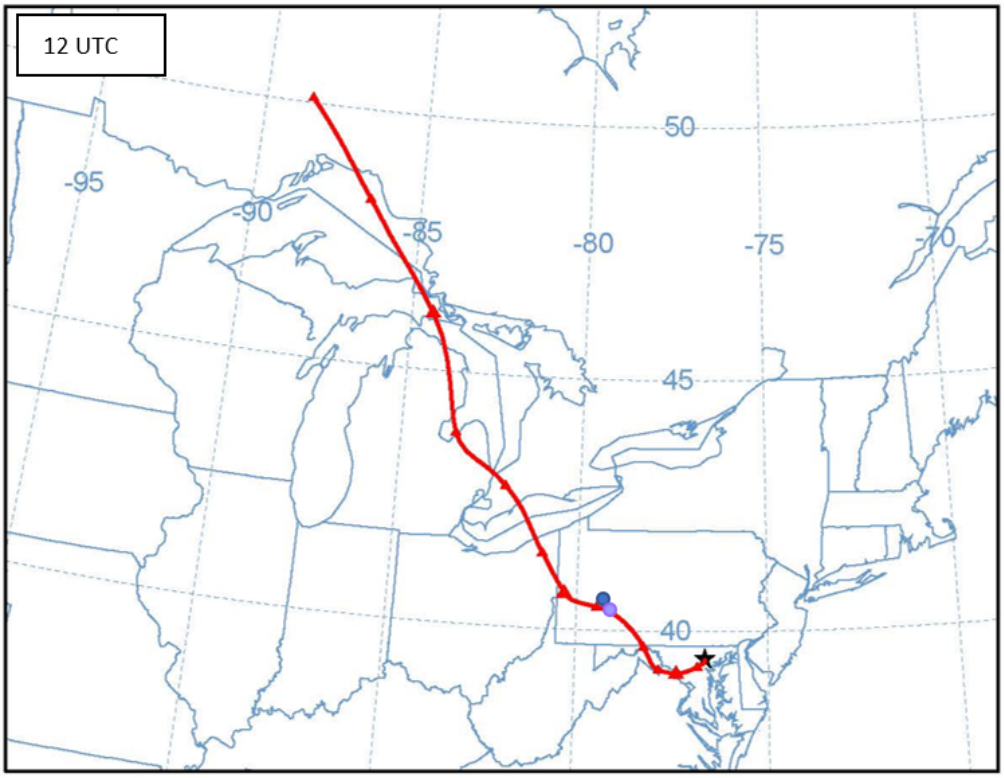
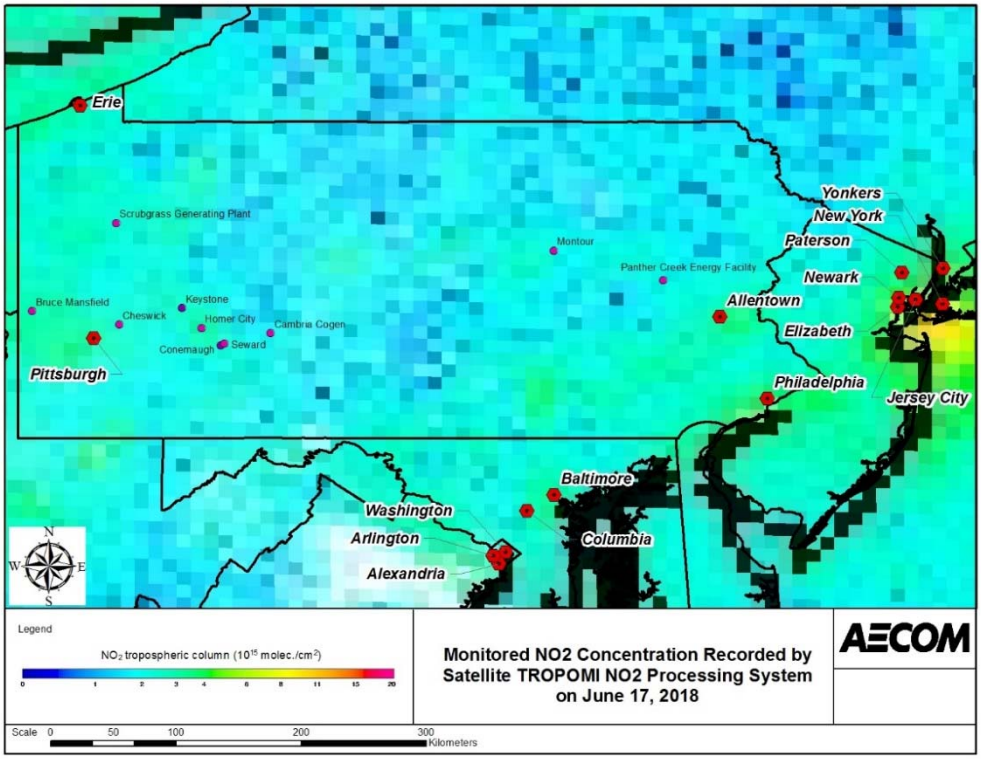


Figure 7: TROPOMI Image for June 17, 2018 Overlaid on Base Map with PA Coal-Fired EGUs and Major Cities Indicated



KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

(7) The petition included the results from a photochemical dispersion model run using CAMx modeling for determining the potential incremental ozone concentration levels associated with the assumed "excess emissions." AECOM's review of the modeling run includes the following findings:

(i) The ratios of non-optimized to optimized NOx emissions (as selected by MDE) for the KEY-CON units used in the CAMx modeling analysis were 2 to 4 times higher than the typical ratios that MDE determined in their 2017-2018 daily emissions analysis. Inflated ratios may also have been used for the other PA coal-fired EGUs as well. It appears that MDE applied this difference of emissions for the KEY-CON and all other PA coal-fired EGUs for every day of the July 2011 CAMx simulation and for all other PA coal-fired EGUs. This configuration is clearly a worst-case situation that is unlikely to happen even on one day, much less for an entire month. Therefore, the modeling results reported for these differences in NOx emissions for the PA coal-fired EGUs represent an extremely improbable outcome.

(ii) Even using these exaggerated NOx emission differences, ozone modeling results at three select MDE monitors for each day in July 2011 model run showed that the impacts of the "excess emissions" from the PA coal-fired EGUs are virtually undetectable. Model runs conducted with more representative emission inputs would generate results with even smaller impacts. Thus, based upon the CAMx modeling MDE provided, the MDE-recommended changes to optimize the PA coal-fired EGU NOx emissions have been demonstrated to have a negligible effect on ambient O_3 concentrations monitored at MDE sites.

AECOM's understanding is that this sensitivity analysis with CAMx modeling used hypothetical emission scenarios for both optimal and non-optimal NOx emissions (as selected by MDE) from PA coal-fired EGUs (with all other sources kept constant at presumed 2023 emission rates). The purpose was to determine the potential magnitude of the change in O3 concentrations in Maryland and elsewhere for July 2011. This month was selected because of the availability of a 2011 CAMx modeling platform and the occurrence of a large number of ozone exceedance days.

The CAMx modeling scenarios were run using the UMD Science Framework (i.e., emissions of NOx from mobile sources had been reduced by 50%). The "Scenario 5r" was the base case scenario and consisted of the GAMMA 2023 inventory (included on the books (OTB) and on the way (OTW)), ERTAC EGU 2.7 2023 without CSAPR and un-optimized EGUs. In their documentation for the Section 184 petition, MDE did not provide a listing of the actual emission rates for the PA coal-fired EGUs nor did they provide the ERTAC 2.7 reference case emission rates, which made it difficult to determine the emissions that were actually used in the modeling for these EGUs. However, in their Attachment 6, MDE indicated the "modeling adjustment values" (in percent change from their assumed reference case) that were used for all EGUs being modeled. All EGUs outside of Pennsylvania were modeled at the same NOx emission adjustment from the reference case for both the "optimized" and "non-optimized" runs to

determine the difference in modeled ozone impacts at selected monitors. However, selected PA coal-fired EGUs had different NOx emission rates for these two cases. Therefore, this modeling was designed to determine the effect of optimized NOx emissions for the PA coal-fired sources only.

A review of Conemaugh and Keystone NOx emission cases is worthwhile to determine how the difference in the optimized vs. non-optimized cases compares with the typical value of the MDE-claimed "excess emissions" of NOx that could have been avoided. To do this, we analyzed the MDE-provided spreadsheets of actual daily NOx emissions for the ozone season period of 2017 and 2018 to determine the ratio of actual NOx emissions to the "optimized" NOx emissions over this period. This analysis is designed to provide a typical emissions ratio rather than an outlier peak ratio.

As shown in Table 3, it appears that the ratios of non-optimized to optimized NOx emissions for Conemaugh and Keystone units used in the CAMx modeling analysis were much higher than the typical ratios that MDE determined in their 2017-2018 daily emissions analysis. This difference is likely to be present for the other modeled PA coal-fired EGUs as well. It appears that MDE applied this difference of emissions for each PA coal-fired EGU for every day of the July 2011 CAMx simulation and for all affected PA coal-fired EGUs. This configuration is clearly a worst-case situation that is unlikely to happen even on one day, much less for an entire month. Therefore, the modeling results reported for these differences in NOx emissions for the PA coal-fired EGUs represents an extremely unlikely outlier case.

Table 3: Analysis of Optimized vs. Non-Optimized NOx Emissions for Conemaugh and Keystone

Plant/Unit	2017+2018 Ozone Season NOx Tons Actually Emitted	2017+2018 Ozone Season Optimized NOx Tons	Ratio of Actual Emissions to Optimized NOx Emissions	CAMx Modeling Ratio of Non-Optimized/Optimized NOx Emissions
Conemaugh Unit 1	1626.9	1519.8	1.070	3.146
Conemaugh Unit 2	1789.0	1558.4	1.148	2.692
Keystone Unit 1	2333.0	1127.3	2.069	8.408
Keystone Unit 2	2008.0	1061.6	1.892	8.383

Using these exaggerated NOx emission differences, the MDE presented ozone modeling results for each day in July 2011 for selected monitors. We focused upon three key MDE monitors for our analysis. In their Attachment 6 (Figures 5, 6, and 7), MDE presented the daily-modeled ozone concentration differences caused by the NOx emission differences for the PA coal-fired EGUs. We obtained the actual monitored 8-hour daily peak ozone concentrations at three monitors (Fair Hill, Edgewood, and PG Equestrian Center) for the month of July 2011, and applied the modeled differences to how the MDE-prescribed NOx emission changes for the selected PA coal-fired EGUs would change those monitored concentrations. The resulting time series plots are provided for the three monitors listed above in Figures 8, 9, and 10 for the Fair Hill, Edgewood, and PG Equestrian Center monitoring sites, respectively.

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

III. KEY-CON's request to the OTC (cont.)

In response to our review of the petition and supporting information, KEY-CON requests the OTC **to reject the petition** for the following reasons:

Continuation of Item #7

It is clear from Figures 8-10 that the incremental modeled ozone impacts at the three MDE monitors associated with the overestimated excess NOx emissions at the PA coal-fired EGUs are virtually undetectable. Model runs conducted with more representative emission inputs would generate results with even smaller impacts. Thus, based upon the CAMx modeling MDE provided, the MDE-recommended changes to optimize the PA coal-fired EGU NOx emissions have been demonstrated to have a negligible effect on ambient ozone concentrations monitored at MDE sites.

Figure 8: July 2011 Daily 8-hour Ozone Concentrations at Fair Hill Monitor: Observed and with Modeled Ozone Reductions

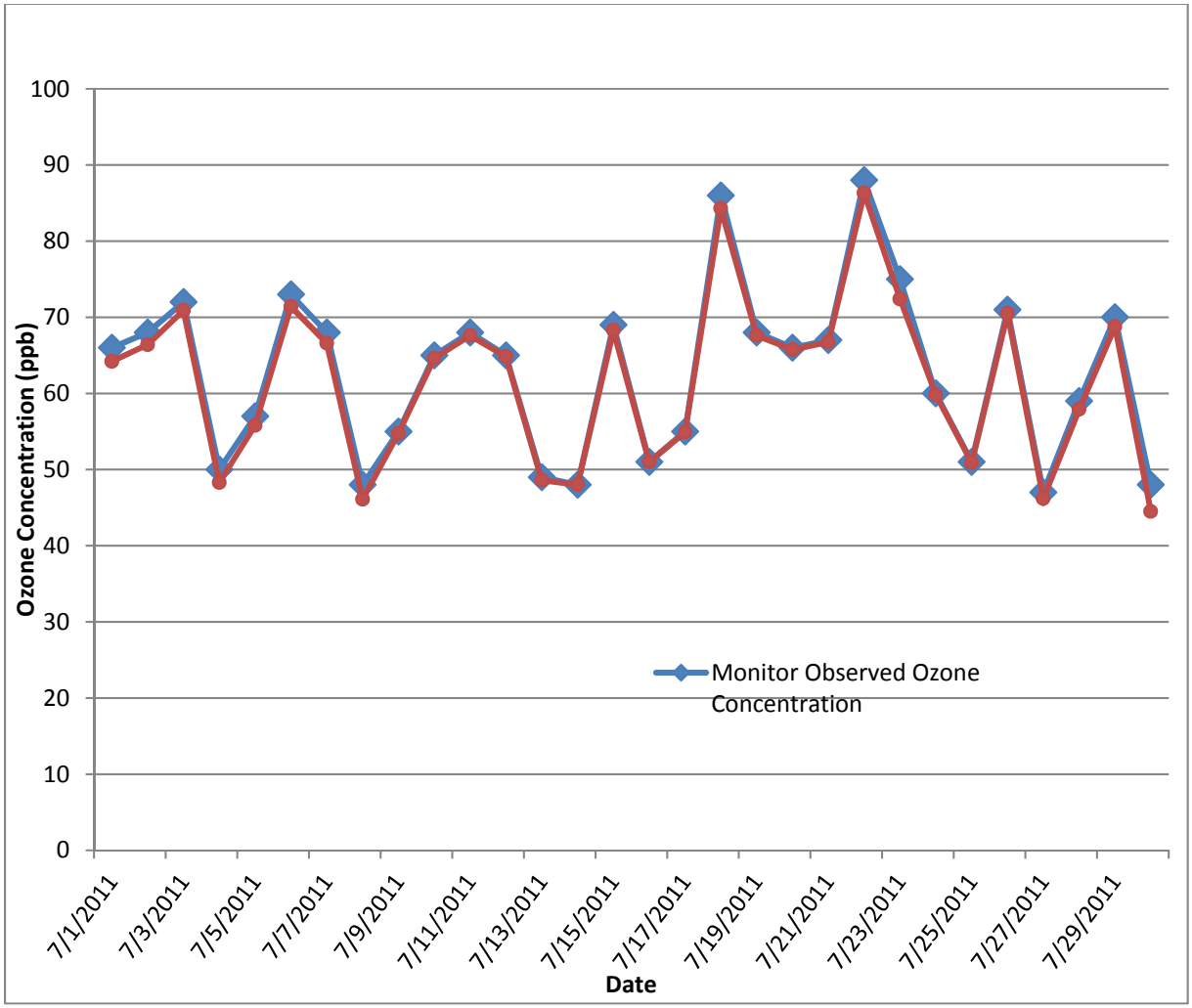


Figure 9: July 2011 Daily 8-hour Ozone Concentrations at Edgewood Monitor: Observed and with Modeled Ozone Reductions

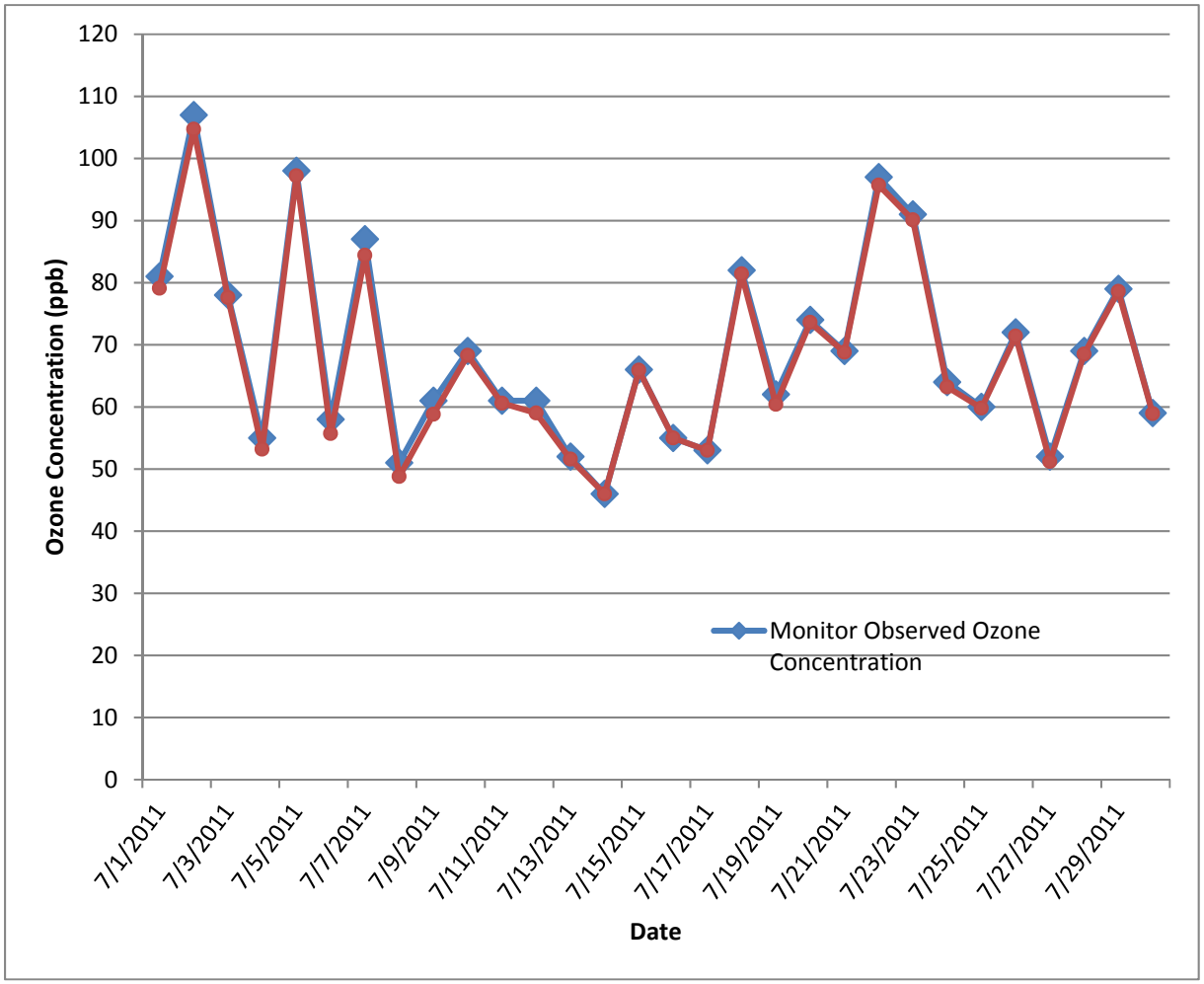
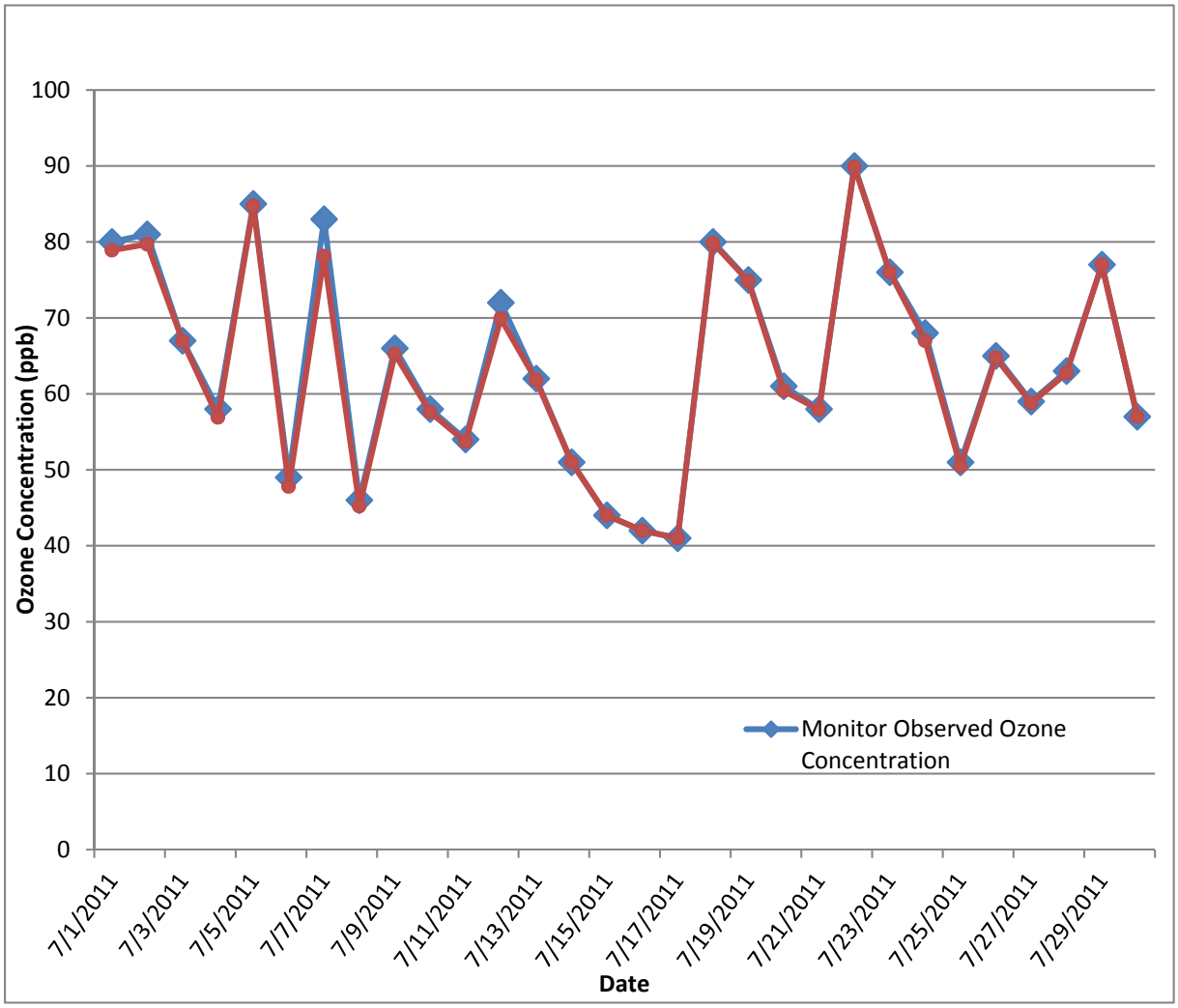


Figure 10: July 2011 Daily 8-hour Ozone Concentrations at PG Equestrian Center Monitor: Observed and with Modeled Ozone Reductions

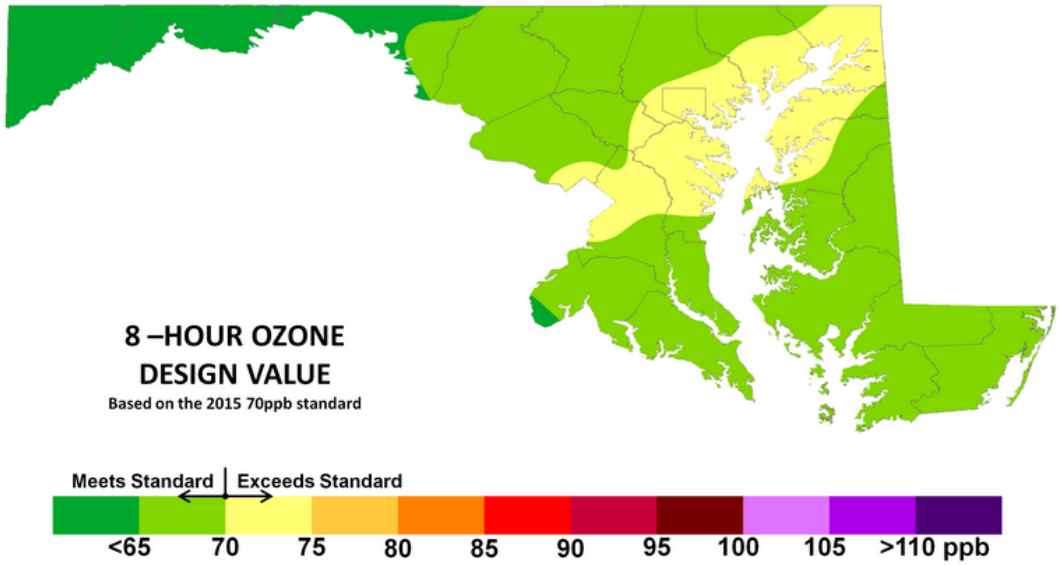


KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

IV. KEY-CON and AECOM's Observation Pertaining to Ozone Exceedances at MDE Monitoring Sites

O_3 NAAQS exceedances at MDE monitoring sites are primarily attributable to NOx emissions from the I-95 urban corridor. A review at the 2018 ozone design concentration map for Maryland (see Figure 11[7]) clearly indicates a peak concentration pattern in line with the Washington-Baltimore-Philadelphia corridor, in line with predominant S or SW winds during most high ozone events. If the PA coal-fired EGUs were a key contributor, the pattern would be more in line with flow from the N and NW, but it is clearly not.

