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# **Evaluation of the Midlothian, Texas Ambient Air Collection & Analytical Chemical Analysis Data**

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

## Executive Summary

Routine volatile organic compound (VOC) monitoring began in the Midlothian area in 1994 as part of the establishment of the Community Air Toxics Monitoring Network (CATMN) mandated by the Texas Legislature. VOC monitoring at up to three sites in the Midlothian area has continued until present. Routine metals monitoring in the Midlothian area has been conducted for various periods of time from 1981 to present, depending, at least in part, on the particle size of federal regulatory emphasis at the time. Overall, the VOC and metals air monitoring data from the Midlothian area compose an impressively rich data set, even with data gaps. 2006 was the last year that there were three active sampling locations in Midlothian. As of January 1, 2006, three of TCEQ's approximately 57 VOC monitors at that time and one of TCEQ's approximately nine PM<sub>2.5</sub> metals samplers at that time were located in Midlothian. The TCEQ has collected and validated approximately 907 VOC, 196 PM<sub>10</sub>, and 461 PM<sub>2.5</sub> samples in Midlothian spanning March, 1997, to July, 2009. Using the number of monitors per capita in 2006 as a measure, air quality in Midlothian has been far better monitored than most of the United States. Currently, there is only one monitoring location in Midlothian, which has been active since 1994. The current monitor, Community Air Monitoring Station (CAMS) 52, located in Midlothian is positioned predominantly downwind of TXI and Gerdau Ameristeel (formerly Chaparral Steel).

In December of 2007, the Texas Department of State Health Services (DSHS) released for public comment their Draft Health Consultation: *Midlothian Area Air Quality Part 1: Volatile Organic Compounds (VOCs) and Metals*. DSHS classified Midlothian air quality as an Indeterminate Public Health Hazard because they felt further information was needed to fully characterize the extent of any public health hazard posed by air contaminants in Midlothian.

On May 9, 2008, the TCEQ Toxicology Division (TD) issued a Request for Proposals (RFP) for the collection and analytical chemical analysis of ambient air samples in Midlothian, Texas. The contract was awarded to URS Corporation on August 22, 2008. The purpose of collecting these samples was to attempt to answer citizen questions and concerns with regard to air quality in their city, as well as potentially fill data gaps noted in the DSHS Draft Health Consultation.

Identified citizen questions include:

- How are Industries in Midlothian, TX affecting air quality?
- Is the TCEQ every 6<sup>th</sup> day monitoring site an accurate representation of daily air concentrations?
- What is the air quality close to schools and parks in Midlothian, TX?
- What percentage of total chromium does hexavalent chromium (Cr<sup>6+</sup>) represent in Midlothian, TX?

Sampling for this project consisted of four separate events (hereafter referred to as quarters) over a one-year time span. For each sampling quarter, 24-hour samples were collected for five consecutive days at five different sampling locations. One sampling day each quarter coincided with the current every 6<sup>th</sup> day TCEQ sampling schedule at the TCEQ CAMS 52 sampling location in Midlothian, TX. There were two types of sampling locations for this project; stationary and mobile. Stationary sites were sampled each of the four quarters while mobile sites were only sampled one of the four quarters. Stationary sites included: Collocation with CAMS 52; Downwind of Gerdau Ameristeel; Jaycee Park; and North of Ash Grove. Mobile sites included: Triangle Park; Midlothian High School; J.A. Vitovsky Elementary School; and Mountain Peak Elementary School.

The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> sampling quarters were completed December 6 – 10, 2008, February 26 – March 2, 2009, May 5 – 9, 2009, and July 3 – 7, 2009, respectively. Conclusions from the study are as follows:

