INDIANA HARBOR AND CANAL

CONFINED DISPOSAL FACILITY

2023 PCB AMBIENT AIR MONITORING DATA ANALYSIS

Prepared by U.S. Army Corps of Engineers – Chicago District

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INDIANA HARBOR AND CANAL – AIR MONITORING DATA ANALYSIS

Introduction

In November 2001, the U.S. Army Corps of Engineers (USACE) implemented an air monitoring program at the property known as the Energy Cooperative, Inc. (ECI) site, located in East Chicago, Indiana. The ECI site is the location of a confined disposal facility (CDF), which was constructed to hold sediment dredged from the Indiana Harbor and Canal (IHC). In July 2003, CDF construction was initiated and the construction phase of the air monitoring program was implemented. CDF construction activities were substantially complete in 2011, and dredging of the IHC started in October 2012. Air monitoring continued during the post-construction, pre-dredging period. The air monitoring program results, including the background phase, construction phase, and post-construction/pre-dredging phase monitoring through 2012 are presented in several reports (USACE 2003b, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013). Post-dredging period (after 2012) air monitoring results are presented in the following reports (USACE 2014, 2018, 2020, 2021, 2022, 2023).

The purpose of this report is to present a statistical analysis of PCB air monitoring data collected from the start of dredging of the IHC and disposal of dredged material into the CDF cells starting in October 2012 through June 2023 to cover the period when TSCA material was dredged and disposed to the IHC CDF in 2019, a post-TSCA disposal period up until the start of the CDF dike expansion/construction which initiated in June 2021 when the CDF on-site air monitoring locations were moved off the dikes, and a post-TSCA disposal period during dike expansion. This report aims to evaluate potential impacts of dredging and sediment disposal activities and dredged material storage at the CDF site on ambient air conditions at the study area.

Air Monitoring Data

Locations, Schedule, and Parameters

Locations and Schedule. The air monitoring data used for the statistical analysis for the pre-dredging period were collected at two locations, referred to as the "south" site and as the "high school" site. During the first part of the pre-dredging period (2001 to mid 2004), data were collected from five monitors, four onsite and one offsite at the high school. However, the four onsite monitors were scaled back to one after statistical analysis indicated no significant difference between the 4 onsite monitors during this period. The pre-dredging south site was located adjacent to the Lake George Branch of the Indiana Harbor Canal on the south parcel of the ECI site and represents the CDF site conditions. The high school site is located approximately 1700 feet south of the south sampler, on the East Chicago High School property, and represents an off-site receptor location.

Immediately prior to the start of dredging, the two air sampling stations were operating in tandem, on a 12-day rotational schedule. Sampling had been conducted every 6 days from 2001 through September 2008. The sampling schedule was changed to every twelve days in October 2008 until the start of the dredging /disposal phase to continue establishing the trends database, but on a less frequent schedule.

In October 2012, the ambient air monitoring program was changed back to five sampling sites to monitor the dredging and sediment disposal activities which started on October 23, 2012. The five monitors include 4 new monitors in the four cardinal directions on top of the earthen dikes that form CDF disposal cells (South, East, North, and West) and the existing monitor at East Chicago High School. The monitoring frequency was changed to a six-day rotational schedule at the same time. The rationale for the additional monitors and higher sampling frequency is to observe the effects (if any) of the dredging and dredged material disposal activities on the ambient air.

The six-day sampling schedule was employed during the 2012 through 2020 dredging events and through approximately one month before dredging started and one month after sediment disposal ended for the events. Outside of these periods, air monitoring samples were collected on a 12-day schedule.

In June 2021, the ambient air monitoring equipment on the top of the CDF dikes was moved to a temporary location in the southwest corner of the CDF site to accommodate the dike expansion work. This air monitoring is consistent with the single ambient air monitoring location on the site during CDF construction in the past. Air monitoring samples are collected on a 12-day schedule during the dike expansion period. The dike expansion was completed in June 2024. Throughout the dike expansion period, the ambient air monitoring at the East Chicago High School continued without changes. Figure 0a shows the locations of the air monitors and meteorological station prior to dike expansion/construction. Figure 0b shows the locations of the air monitors and meteorological station during dike expansion/construction.

Parameters. Each air monitoring sample is a 24-hour sample. Parameters measured include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), metals, and Total Suspended Particulates (TSP). Selection of the "chemicals of concern" for measurement and analysis is discussed in previous reports, except for PCB congeners, which will be discussed below. Analysis of the PAH, VOC, metals and TSP data collected through June 2023 will be presented in a separate report.

PCB Congener Laboratory Analysis – Prior to May 2015, PCB analysis consisted of 31 congeners. The 31 PCB congeners included: Congeners 8, 15, 18/30, 20/28, 31, 44, 49, 52, 56, 60, 66, 70, 77, 81, 92, 95, 101, 105, 114, 118, 123, 126, 132, 138, 153, 156/157, 167, 169, 170, 180/193, and 189. This list included the 12 dioxin-like congeners which were identified by the World Health Organization (WHO congeners: PCB-77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189). In May 2015, laboratory analysis for PCB congeners was expanded to include all PCB 209 congeners.

PCB Congener Statistical Analysis - Five PCB congeners were included in PCB data analyses through 2014. The 5 PCB congeners are Congeners 8, 15, 18/30, 20/28, and 31. Previous data analysis also included the sum of 18 PCB congeners (Congeners 8, 15, 18/30, 20/28, 31, 77, 81, 105, 114, 118, 123, 126, 156/157, 167, 169, 170, 180/193, and 189).

The analysis for this report includes the five individual congeners previously selected (8, 15, 18/30, 20/28, and 31). In addition, the sum of 18 and 209 PCB congeners will be used to compare the effect of dredging/disposal activities on ambient air. The sum 209 PCB congeners analyses are for data collected from May 2015 through June 2023.

The PAH and PCB samples are obtained using a high-volume vacuum pump air sampler, with a glass fiber filter, a polyurethane foam (PUF) and adsorbent resin (XAD-2) media. More detailed description of the sampling methodologies including sampling methods for VOCs and TSP/metals, sampling media, analytical methods, and quality assurance methods can be found in the *Indiana Harbor and Canal Dredging and Disposal Project, Ambient Air Monitoring Plan: Volume 1* (USACE, 2003a). The sampling methodology and analytes remained consistent after the post dredging air monitoring phase was initiated in October 2012. The analytical laboratory was changed in September 2013, and there were some changes in reporting methods and limits at that time.

Data Organization and Preparation

Pre-dredging data

The ambient air monitoring data can be subdivided into two main groups: Pre-dredging and post-dredging. Pre-dredging refers to all data collected prior to sediment disposal to the CDF in October 2012 back to the start of 2010, when construction activities at the CDF were substantially complete. The entire monitoring data set collected from 2001 to October 2012 was initially considered as the pre-dredging data set. However, trend analyses performed over this extended period of time indicate statistically significant evidence of decreasing or increasing trends for several parameters. The changing trends in ambient air levels of these parameters in the project area over the pre-dredging period may potentially be attributed to industry/source changes, regulation changes, climate change, etc., over the extended sampling period between 2001 and 2012. Identification of the exact cause(s) is beyond the scope of this analysis. However, recognizing these trends, the pre-dredging data set was reduced to data collected between January 2010 and October 2012 to be more representative of a "background" period. This period coincides with the period after most of the CDF construction activities were substantially complete and prior to the start of sediment disposal to the CDF. The data collected before 2010 are not used for this evaluation except for selected trend analyses.

Post-dredging data

Post-dredging data collected after sediment disposal to the CDF started in late October 2012 were further divided into active Discharge and idle Quiescent Pond periods, with Active Discharge signifying periods when dredging and dredged material disposal are occurring, and Quiescent Pond signifying shutdown periods with no dredging or disposal but the presence of the ponded CDF.

Post-TSCA data

Post-dredging data were also subdivided into pre-TSCA (prior to TSCA material placement to the CDF in July 2019) and post-TSCA periods (from July 2019 through June 2023) to assess the effect of placement and storage of TSCA material at the CDF on atmospheric PCBs. Note that monitoring at the CDF changed from 4 monitors to 1 monitoring during the dike expansion/construction period which is still ongoing at the time of this report as discussed previously.

Temperature correction

Atmospheric concentrations of semi-volatile and volatile compounds (i.e. PAHs, PCBs, and VOCs) depend on temperature because volatilization from sources like soil, sediment, and water bodies is a temperature-controlled process. The Clausius-Clapeyron equation was used to model temperature-dependence of the measured data. When a significant negative trend was observed for semi-volatile and volatile compounds partial pressures with the inverse of ambient temperature, regression parameters were used to 'temperature-correct' the data to a reference temperature of 15 deg C. Removing this temperature-dependence allows greater discernment of underlying trends in the data. PAH, PCB and VOC data were temperature-corrected for the study period. For this report, PCB data analyses were performed using temperature-corrected data sets, except as noted herein.

Statistical Analysis

All statistical analyses presented in this report were performed with Microsoft Excel, and the statistical package ProUCL 5.1 developed by USEPA for environmental data analysis.

Air quality data were plotted over time and descriptive statistics were tabulated to summarize the measured data. The nonparametric Kaplan-Meier (KM) method was used to calculate general statistics for data sets with multiple detection limits and NDs exceeding detected observations. The Mann Kendall trend statistics were computed to determine long term trends in concentrations with time. Statistical comparisons between sub-groups (monitoring stations, sampling periods, season, and dredging status or activity) were made using the two-sample nonparametric Gehan test for data sets consisting of NDs with multiple reporting/detection limits. The Wilcoxon-Mann-Whitney nonparametric test was used for statistical comparison of data with no NDs (sum of PCB congeners). Statistical tests were performed at the 95% confidence level. Except where noted, tests were performed on temperature-corrected data to identify trends unrelated to temperature (i.e., dredging activities).

Summary of Pre-Dredging and Post-Dredging Data Analysis

The air monitoring data used for the statistical analysis for the pre-dredging period were collected at the south site (representing the CDF) and the high school site, and analyzed by site, season, and period of construction activities at the CDF to understanding background ambient air conditions prior to dredging start.

The primary purpose of post-dredging air data analysis is to assess the effect of dredging and dredged material disposal activities and dredged material storage at the CDF site on the atmospheric conditions at the CDF site and off site at the selected potential receptor location at the high school. To this end, pre-dredging background data are compared to post-dredging data to identify significant differences and identify temporal trends at all CDF stations and the HS station. More 'recent' pre-dredging data from 2010 to 2012 were utilized as representative of background for most statistical analyses rather than the entire pre-dredging monitoring period starting 2001. In previous analyses, the post-dredging period was broken down into 'active' periods of discharge / sediment placement and 'idle' periods with quiescent pond only / no sediment placement to explore the potential effects of CDF operations and whether pre-dredging background trends have changed at the CDF stations or high school. These previous analyses have shown that dredging and disposal of sediment into the CDF increase atmospheric PCBs at the CDF site during placement but not at the HS station.

This report analysis re-evaluates these findings with the additional data collected since the last analysis. This report also adds an analysis to assess the effect of placement and storage of TSCA material at the CDF using post-dredging data set subdivided into pre-TSCA (prior to TSCA material placement to the CDF in July 2019) and post-TSCA periods (from July 2019 through May 2021). This analysis aggregates the CDF south, east, north, and west stations data as the CDF data for comparison against the high school data.

It is important to recognize that except for dredging in the Lake George Branch (which occurred in October and November 2012), dredging activities in the IHC are not expected to impact the air at the High School or the CDF site primarily due to the distance between the dredge sites outside the Lake George Branch and the project air monitors. The impact of this project on the air quality at the High School and CDF would be likely more from the placement of dredged material into the CDF cells and the presence of the dredged material stored in the cells (in the future the designation of pre-dredging and post-dredging periods may be more appropriately re-designated pre- and post-sediment placement periods). In addition, it should be noted the dredging generally occurs at the same time as the sediment placement.

PCB Analysis

For PCBs, descriptive statistics are shown for congeners 8, 15, 18, 28, 31, the sum of the 18 congeners originally reported when the ambient air monitoring program started in 2001, and the sum of 209 congeners. Congeners 8, 15, 18, 28, 31 were originally selected for statistical analysis because they have lower molecular weight and therefore are relatively more volatile than other congeners reported, because they are detected most frequently of the congeners reported, and because they are generally detected at higher concentrations than other congeners that were reported. Starting in May 2015, the PCB laboratory analysis started including all PCB congeners (compared to 31 congeners reported previously) for all samples.

One further note, statistical tests for the 5 congeners are temperature-corrected, whereas the sum of 18 and 209 congeners are not. For consistency with previous analyses, the sum of 18 PCBs is analyzed and presented in this report.

General statistics

Atmospheric concentrations of PCBs vary by well over an order of magnitude over the entire monitoring period (Figures 1-7). PCBs exhibit a clear oscillatory pattern with levels increasing in the warmer months and decreasing in the cooler month, signifying PCBs are heavily dependent on temperature. (Note the shift of the highest PCB concentrations in 2016, 2017, 2018, and 2020 to the fall instead of in the summer as in previous years due to dredging activities in the fall for these years.) As previously described, temperature-dependence is removed for most statistical tests.

Higher atmospheric concentrations of PCBs are observed at the CDF in the post-dredging period (after October 2012) compared to the pre-dredging period which will be explored in further statistical detail. Sum 18 PCBs and Sum 209 PCBs are higher at the CDF stations than at the HS as can be seen in Figures 6 and 7.

While PCB 8 dominated total PCB levels in the past, Table 1 shows CDF onsite monitors median concentrations of PCB 18 (32.4 to 61.95 pg/m^3), PCB 28 (27.3 to 46.8 pg/m^3), and PCB 31 (24.2 to 44.3 pg/m^3) exceed PCB 8 (16.2 to 24.4 pg/m^3) in recent years (2012 to 2023). (Note that the North, East and West CDF monitors operated only through May 2021, when they were discontinued due to dike construction; and the South CDF monitor was moved from top of the CDF dike to a south location off the dike as discussed previously.) High school 2012-2023 median concentrations of Congeners 8, 15, 18, 28 and 31 are all lower than onsite monitors median concentrations.