Figure 11: 2018 Ozone Design Concentrations from Monitors in Maryland

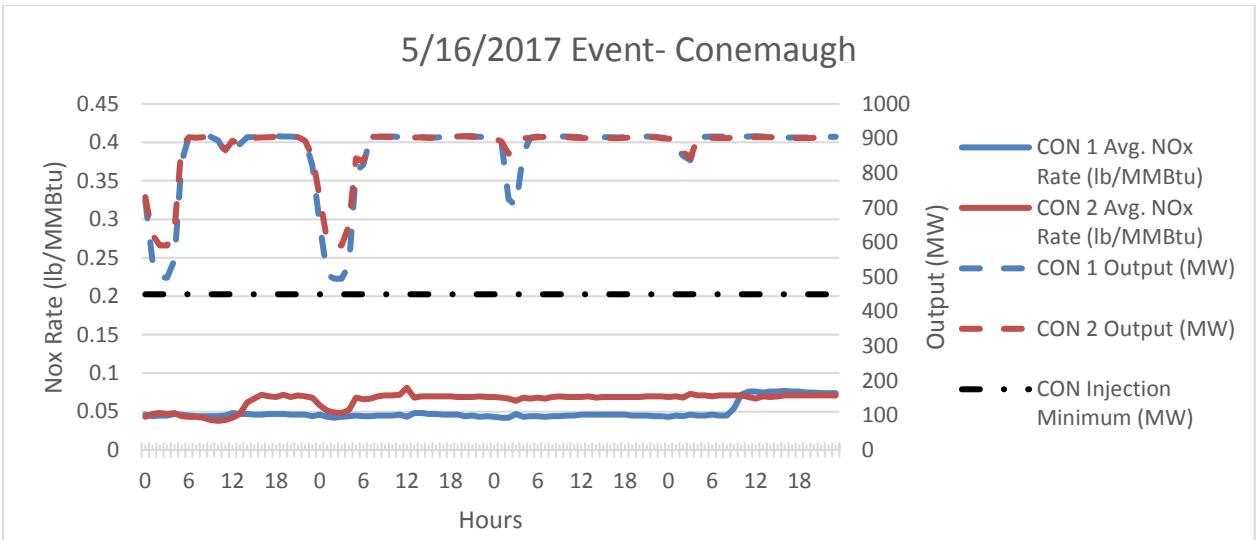


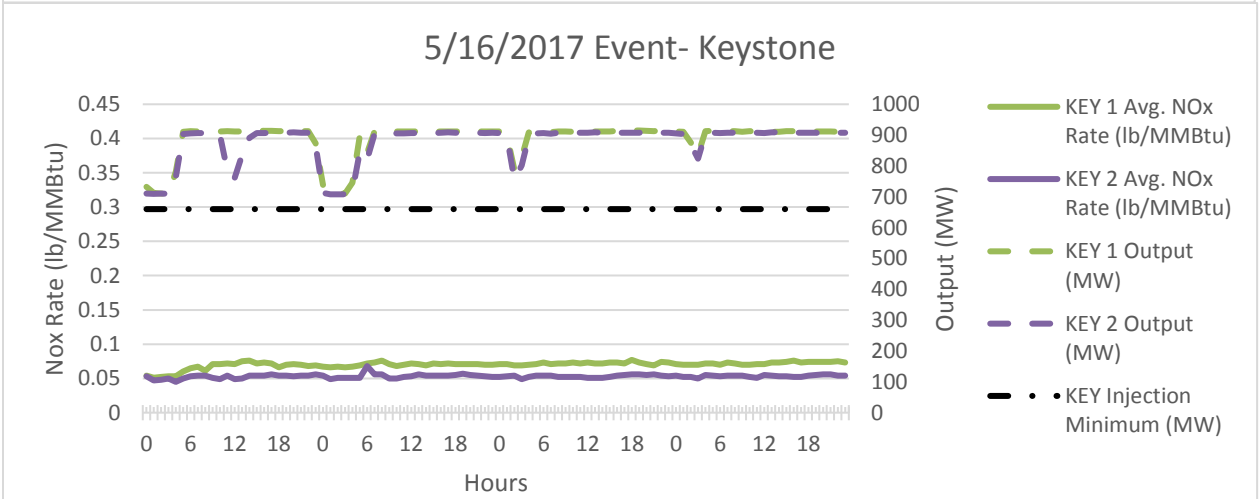
[7] Available at https://mde.state.md.us/programs/Air/AirQualityMonitoring/Pages/HistoricalData.aspx.

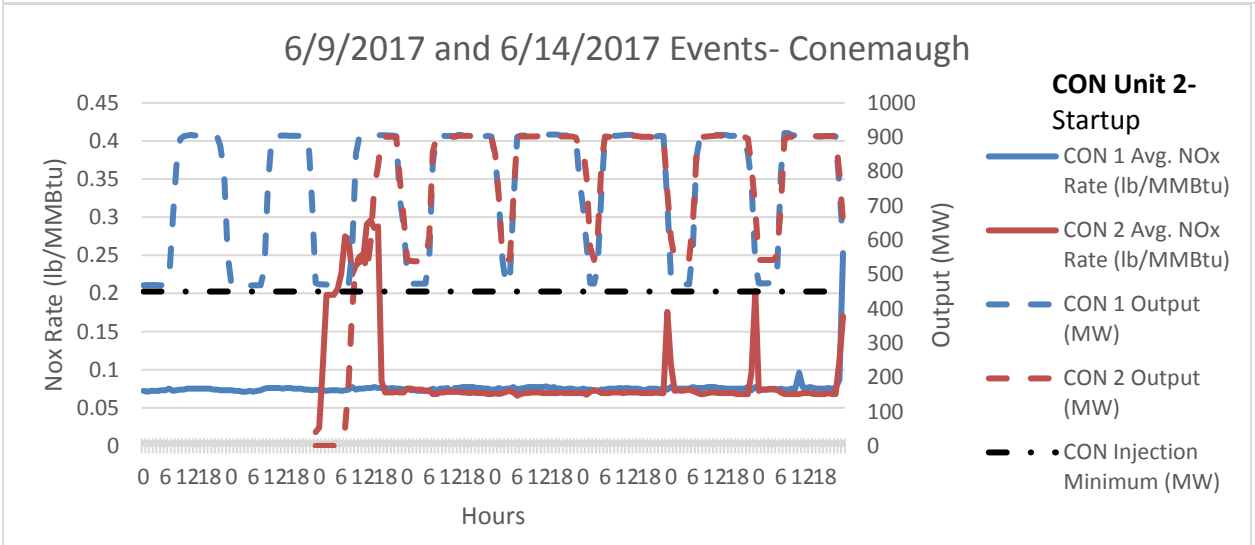
KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

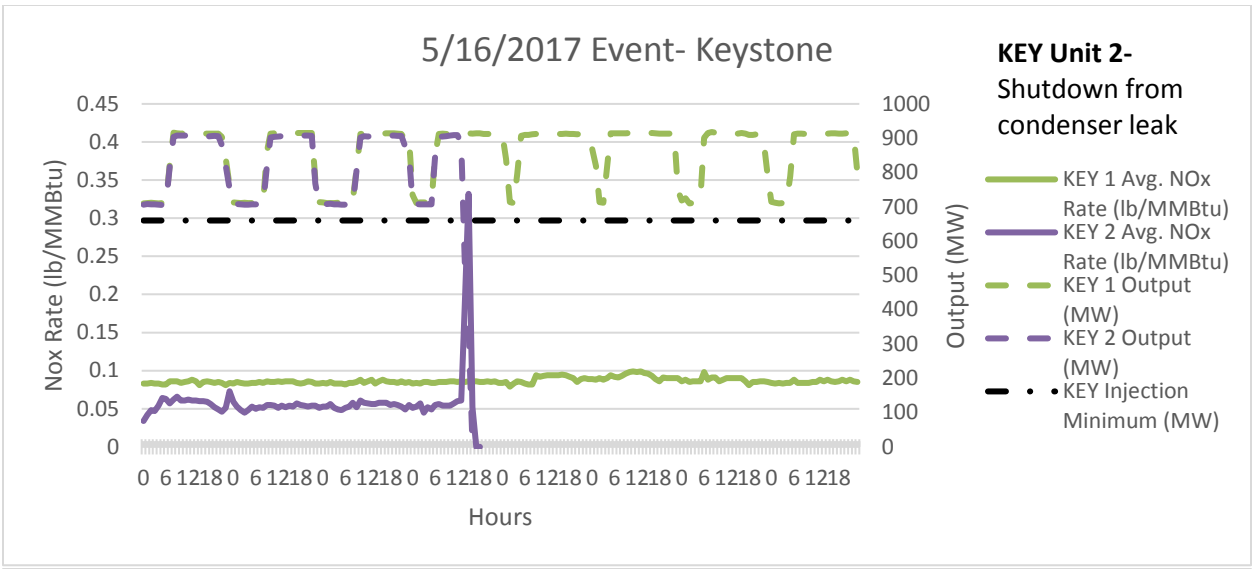
Appendix A

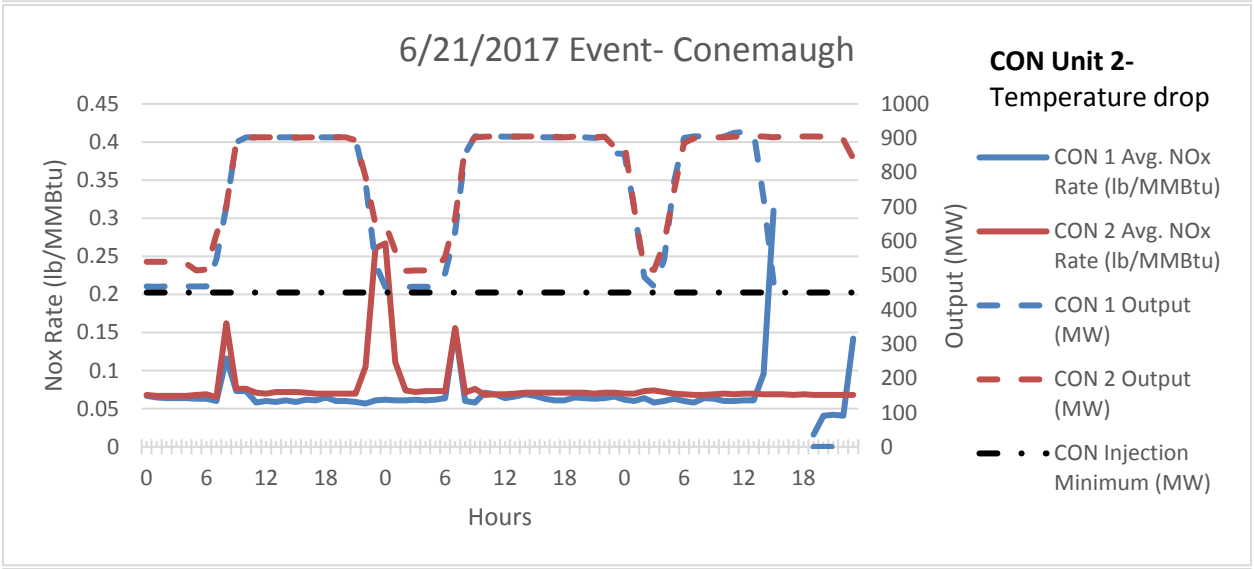
Time Series Plots of NOx emissions rates for KEY-CON Units 1 and 2 during O_3 NAAQS exceedance events included in the petition

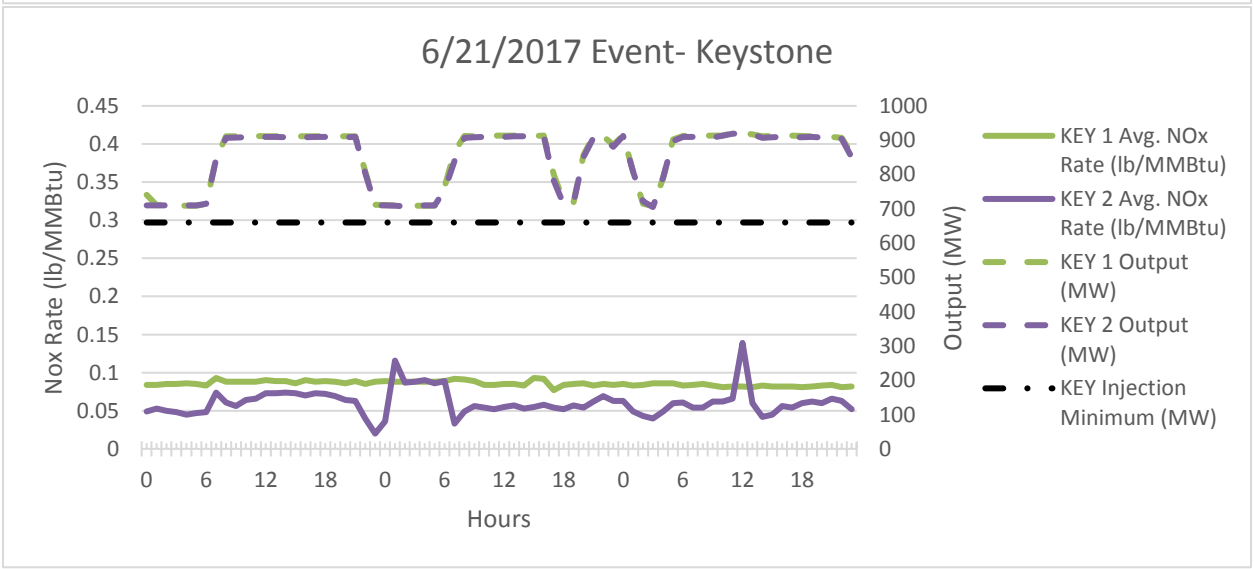

5/16/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

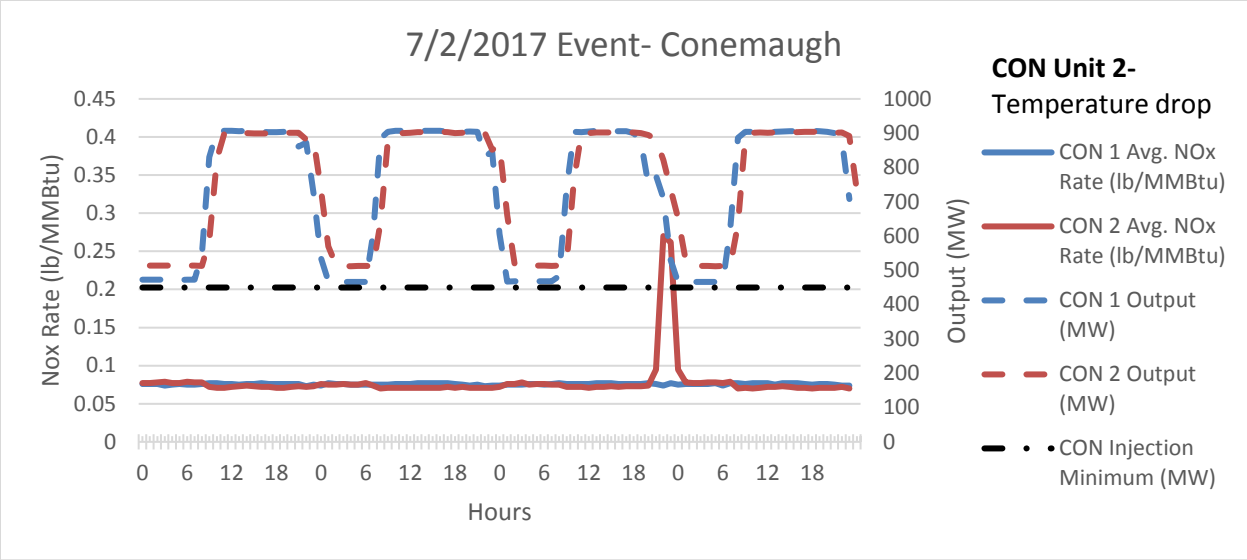

5/16/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

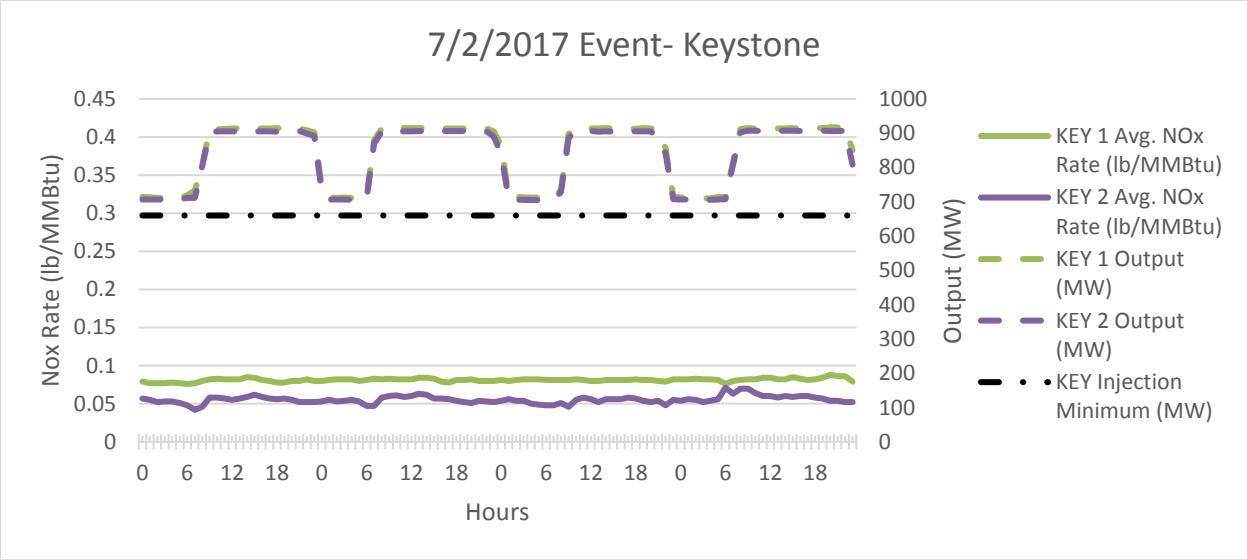

6/9/2017 and 6/14/2017 Events- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON Unit 2- Startup
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

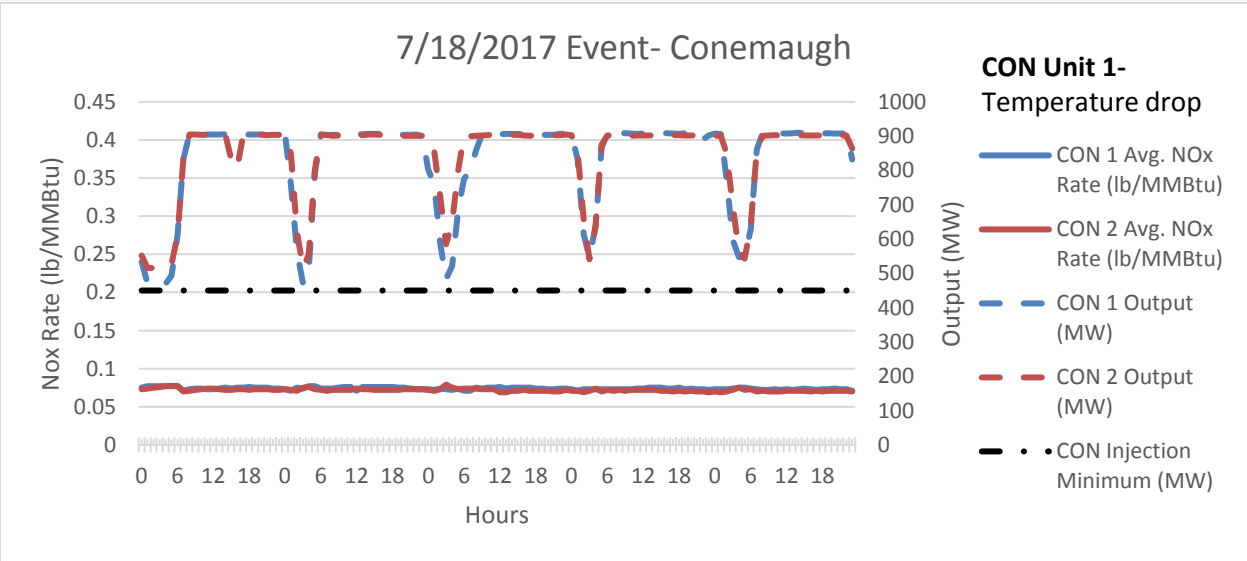

5/16/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY Unit 2-
Shutdown from condenser leak
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

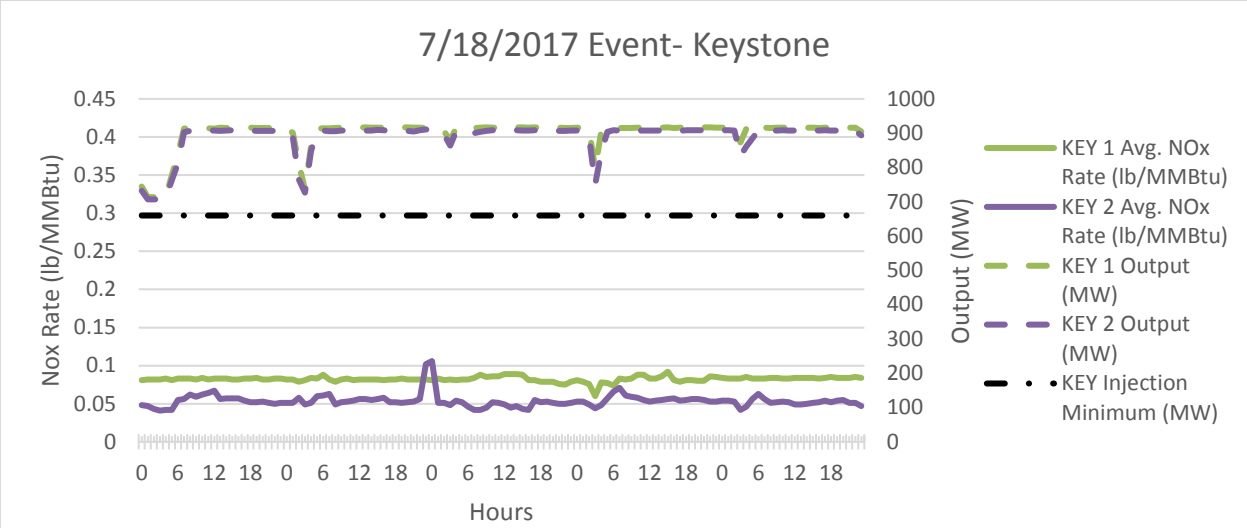

6/21/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON Unit 2-
Temperature drop
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

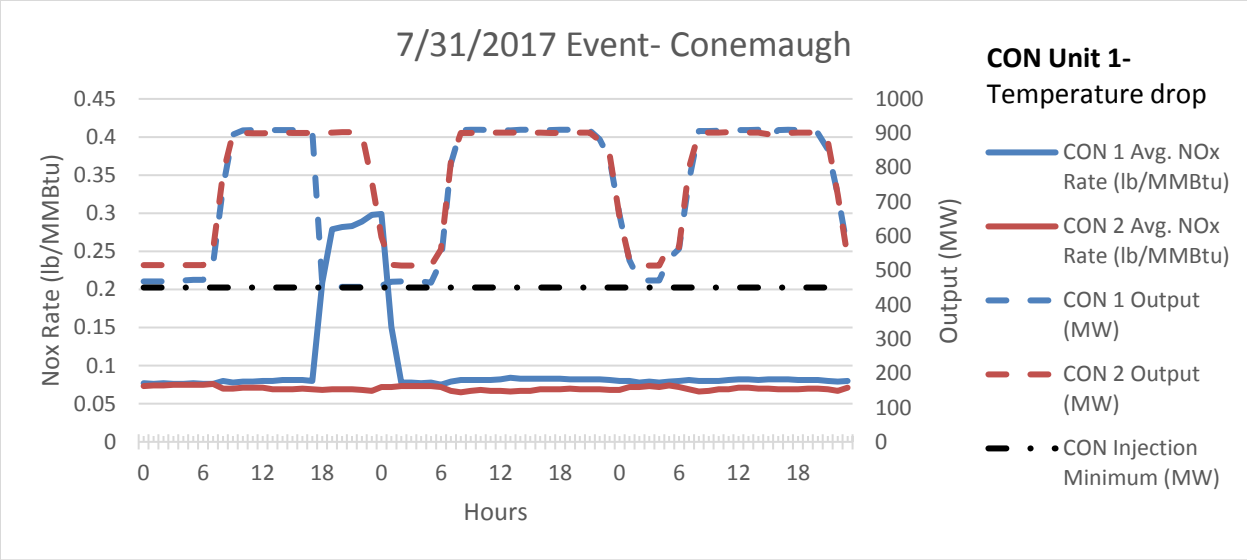

6/21/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

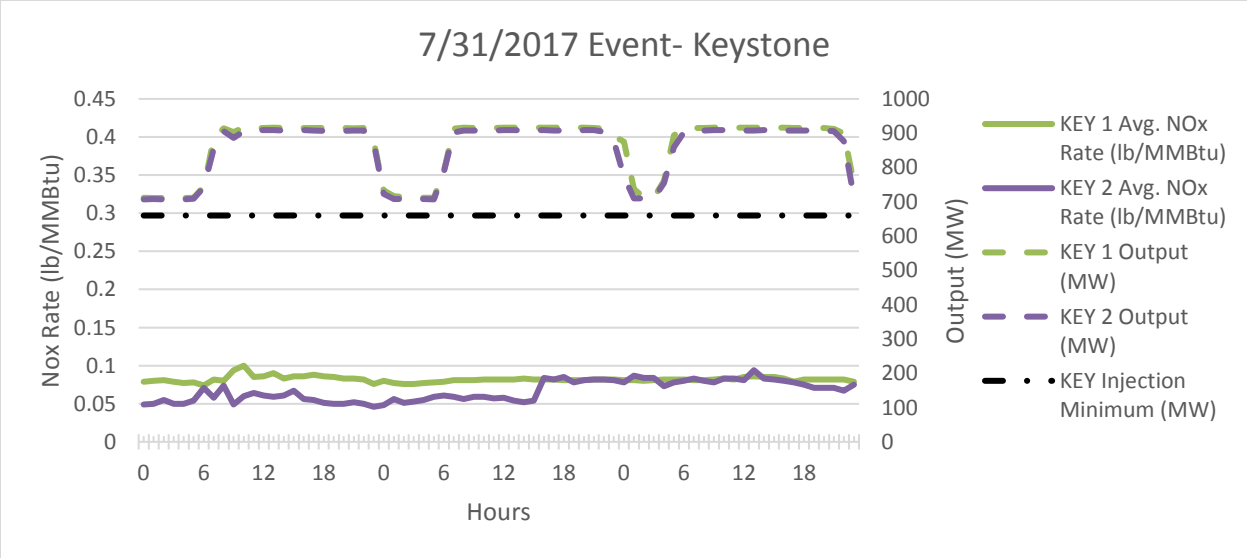

7/2/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18 0 6 12 18
CON Unit 2-
Temperature drop
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