- All measured concentrations of VOCs and PM<sub>10</sub> metals are not of a health concern.
- Measured concentrations of VOCs and PM<sub>10</sub> metals are likely typical for this area as compared with historical CAMS 52 and CAMS 302 monitor data, respectively.
- The TCEQ CAMS 52 monitor is accurately measuring VOC air concentrations at this location, as compared to the third-party collocated data.
- There are no statistical differences between the regulatory every 6<sup>th</sup>-day VOC and PM<sub>10</sub> samples and the other sixteen sampled days.
- Measured concentrations at the CAMS 52 monitor are a good indicator of VOC measurements across Midlothian and, while this site measures potentially worst-case concentrations of PM<sub>10</sub> metals, is a good indicator of air quality around Midlothian, including schools and parks.
- The majority of the data indicate that there are no seasonal differences for VOCs and PM<sub>10</sub> metals in this area.
- The highest VOC measurements do not correspond to days when winds put the monitors downwind of industry; therefore, the implication is that the sources of benzene, and VOCs in general, are likely not the identified industry in Midlothian.
- Nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in Midlothian; however, those contributions are slight, all measured levels are still well below their respective AMCVs, and are not of health concern.
- The TCEQ CAMS 52 monitor is positioned downwind of TXI and Gerdau Ameristeel when winds are southerly (the predominant wind direction) and the measurable impact local industry has on the ambient levels of PM<sub>10</sub> metals detected in Midlothian can, and will be, measured by the TCEQ CAMS 52 monitor.
- Overall concentrations of VOCs and PM<sub>10</sub> metals measured at schools and parks are lower than, or similar to those measured closer to industry; all measured concentrations are not of health concern. Regarding differences in ambient air between weekend and weekdays at schools, due to the limited dataset collected at each school no clear discernable pattern can be observed for VOCs and PM<sub>10</sub> metals, and therefore no clear conclusions can be drawn for the school data.
- PM<sub>10</sub> Cr<sup>6+</sup> represents a small percentage of the total chromium measured in the Midlothian area. The overall study average percent Cr<sup>6+</sup> of total chromium was calculated to be 1.07%, which is well below the USEPA default assumption<sup>1</sup> of 34% as well as the DSHS assumption of 100% for their draft Health Consultation.

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<sup>1</sup> USEPA. 1996. National Air Toxics Assessment (NATA) Appendix G: Health Effects Information used in Cancer and Noncancer Risk Characterization for the NATA 1996 National-Scale Assessment. United States Environmental Protection Agency, <http://earth1.epa.gov/ttn/atw/sab/appendix-g.pdf>.

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## **Summary of Citizen Questions and Concerns**

The design of this study was centered on attempting to answer citizen questions and concerns, as well as to fill any data gaps DSHS identified in their draft Health Consultation. This section summarizes citizen questions and concerns and provides a summary of the conclusions in regards to the question/concern.

### ***Is this study going to be able to capture levels typical of the fully operating cement kilns?***

Just prior to the start of this study, TXI idled their two operating wet cement kilns indefinitely due to the economic downturn and less demand for cement while continuing to operate their dry cement kiln. This led the citizens to question whether or not this study would be able to capture the same levels of pollutants emitted by the facility during full operation. In order to address this concern, the Toxicology Division (TD) compared all collected study data to all available and relevant historical Texas Commission on Environmental Quality (TCEQ) volatile organic compound (VOC) and particulate matter less than 10  $\mu\text{m}$  ( $\text{PM}_{10}$ ) metals data. Historical VOC data were available from the Community Air Monitoring Station (CAMS) 52 monitor from March 29, 1997 to May 31, 2009. Unfortunately, CAMS 52 does not have any historical  $\text{PM}_{10}$  metals data available; therefore, in order to have an appropriate (i.e., apples-to-apples) comparison,  $\text{PM}_{10}$  metals study data were compared to the former TCEQ CAMS 302  $\text{PM}_{10}$  metals data available from January 1, 2001 to June 26, 2004.

When comparing the new data to historical data, the data from this study indicate that the measured VOC and  $\text{PM}_{10}$  metals concentrations are typical of what has been observed previously at the TCEQ CAMS 52 and former TCEQ CAMS 302 monitoring sites. These data also indicate that CAMS 302 and CAMS 52 are good predictors of worst-case  $\text{PM}_{10}$  measurements across Midlothian.

### ***Does industry change their operations for the TCEQ every 6<sup>th</sup>-day sampling schedule?***

The TCEQ every 6<sup>th</sup>-day sampling schedule is a schedule pre-determined by EPA that can be accessed on EPA's website (more detail on this is given in the VOC Collocated Monitor Comparisons section). Since this schedule is readily available, there is skepticism that industry does not modify operations on known sampling days. In order to address this concern during the study, the study sampling dates were not made public.