Onsite monitors median concentrations of Sum 18 PCBs range from 113.6 pg/m^3 (CDF west station) to 196.3 pg/m^3 (CDF south station) compared to HS median Sum 18 PCBs of 44.6 pg/m^3. Onsite monitors median concentrations of Sum 209 PCBs range from 566.3 pg/m^3 (CDF west station) to 764.9 pg/m^3 compared to HS median Sum 209 PCBs of 176.1 pg/m^3. The highest CDF median PCB sum (both 18 PCBs and 209 PCBs) concentrations are at the south station, the lowest CDF median PCB sum concentrations are at the west station.

Trend analysis

Table 2 presents results from a Mann-Kendall trend analysis of PCB concentrations over different monitoring periods and combinations of monitoring stations. The high school and south stations were analyzed over the entire sampling period (2001-2023), using the original PCB data (no temperature correction). More recent original PCB data (2010-23 for the high school and south station, and 2012-21 for the north, east, and west stations) were also examined for trends. Sum 209 PCBs were examined for trends over the 2015-2023 period (analysis of all 209 PCBs started in 2015).

Over the 2001-2023 period, at the high school, PCB 8, PCB 18, PCB 31, and sum 18 PCBs decrease statistically with time, while PCB 15 and PCB 28 exhibit no significant trend. Over the same 2001-2023 period, at the south station, PCB 8 decreases, while PCB 15, PCB 18, PCB 28, PCB 31, and sum 18 PCBs increase statistically with time. Appendix A includes Mann-Kendall trend analysis plots for PCBs at the high school and south stations from 2001 to 2023.

Over the recent monitoring period (2010-2023), the trends at the high school are the same as for the 2001-2023 period for PCB 8 and sum 18 PCBs. High school PCB 18, PCB 28, PCB 31, and sum 209 PCBs (2015-2023), exhibit no trend, and PCB 15 increases over the 2010-2023 period. At the south site (note that the “south” site is located south of the Lake George Branch prior to dredging start and located north of the Lake George Branch after dredging started – see Figure 00), all PCB congeners except PCB 8, increase statistically over the 2010-2022 period. Sum 18 PCBs also increase statistically over the 2010-2023 period. South site PCB 8 exhibits no significant trend over the 2010-2023 period, and south site sum 209 PCBs decrease over the 2015-2023 period.

Except for a few exceptions, the north, east and west stations PCB data exhibit increasing trend over the 2012-2021 period. The exception is east station PCB 8 exhibiting no trend over this period. Sum 209 PCBs exhibit no significant trend of the 2015-2021 period at the north, east, and west stations.

In summary, with one exception (PCB 15 over the 2010-2023 period), there are no PCB increases over time at the high school, compared to PCB congeners and sum 18 and sum 209 PCBs increases at the CDF site monitoring stations, indicating dredging and sediment placement activities are not significantly impacting PCB concentrations at the high school. More significantly, some individual PCB congeners (8, 18, 31), and sum 18 PCBs have decreased over the entire monitoring period (2001-2023) at the high school. The PCB increases at the CDF site stations are likely due to presence of sediment in the CDF, and/or sediment offloading activities. The decrease of Sum 209 PCBs at the south monitor over the 2015-2023 period suggests sediment offloading is the most significant factor in impacting PCBs at the CDF, i.e., with no dredging/offloading in 2022 and 2023, PCB concentrations significantly decreased. Other sources of PCBs, particularly affecting the high school, appear to be decreasing or showing no significant trends.

Season

Table 3 compares 2012-2023 PCB concentrations between summer, winter, and spring/fall seasons with temperature effects removed from the dataset for the individual 5 congeners. Sum 18 PCBs and Sum 209 PCBs are not temperature corrected in the seasonal analyses.

With a few exceptions, PCBs are generally highest in the summer, then spring/fall, then winter PCB levels are lowest. This holds true for PCBs atmospheric concentrations with temperature effects removed and the original PCB data with no temperature correction (Sum 18 PCBs and Sum 209 PCBs). The seasonal/temperature effects are significant at the high school as well as at the CDF stations. Dredging and sediment placement to the CDF always take place in the spring/fall or the summer, the higher PCBs during these seasons and lack of significant differences between summer and spring/fall PCB levels at the CDF site may be partly due to the dredging/sediment placement activities during these seasons.

Monitoring stations

Table 4 compares PCB concentrations between monitoring stations. During the period after dredging started, all PCBs are statistically less at the high school than at any of the CDF stations. (Note that all analyses are on 2012-2021 data, except for comparison of high school and south stations which are on 2012-2023 data). Sum 18 PCBs and sum 209 PCBs are also statistically less at the high school than any of the CDF stations. PCB 15, 18, 29, 31, are statistically less at the high school than at the site (south station) before dredging/disposal started (2010-2012) (Table 5).

Among the CDF stations, PCBs are generally highest at the south and north stations and lowest at the west station. PCBs are lower at the east station than the south and north stations, but are higher at the east station than the west station. Higher PCB levels at the south station may be due to proximity to the Canal, and lower PCB levels at the west station may be due to largest distance from this station to roads and the Canal. For the remaining analyses, individual CDF onsite stations data will be combined and treated as one set of CDF site data.

Active/Discharge

During sediment discharge into the CDF, atmospheric levels of PCB congeners 8, 15, 18, 28, 31, sum 18 PCBs, and sum 209 PCBs are statistically higher at combined CDF stations than at the high school (Table 5.)

Idle/Quiescent Pond

During idle quiescent pond conditions, atmospheric levels of PCB congeners 8, 15, 18, 28, 31, sum 18 PCBs, and sum 209 PCBs are also statistically higher at combined CDF stations than at the high school (Table 5).

Pre-dredging/Background

Most pre-dredging background PCB concentrations are statistically higher at the south station than the high school station (Table 5). The only exception is PCB 8 with levels that are similar. Thus the observed trend of higher PCB 8 concentrations at the CDF than the high school during post-dredging (discharge and quiescent pond) may be due to dredged material disposal activities and/or sediment storage at the CDF site. The trend for other PCBs (higher levels at the CDF than the high school) remains consistent between pre-dredging and post-dredging periods.

In conclusion, levels of several PCB congeners at the high school are statistically less than levels at the CDF during post-dredging and pre-dredging periods. There is no evidence to suggest CDF activities are significantly impacting the high school. Higher concentrations of PCBs at the CDF site are attributed to known concentrations of PCBs in the adjacent canal sediment and water column, as well as sediment placement and storage in the CDF.

TSCA dredging and placement

TSCA material was dredged and placed in the east cell in July to September 2019. To explore the potential effect of dredging, placement, and storage of TSCA material into the CDF, PCB levels at the high school and at the CDF before TSCA material was placed in the CDF (prior to July 2019) were compared to levels after TSCA material was placed (July 2019 and after).

Pre-TSCA vs Post-TSCA

At the high school, PCB 8 is statistically greater during the pre-TSCA than post-TSCA. PCBs 15, 18, 28, 31, sum 18 PCBs and sum 209 PCBs are not statistically different between the pre-TSCA and post-TSCA periods at the high school (Table 6).

At the CDF site, PCBs 8, 15, 18, 28, 31, sum 18 PCBs are statistically greater during the post-TSCA than pre-TSCA. Sum 209 PCBs is not statistically different between the pre-TSCA and post-TSCA periods at the CDF (Table 6).

These findings confirm that dredging/sediment placement/sediment storage at the CDF may have affected PCB atmospheric concentrations at the CDF but not at the high school.

Standards/Guidelines for PCBs in Air

Because PCBs are a main concern at the IHC CDF site, PCB concentrations detected at the IHC CDF and high school air monitoring stations were compared to federal standards/guidelines and standards at some PCB sediment dredging projects (Table 7).

The National Institute for Occupational Safety and Health (NIOSH) recommends a 10-hour workday Time Weighted Average (TWA) PCB exposure limit of 1.0 $\mu g/m^3$ and the Occupational Safety and Health Administration (OSHA) enforces an 8-hour workday TWA Permissible Exposure Limit (PEL) of 500 $\mu g/m^3$ and 1,000 $\mu g/m^3$ for PCBs containing 54% and 42% chlorine respectively. These levels are believed to be protective of worker safety and health over a 40-hour week and working lifetime if used in combination with controls, monitoring, labeling, training, and personal protective equipment. The maximum measured PCB concentration at the CDF (0.01528 $\mu g/m^3$) is orders of magnitude below the occupational standards.

The Hudson River Dredging Standards are 24-hour average air quality action levels developed to address quality of life aspects in residential and commercial/industrial areas for a remedial dredging project. The residential and industrial total PCB standards (0.11 $\mu g/m^3$ and 0.26 $\mu g/m^3$ respectively) trigger additional monitoring, mitigation implementation, action plan, and reporting if exceeded (USEPA 2004). The maximum measured PCB concentration at the CDF (0.01528 $\mu g/m^3$) is below the Hudson River Dredging standards.

The New Bedford Harbor dredging project developed risk based goals (RBGs) and trigger levels for carcinogenic and noncarcinogenic effects (where RBGs are air concentrations when averaged over time will not result in unacceptable excess cancer risks or noncancer hazards) for residents and workers. First trigger levels of 0.11 $\mu g/m^3$ and 0.344 $\mu g/m^3$ trigger additional monitoring, mitigation implementation, action plan, and reporting if exceeded (Jacobs Engineering Group Inc, 2015). The maximum measured PCB concentration at the CDF (0.01528 $\mu g/m^3$) is below the New Bedford Harbor Dredging standards.

Conclusions

The PCB air monitoring data were statistically analyzed based on location, by season, by active discharge and quiescent pond periods, and by pre-TSCA dredging/disposal and post-TSCA dredging/disposal periods. Tables present the data and statistical significance. The following conclusions summarize the main findings from the analysis.

- Atmospheric concentrations of PCBs vary by well over an order of magnitude over the entire monitoring period (Figures 1-7). PCBs exhibit a clear oscillatory pattern with levels increasing in the warmer months and decreasing in the cooler month, signifying PCBs are heavily dependent on temperature. Sum 18 PCBs and Sum 209 PCBs are visually higher at the CDF site than at the high school (Figures 6 and 7).
- All PCB congener concentrations during post-dredging are statistically lower at the high school than at the CDF (CDF stations combined data). This is consistent with pre-dredging results for PCB 8, 15, 18, 28, 31, where the high school concentrations are also statistically lower than the south station concentrations (except for PCB 8 which was no different between the two locations during the background period). Among the CDF stations, PCBs are generally highest at the north and south stations and lowest at the west station (based on data collected through May 2021 when the north, east, and west stations were disconnected, and the south station moved off the dike during dike expansion).
- Except for PCB 15 increase over the 2010-2023 period, there are no PCB increases over time at the high school (over the 2001-2023 period and the 2010-2023 period), compared to PCB congeners and sum 18 and sum 209 PCBs increases at the CDF site monitoring stations, indicating dredging and sediment placement activities are not significantly impacting PCB concentrations at the high school. More significantly, some individual PCB congeners (8, 18, 31), and sum 18 PCBs have decreased over the entire monitoring period (2001-2023) at the high school.
- At the high school, PCB 8 is statistically greater during the pre-TSCA (prior to TSCA material dredging/placement to the CDF in July 2019) than post-TSCA. PCB congeners 15, 18, 28, 31, sum 18 PCBs and sum 209 PCBs are not statistically different between the pre-TSCA and post-TSCA periods at the high school.
- These findings suggest that dredged material disposal activities, including TSCA material dredging/disposal, and the presence of dredged material, including TSCA material, at the CDF may have impacted (increased) the atmospheric PCB conditions at the CDF site, but have not impacted the atmospheric PCB conditions at the high school. The high detection of PCBs at the site are lower than community action levels for similar dredging projects and occupation exposure limits for PCBs in air.

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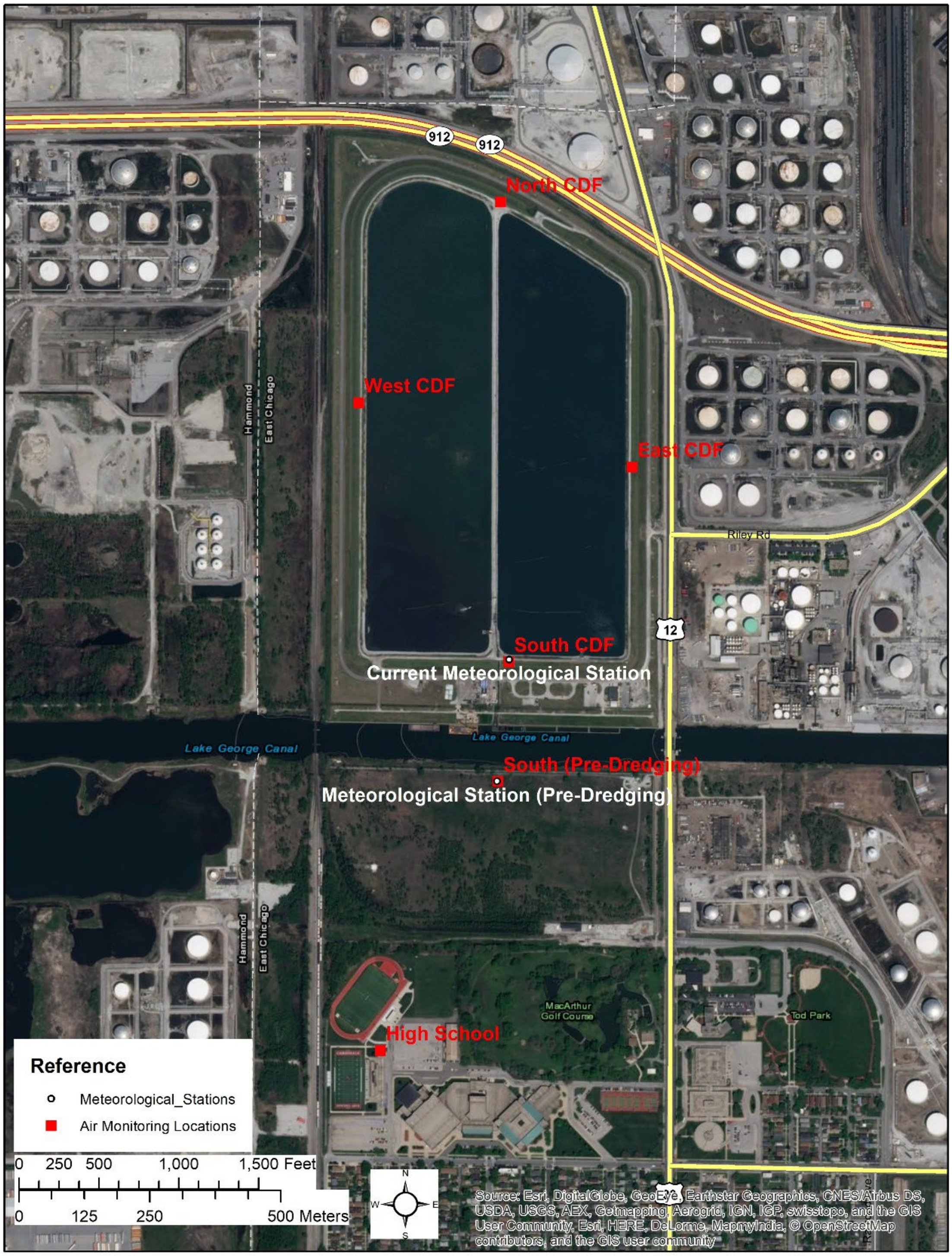


Figure 0a. Location of IHC CDF Air Monitors and Meteorological Stations Prior to Dike Expansion.