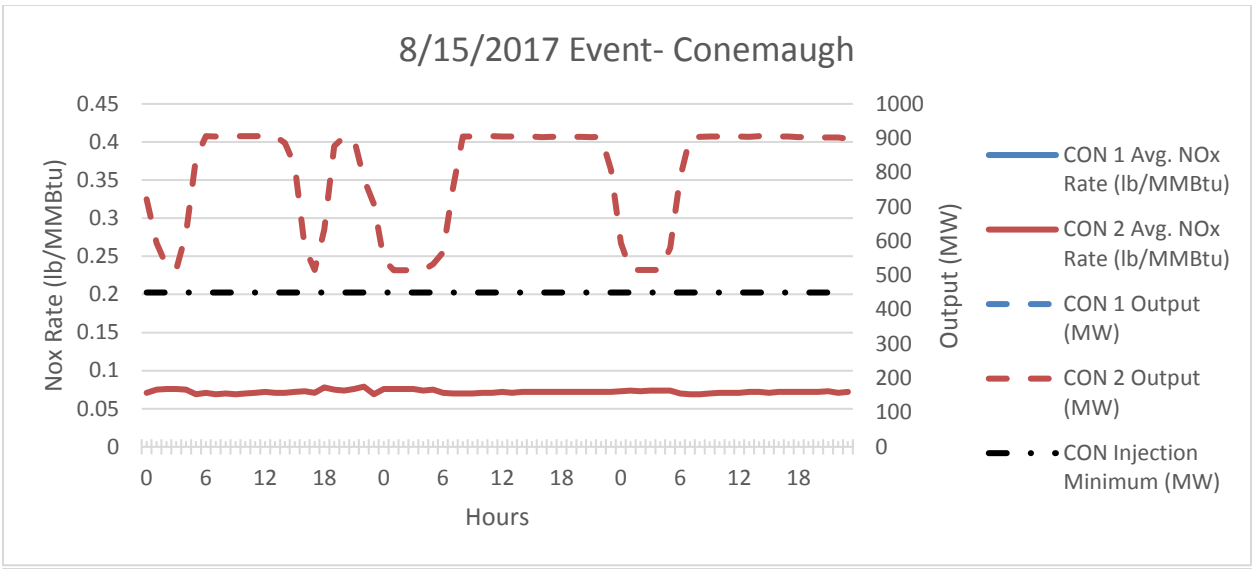

7/2/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18 0 6 12 18
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

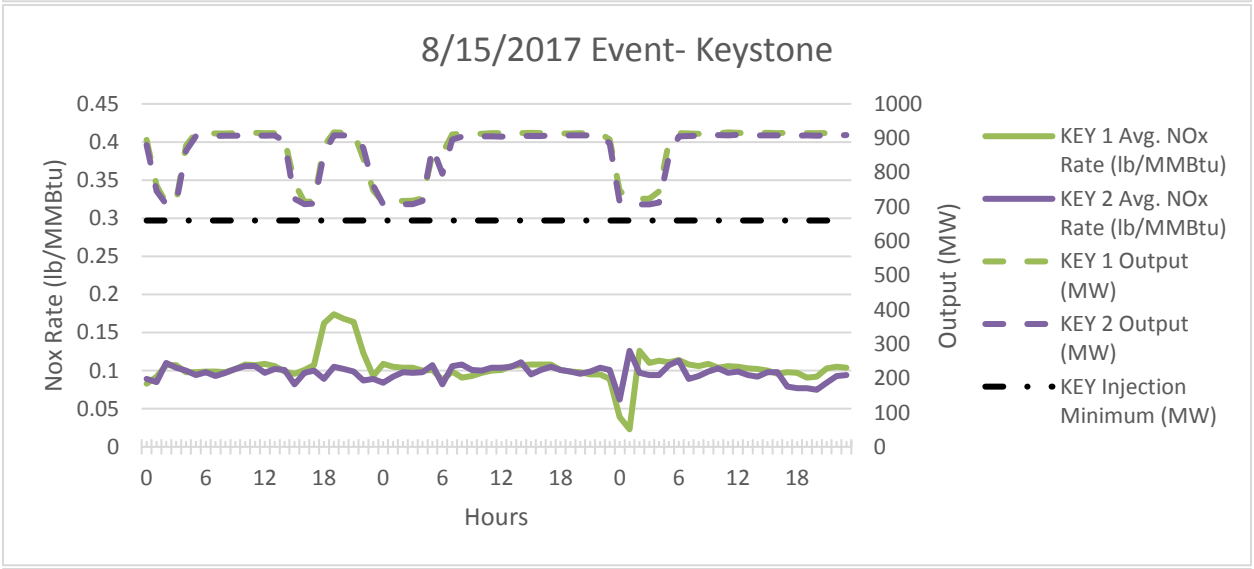

7/18/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18 0 6 12 18 0 6 12 18
CON Unit 1-
Temperature drop
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

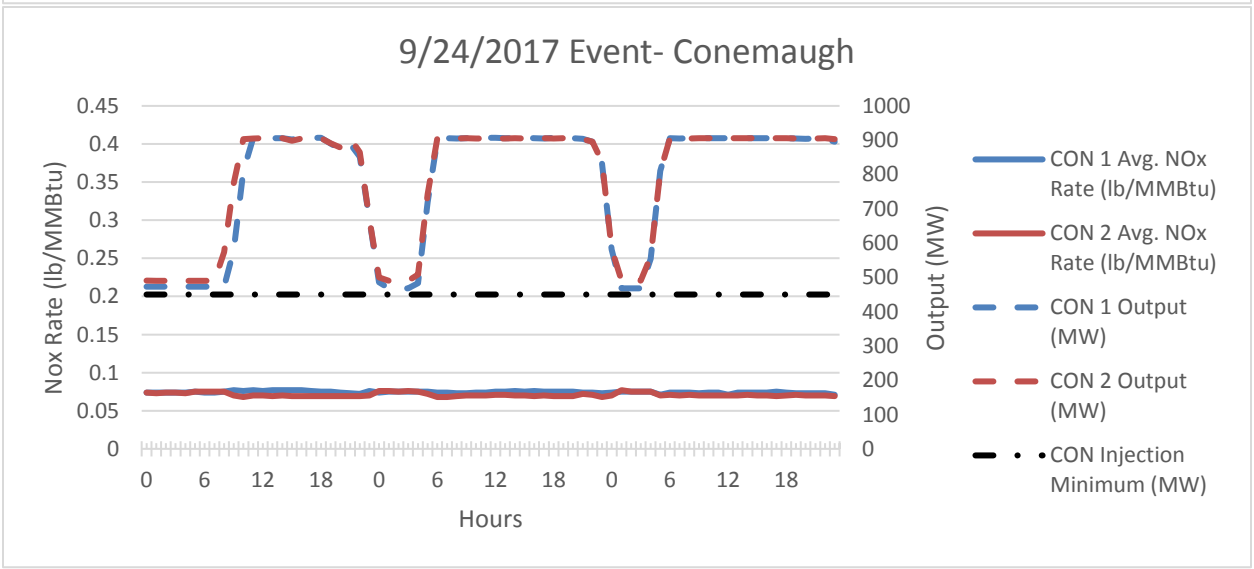

7/18/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

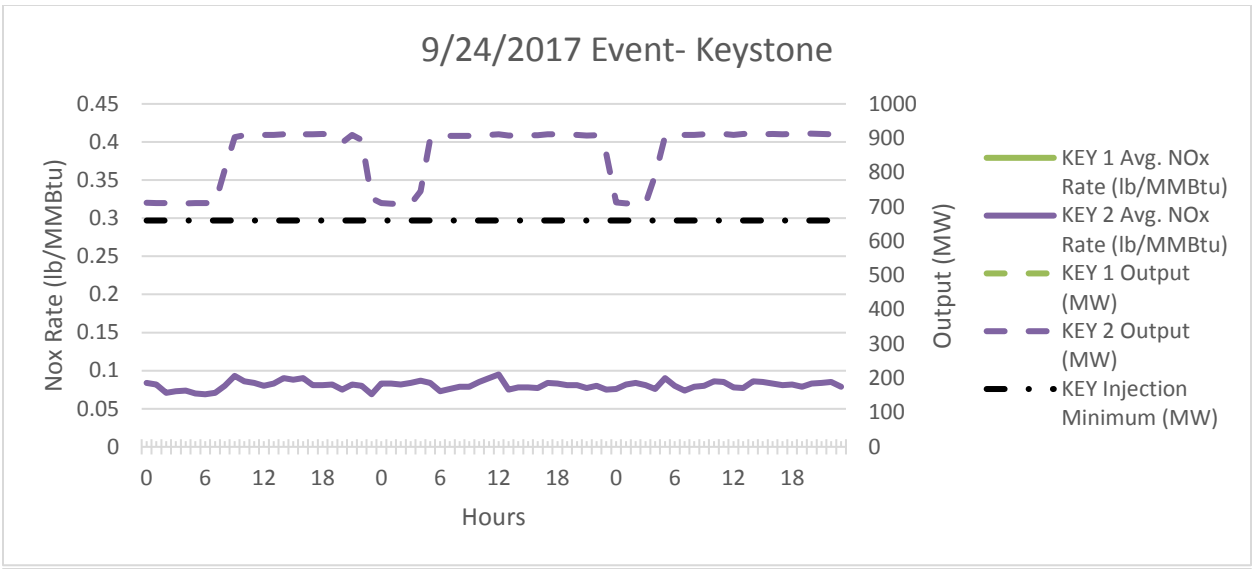

7/31/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON Unit 1-
Temperature drop
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

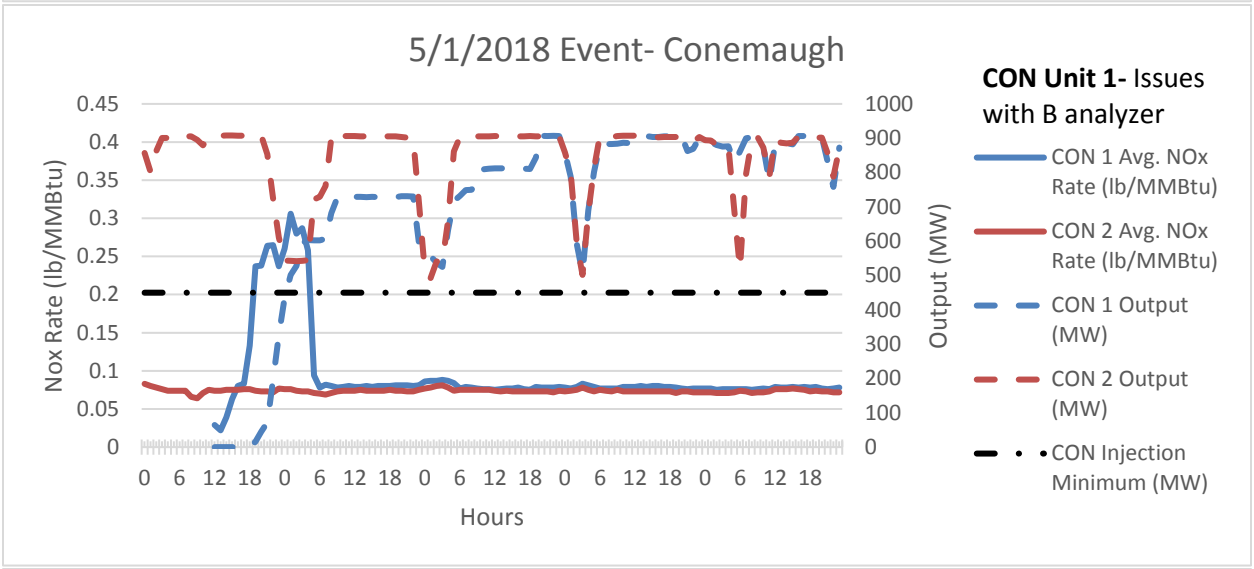

7/31/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

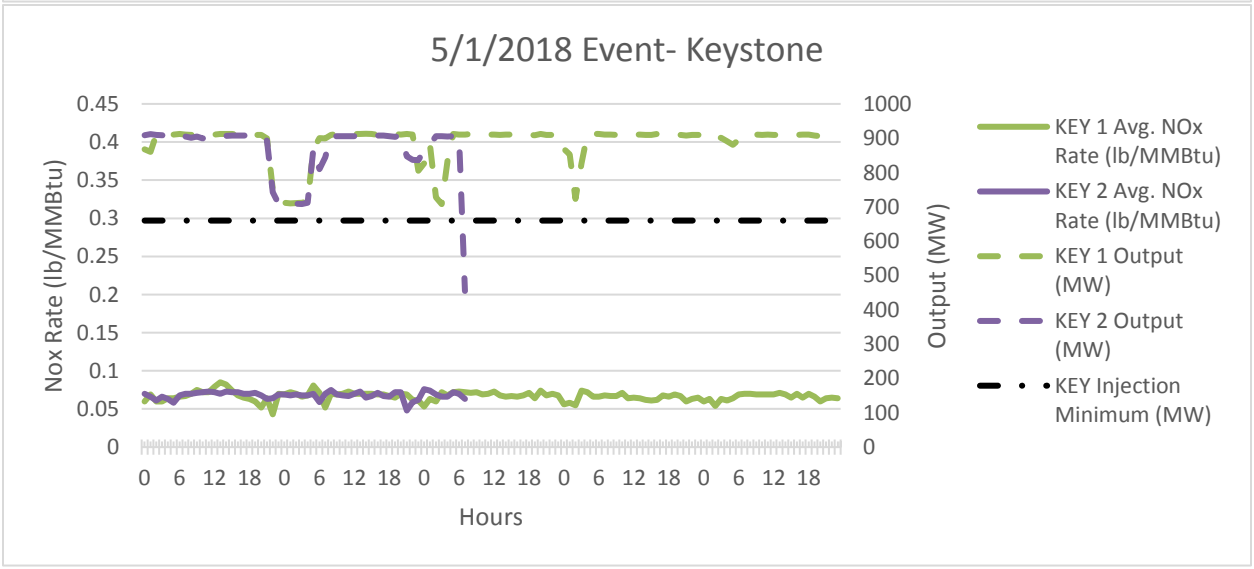

8/15/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

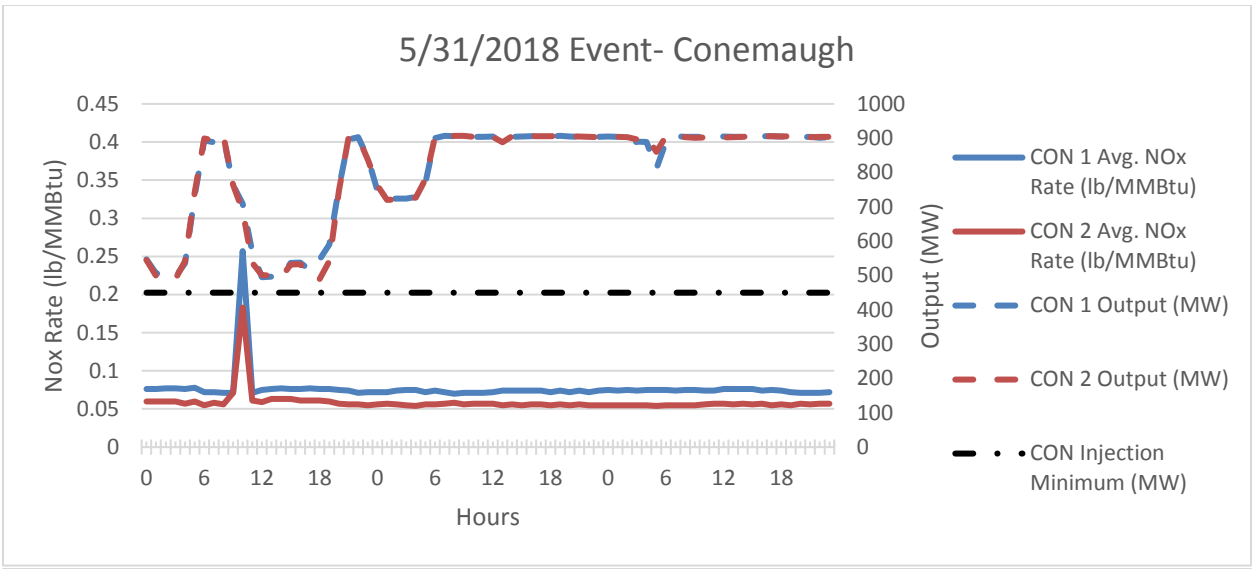

8/15/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

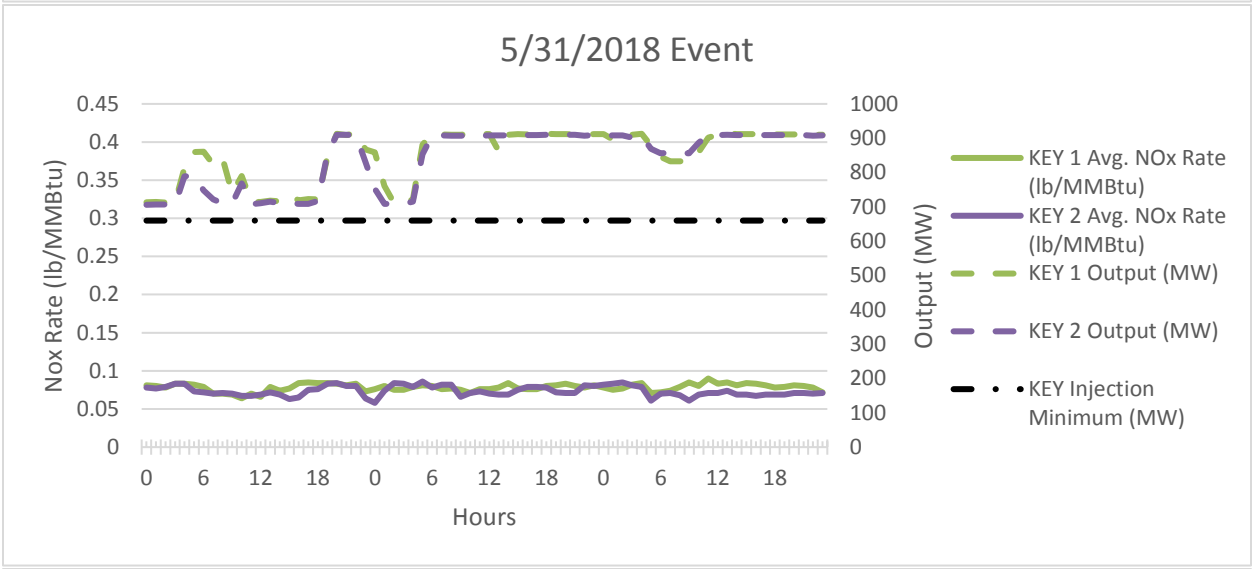

9/24/2017 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

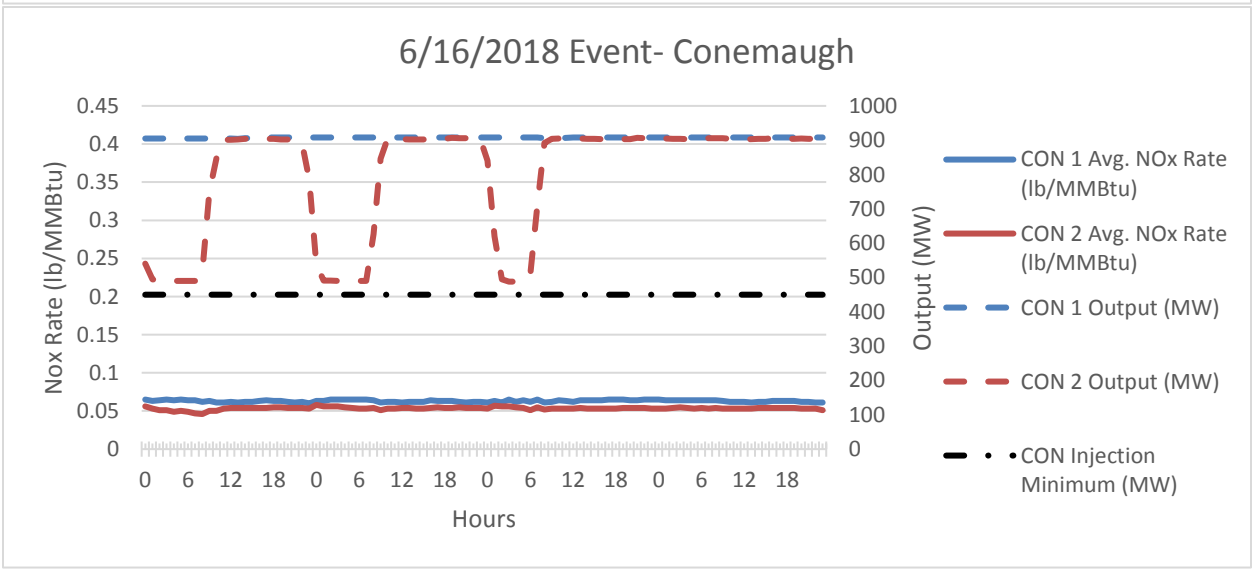

9/24/2017 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

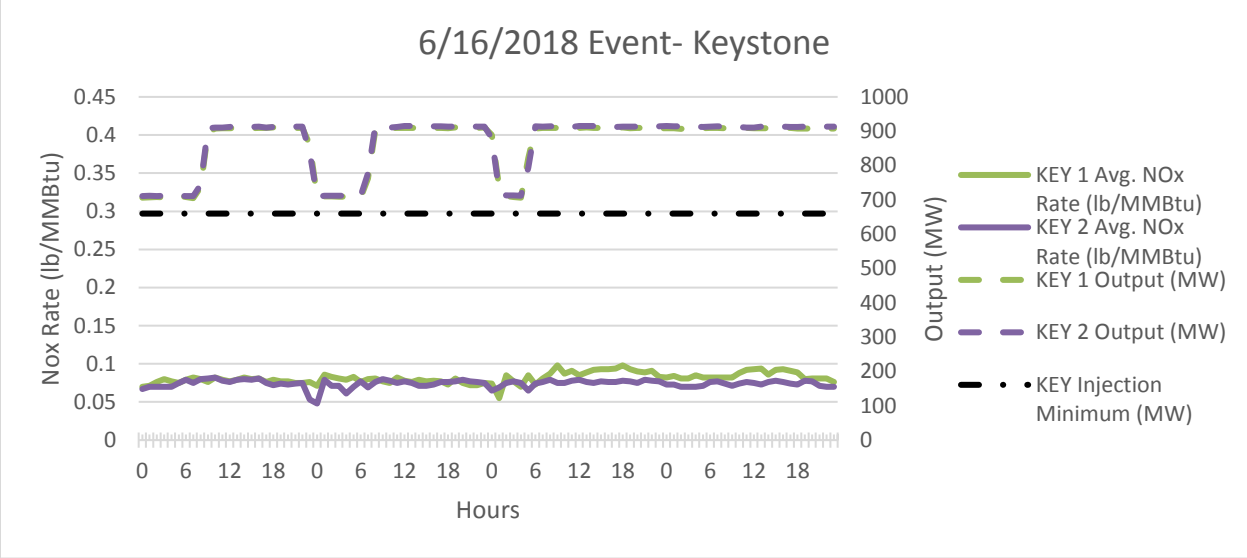

5/1/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON Unit 1- Issues with B analyzer
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