The TD compared the every 6<sup>th</sup>-day samples to the surrounding Collocated monitor samples to help show if there are any differences between the two sets of data. No significant differences were found between the every 6<sup>th</sup>-day samples and the other study sampling days. This indicates that there is no difference between a regulatory every 6<sup>th</sup>-day sampling day and the other sampled days during this study. Since the sampling dates were not released publicly the assumption can be made that this is representative of typical conditions throughout the year.

### ***How are Industries in Midlothian affecting the air quality?***

One of the major concerns expressed by citizens of Midlothian is whether or not the local industry is affecting their air quality. There are three cement plants located to the north and south west of Midlothian, and it is therefore understandable that a public concern for air quality exists. All of the comparisons in this evaluation are designed to help answer this question.

When looking at all of the data collected during this study, the measured concentrations of VOCs are similar across Midlothian and are likely not due to emissions from the cement plants but from a combination of mobile sources. The measured concentrations of PM<sub>10</sub> metals are, however, different across Midlothian, with relatively higher levels measured closer to industry and lower levels measured within the community. This indicates that nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in Midlothian; however, those contributions are slight, all measured levels are still well below their respective Air Monitoring Comparison Values (AMCVs), and both VOCs and PM<sub>10</sub> metals are not at levels of health concern.

### ***Is the TCEQ CAMS 52 monitor located appropriately?***

The TCEQ CAMS 52 monitor is located approximately 1 mile north of TXI and Gerdau Ameristeel, which is predominately downwind of these two industries. However, the TCEQ monitor is not located in the middle of the city of Midlothian. The citizens are concerned that the location of the monitor is not appropriate for determining the air quality within the city. To answer this concern, the TD compared data from the Collocated monitor to the other study monitoring sites.

The Collocated monitor is approximately 1.1 miles north of TXI and 1.2 miles north, northeast of Gergau Ameristeel. The center of the city is offwind from TXI and Gerdau Ameristeel and upwind of Ash Grove and Holcim. The term offwind refers to the fact that the city center is located approximately 2.4 miles to the northeast of TXI and Gerdau Ameristeel, which is off the wind path from TXI and Gerdau Ameristeel when winds are coming from the south and southeast. The term upwind refers to the fact that the city center is located approximately 2.5 miles to the south, southwest of Ash Grove and Holcim, in which case winds would be traveling from the city center toward the industries when winds are out of the south and southeast. Looking at the Collocated monitor as compared to the other monitoring sites located within the city, the data suggest the CAMS 52 monitoring site is a good indicator of air quality in regards to VOCs in Midlothian, and potentially is a worst-case indicator of air quality in regards to PM<sub>10</sub> metals in the area. Since the TCEQ CAMS 52 monitor is positioned downwind of TXI and Gerdau Ameristeel, when winds are southerly the measurable impact of local industry on ambient levels of PM<sub>10</sub> metals will be detected.

### ***What is the air quality close to schools and parks in Midlothian?***

Children are potentially more susceptible to pollutants and therefore concern has been expressed by the citizens over areas where they spend a large part of their time; schools and parks. The study was designed to answer this question by locating three of the mobile sites at schools, one of the mobile sites at a park, and one of the stationary sites at a park.

When comparing all of the data for the study, the measured concentrations of VOCs are similar across Midlothian, which includes two park locations and three school locations, and are likely not due to emissions from the cement plants but from a combination of mobile sources. The measured concentrations of PM<sub>10</sub> metals are, however, different across Midlothian, with relatively higher levels measured closer to industry and lower levels measured within the community, including the sites located at parks and schools. Except for Mountain Peak Elementary School, where higher levels of mercury were measured relative to the other schools. However, those levels were similar to other mercury levels measured by monitors in that sampling quarter and could not be attributed to nearby industry when looking at the wind directions. Overall, these data indicate that nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in the Midlothian area; however, those

contributions are slight, all measured levels are still well below their respective AMCVs, and both VOCs and PM<sub>10</sub> metals are not at levels of health concern.