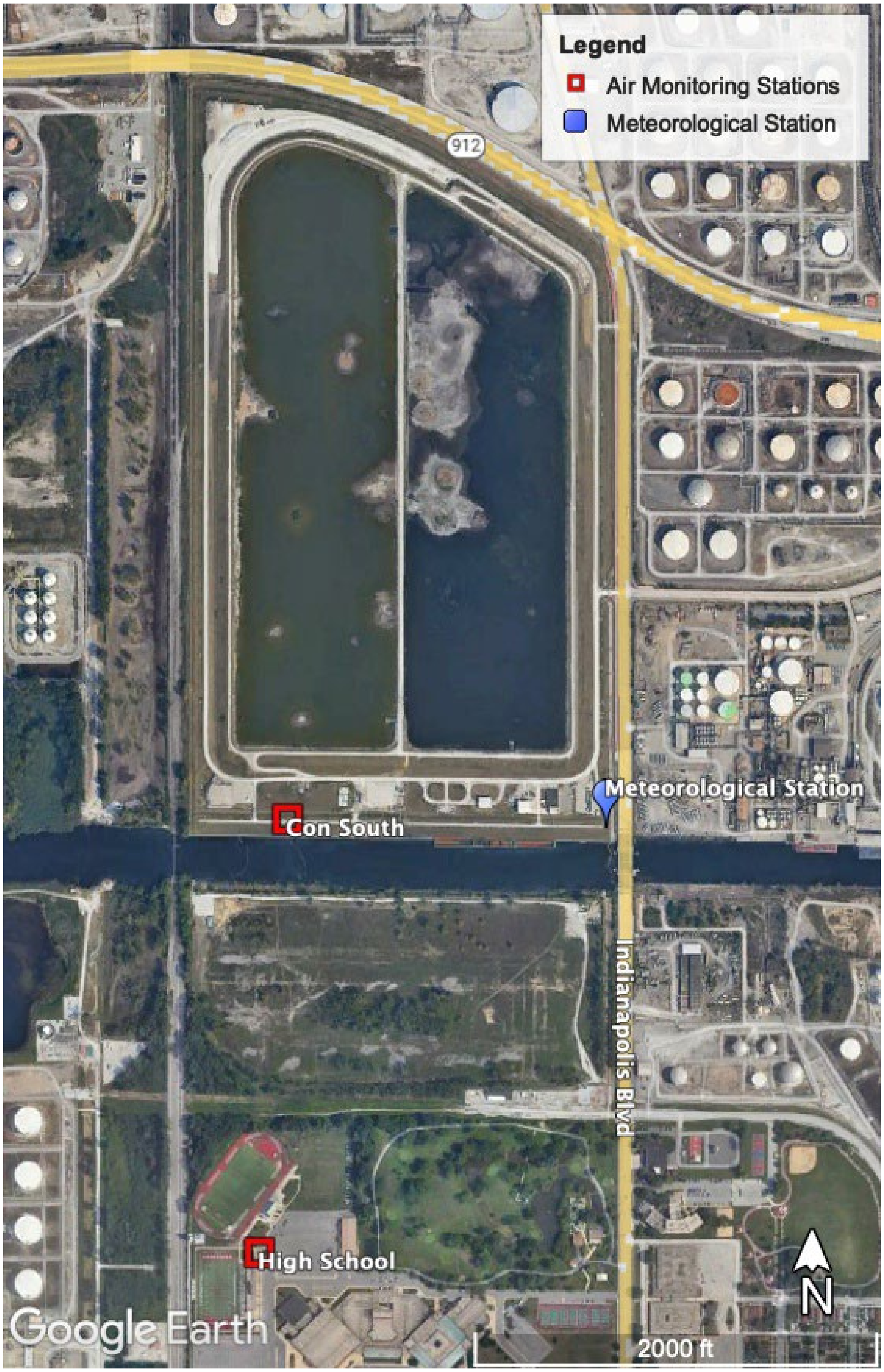
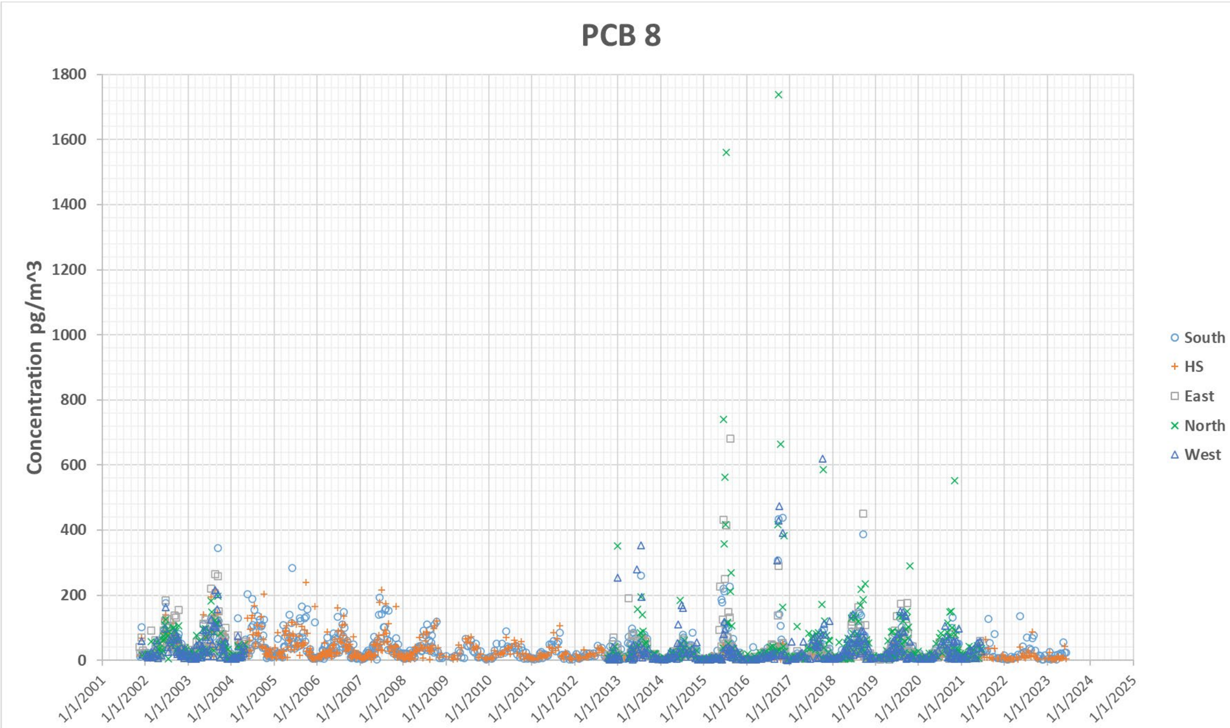
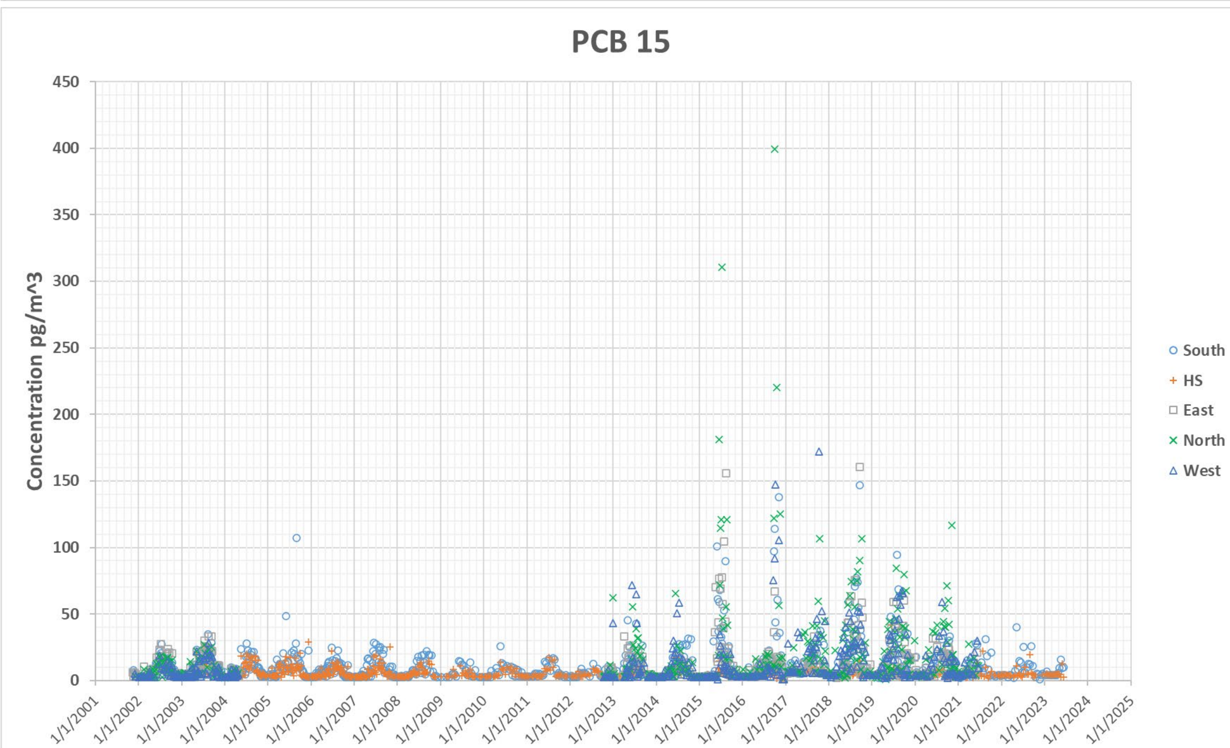
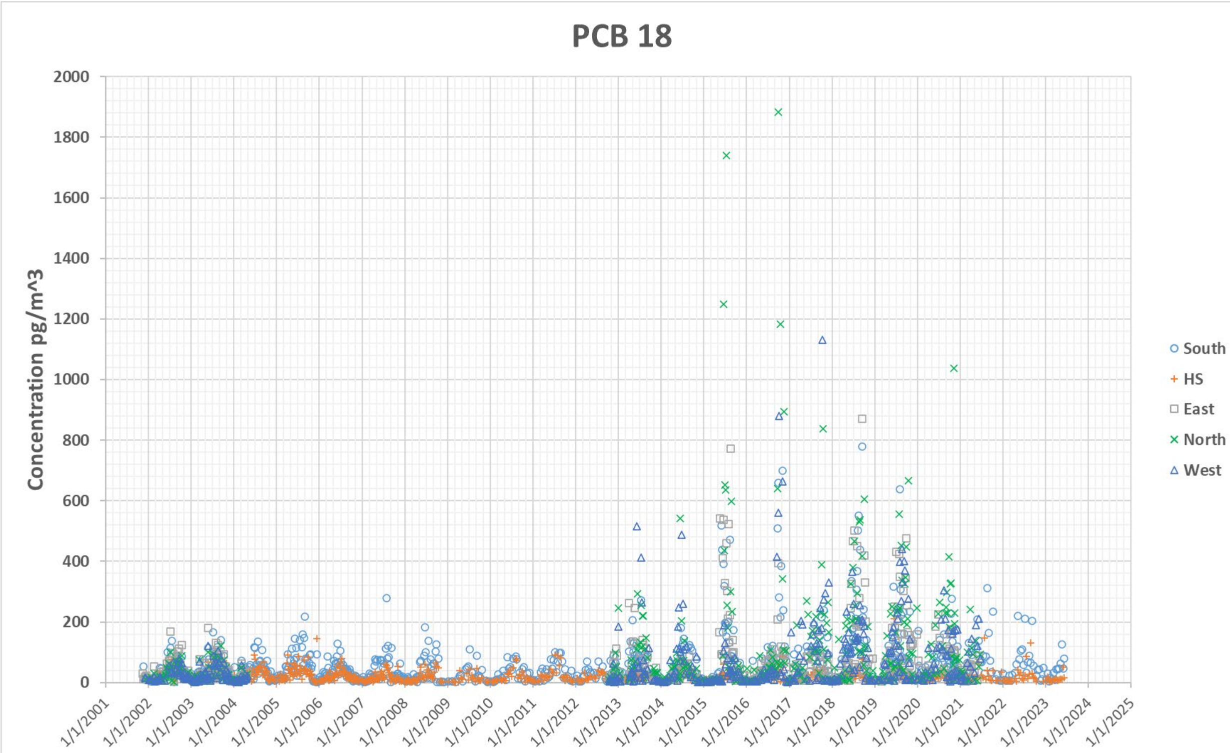