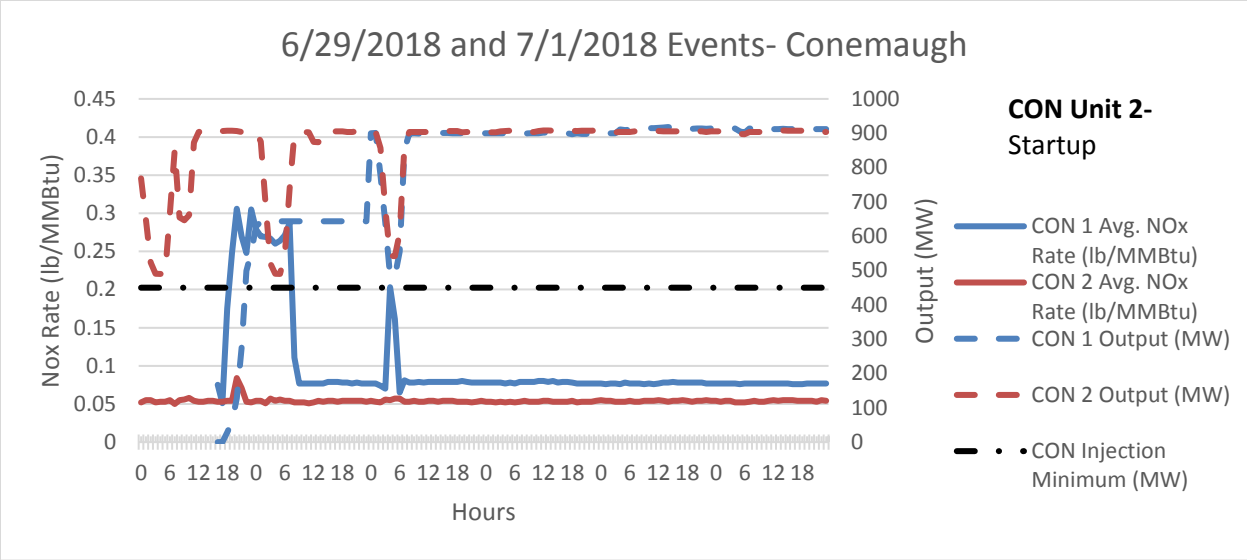

5/1/2018 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

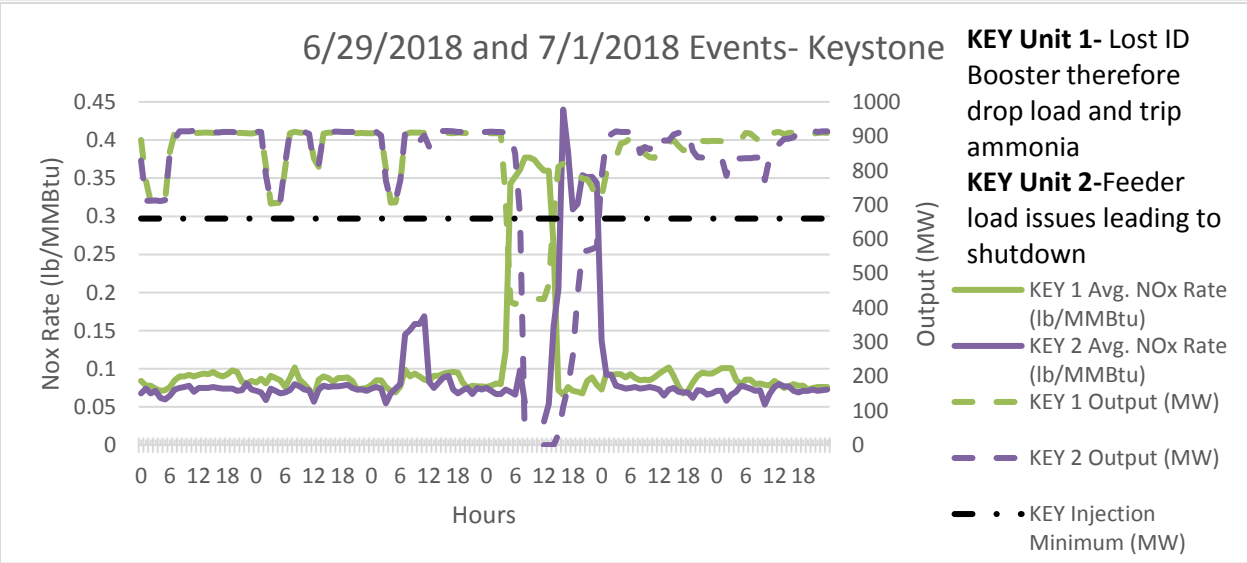

5/31/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

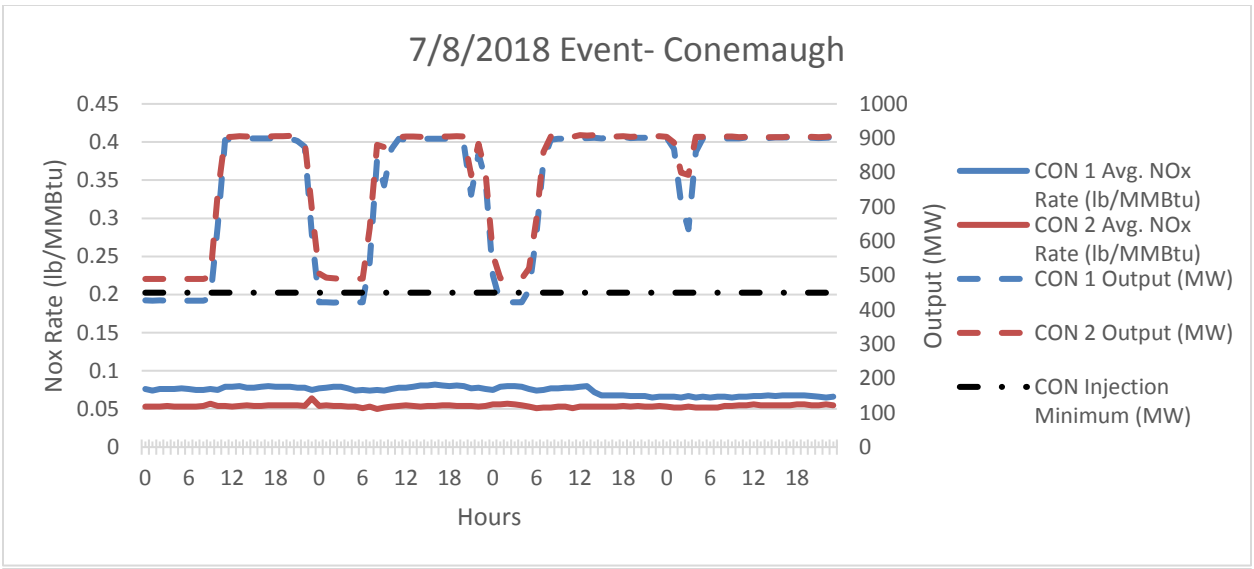

5/31/2018 Event
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

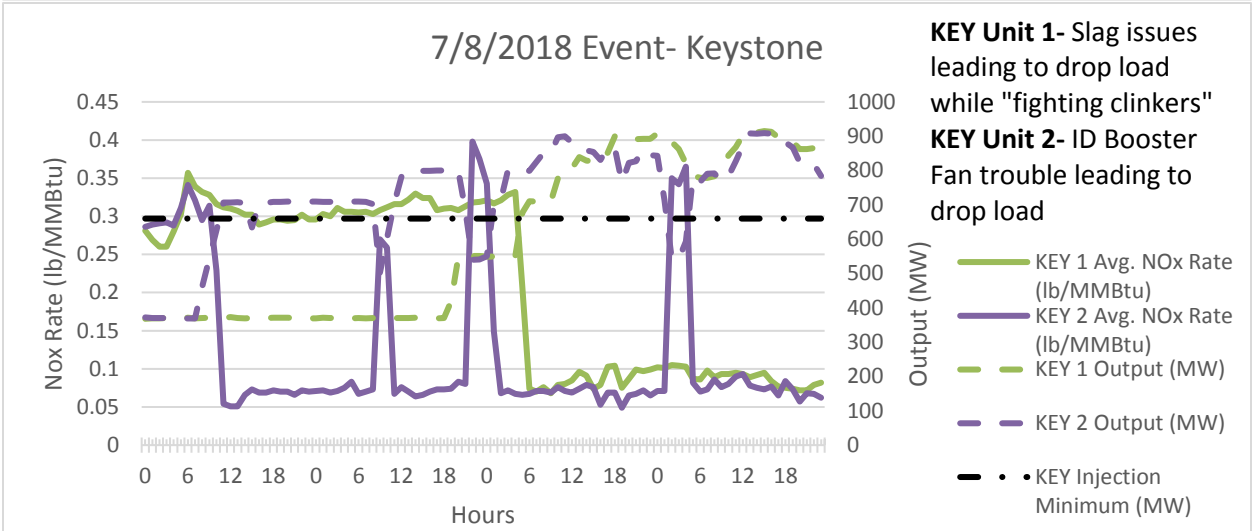

6/16/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)


6/16/2018 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

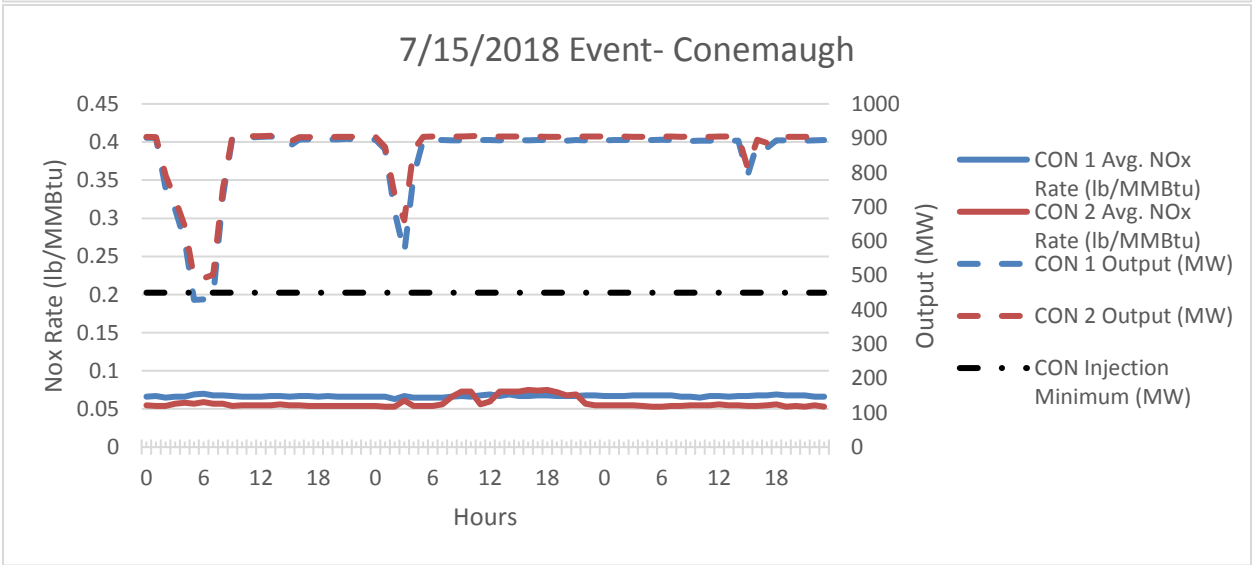

6/29/2018 and 7/1/2018 Events- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON Unit 2- Startup
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)

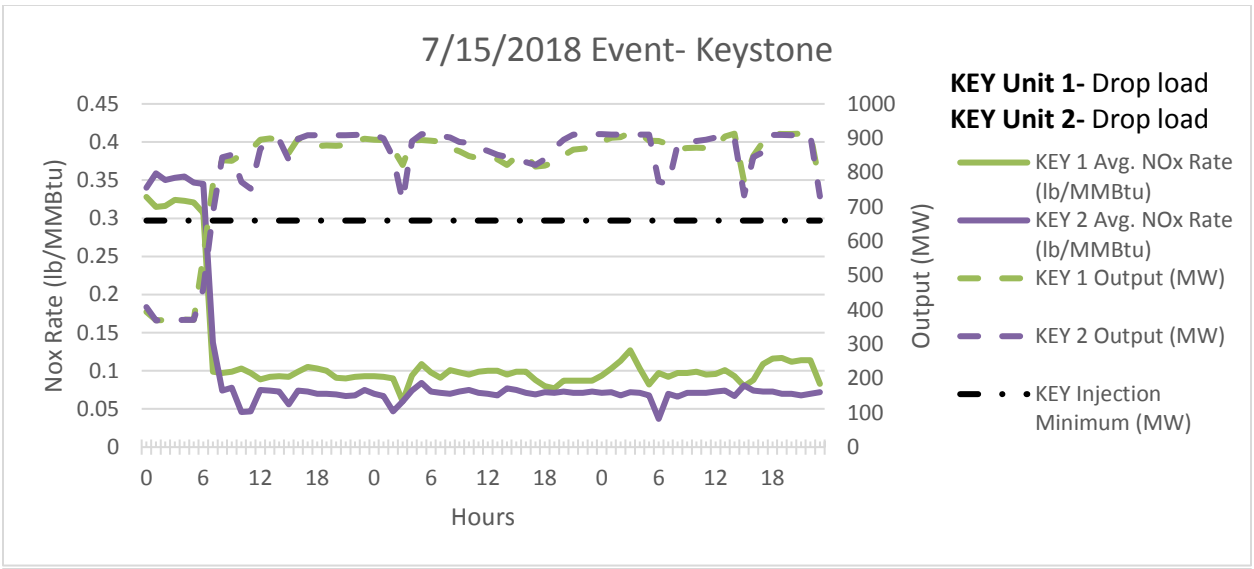

6/29/2018 and 7/1/2018 Events- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY Unit 1- Lost ID Booster therefore drop load and trip ammonia
KEY Unit 2-Feeder load issues leading to shutdown
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

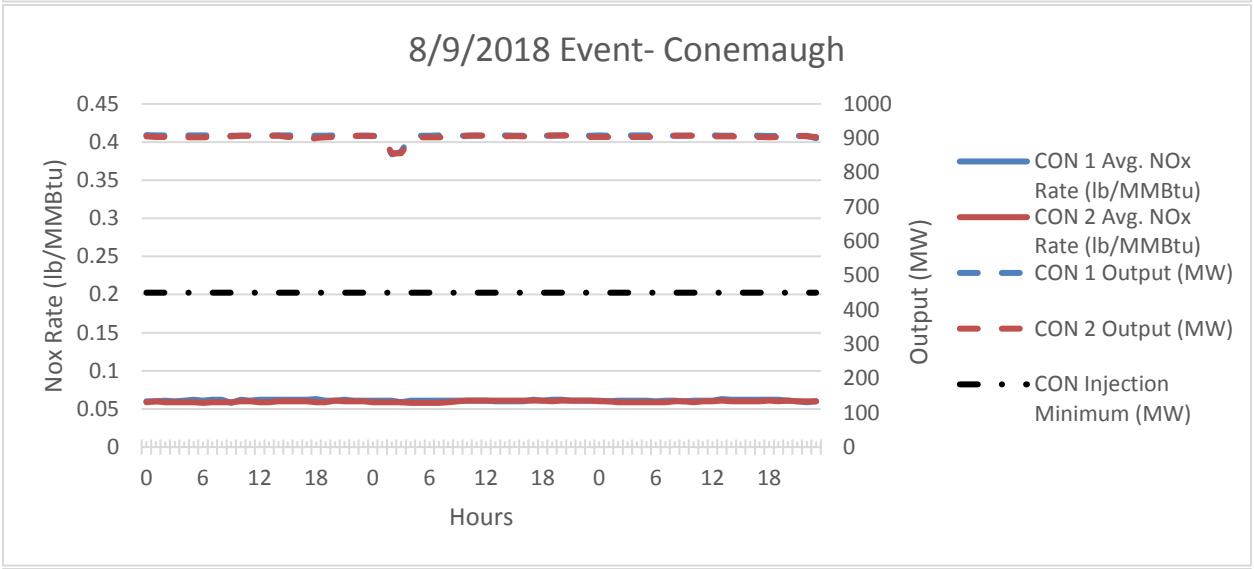


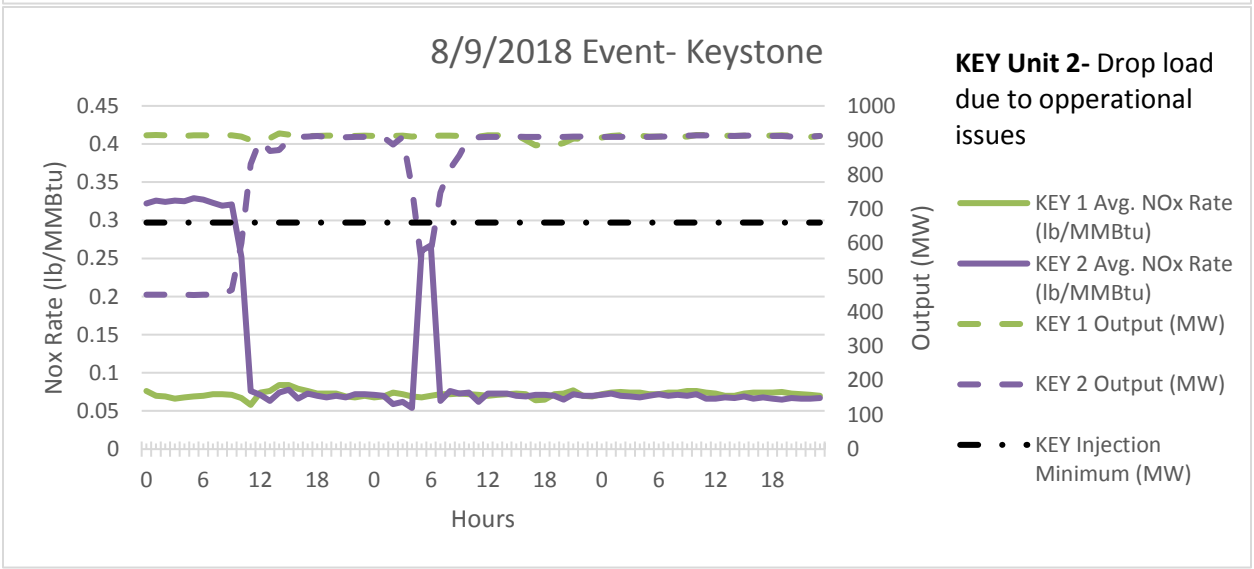


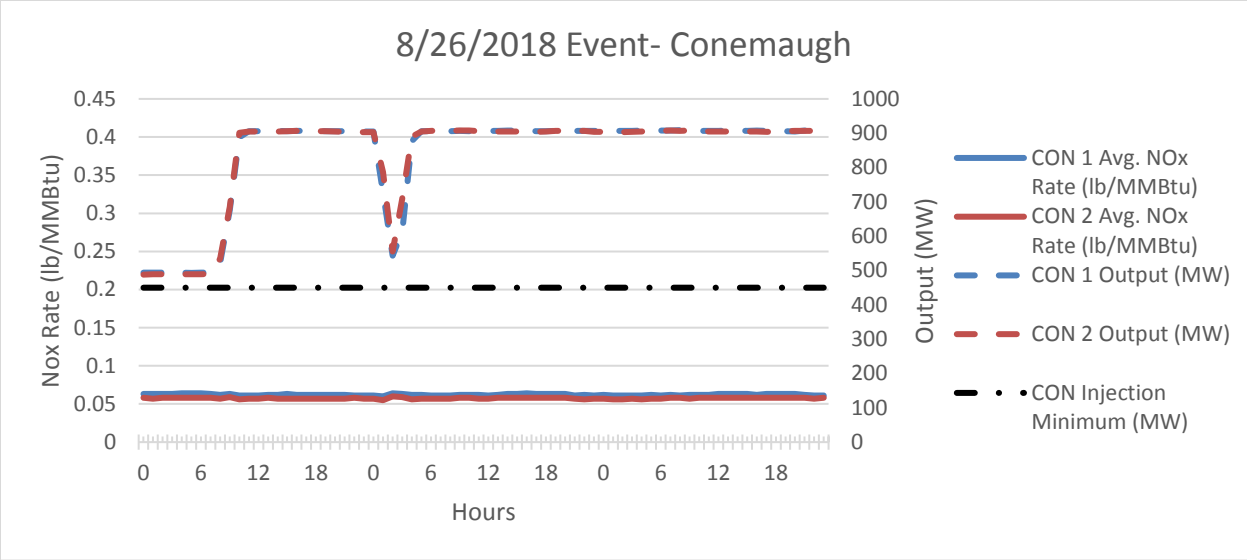
KEY Unit 1- Slag issues leading to drop load while "fighting clinkers"
KEY Unit 2- ID Booster Fan trouble leading to drop load

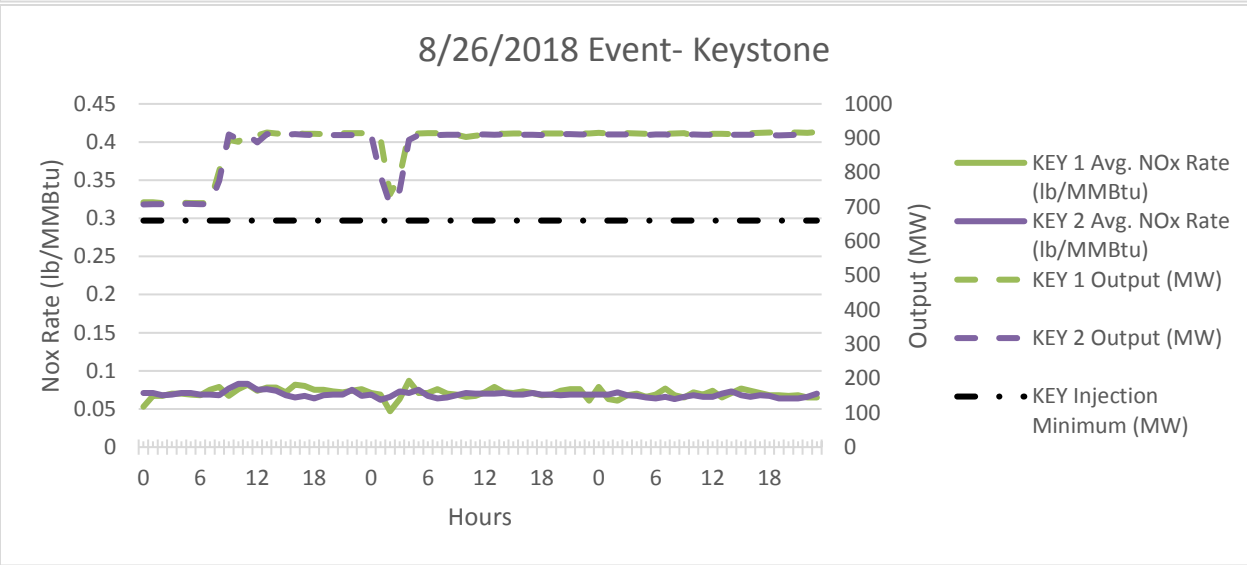


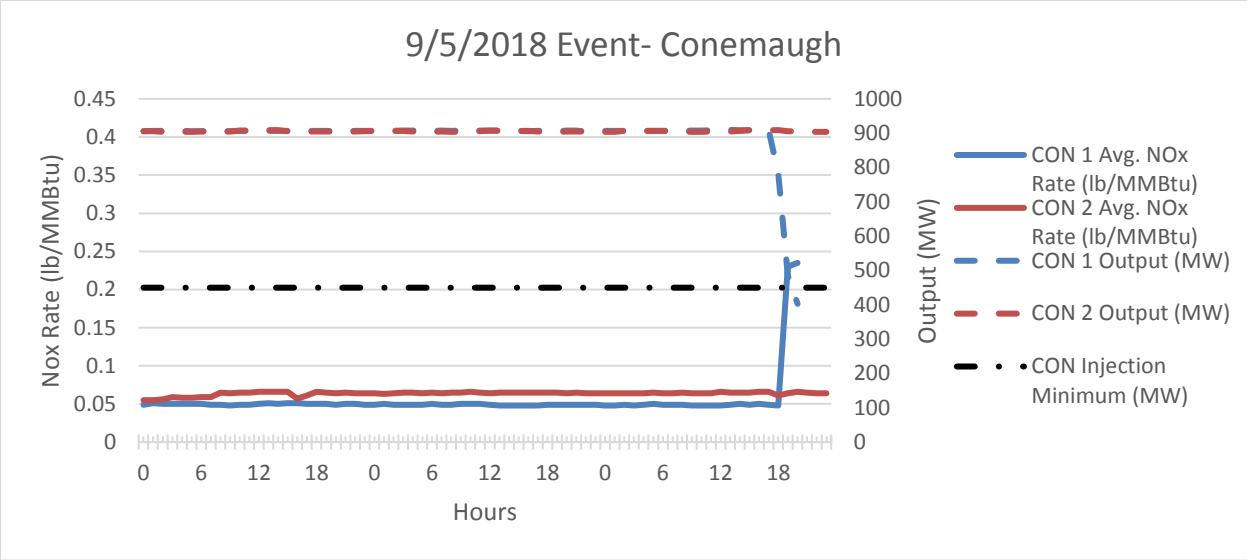

7/15/2018 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY Unit 1- Drop load
KEY Unit 2- Drop load
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