The TD also looked specifically at each school and at the levels of detected pollutants to attempt to determine if pollutants were higher during school days. Since this was requested after the beginning of the study the original design of the study did not include this comparison; data for this comparison are limited. No clear discernable weekly pattern can be observed for VOCs and PM<sub>10</sub> metals from this limited dataset and therefore no clear conclusions can be drawn between weekend and weekdays specific to the school data.

### ***What percentage of total chromium does hexavalent chromium represent in Midlothian?***

The question of what is the contribution of hexavalent chromium (Cr<sup>6+</sup>) to total chromium was first brought up in the DSHS draft Health Consultation and has since become a concern for the citizens. Cr<sup>6+</sup> is the most toxic form of chromium, but typically does not constitute a large percentage of ambient total chromium<sup>2,3,4,5</sup> and is rapidly reduced to trivalent chromium (Cr III), a less toxic form, in the atmosphere<sup>6,7</sup>.

Based on the study data, the actual average contribution of Cr<sup>6+</sup> to total chromium in the Midlothian area is 1.07%, which is well below the assumption of 100% that DSHS used in their draft Health Consultation, as well below the USEPA default assumption of 34% used in the National-Scale Air Toxics Assessment (NATA). These analyses indicate that PM<sub>10</sub> Cr<sup>6+</sup> represents only a fraction of the total chromium measured in the Midlothian area.

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<sup>2</sup> Battelle Memorial Institute. 2003. Phase II air toxics monitoring data: analyses and network design recommendations. Available at: <http://www.ladco.org/toxics.html>.

<sup>3</sup> Bell, R.W. and J.C. Hipfner. 1997. Airborne Hexavalent chromium in southwestern Ontario. *J Air Waste Manage Assoc*, 47:905-910.

<sup>4</sup> Potvin Air Management Consulting. 2006. Informal Consultation on Local Air Issues in Sault Ste. Marie, Ontario-Michigan under the Canada-United States Air Quality Agreement: Technical Support Document on Air Quality 2001-2003. Summary Report Prepared for Environment Canada, U.S. Environmental Protection Agency, Ontario Ministry of the Environment, Michigan Department of Environmental Quality and Inter-Tribal Council of Michigan. Accessed January 15, 2008. [http://www.epa.gov/ARD-R5/transboundary\\_air\\_quality\\_study-final07-30-07.pdf](http://www.epa.gov/ARD-R5/transboundary_air_quality_study-final07-30-07.pdf)

<sup>5</sup> State of California Air Resources Board (ARB). 1986. Staff report: initial statement of reasons for proposed rulemaking: Public hearing to consider the adoption of a regulatory amendment identifying hexavalent chromium as a toxic air contaminant. <http://www.arb.ca.gov/toxics/id/summary/hex.pdf>

<sup>6</sup> ATSDR. 2000. Toxicological Profile for Chromium. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

<sup>7</sup> Werner Michelle L, Nico Peter S, Marcus Matthew A, and Anastasio Cort. 2007. Use of micro-XANES to speciate chromium in airborne fine particles in the Sacramento Valley. *Environ Sci Technol*, 41(14):4919-24.

## Background

In December of 2007, the Texas Department of State Health Services (DSHS) released for public comment their Draft Health Consultation: *Midlothian Area Air Quality Part 1: Volatile Organic Compounds (VOCs) and Metals* (hereafter referred to as the draft Health Consultation). In their draft Health Consultation, DSHS classified Midlothian, Texas (hereafter referred to as Midlothian) as an Indeterminate Public Health Hazard. There were four main reasons given for this classification:

- 1) Health-based screening values were not available for sixteen volatile organic compounds (VOCs) and two metals;
- 2) Due to the lack of Midlothian-specific hexavalent chromium ( $\text{Cr}^{6+}$ ) speciation data, all total chromium data was considered to be composed of 100% hexavalent chromium in the risk calculations;
- 3) The EPA National Ambient Air Quality Standards (NAAQS) compounds had not yet been evaluated by DSHS;
- 4) DSHS felt there were a limited number of monitors in Midlothian, and that their locations did not reflect community exposure.