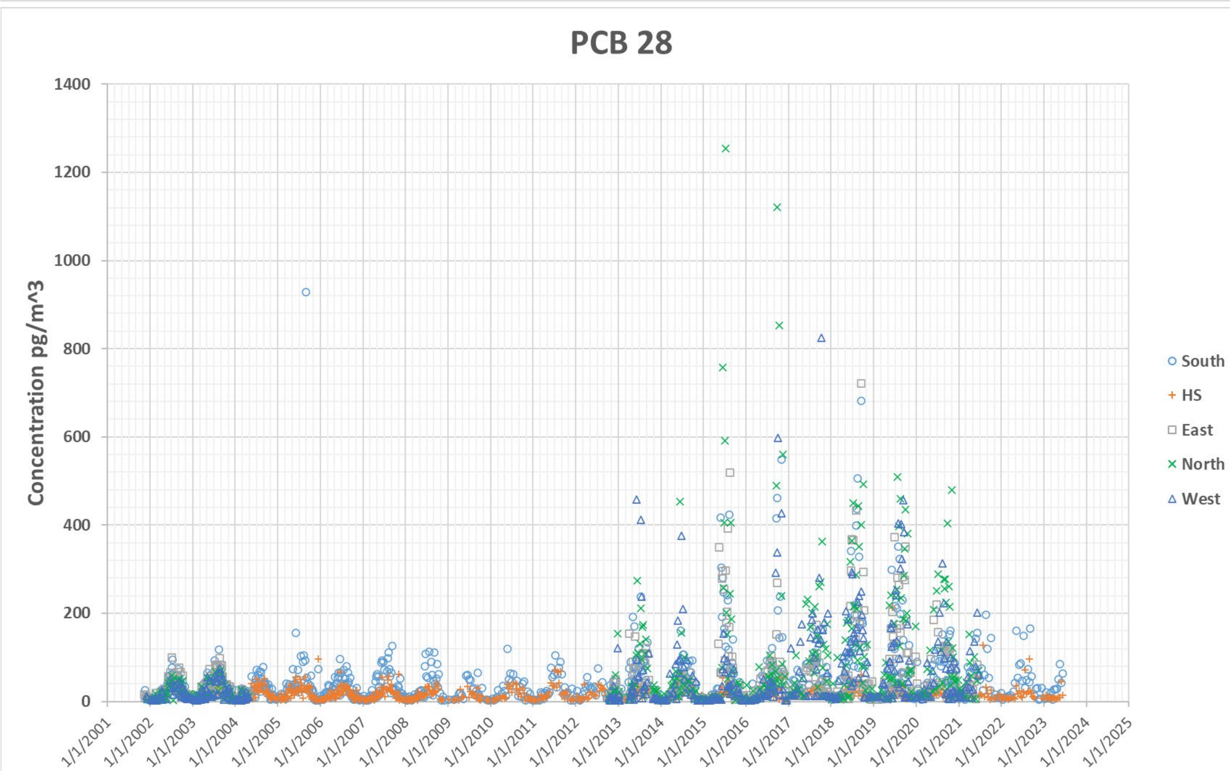
Figure 0b. Location of IHC CDF Air Monitors and Meteorological Station During Dike Expansion.





Figures 1 and 2. Atmospheric concentrations of PCB 8 and PCB 15 (pg/m^3) from all stations over the entire monitoring period.





Figures 3 and 4. Atmospheric concentrations of PCB 18 and PCB 28 (pg/m^3) from all stations over the entire monitoring period.

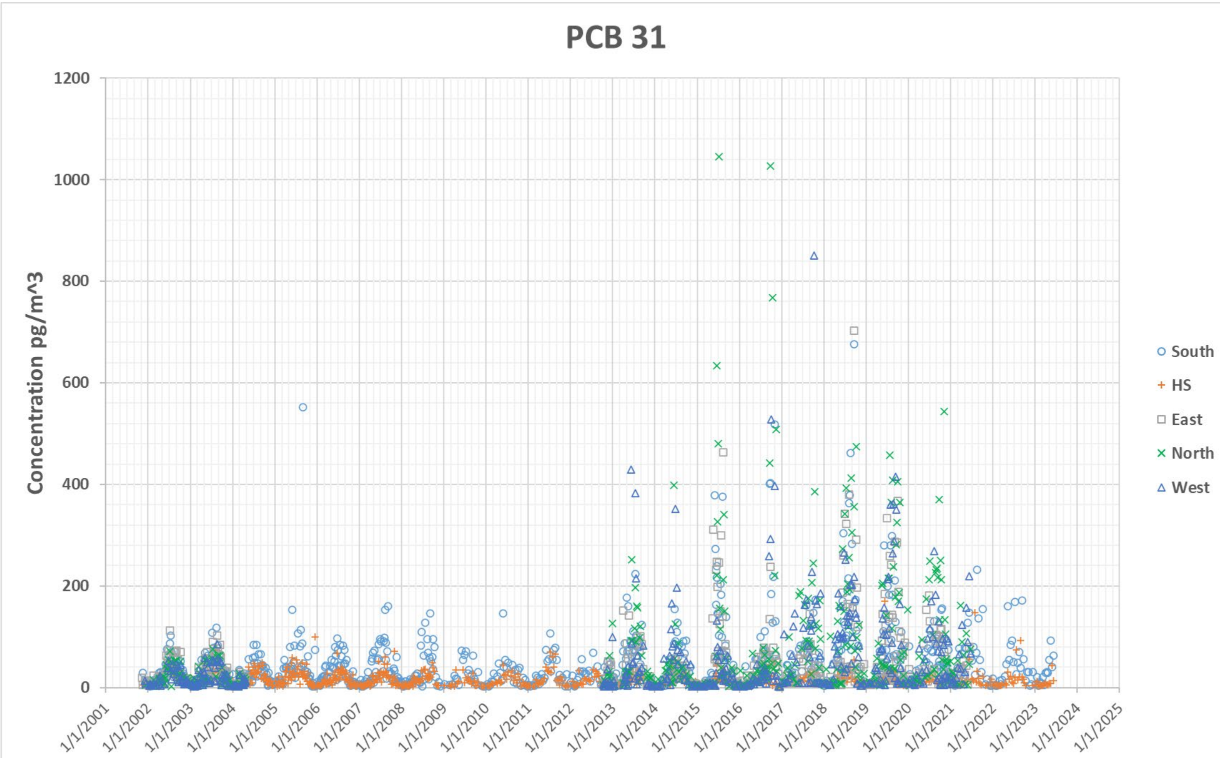
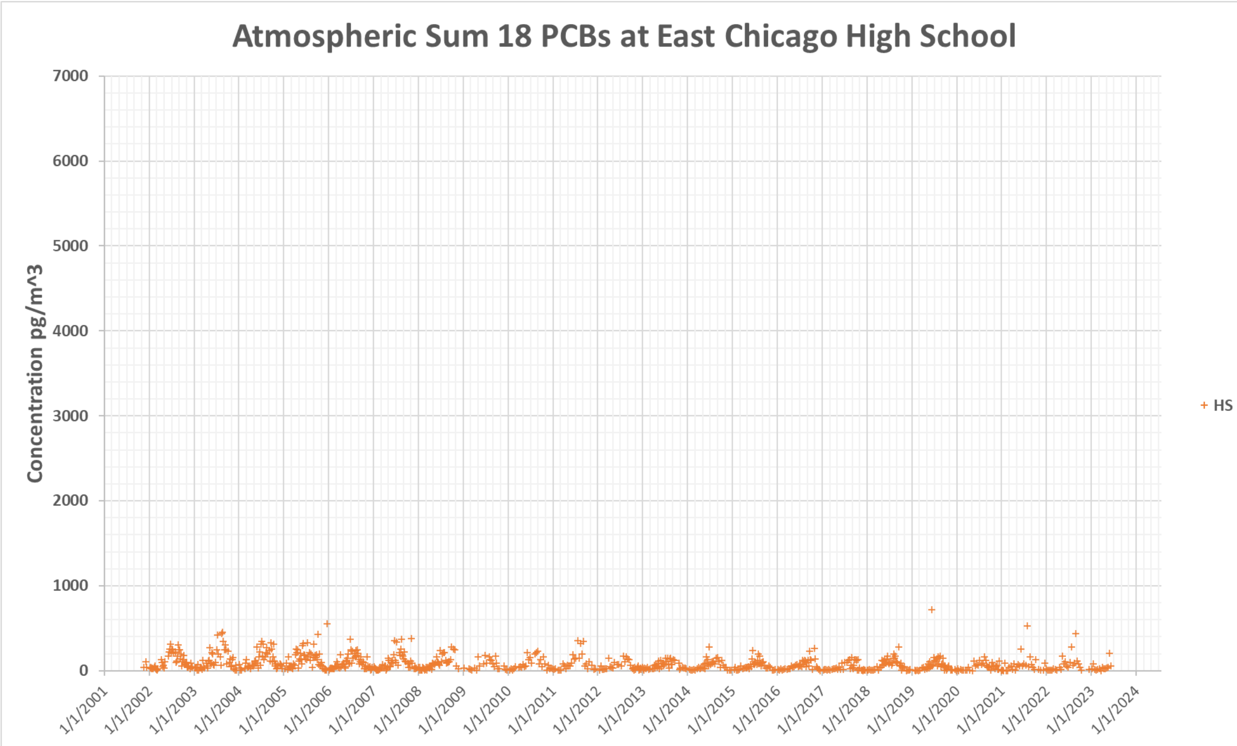
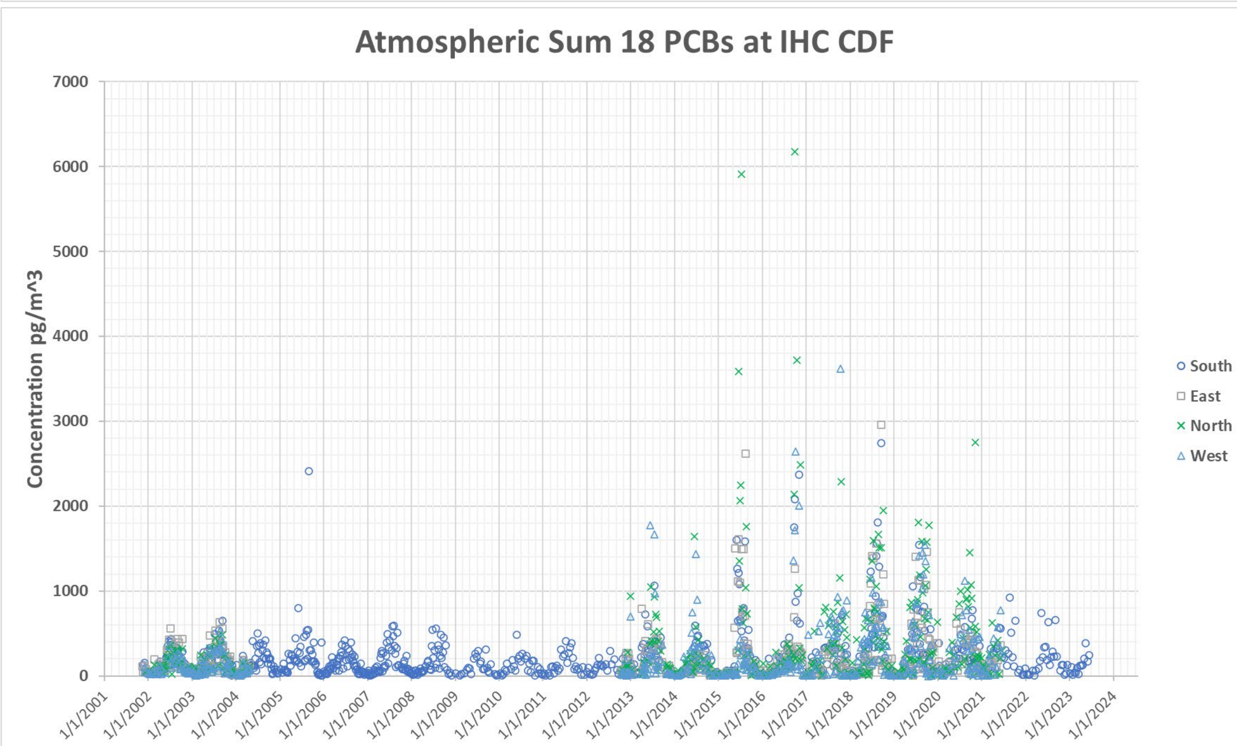
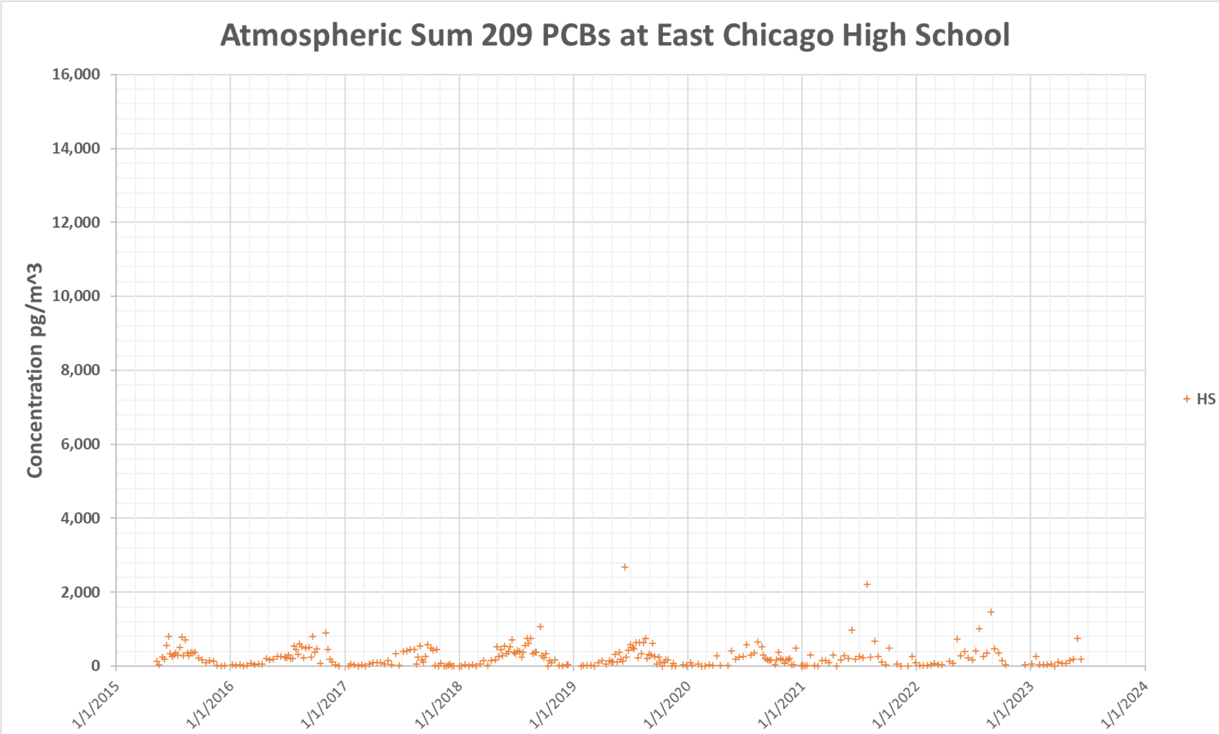