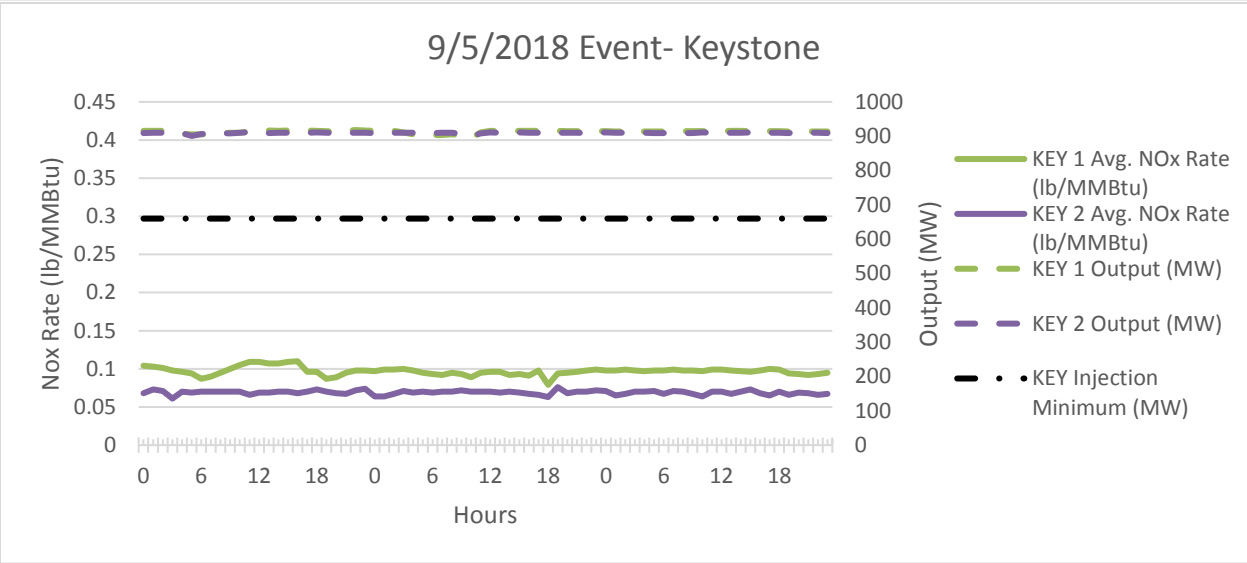

8/9/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)


8/9/2018 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
KEY Unit 2- Drop load due to opperational issues
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)


8/26/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Output (MW)
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18
Hours
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)


8/26/2018 Event- Keystone
Nox Rate (lb/MMBtu)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Output (MW)
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18
Hours
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)


9/5/2018 Event- Conemaugh
Nox Rate (lb/MMBtu)
Output (MW)
Hours
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18
CON 1 Avg. NOx Rate (lb/MMBtu)
CON 2 Avg. NOx Rate (lb/MMBtu)
CON 1 Output (MW)
CON 2 Output (MW)
CON Injection Minimum (MW)


9/5/2018 Event- Keystone
Nox Rate (lb/MMBtu)
Output (MW)
Hours
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1000
900
800
700
600
500
400
300
200
100
0
0 6 12 18 0 6 12 18 0 6 12 18
KEY 1 Avg. NOx Rate (lb/MMBtu)
KEY 2 Avg. NOx Rate (lb/MMBtu)
KEY 1 Output (MW)
KEY 2 Output (MW)
KEY Injection Minimum (MW)

KEY-CON Comments to Clean Air Act Section 184(c) petition submitted by MDE

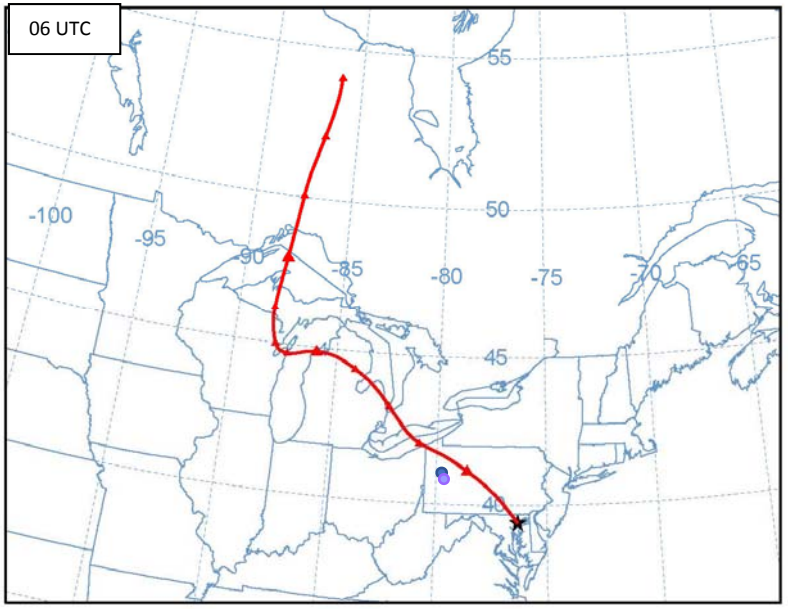
Appendix C: HYSPLIT Back-Trajectory Plots for Days of Ozone Exceedances in 2018

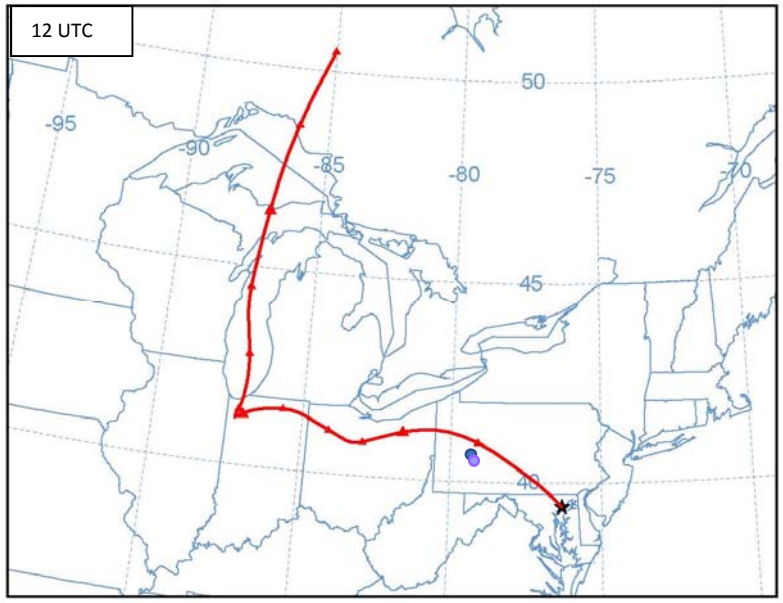
Dates Included are:

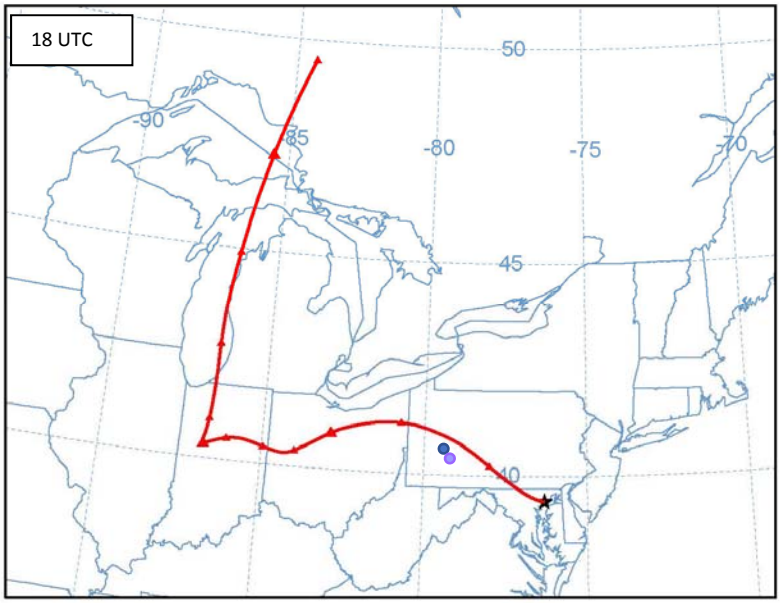
- 5/01/2018
- 5/02/2018
- 5/03/2018
- 50/4/2018
- 6/01/2018
- 6/17/2018
- 6/18/2018
- 6/30/2018
- 7/02/2018
- 7/03/2018
- 7/09/2018
- 7/10/2018
- 7/16/2018
- 8/10/2018
- 8/27/2018
- 9/06/2018

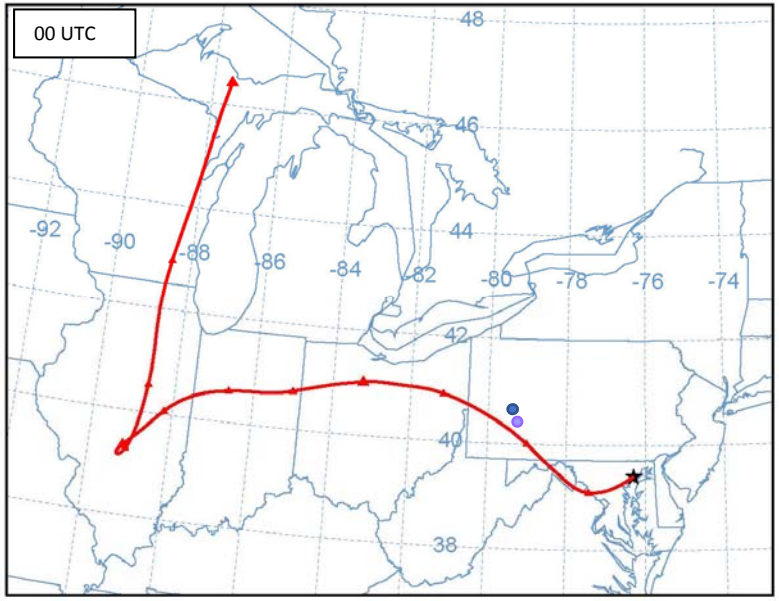
In each figure, small blue and purple dots show the location of the Keystone and Conemaugh stations, respectively.