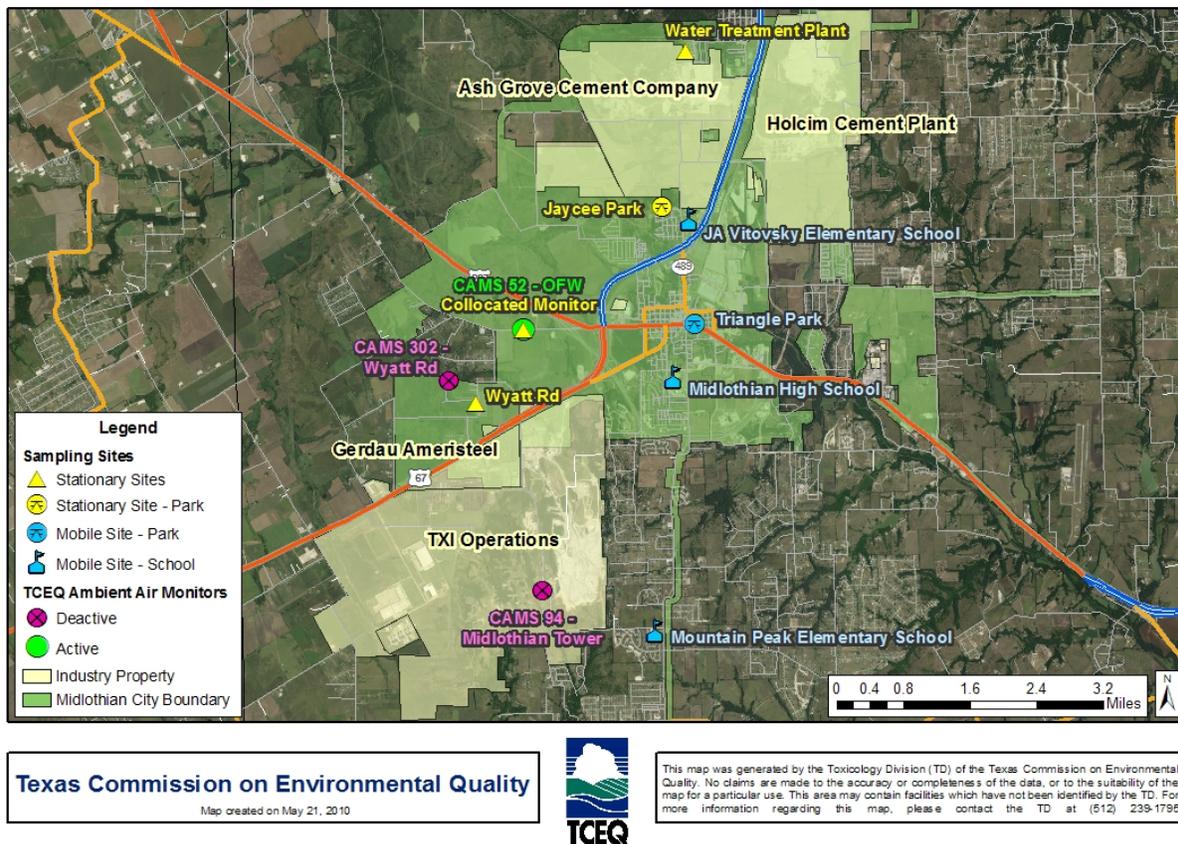
Essentially DSHS felt further information was needed to fully characterize the extent of any public health hazard posed by air contaminants in Midlothian. To-date, the draft Health Consultation has not been finalized. Currently, the Agency for Toxic Substances and Disease Registry (ATDSR) and DSHS are re-examining the health concerns of the Midlothian community. The first draft of four reports is expected to be posted for public comment in the summer of 2010.