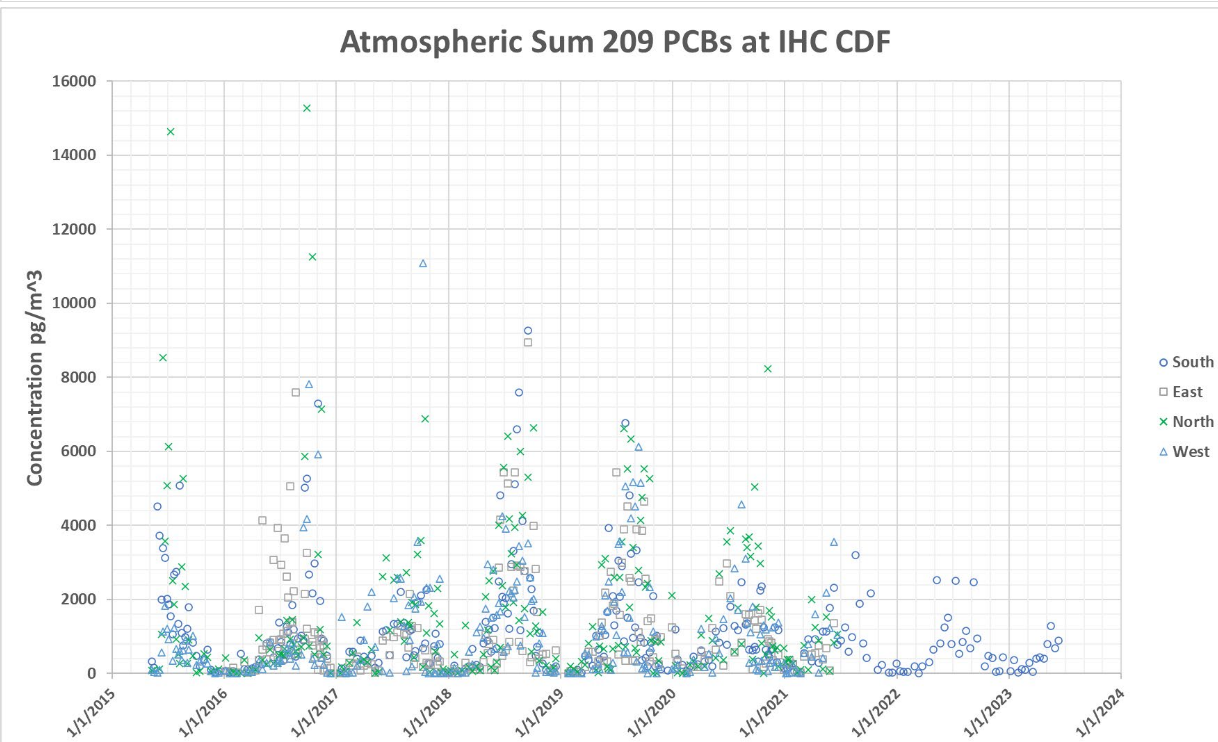
Figure 5. Atmospheric concentrations of PCB 31 (pg/m^3) from all stations over the entire monitoring period.





Figures 6a and 6b. Atmospheric concentrations of Sum 18 PCBs (pg/m^3) at East Chicago HS station (6a) and at IHC CDF stations (6b) over the entire monitoring period.





Figures 7a and 7b. Atmospheric concentrations of Sum 209 PCBs (pg/m^3) at East Chicago HS station (7a) and at IHC CDF stations (7b) from May 2015 to June 2023.

Table 1. Statistical description of measured PCB (pg/m^3) concentrations from Oct 2012-June 2023 (South and HS), from Oct 2012-June 2021 (North, East, West), Sum 209 PCBs from May 2015-June 2023 (South and HS), Sum 209 PCBs from May 2015-June 2021 (North, East, West)

Variable	*Number of Observations*	*% NDs*	*Minimum Detected Data*	*Maximum Detected Data*	*50%ile*	*KM Mean*	*KM SD*
NorthPCB8	337	8.01%	1.43	1738	20.6	61.53	154.9
EastPCB8	313	7.03%	1.71	682.1	18.82	37.36	66.2
WestPCB8	322	11.80%	1.22	619.3	16.16	36.86	66.89
SouthPCB8	389	4.11%	1.33	439.2	24.39	37.93	51.9
HSPCB8	397	17.38%	1.06	87.99	9.45	12.6	10.88
NorthPCB15	335	25.67%	1.15	399.6	8.35	21.23	37.98
EastPCB15	310	24.84%	1.72	160.3	8.105	14.45	19.56
WestPCB15	322	31.37%	0.9	172	6.46	14.42	20.14
SouthPCB15	389	21.85%	0.66	146.8	9.41	14.83	19.02
HSPCB15	397	49.12%	0.97	41.65	4.48	4.435	3.434
NorthPCB18	337	4.75%	2.58	1882	50.33	126.9	217.6
EastPCB18	318	1.57%	1.98	870.2	47.93	87.21	120.2
WestPCB18	322	8.07%	1.46	1131	32.41	82.96	126.8
SouthPCB18	389	1.54%	2.75	779.9	61.95	91.46	110.1
HSPCB18	397	14.36%	1.24	210.7	12	17.26	18.8
NorthPCB28	337	8.90%	2.76	1254	40.66	100.7	154.1
EastPCB28	317	6.62%	2.69	722	36.96	68.25	91.3
WestPCB28	322	13.98%	2.76	825.7	27.29	71.71	103.7
SouthPCB28	389	5.14%	3.1	682.4	46.79	73.27	89.86
HSPCB28	397	24.69%	3.07	212.8	12.99	15.63	16.53
NorthPCB31	337	8.90%	2.81	1045	35.69	90.01	137.5
EastPCB31	316	6.65%	2.69	703.2	31.79	60.66	83.08
WestPCB31	322	13.98%	2.27	850.4	24.18	64.41	95.88
SouthPCB31	389	3.60%	2.8	676.7	44.33	68.44	82.88
HSPCB31	397	21.91%	2.43	170.2	10.32	13.58	15.08
Variable	***Number of Observations***	***Minimum***	***Maximum***	***Mean***	***SD***	***50%ile***	
North Sum 18 PCBs	337	0.376	6180	409.1	693.4	166.1	
East Sum 18 PCBs	318	2.63	2956	272.9	377.8	150.2	
West Sum 18 PCBs	322	0.311	3621	277.5	416.5	113.6	
South Sum 18 PCBs	389	2.85	2741	292.4	356.6	196.3	
HS Sum 18 PCBs	398	0.00	718.4	62.44	69.61	44.56	
North Sum 209 PCBs	248	1.562	15282	1626	2224	746.2	
East Sum 209 PCBs	235	8.589	8952	1099	1364	594.9	
West Sum 209 PCBs	232	1.863	11092	1128	1483	566.3	
South Sum 209 PCBs	299	6.492	9271	1134	1338	764.9	
HS Sum 209 PCBs	299	1.861	2670	248.8	291.5	176.1	

NOTE: All data are original (not temperature-corrected).

Table 2. Statistically significant trends[a] of atmospheric PCB concentrations over time and by site[b]. 'I' indicates a significant increase, 'D' indicates a significant decrease, and '-' indicates no significant trend.

	H 2001-2023	S 2001-2023	H 2010-2023	S 2010-2023	E 2012-2021	N 2012-2021	W 2012-2021
PCB 8	D	D	D	-	-	I	I
PCB 15	-	I	I	I	I	I	I
PCB 18	D	I	-	I	I	I	I
PCB 28	-	I	-	I	I	I	I
PCB 31	D	I	-	I	I	I	I
Sum 18 PCBs	D	I	D	I	I	I	I
Sum 209 PCBs	No data before May 2015 -		-	D	-	-	-

[a]Statistically significant trends over time using Mann-Kendall trend analysis at the 5% significance level. [b] The trends are performed on non-temperature-corrected data.

Table 3. Two-sample two-tailed Gehan test for significant differences[a] in PCBs concentrations between seasons from 2012-2023.

	High School			*CDF Site*		
	Sum-Win	Sum-Sp/F	Sp/F-Win	Sum-Win	Sum-Sp/F	Sp/F-Win
PCB 8	>	>	-	>	-	>
PCB 15	>	>	>	>	>	>
PCB 18	>	-	>	>	-	>
PCB 28	>	>	>	>	-	>
PCB 31	>	>	>	>	-	>
PCB-Sum18	>	>	>	>	>	>
PCB-Sum209	>	>	>	>	>	>

[a] > indicates greater than, < indicates less than, and - indicates no significant difference using a significance level of 5%. [b] All data except sum 18 and sum 209 PCBs are temperature-corrected.

Table 4. Two-sample two-tailed Gehan test for significant differences[a] in PCB[b] concentrations between monitoring stations from 2012-2021; except for comparison of high school and south station data from 2012-2023.

	H-S	*H-E*	*H-N*	*H-W*	*S-E*	*S-N*	*S-W*	*E-N*	*E-W*	*N-W*
PCB 8	<	<	<	<	>	-	>	-	>	>
PCB 15	<	<	<	<	-	-	>	<	-	>
PCB 18	<	<	<	<	>	-	>	<	>	>
PCB 28	<	<	<	<	>	-	>	<	>	>
PCB 31	<	<	<	<	>	-	>	<	>	>
Sum 18 PCBs	<	<	<	<	>	-	>	-	>	>
Sum 209 PCBs	<	<	<	<	-	-	>	<	-	>

[a] > indicates greater than, < indicates less than, and - indicates no significant difference using a significance level of 5%. [b] All data except sum 18 and sum 209 PCBs are temperature-corrected.

Table 5. Two-sample two-tailed Gehan test for significant differences[a] in PCB[b] concentrations between high school and CDF stations for Discharge (2012-21), Quiescent Pond (2012-23), and Background (2010-12 data)

	Discharge	*Quiescent Pond*	*Background*
	HS-CDF	***HS-CDF***	***H-S***
PCB 8	<	<	-
PCB 15	<	<	<
PCB 18	<	<	<
PCB 28	<	<	<
PCB 31	<	<	<
Sum 18 PCBs	<	<	
Sum 209 PCBs	<	<	

[a] > indicates greater than, < indicates less than, and - indicates no significant difference using a significance level of 5%. [b] All data except sum 18 and sum 209 PCBs are temperature corrected.

Table 6. Two-sample two-tailed Gehan test for significant differences[a] in PCB[b] concentrations prior to TSCA Discharge (before 7/2019) vs post-TSCA Sediment Placement into CDF (7/2019 to 6/2023)

	HS – Pre-TSCA vs Post-TSCA Placement	*CDF – Pre-TSCA vs Post-TSCA Placement*
PCB 8	>	<
PCB 15	-	<
PCB 18	-	<
PCB 28	-	<
PCB 31	-	<
Sum 18 PCBs	-	<
Sum 209 PCBs	-	-

[a] > indicates greater than, < indicates less than, and - indicates no significant difference using a significance level of 5%. [b] All data except sum 18 PCBs are temperature-corrected.