May 1, 2018 – Edgewood Monitor

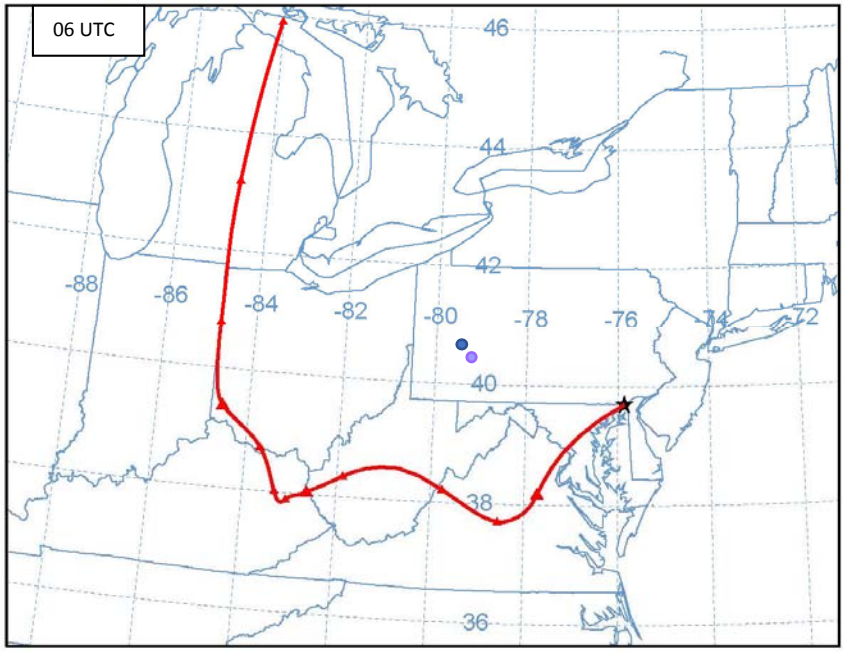


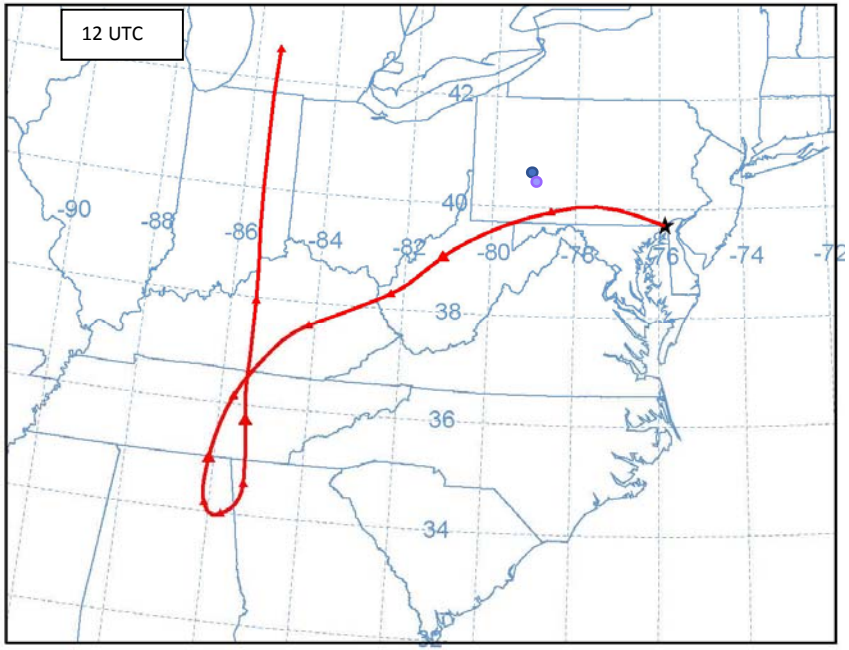


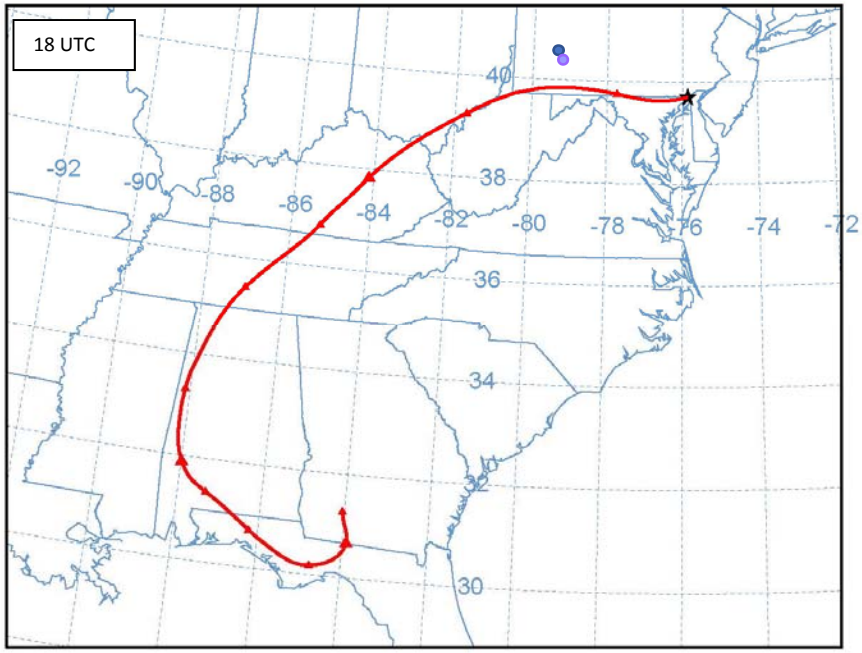


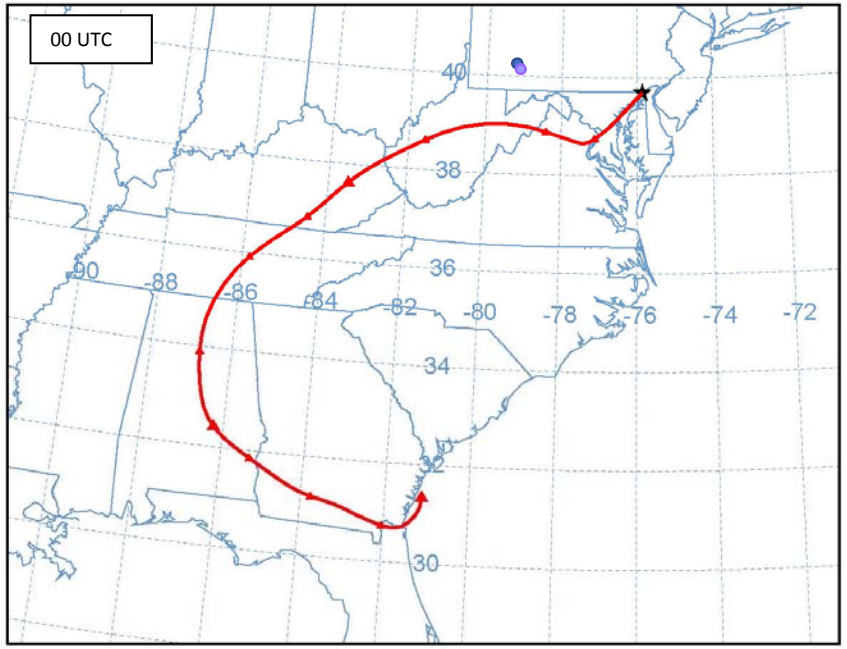


May 2, 2018 – Fair Hill Monitor

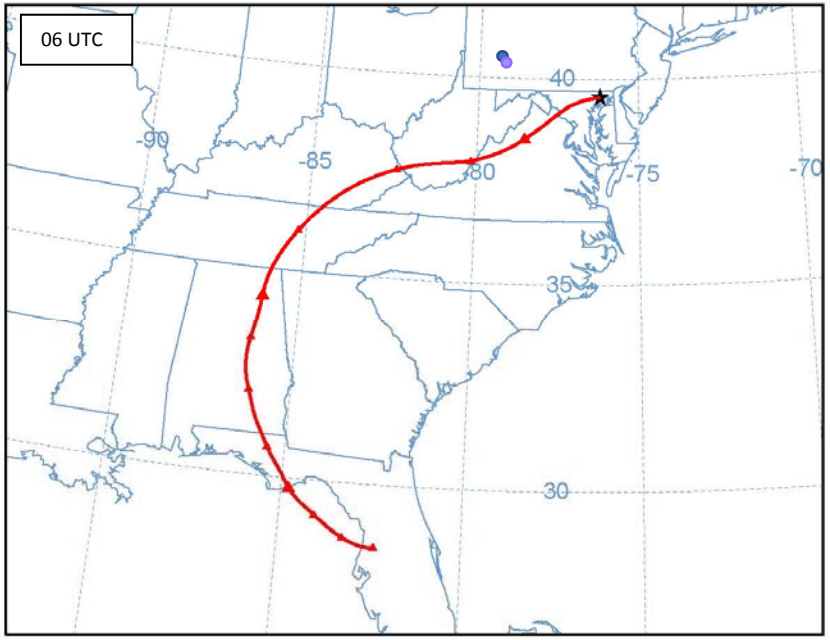


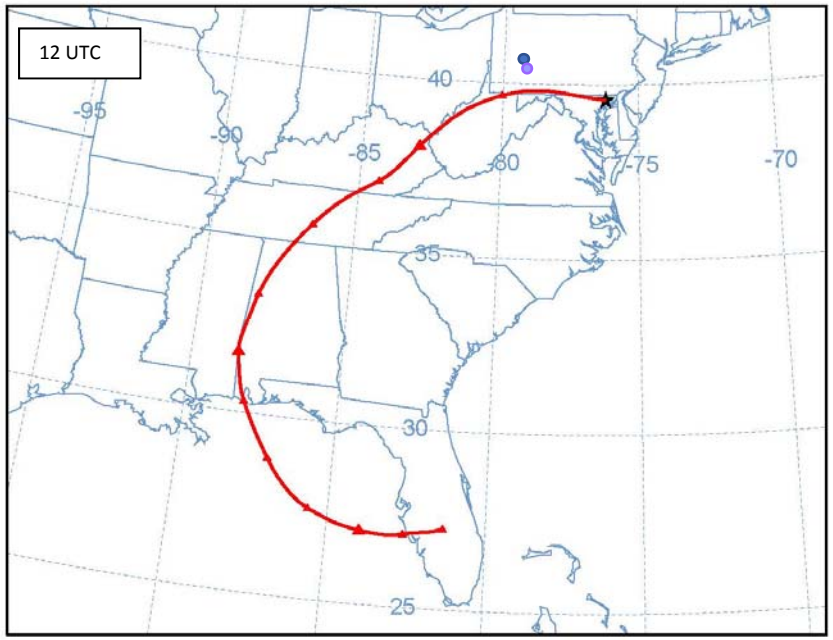


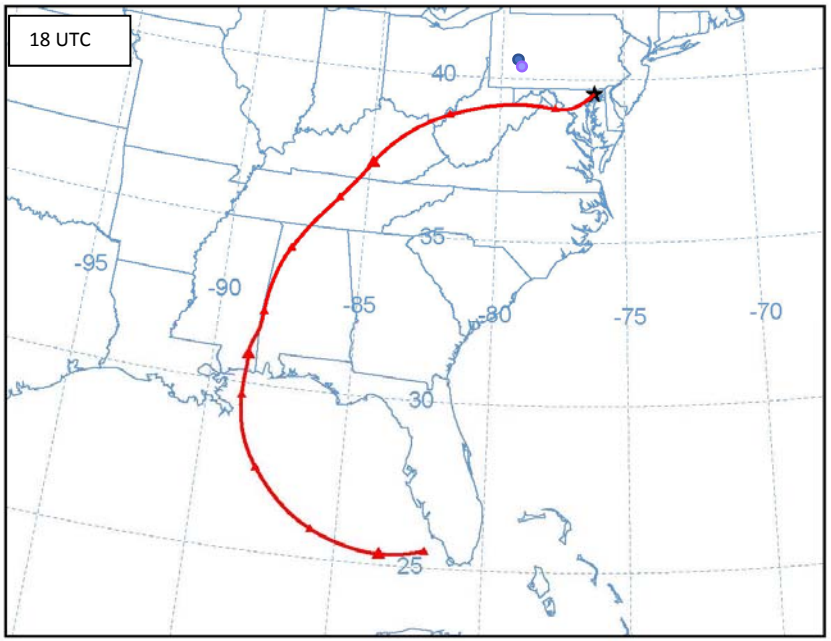


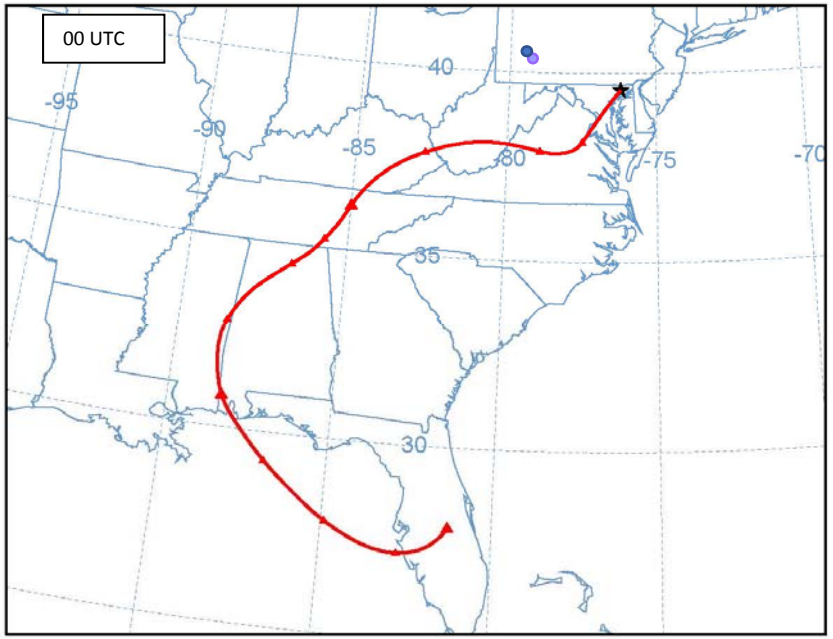


May 3, 2018 – Aldino Monitor

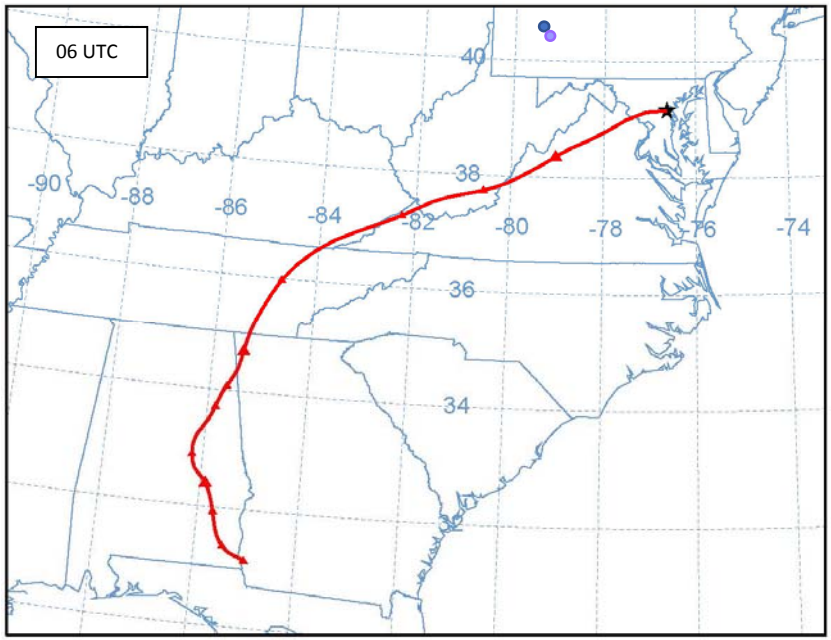


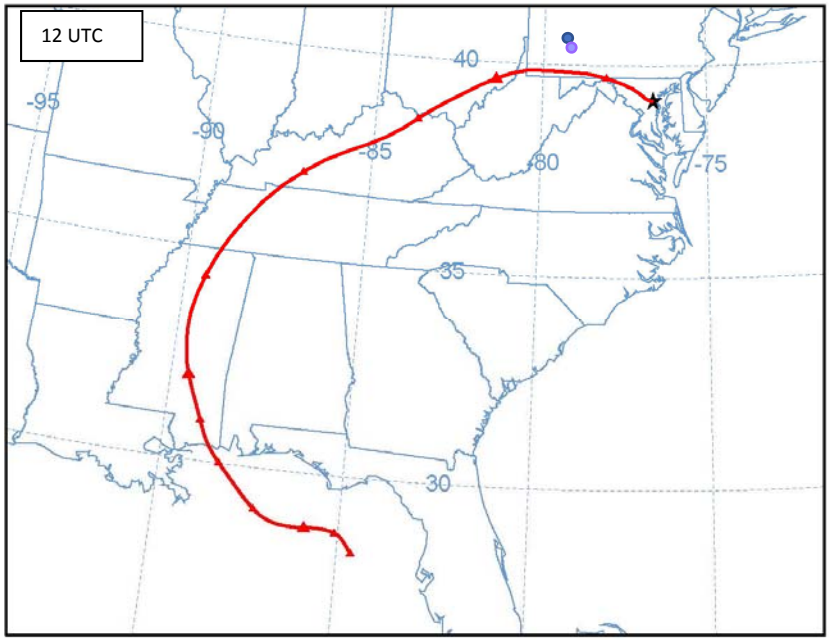


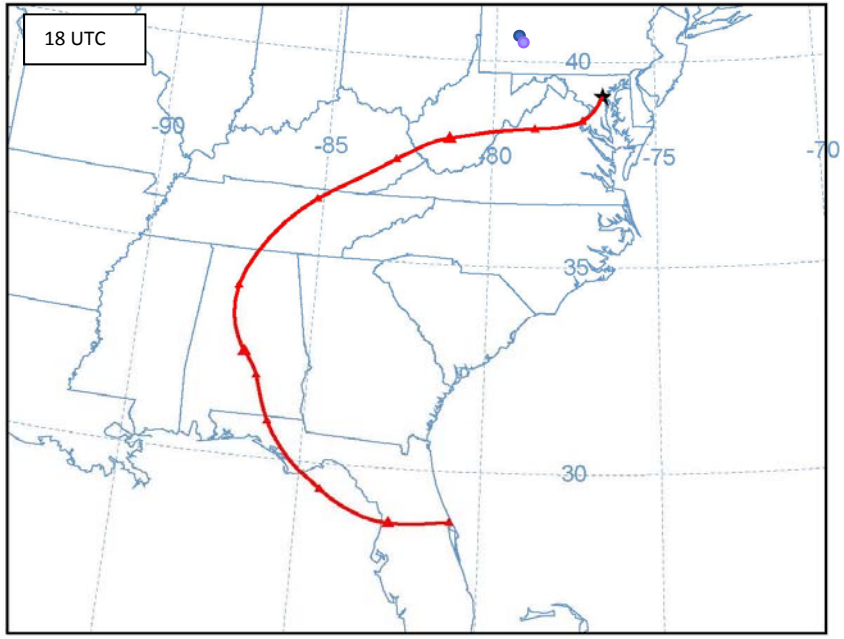


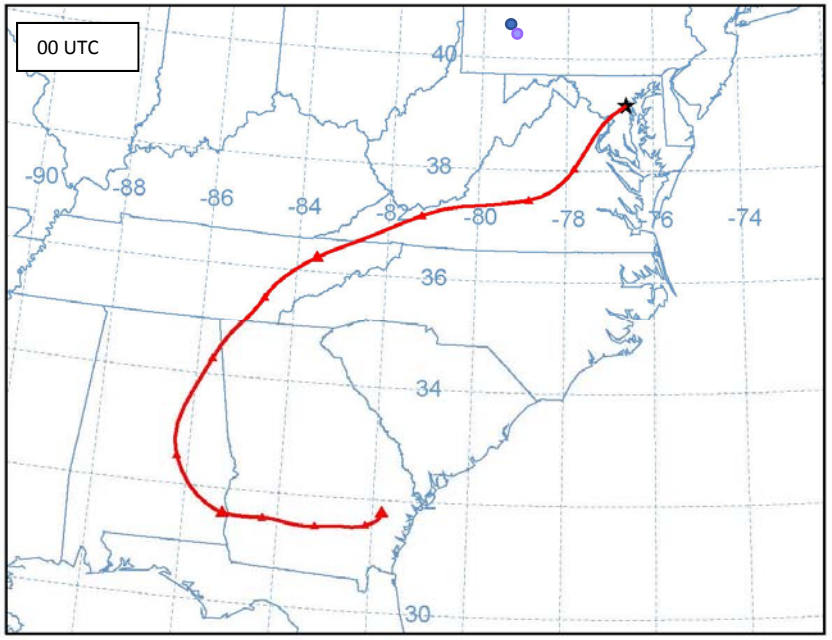


May 4, 2018 – Glen Burnie Monitor

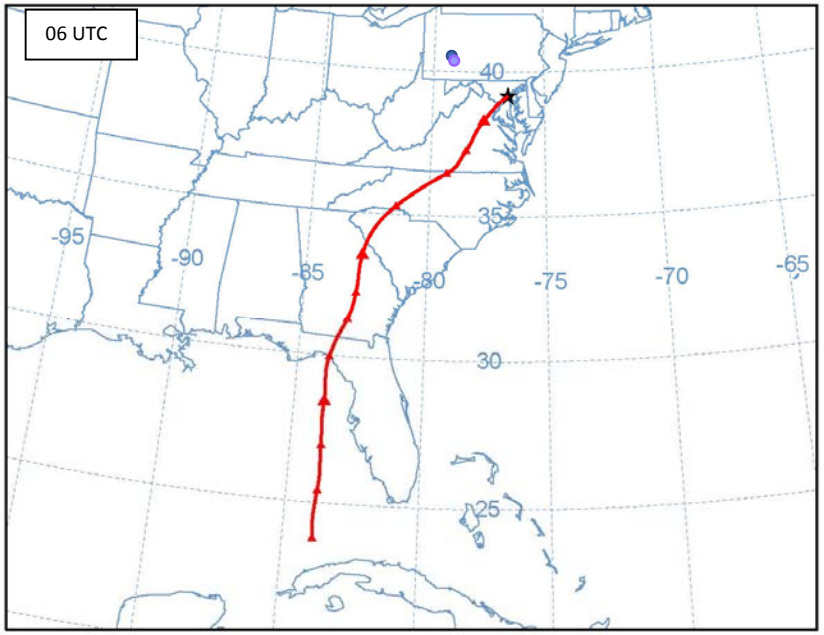


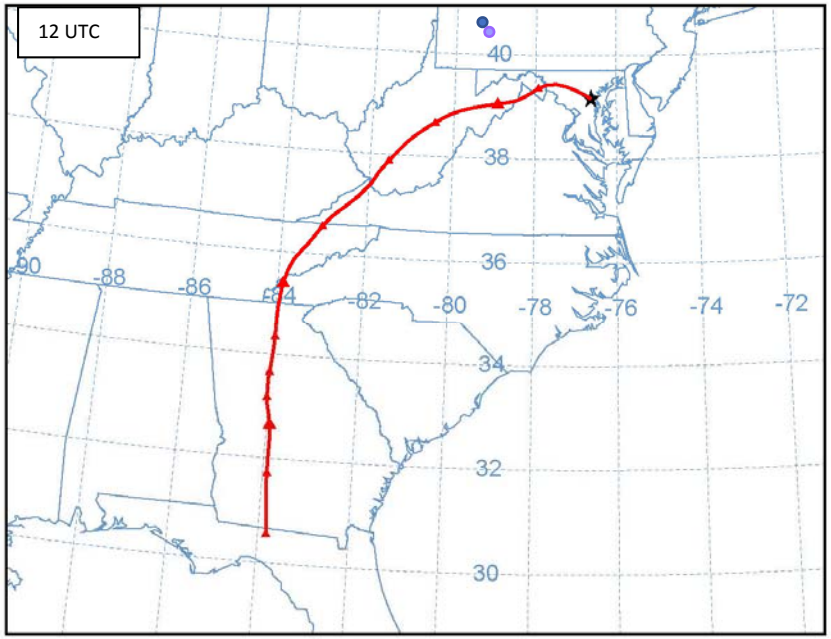


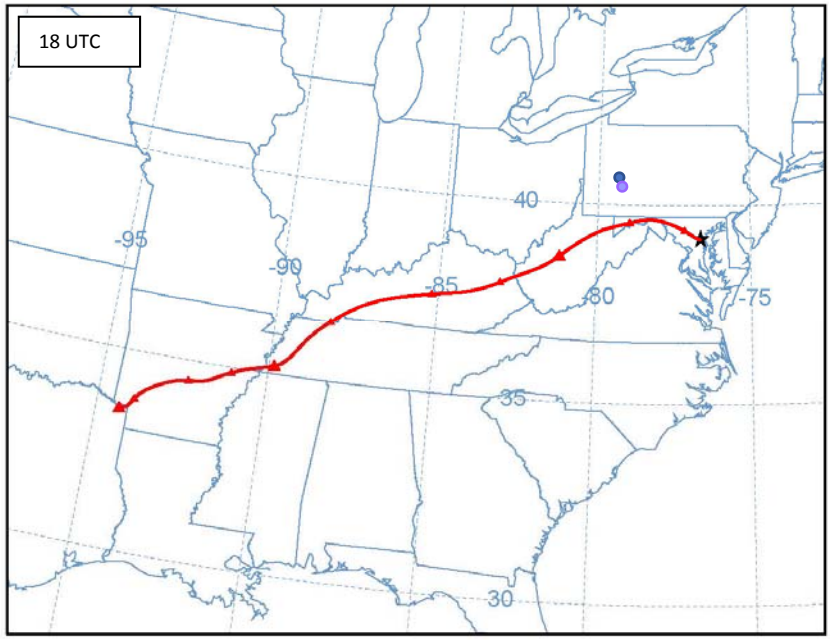


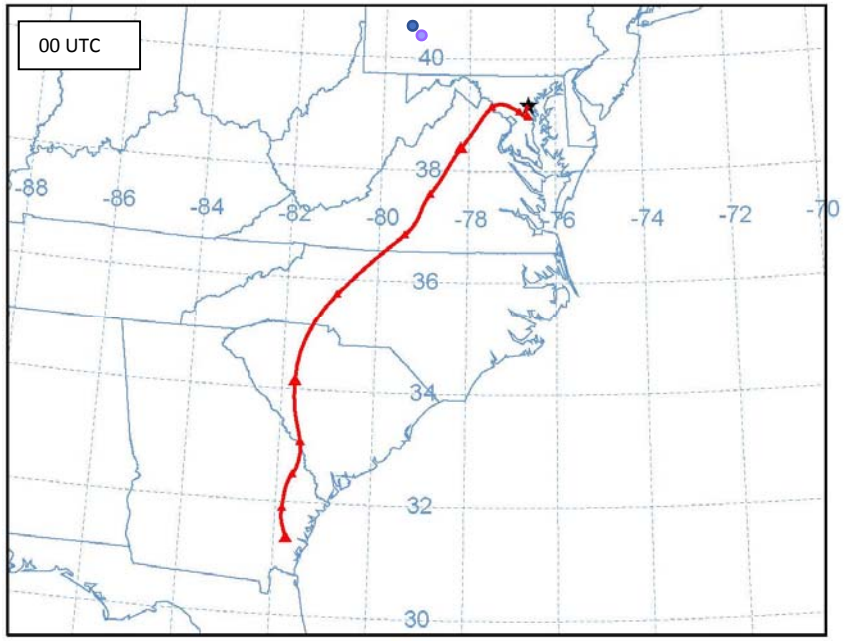


June 1, 2018 - Glen Burnie Monitor

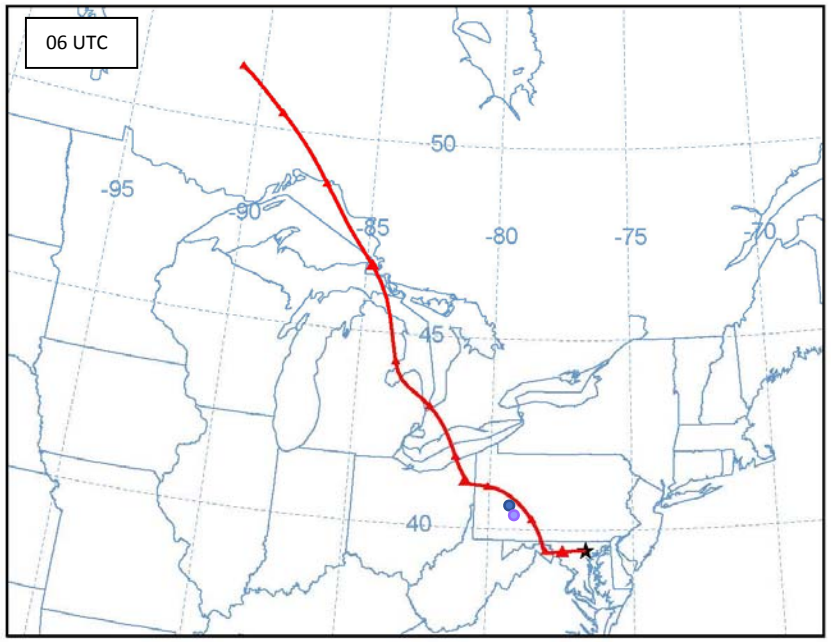


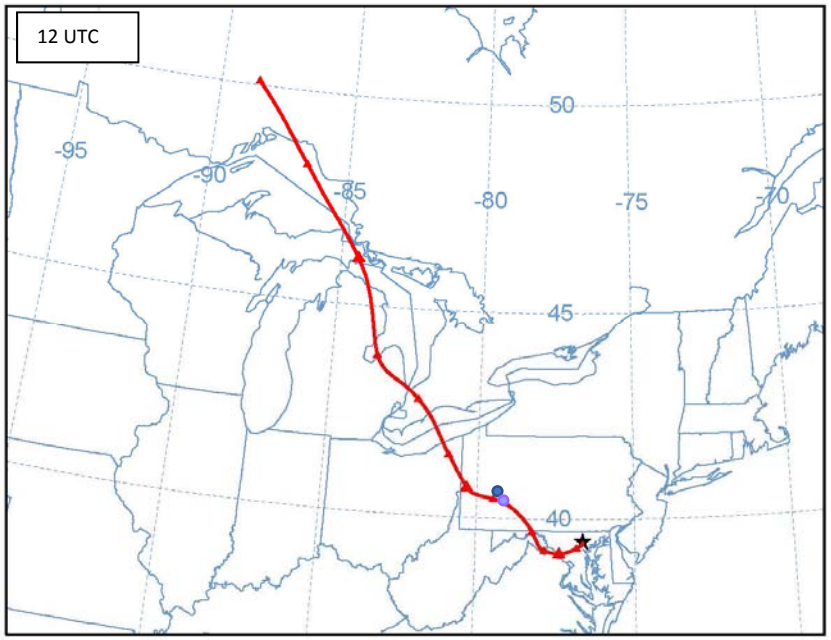


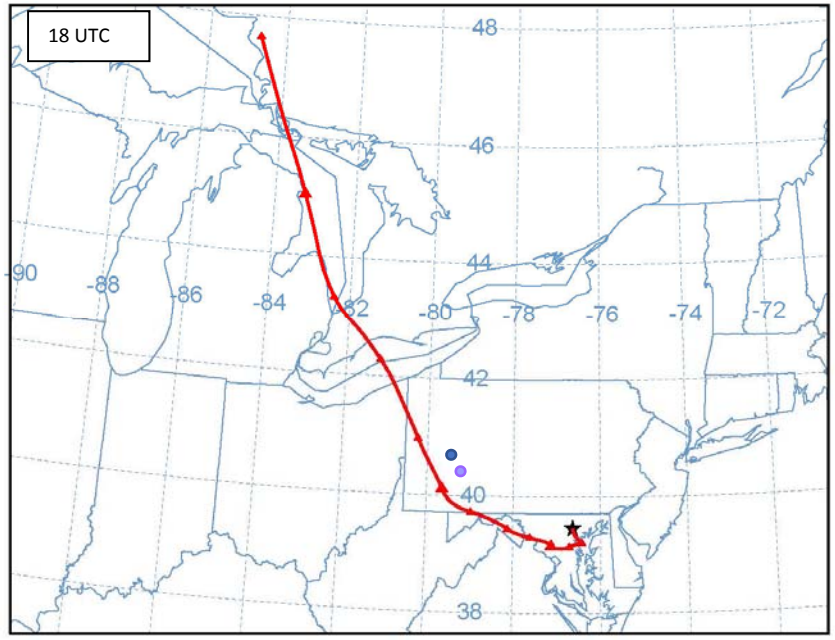