There is a large volume of data from Midlothian. DSHS acknowledged this in a 1995 presentation at a Texas Natural Resource Conservation Commission (TNRCC) (predecessor agency for the Texas Commission on Environmental Quality (TCEQ)) public meeting in Midlothian:

“Never before in history has the agency, or its predecessor, the Texas Air Control Board, collected so many environmental samples, from so many different media, from so many sampling locations, analyzing for so many different compounds, and finding so few indications of even the mildest of health concern...They have collected hundreds of air samples...Except for a few isolated and transient examples, these levels have all been below (and, for the most part, far below) their respective ESLs (Effects Screening Levels). The ESLs themselves are levels which are generally 100 fold (or more) lower than the lowest level known to cause the slightest adverse effect or ‘Lowest Observable Adverse Effect Level’ (LOAEL). Consequently, the contaminant levels observed have been far, far below the lowest level that might potentially cause any adverse health effects.”

Routine VOC monitoring began in the Midlothian area in 1993 as part of the establishment of the Community Air Toxics Monitoring Network (CATMN) mandated by the Texas Legislature. VOC monitoring at up to three sites in the Midlothian area has continued until present. Routine metals monitoring in the Midlothian area has been conducted for various periods of time from 1981 to present, depending, at least in part, on the particle size of federal regulatory emphasis at the time. The VOC and metals air monitoring data from the Midlothian area compose an impressively rich data set, even with data gaps. The current monitor, CAMS 52, located in Midlothian is positioned predominantly downwind of TXI and Gerdau Ameristeel (formerly Chaparral Steel) (Figure 1).

## Midlothian, Texas Ambient Air Monitoring Locations and Sampling Sites



**Figure 1. Past and Current TCEQ CATMN and Midlothian Ambient Air Collection Monitor Locations.**

There have also been several special studies conducted in Midlothian at various periods over the past twenty years. These special studies include the collection of ambient air data apart from the CATMN network (i.e., event triggered samples, mobile monitoring, stack samples) (Tables 1 and 2), soil sampling (Table 3), groundwater sampling (Table 2), and vegetation sampling (Table 2). Both the TCEQ (TNRCC at the time) and the United States Environmental Protection Agency (EPA) conducted Risk Assessments in Midlothian in 1995 and 1996, respectively.

- *Critical Evaluation of the Potential Impact of Emissions from Midlothian Industries: A Summary Report.* TNRCC AS-71, October 25, 1995.
- *Screening Risk Analysis for the Texas Industries (TXI) Facility in Midlothian, Texas.* TNRCC AS-72, November 2, 1995. Supplemental documents:
  - Appendices 1-4. TNRCC AS-72A, Rev. – November 13, 1995.
  - Appendices 5-6. TNRCC AS-72B, November 2, 1995.
  - Executive Summary. TNRCC AS-72C, November 2, 1995.
- *Midlothian Cumulative Risk Assessment.* EPA-906-R-96-001, January 31, 1996.

**Table 1. TCEQ Stationary Monitor Locations in Midlothian, Texas, past and present.**

Site Description	Street Address	Sampler Type	Activated	Deactivated	Duration
1 Auger Road Water Treatment Plant	1969 Auger Road	PM <sub>10</sub>	1991	1994	2 yrs
2 Auger Road	801 Auger Road	PM <sub>10</sub>	1991	1993	2 yrs
3 Box Crow Cement Co	2 Tar Rd. Box 485	PM <sub>10</sub>	1993	1995	1 yr
4 Cedar Drive	1120A Cedar Drive	PM <sub>10</sub>	1992	1994	2 yrs
5 Cement Valley Road	3330 Cement Valley Road	PM <sub>10</sub>	1992	1992	6 mo
6 Chaparral Steel Company	2060 S. Hwy. 67	TSP Lead, PM <sub>10</sub>	1993	1999	6 yrs
7 City Hall Roof	235 8th St.	TSP	1981	1984	4 yrs
8 Gorman Road	5050 Gorman Road	PM <sub>10</sub>	1992	1993	1 yr
9 Hidden Valley Trail	491 Hidden Valley Trail	PM <sub>10</sub>	1992	1993	1 yr
<b>10 Midlothian OFW (CAMS 52)</b>	<b>2725 Old Fort Worth Road</b>	<b>CATMN, NOx, H<sub>2</sub>S, O<sub>3</sub>, Metals, SO<sub>2</sub></b>	<b>1994</b>	<b>ACTIVE</b>	<b>15 + yrs</b>
11 Midlothian Tower (CAMS 94)	4252 Waterworks Road	CATMN, NOx, H <sub>2</sub> S, O <sub>3</sub> , Metals, SO <sub>2</sub>	1994	2007	13 yrs
12 Midlothian Wyatt Rd (CAMS 302)	1241 East Wyatt Road	CATMN, NOx, H <sub>2</sub> S, Metals, SO <sub>2</sub>	2000	2006	5 1/2 yrs
13 Mt. Creek Water Supply	462 Waterworks Road	PM <sub>10</sub>	1992	1993	1 yr
14 Tayman Drive Water Treatment Plant	440 Tayman Drive	PM <sub>10</sub> , CATMN	1992	1997	5 yrs