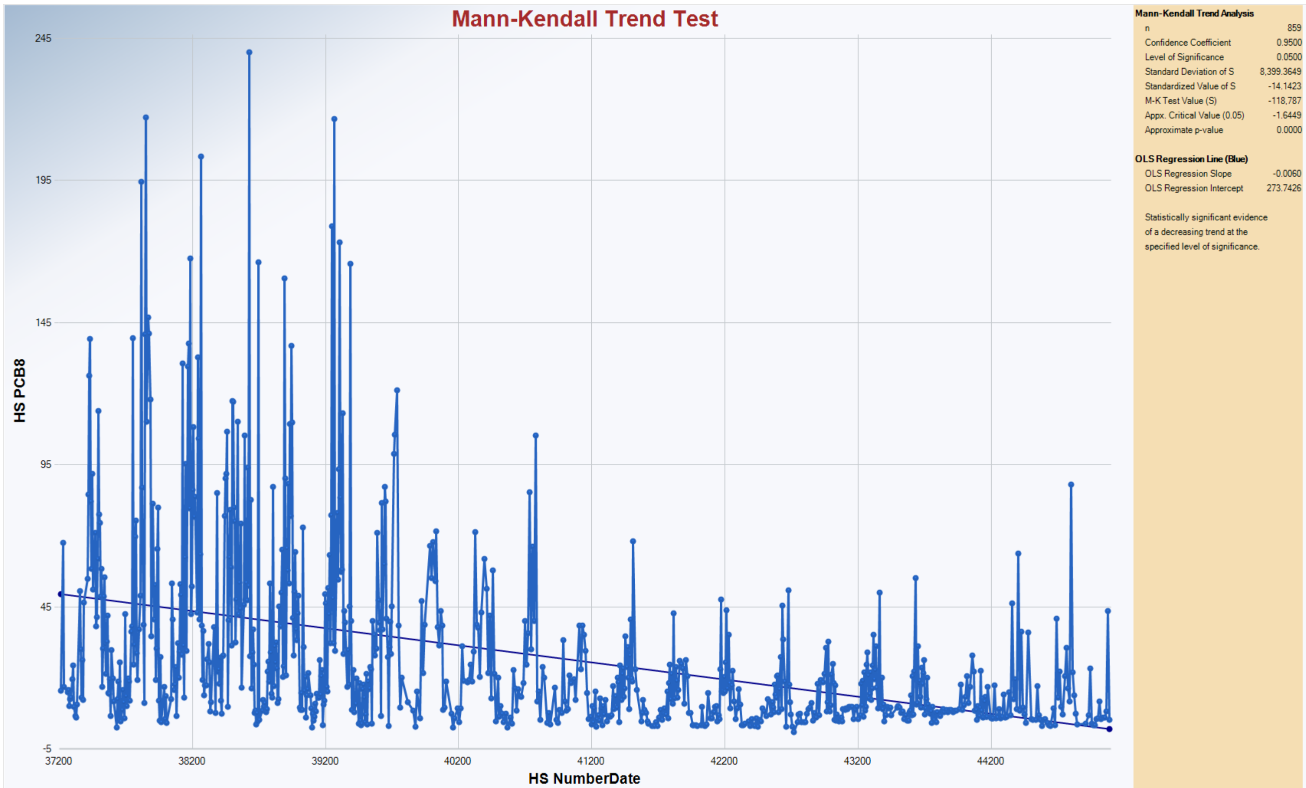
Table 7. Health, safety, and risk-based atmospheric PCB standards.

PCB Risk Values	Level (μg/m^3)	Notes
Hudson River Dredging Quality of Life Performance Residential Standard	0.11	24 hr average, with Concern Level of 0.08 μg/m^3 (USEPA, 2004).
Hudson River Dredging Industrial Standard	0.26	24 hr average, with Concern Level of 0.21 μg/m^3 (USEPA, 2004).
New Bedford Harbor Dredging First Trigger Level for Resident	0.11	If first trigger level is exceeded, evaluate factors that contributed to elevated measurement (Jacobs 2015).
New Bedford Harbor Dredging Dredging First Trigger for Worker	0.344	If first trigger level is exceeded, evaluate factors that contributed to elevated measurement (Jacobs 2015).
NIOSH	1.0	Air workplace 10 hr workday TWA Advisory (Chlorodiphenyl 52%, 2016).
OSHA PEL (PCB with 54% chlorine)	500	Air workplace TWA (40 hr workweek, 8 hr workday) (Chlorodiphenyl 52%, 2016).
OSHA PEL (PCB with 42% chlorine)	1,000	Air workplace TWA (40 hr workweek, 8 hr workday) (Chlorodiphenyl 42%, 2016).

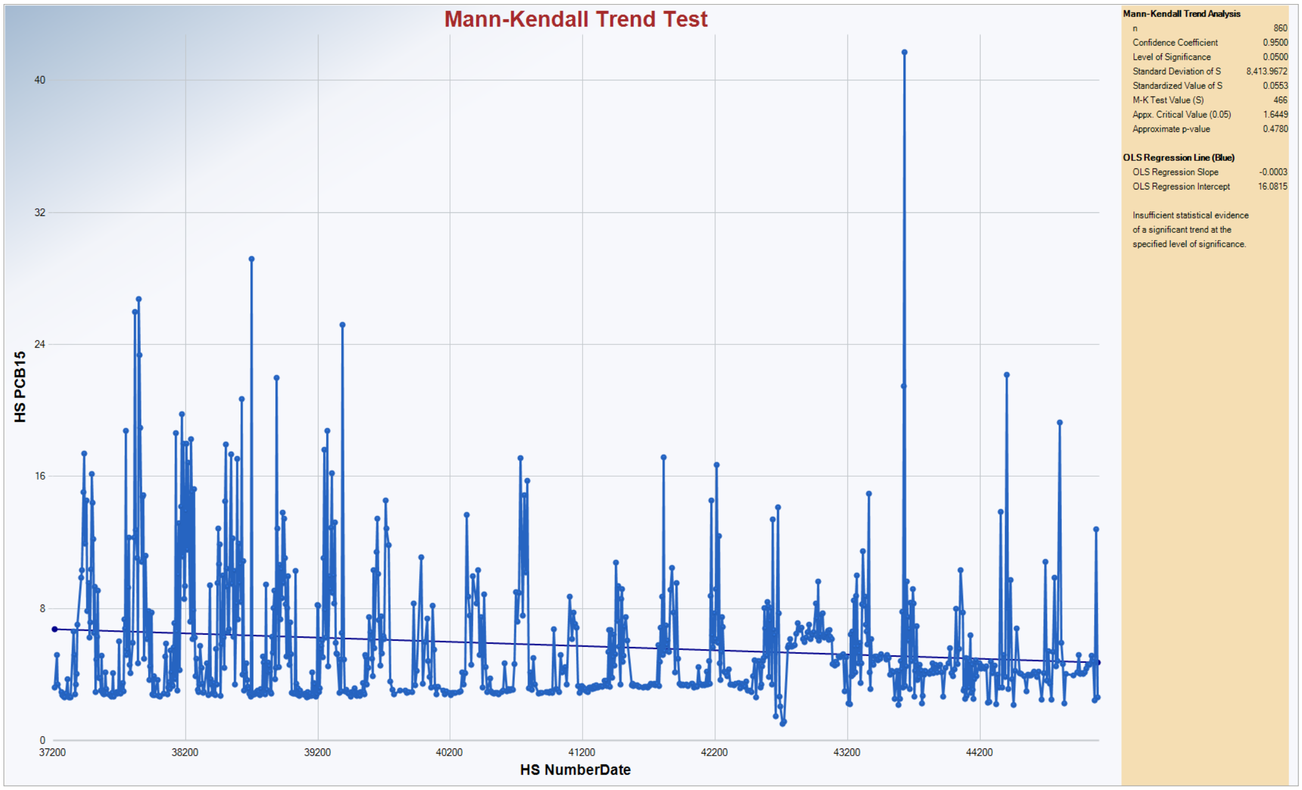
Appendix A

PCB Trends at High School and South Stations

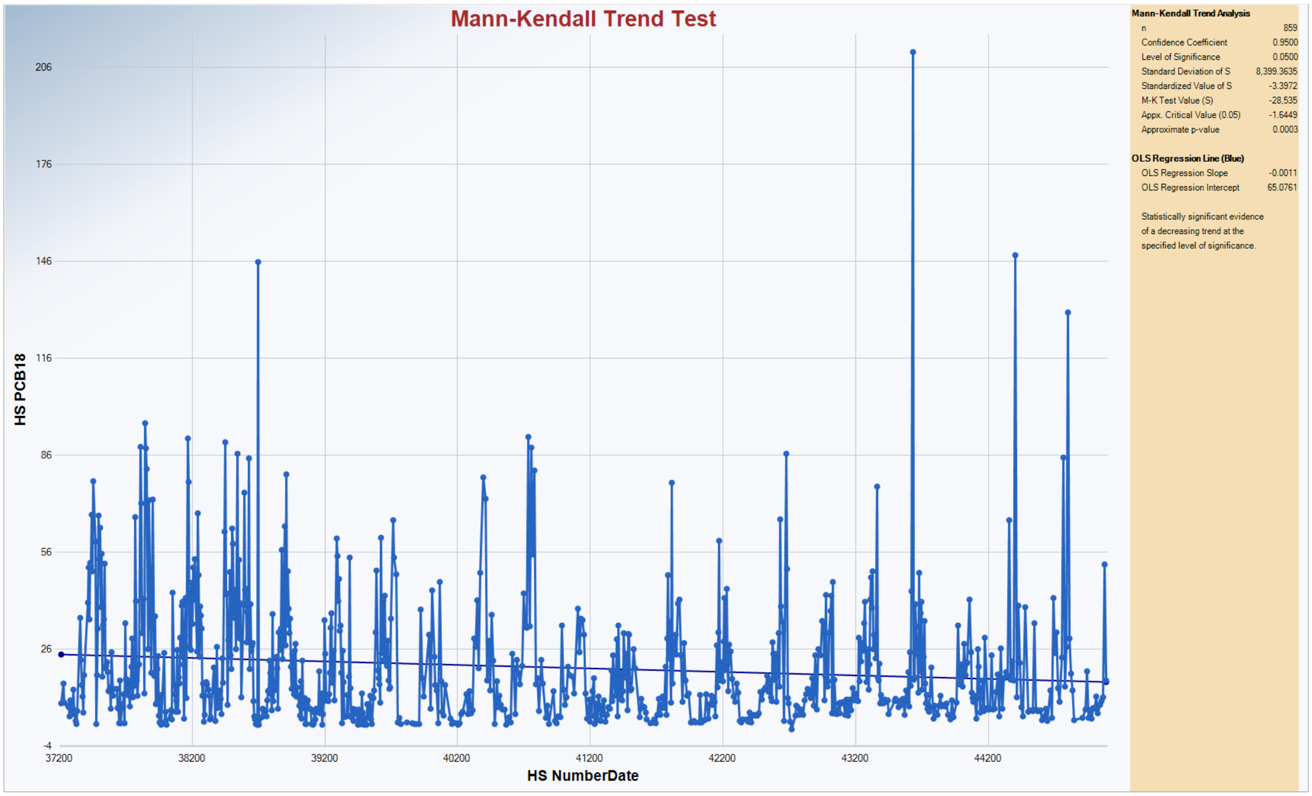
2001-2023 Data



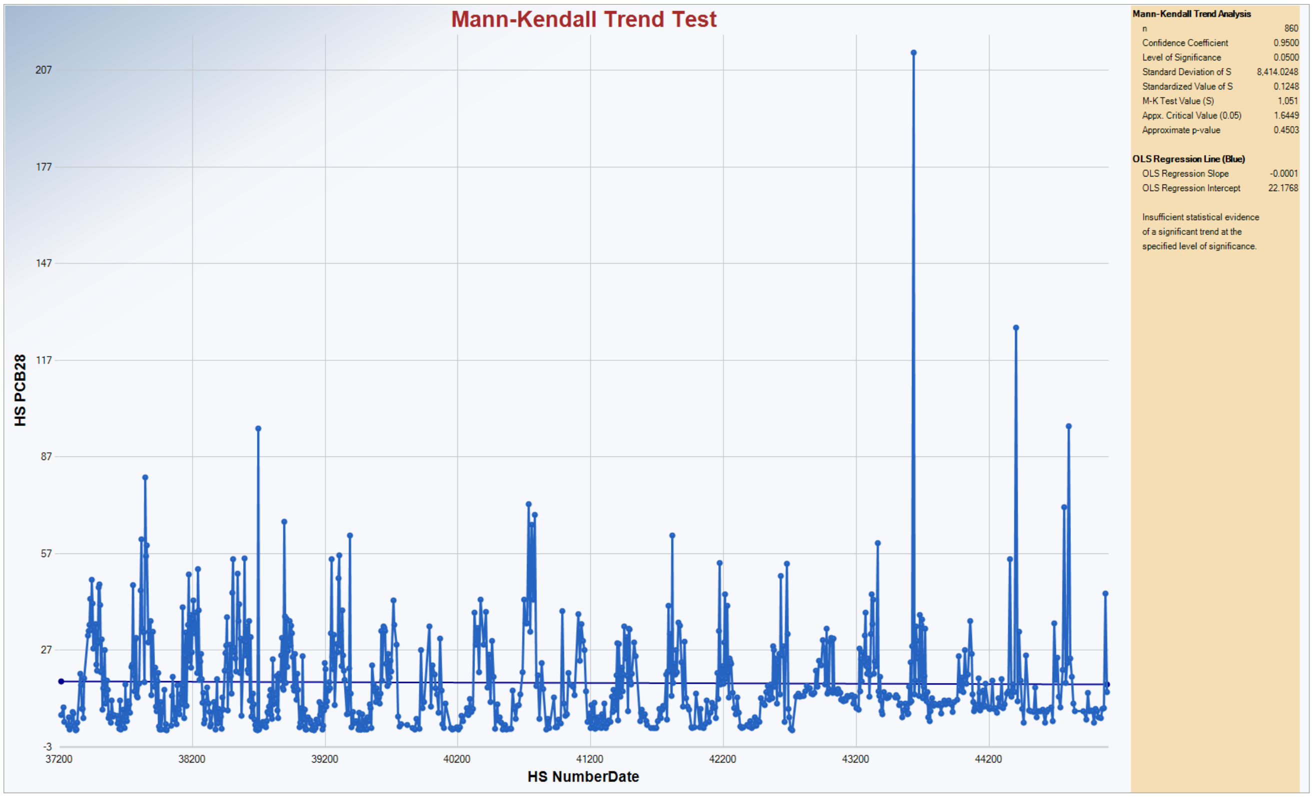
Appendix Figure A1. Mann-Kendall trend for **PCB8** at the **high school station** from 2001 to June 2023 with statistically significant evidence of **decreasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