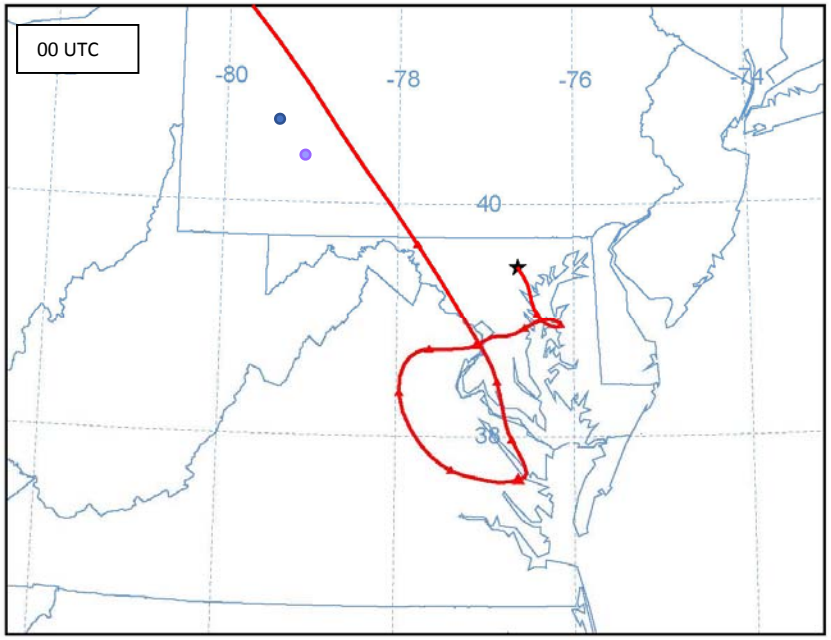


June 17, 2018 – Cockeysville Monitor

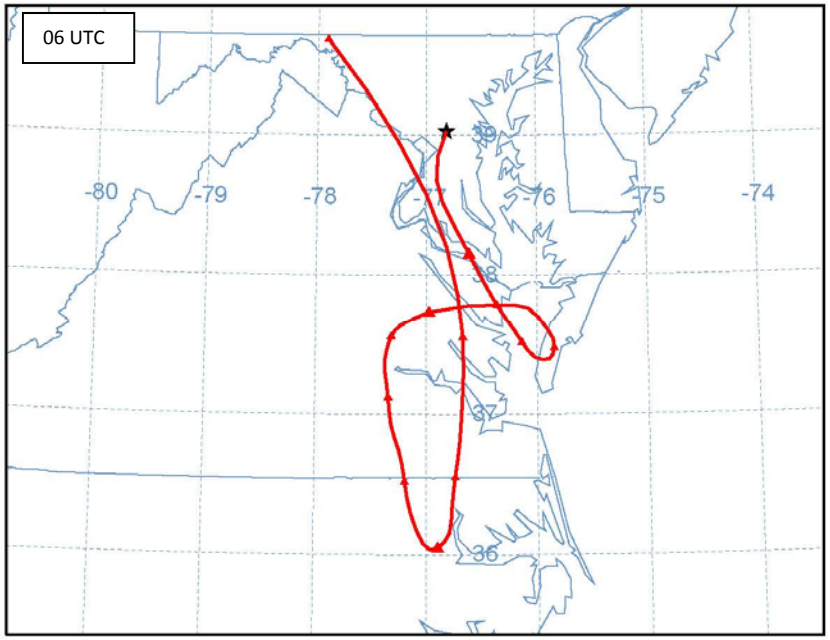


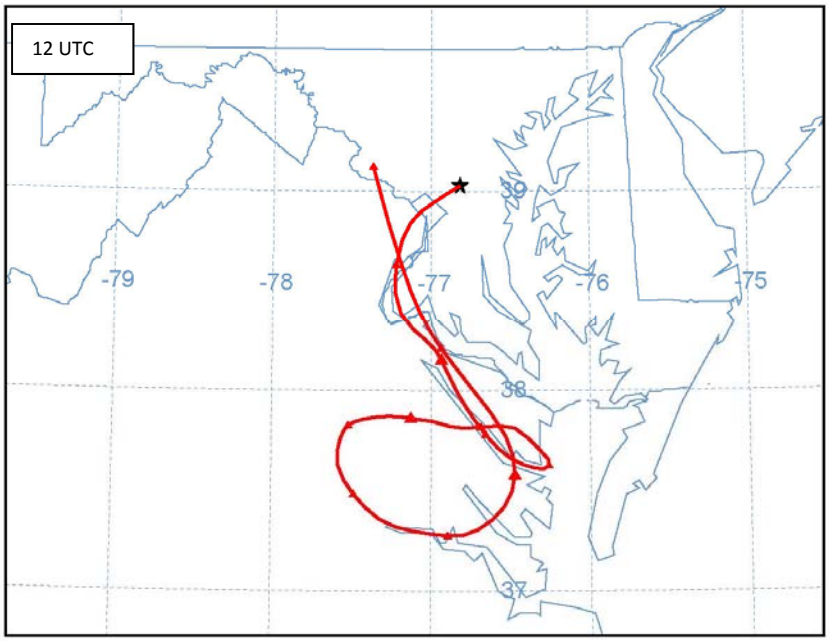


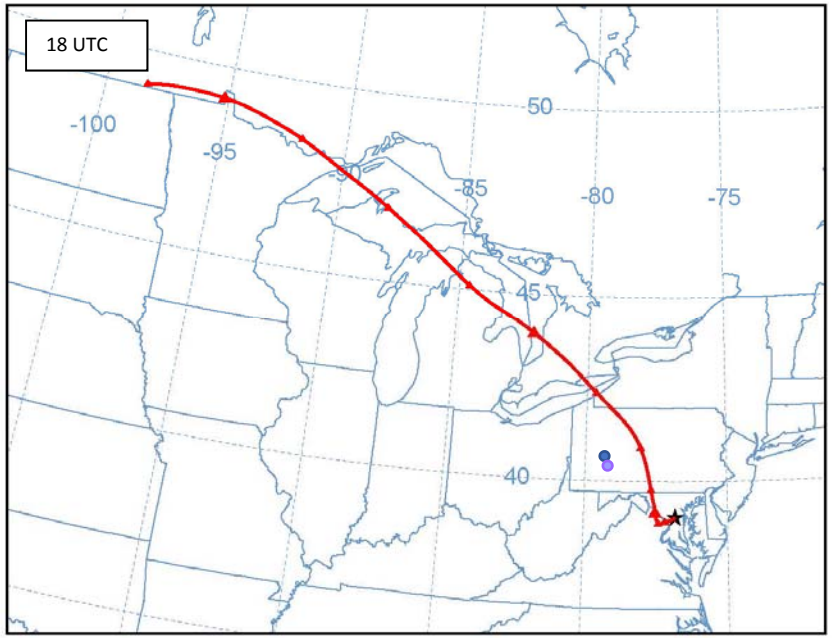


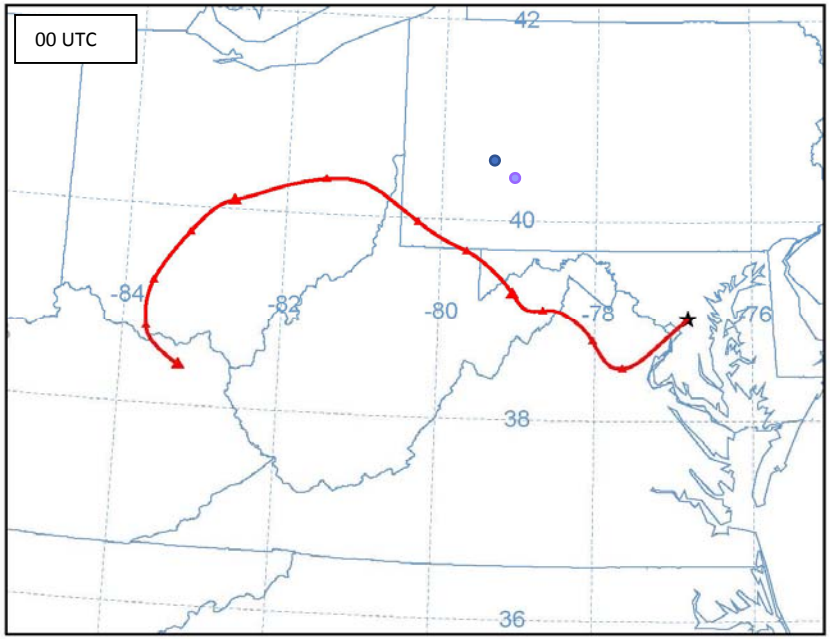


June 18, 2018 – Beltsville Monitor

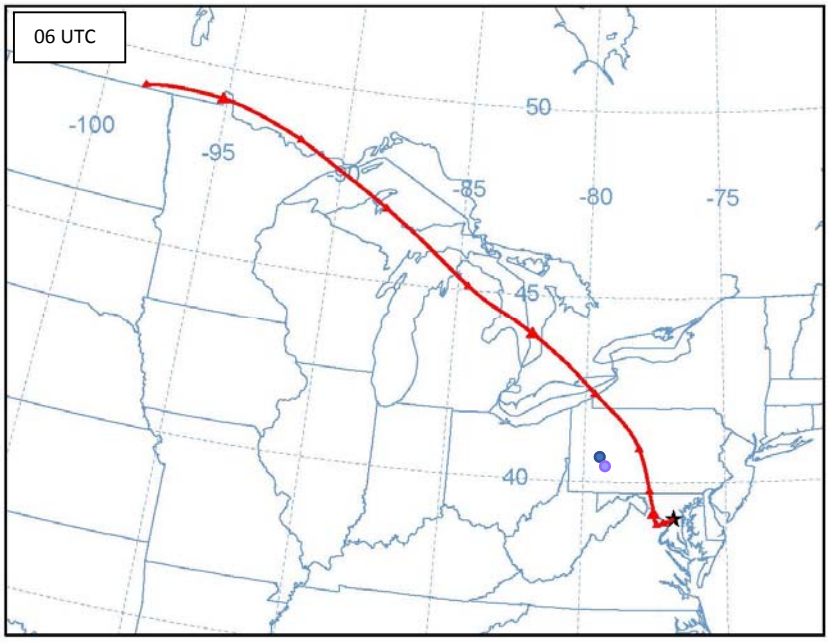


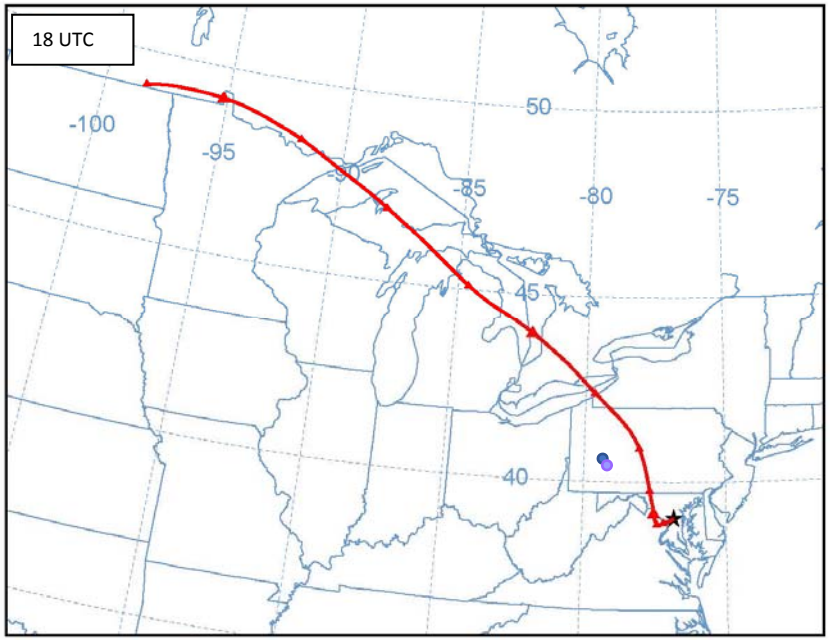


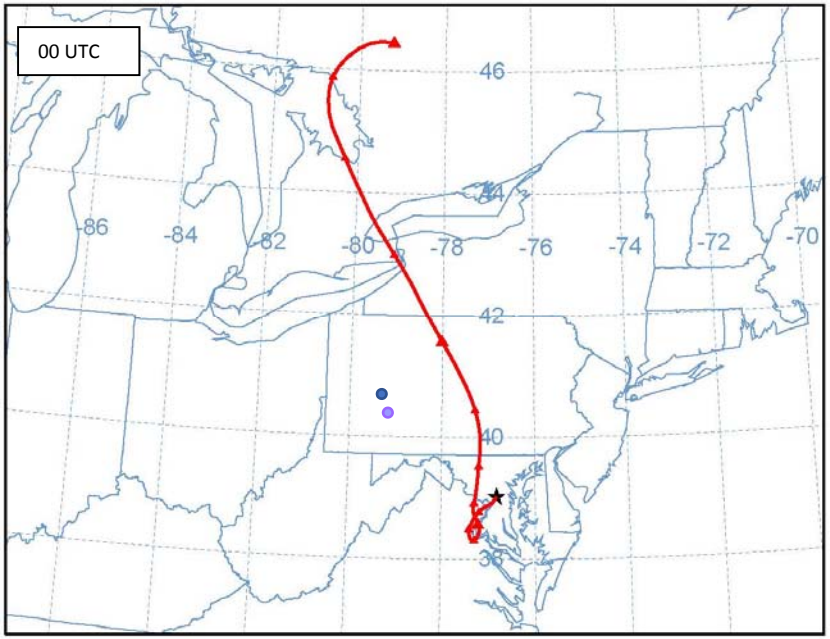




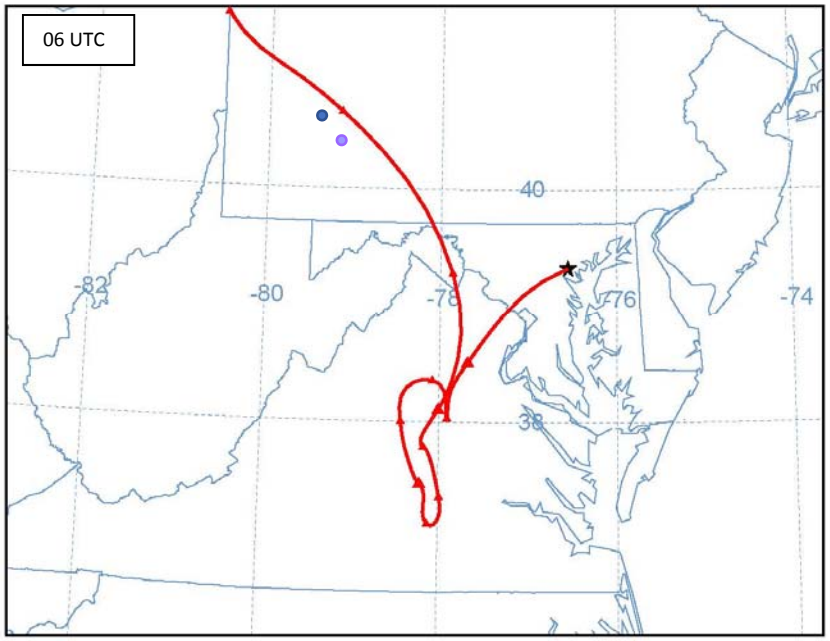
June 30, 2018 – Beltsville Monitor

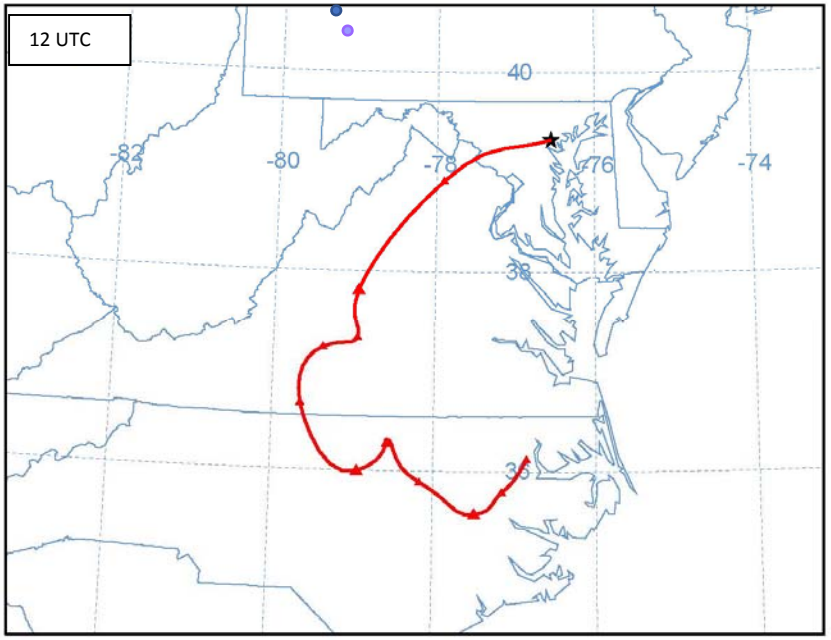


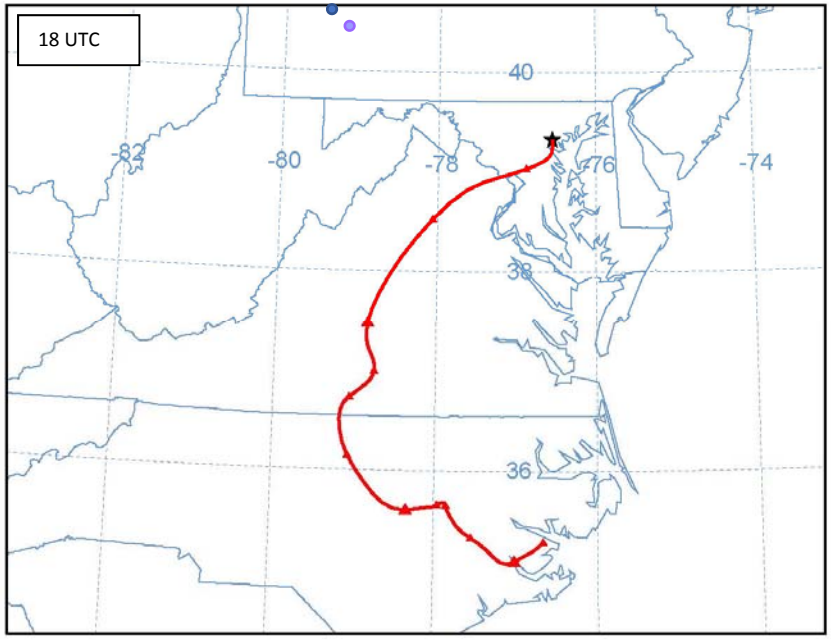


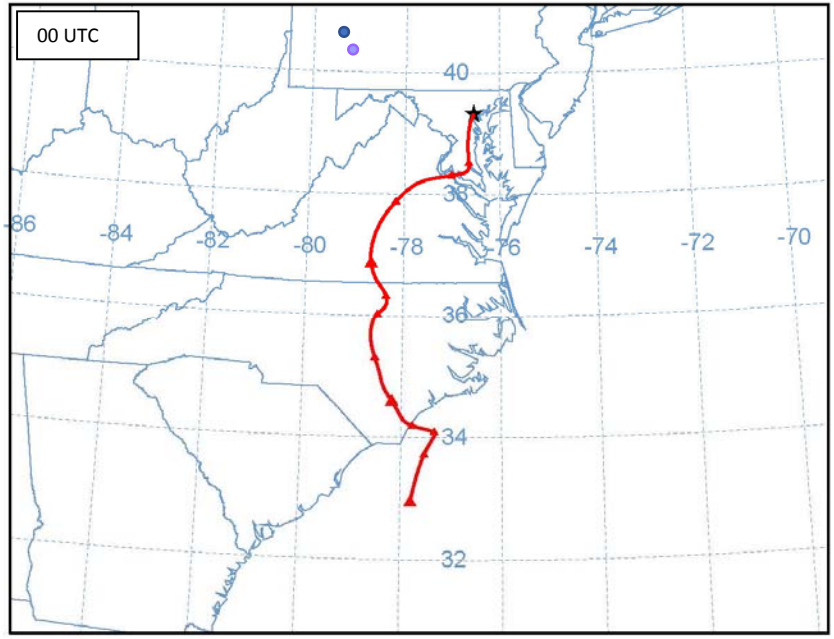


July 2, 2018 – Furley Monitor

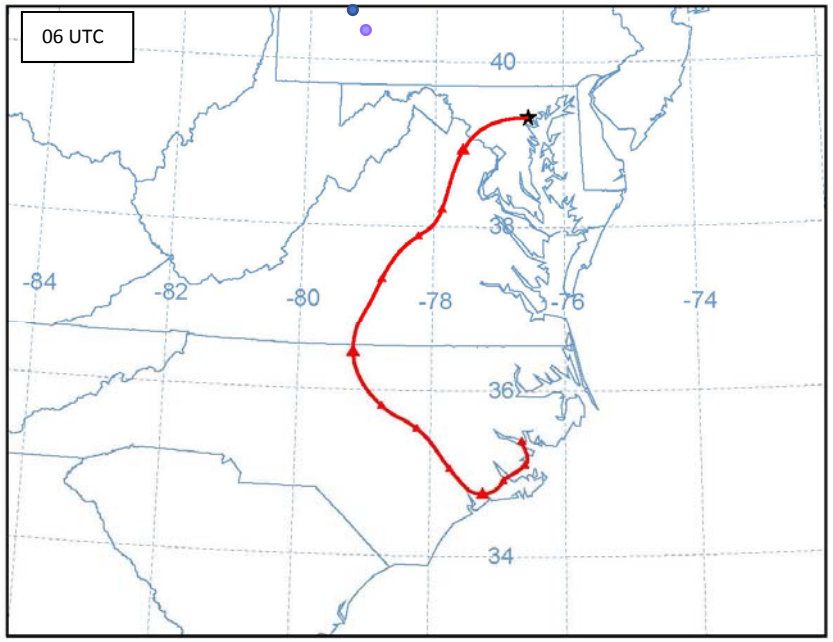


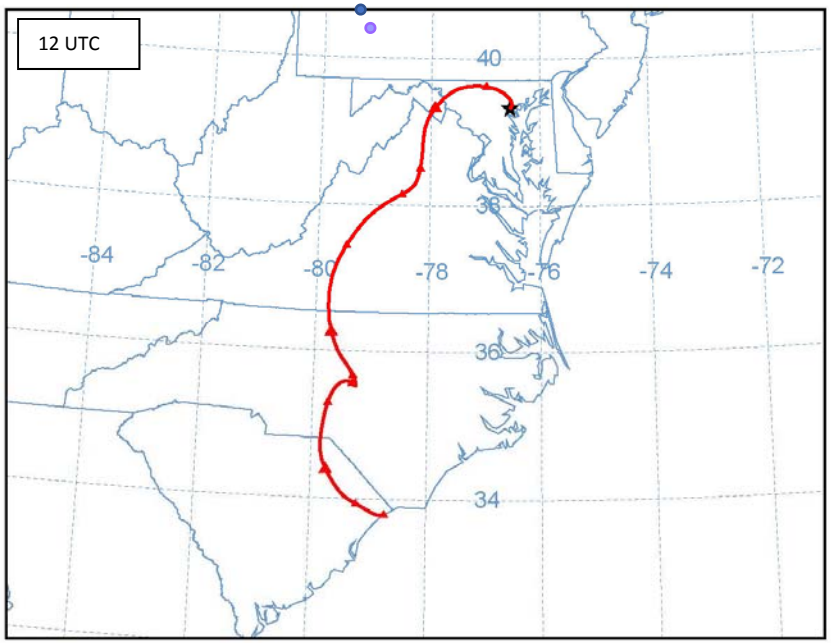


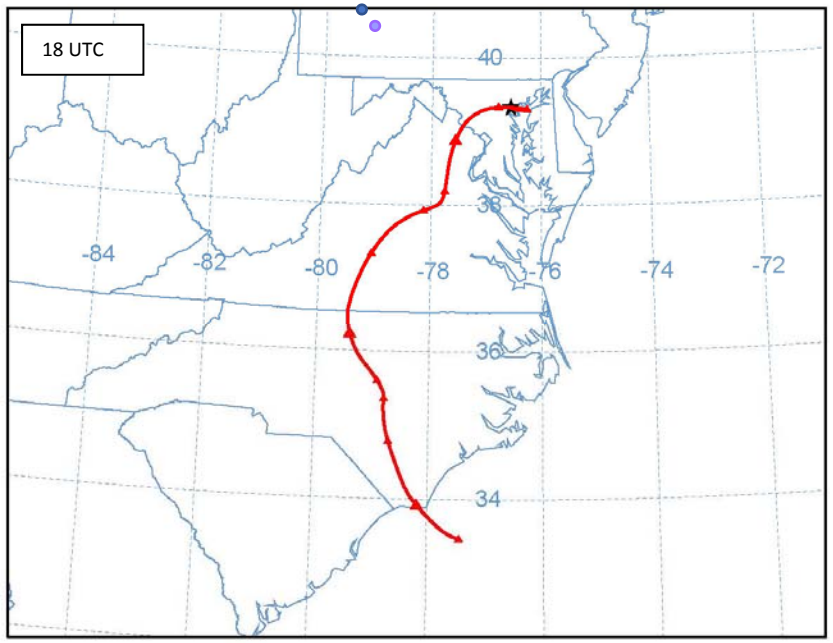


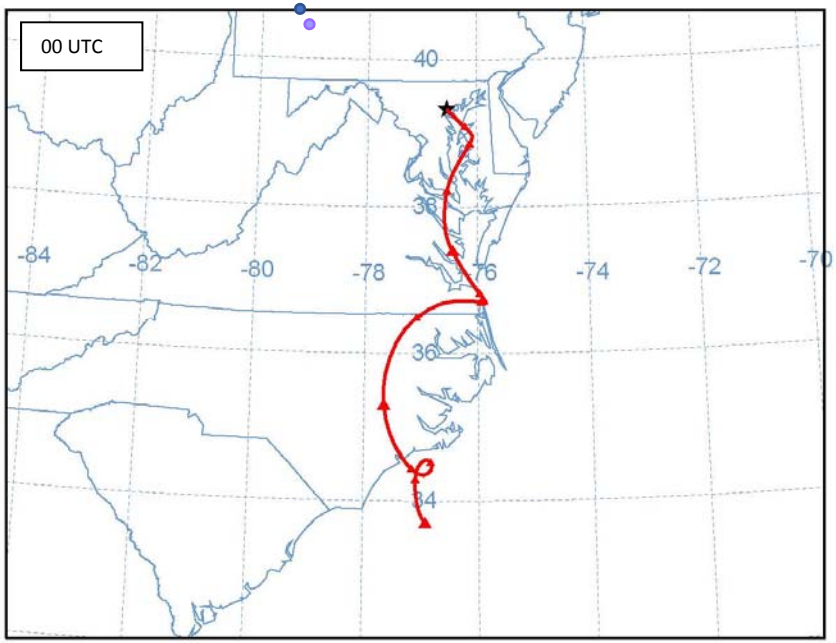


July 3, 2018 – Furley Monitor

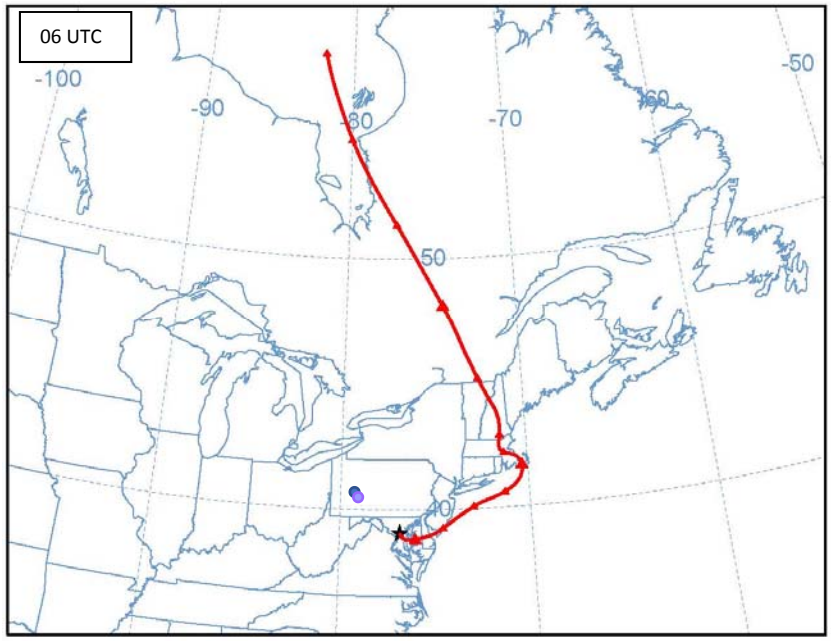


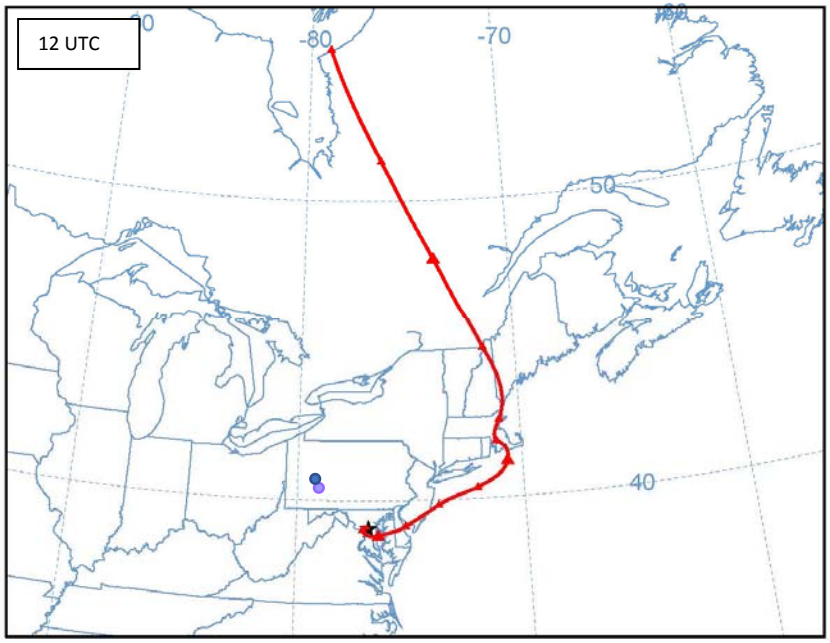


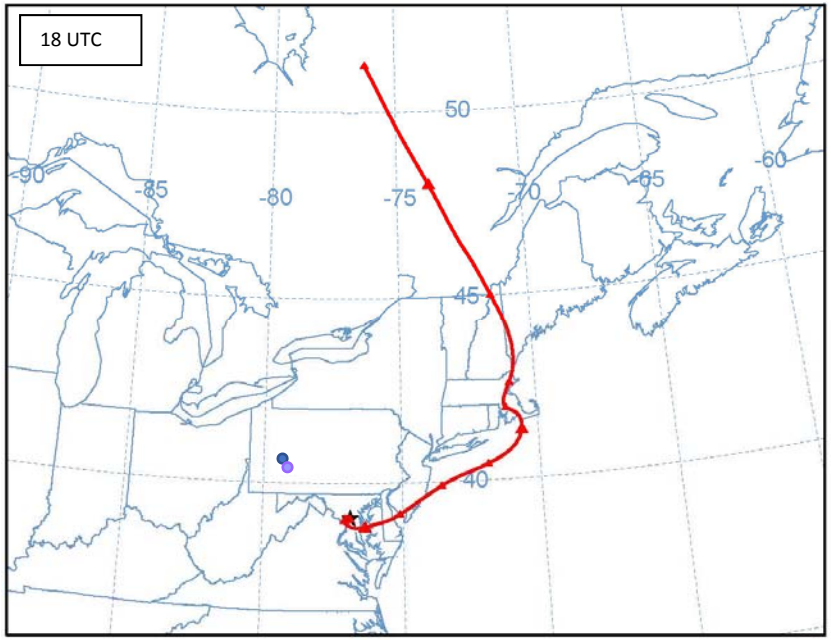


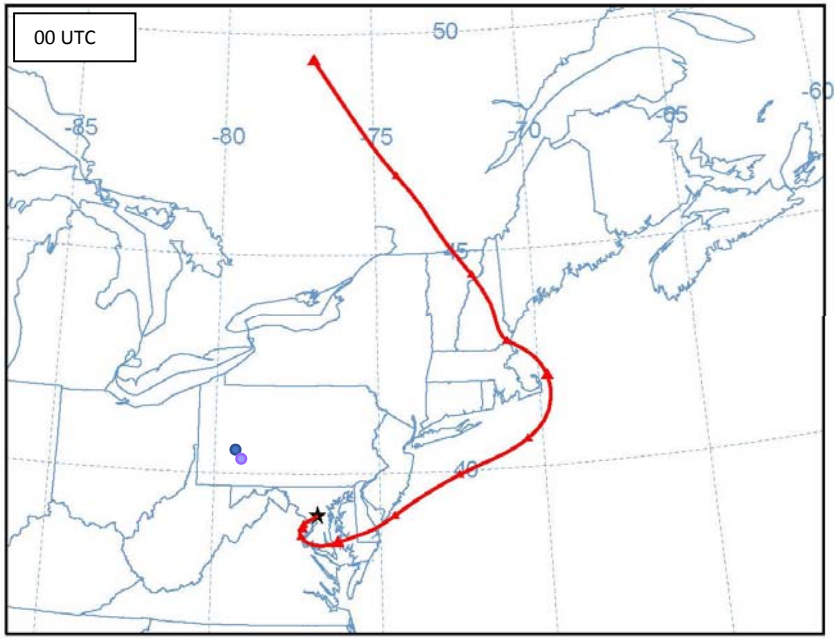


July 9, 2018 – HU-Beltsville Monitor

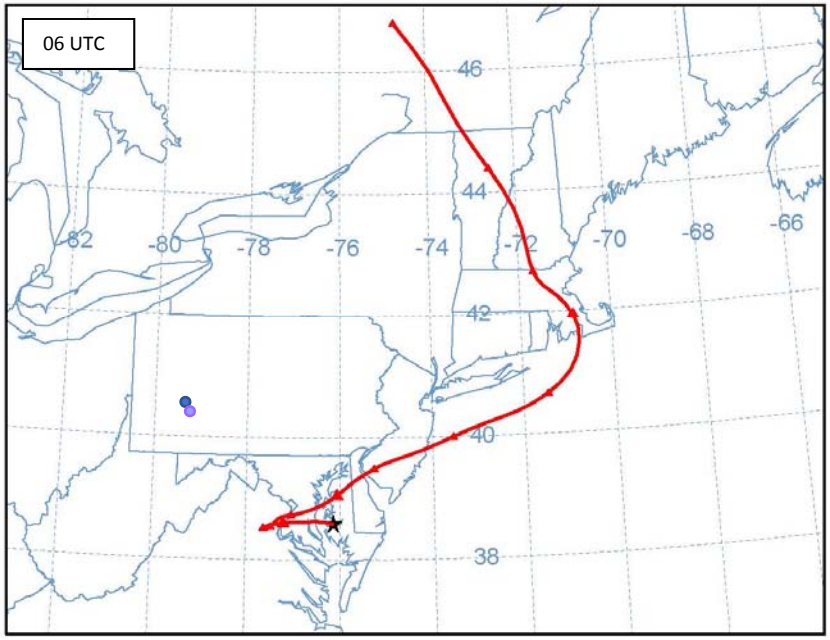


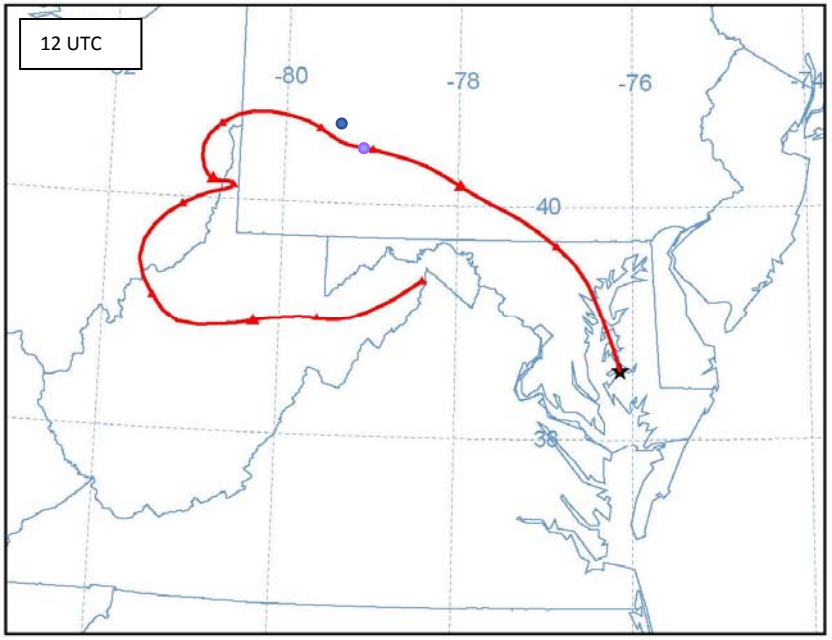


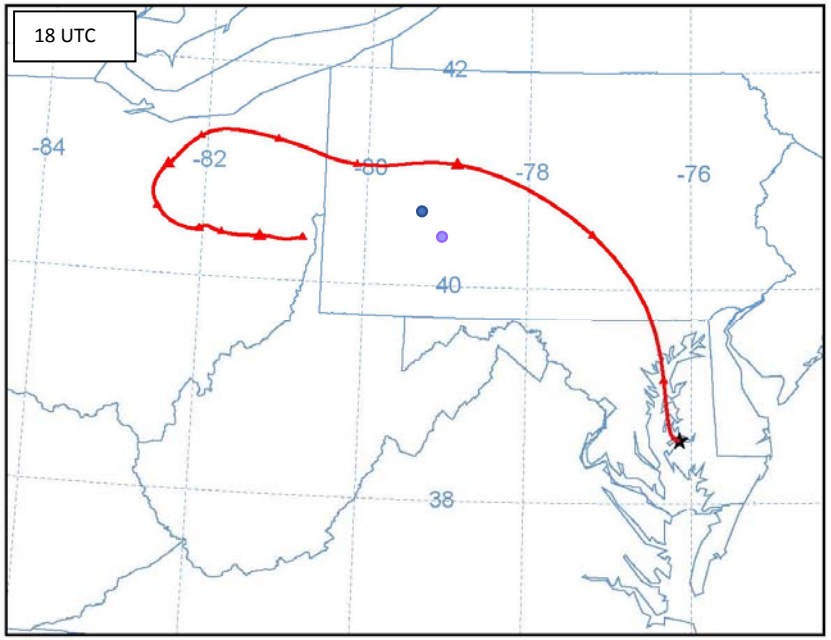


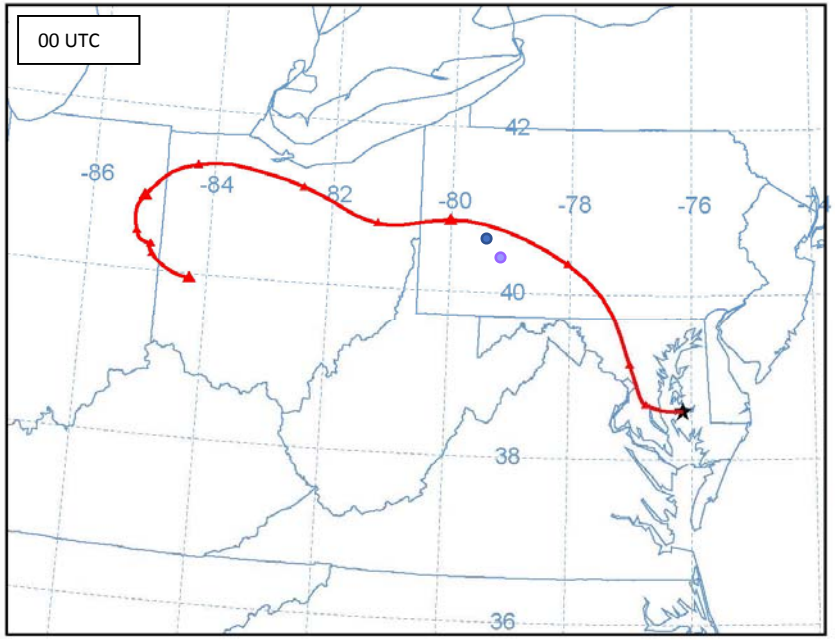


July 10, 2018 – Horn Point Monitor

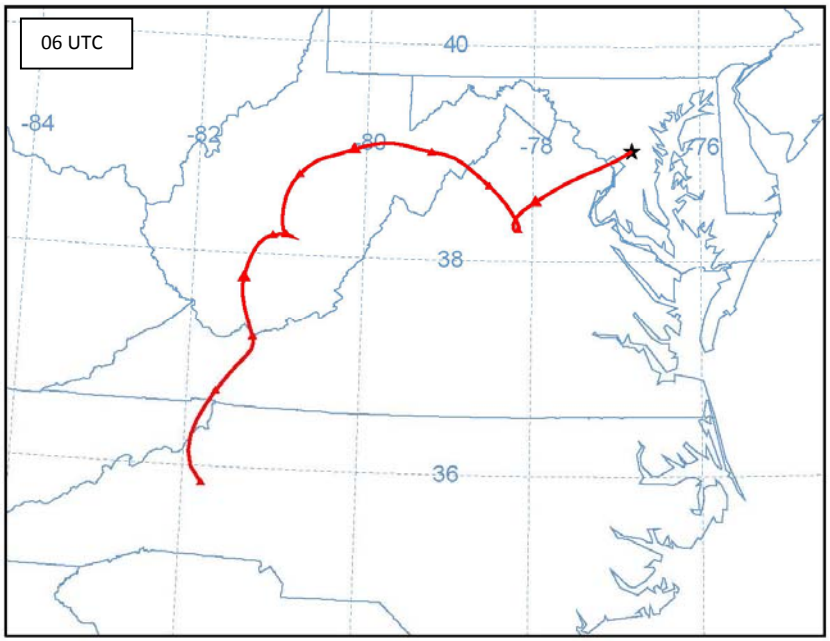


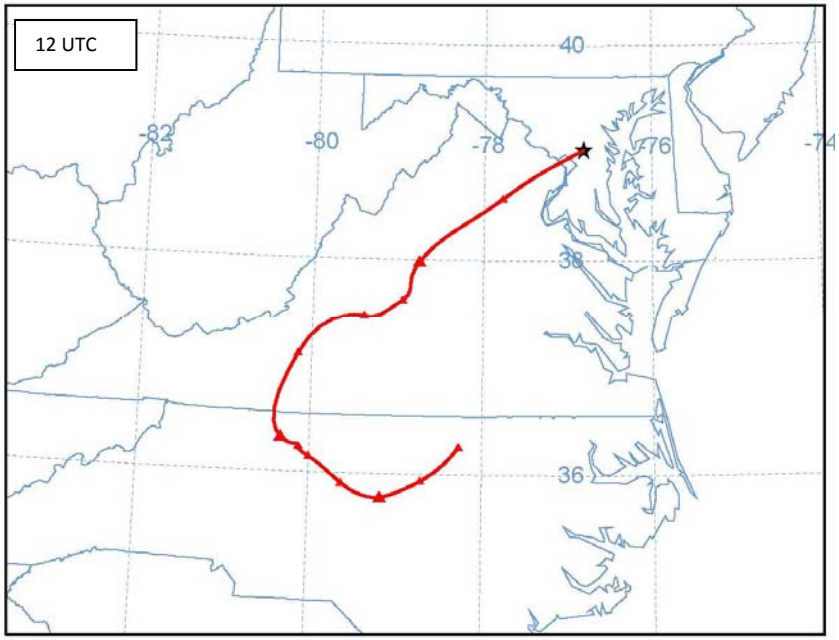


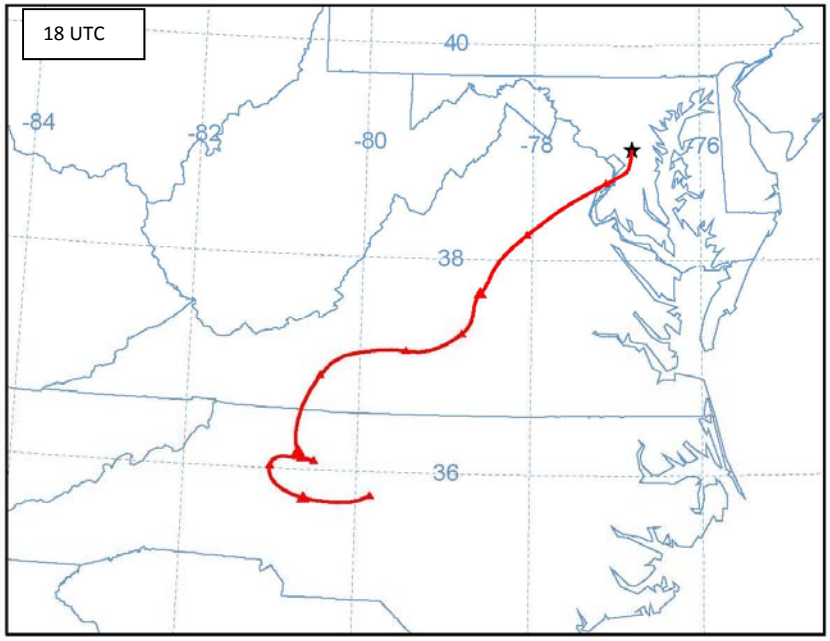


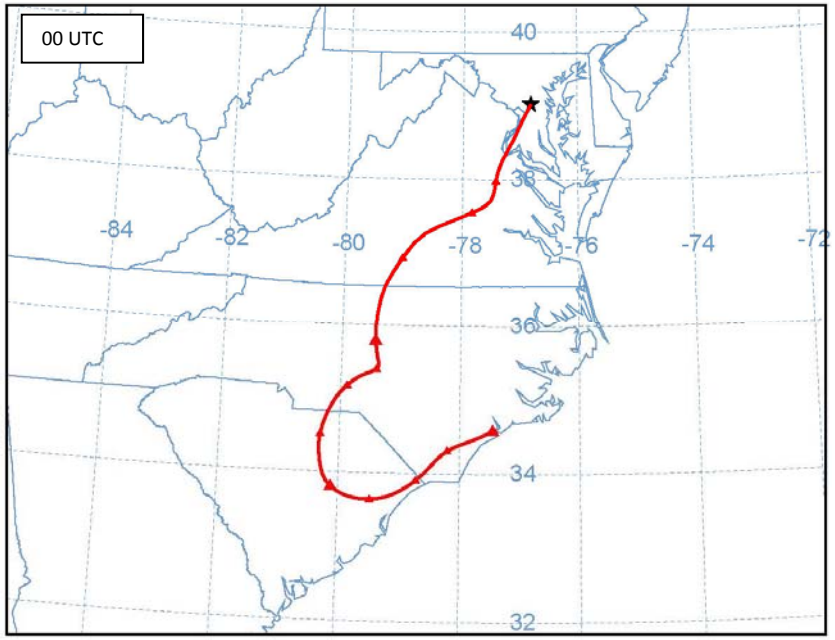


July 16, 2018 – Beltsville Monitor

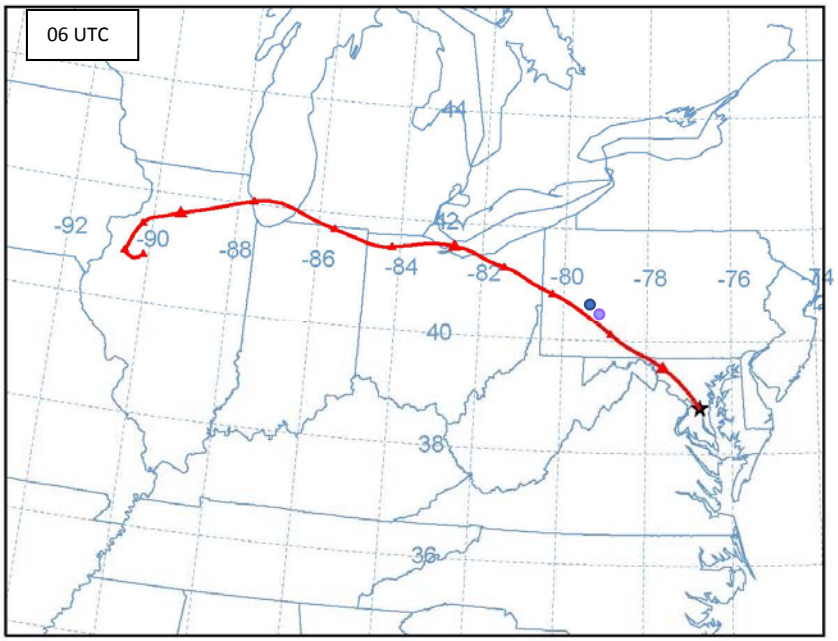


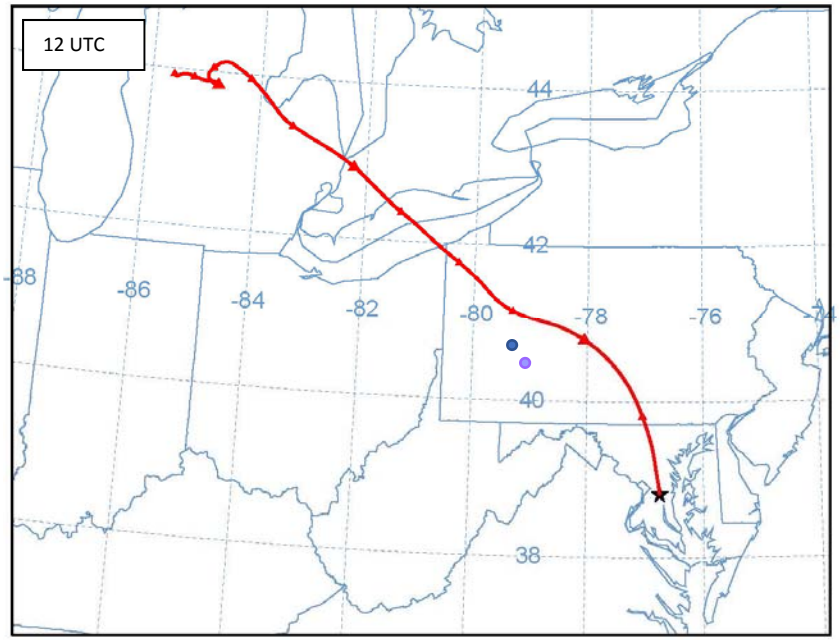


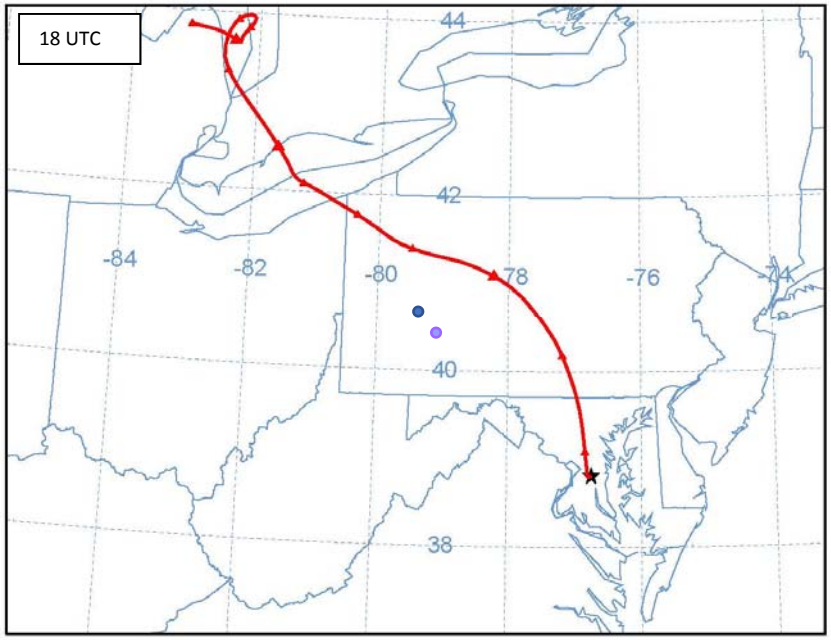


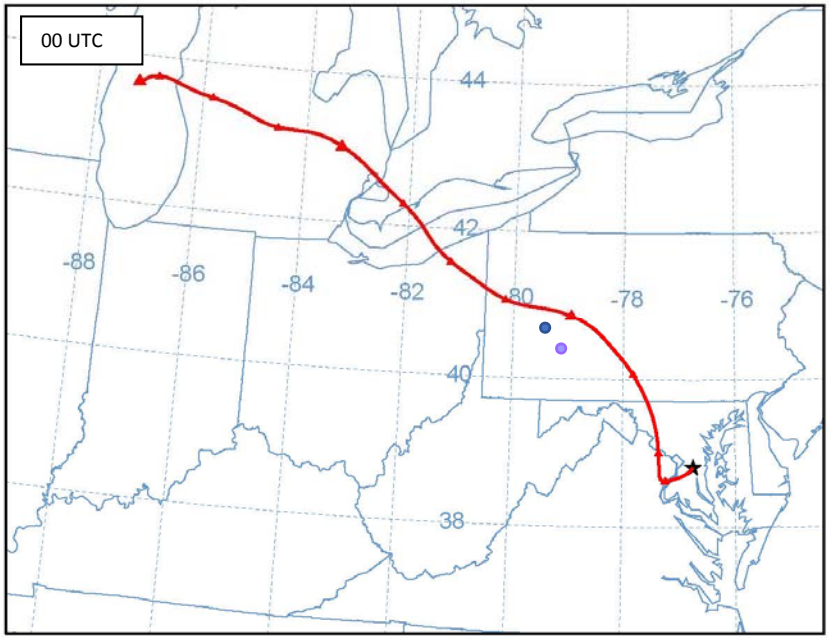


August 10, 2018 – PG Equestrian Center Monitor

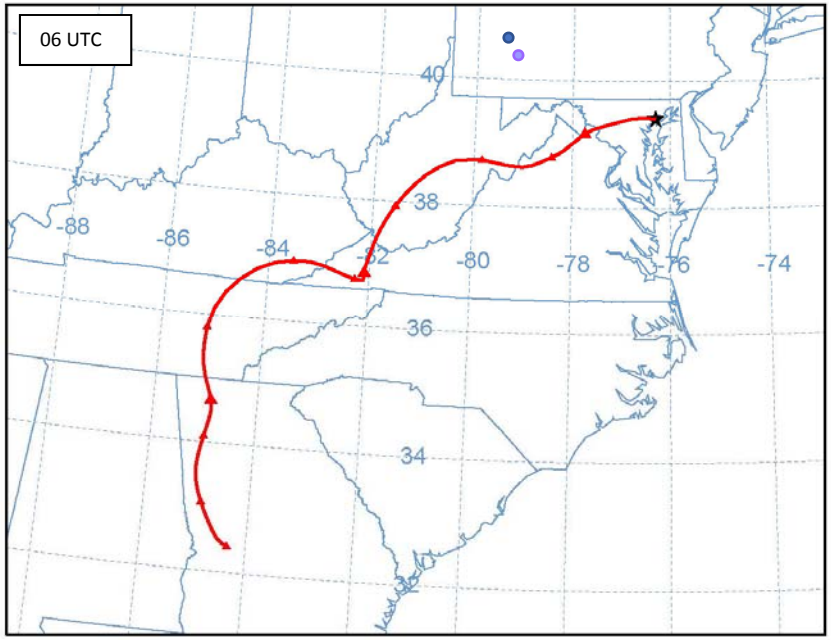


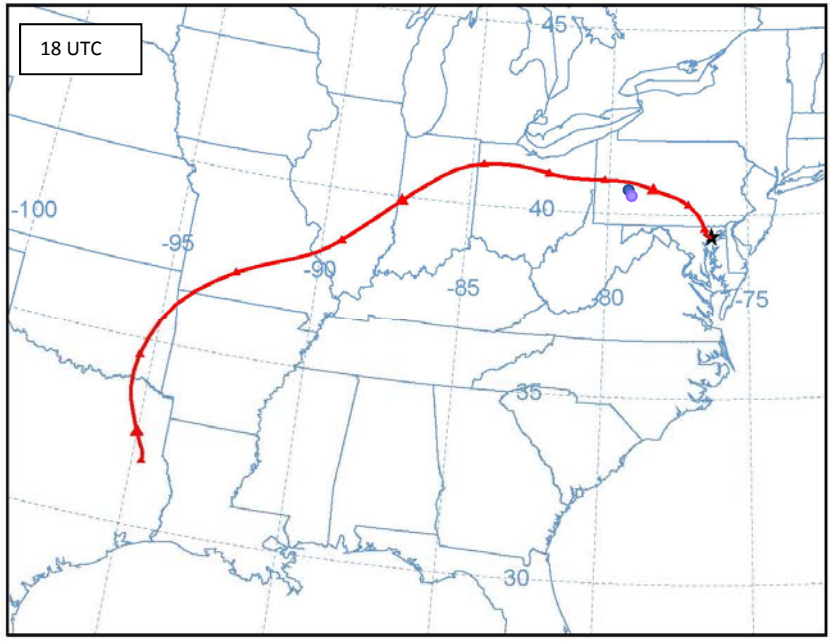


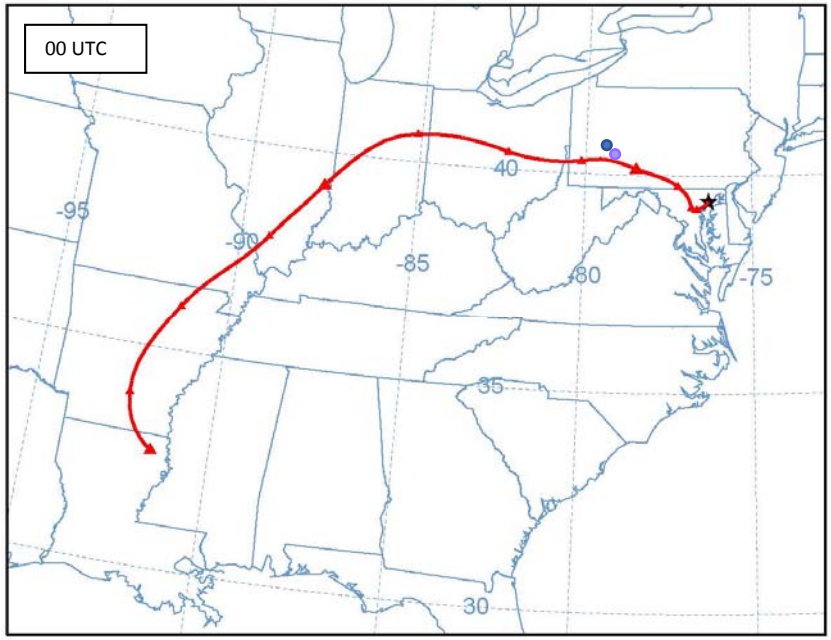




August 27, 2018 – Edgewood Monitor







September 6, 2018 – Fair Hill Monitor