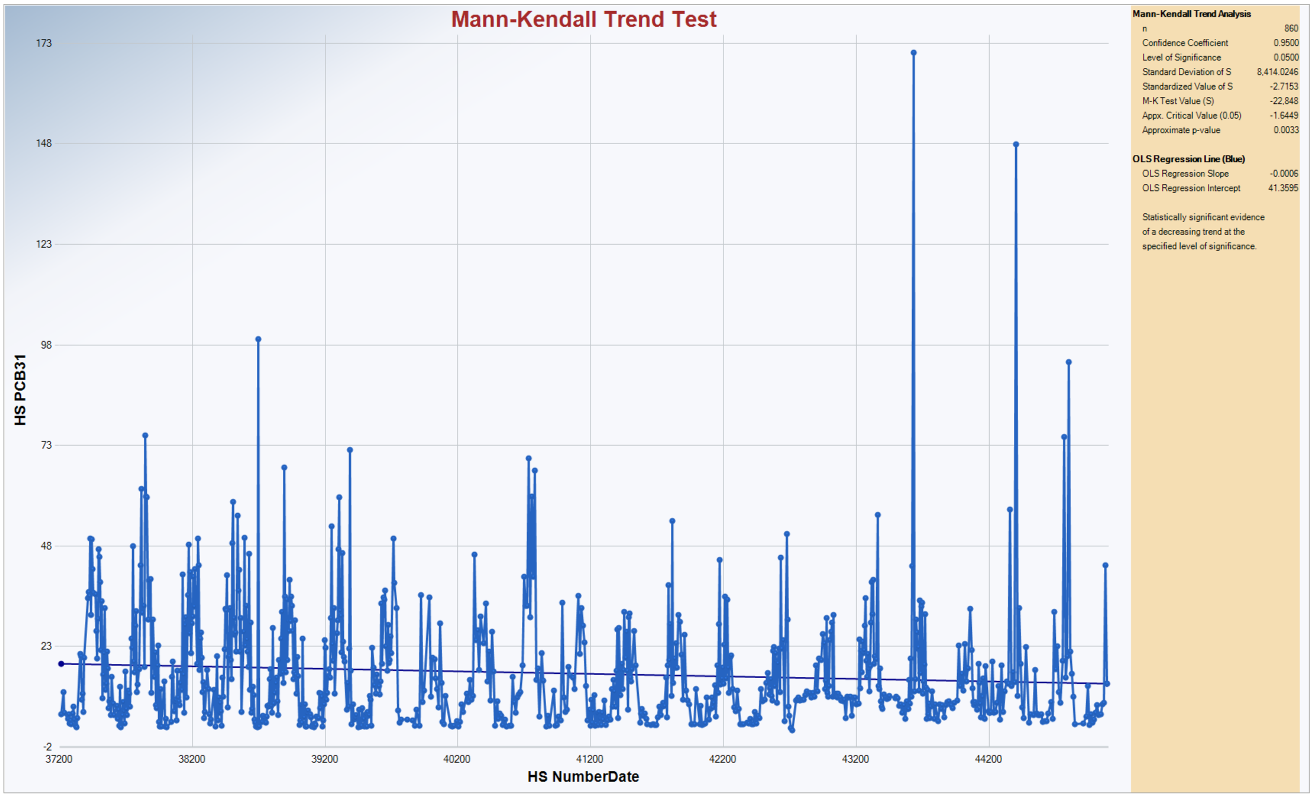
Appendix Figure A2. Mann-Kendall trend for **PCB15** at the **high school station** from 2001 to June 2023 with **insufficient statistical evidence of a significant trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



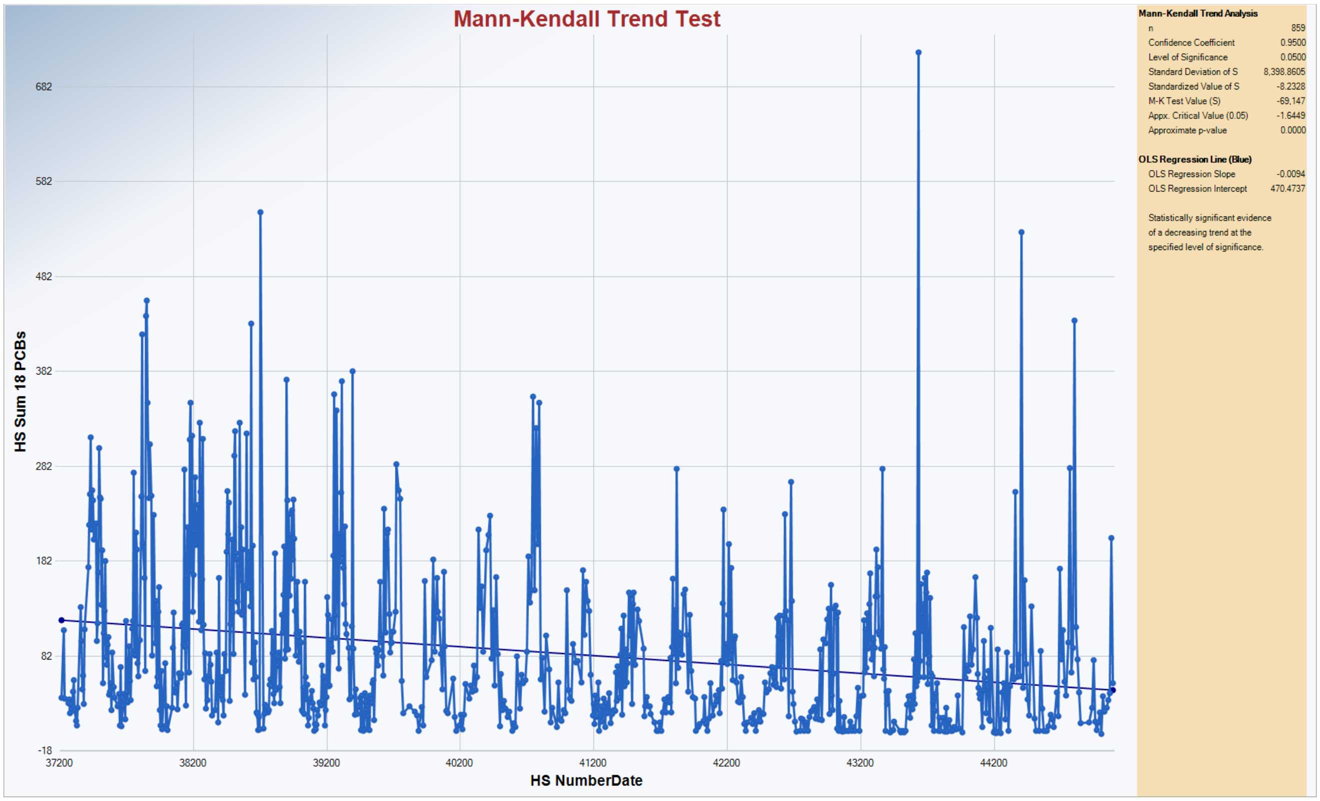
Appendix Figure A3. Mann-Kendall trend for **PCB18** at the **high school station** from 2001 to June 2023 with statistically significant evidence of **decreasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



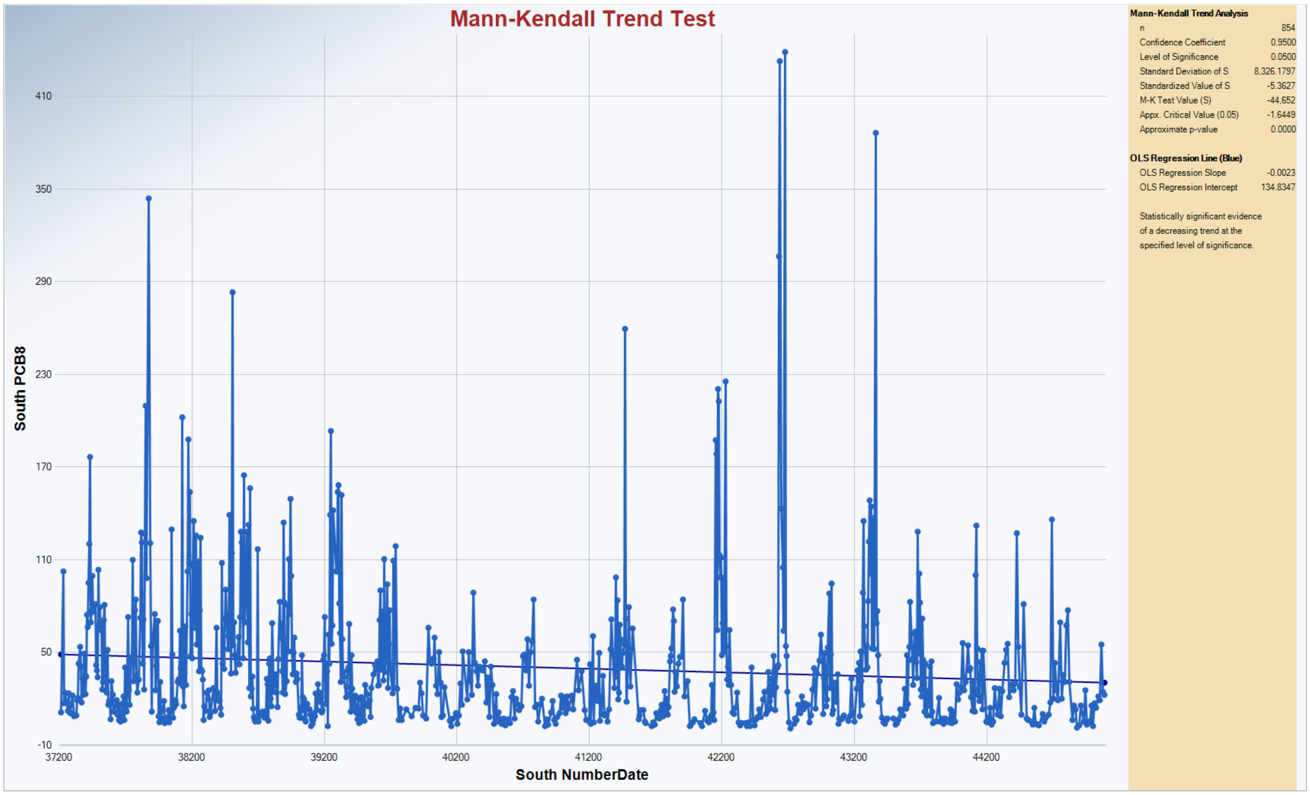
Appendix Figure A4. Mann-Kendall trend for **PCB28** at the **high school station** from 2001 to June 2023 with **insufficient statistical evidence of a significant trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



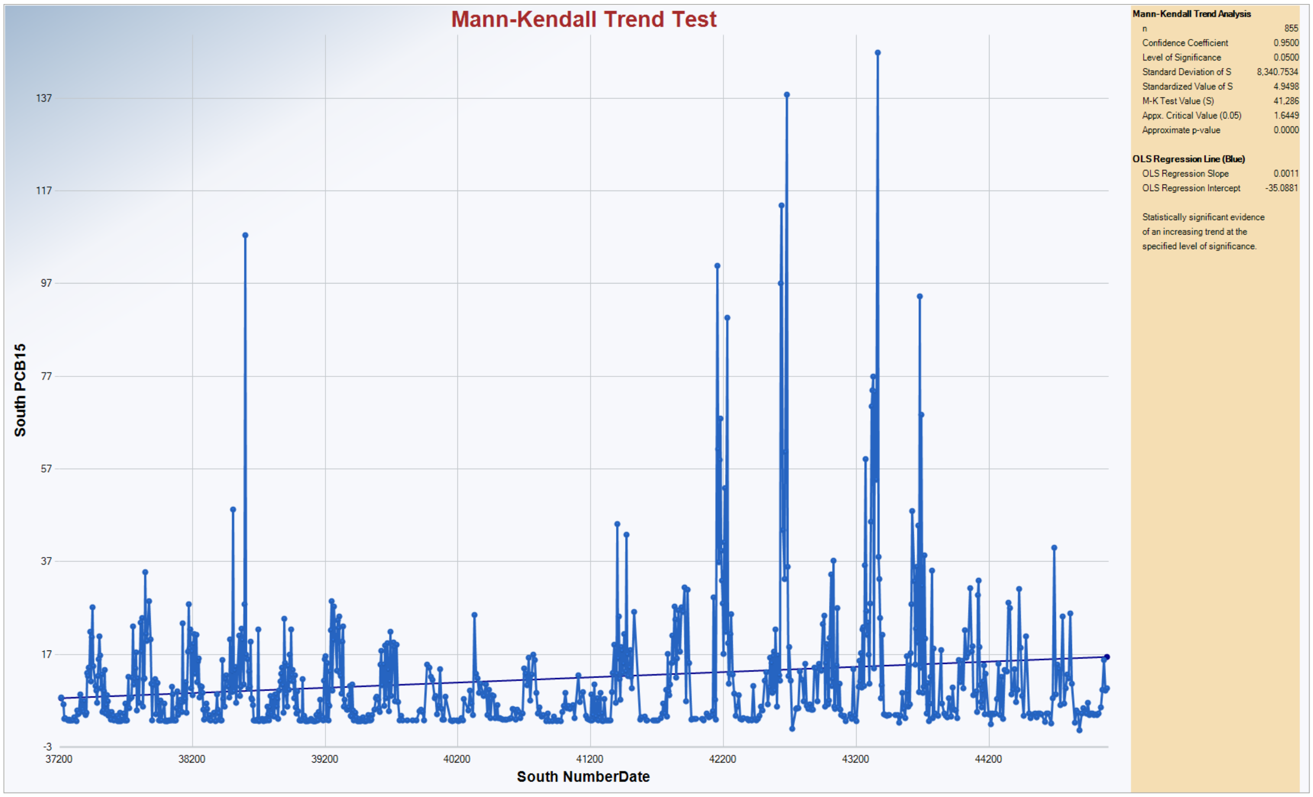
Appendix Figure A5. Mann-Kendall trend for **PCB31** at the **high school station** from 2001 to June 2023 with statistically significant evidence of **decreasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



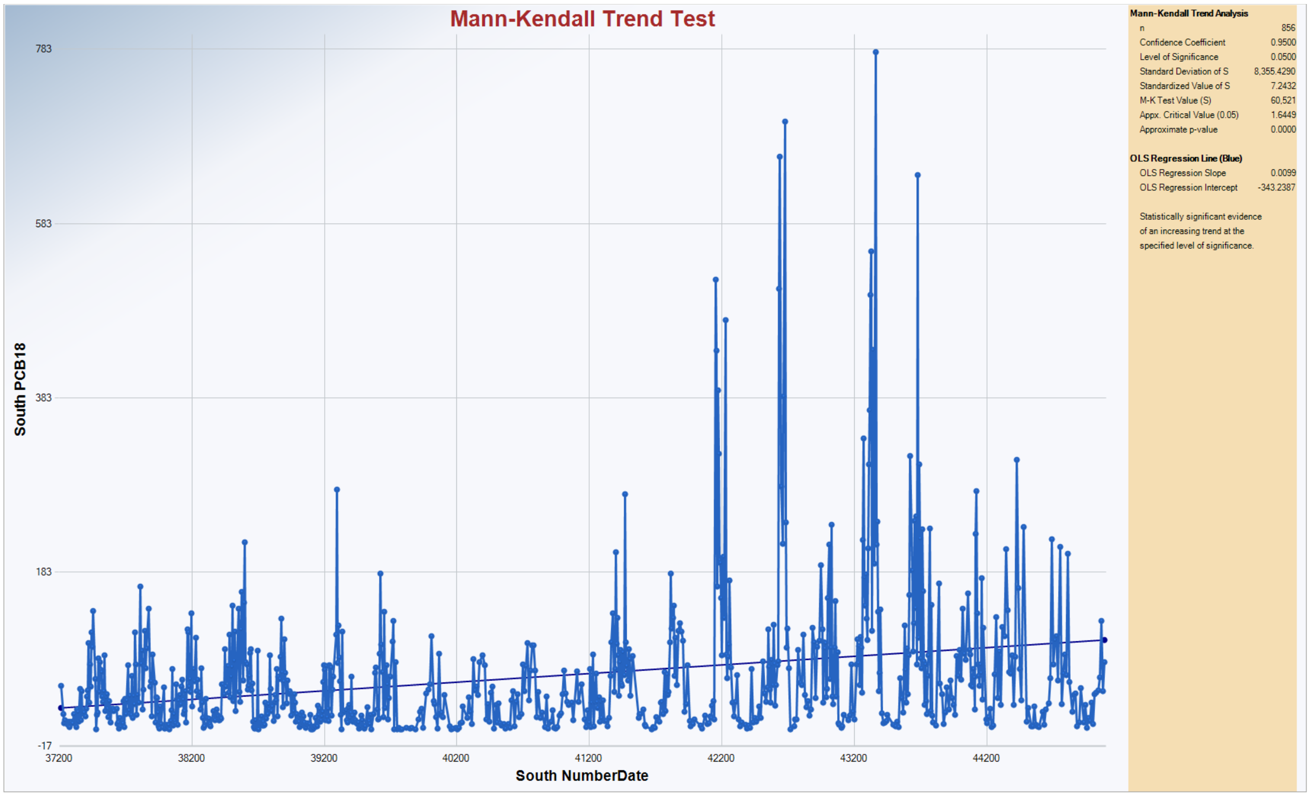
Appendix Figure A6. Mann-Kendall trend for **Sum 18 PCBs** at the **high school station** from 2001 to June 2023 with statistically significant evidence of **decreasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6//11/2023 [numerical date 45088] for all trend analyses).



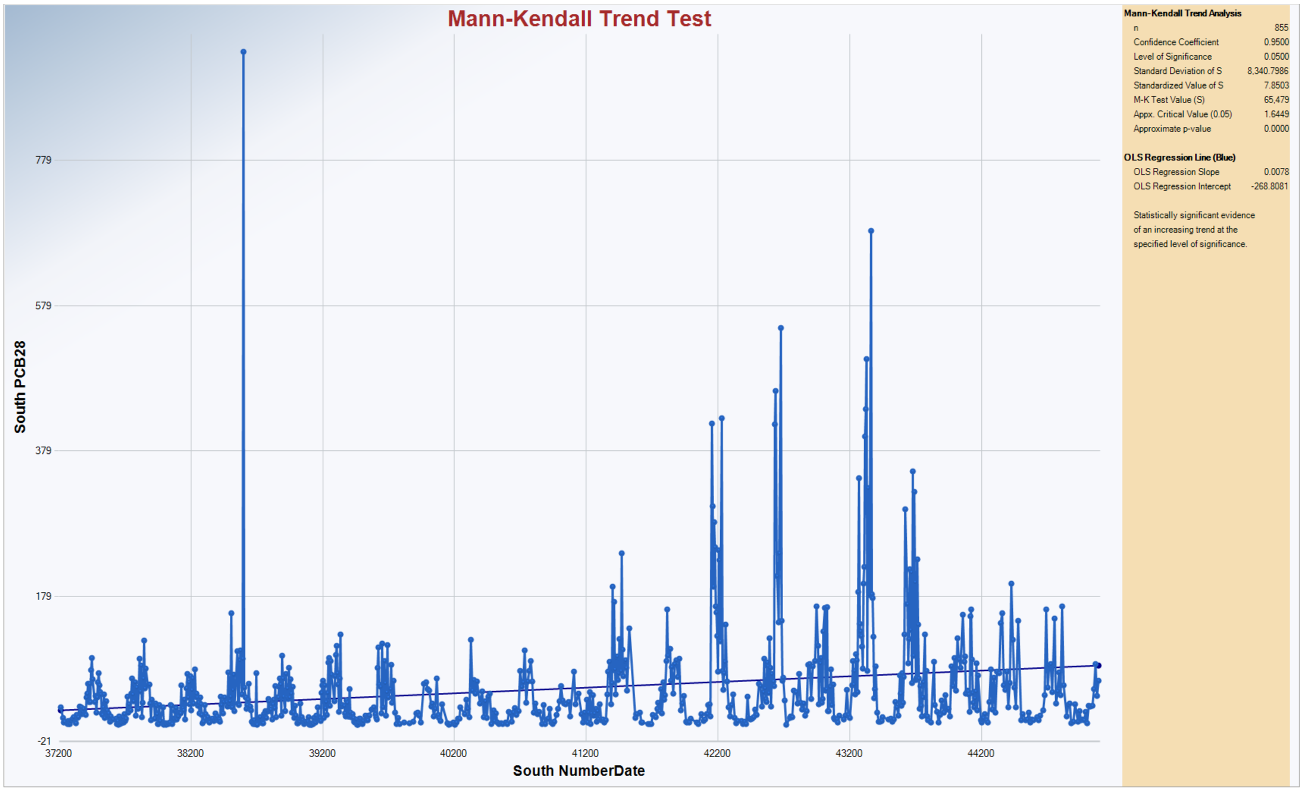
Appendix Figure A7. Mann-Kendall trend for **PCB8** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **decreasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



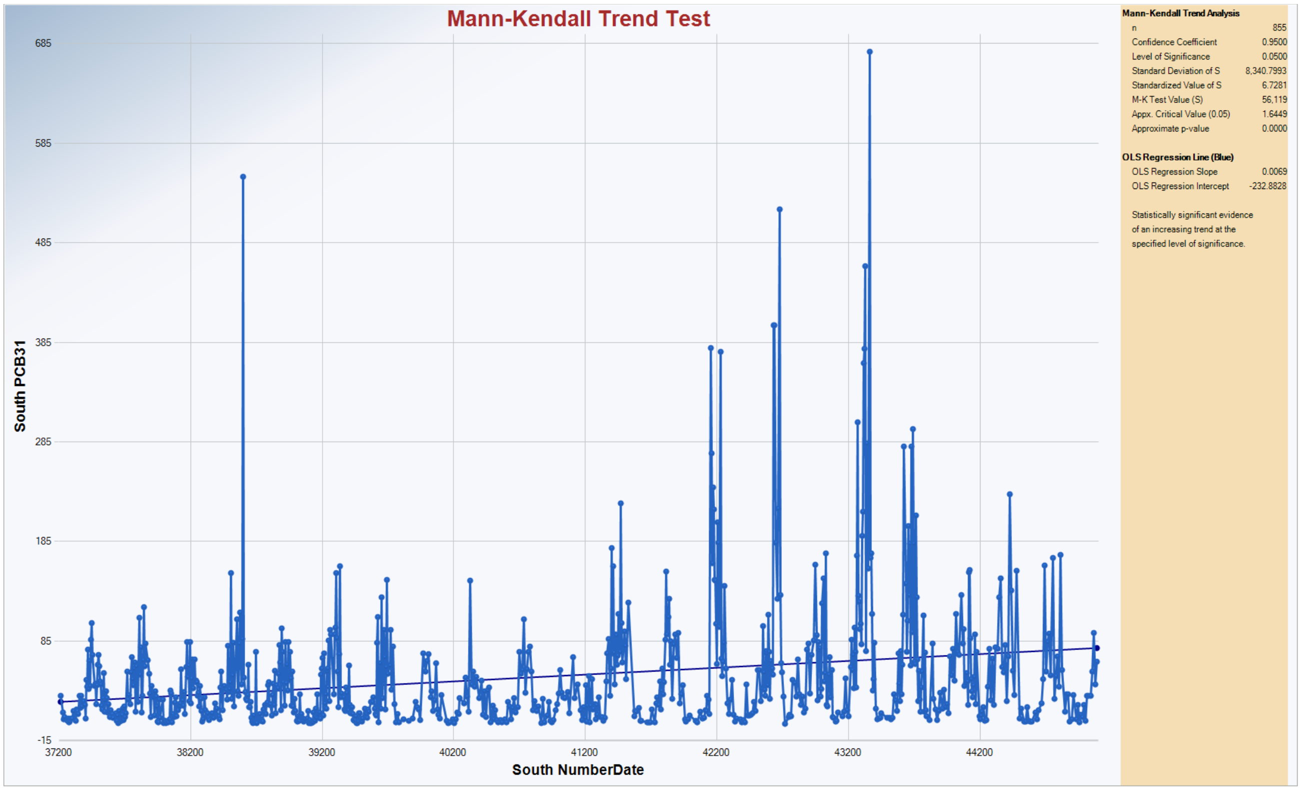
Appendix Figure A8. Mann-Kendall trend for **PCB15** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **increasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



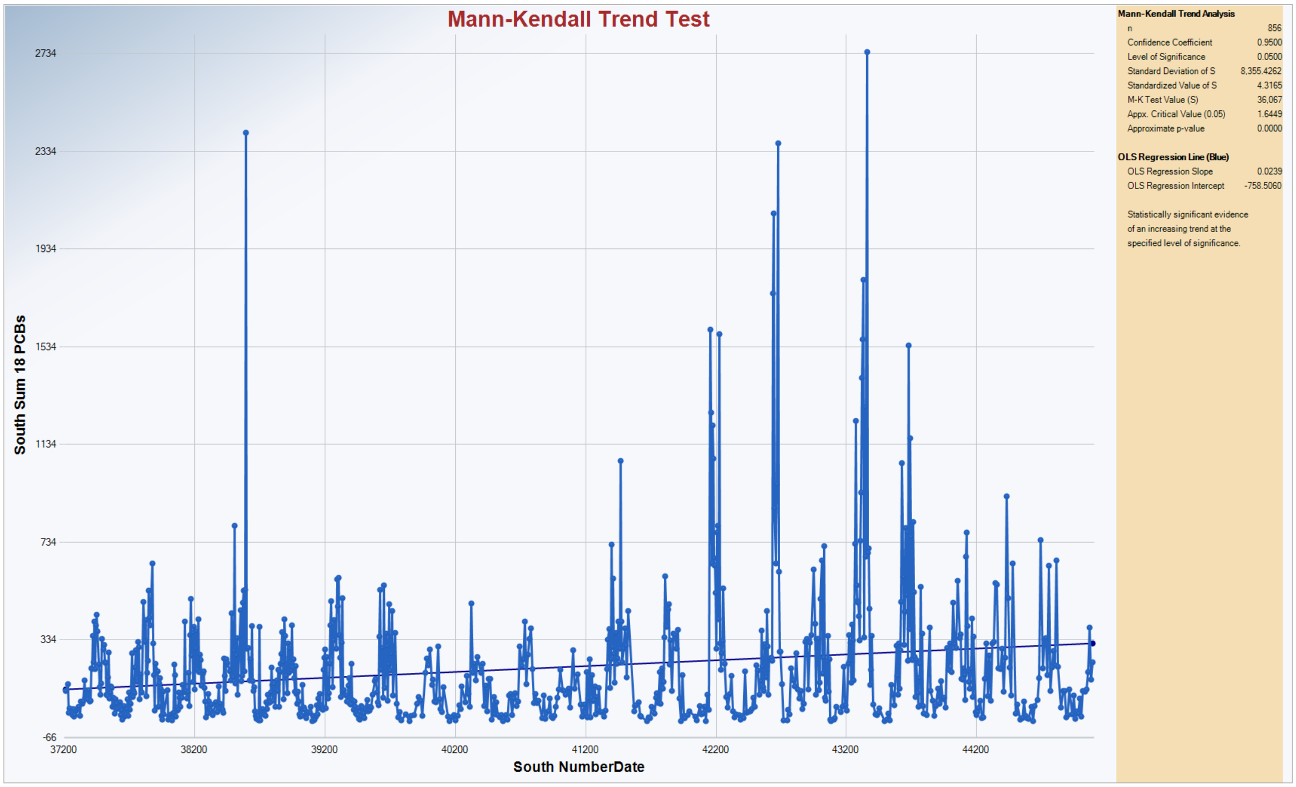
Appendix Figure A9. Mann-Kendall trend for **PCB18** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **increasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



Appendix Figure A10. Mann-Kendall trend for **PCB28** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **increasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



Appendix Figure A11. Mann-Kendall trend for **PCB31** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **increasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).



Appendix Figure A12. Mann-Kendall trend for **Sum 18 PCBs** at the **CDF south station** from 2001 to June 2023 with statistically significant evidence of **increasing trend** over sampling period. (Data from 11/19/2001 [numerical date 37214] to 6/11/2023 [numerical date 45088] for all trend analyses).