\*For sites with multiple sampler types, different samplers were activated at different times; activated date refers to when the site was first activated.

PM<sub>10</sub> - Particulate Matter less than 10 µm in size (inhalable fraction) Sampler  
 TSP Lead - Total suspended particle lead Sampler  
 CATMN - Community Air Toxics Monitoring Network Canister Sampler  
 NOx - Nitrogen oxides Monitor  
 H<sub>2</sub>S - Hydrogen sulfide Monitor  
 O<sub>3</sub> - Ozone Monitor  
 Metals - Metal Sampler  
 SO<sub>2</sub> - Sulfur dioxide Monitor

**Table 2. TCEQ Mobile Monitoring, Event-Triggered, and Miscellaneous Air Samples in Midlothian, Texas.**

Mobile Monitoring Trips	# of Locations	Analysis
January 1991	19 Locations	H <sub>2</sub> S & SO <sub>2</sub>
November 1991	27 Locations	VOCs, PAHs, PM <sub>10</sub> , Metals, H <sub>2</sub> S, & SO <sub>2</sub>
June 1992	Samples collected downwind of TXI & NTCC during trial burns using waste derived fuel (WDF)	VOCs, PAHs, PM <sub>10</sub> , & Metals
June 1994	12 Locations	H <sub>2</sub> S & SO <sub>2</sub>
Event-Triggered Samples	# Collected	Analysis
1990 - 1995	~20	VOCs
Miscellaneous Air Samples		Analysis
Air samples near 'Slag Road' - To investigate if levels of Cr would be elevated in ambient air near roads where slag had been used		Cr & CrVI
Dioxin/Furan Stack Sampling	Conditions	Analysis
1991 - Honam, NTCC, & TXI	Sampling under conditions where coal is burned 100%; or where waste derived fule (WDF) is burned 36%, 60%, or 100%; or where tire derived fule (TDF) is burned 30%	Dioxins/Furans

PM<sub>10</sub> - Particulate Matter less than 10 µm in size (inhalable fraction)  
 VOCs - Volatile Organic Compounds  
 PAHs - Polycyclic Aromatic Hydrocarbons  
 Cr - Total chromium  
 CrVI - Hexavalent chromium  
 H<sub>2</sub>S - Hydrogen sulfide Monitor  
 SO<sub>2</sub> - Sulfur dioxide Monitor  
 NTCC - North Texas Cement Company

**Table 3. TCEQ Soil, Groundwater, and Miscellaneous Samples Collected in Midlothian, Texas.**

<b>Soil Sampling</b>	<b># of Locations</b>	<b>Analysis</b>
1991 - Metals Study	23 Locations + 2 Bkgd	Metals
1992 - Metals Study	40 Locations + 2 Bkgd	Metals
1994 - Metals Study	45 Locations + 2 Bkgd	Metals
1995 - Metals Study	80 Locations + 8 Bkgd	Metals
1995 - Chaparral Steel Special Study	22 Locations near plant	Metals - Agreed Order for Chaparral to further investigate soil, sediment, and water concentrations on their property and property they're leasing from TXI. Chaparral will also monitor ambient air north and south of their facility.
1995 - Dioxin/Furan Study	54 Locations + 6 Bkgd	Dioxins & Furans
2005 - Residential Soil Study	Various location on residential property	Metals, SVOCs, TPH, Pesticides, Herbicides, Dioxins, & Furans
<b>Groundwater Sampling</b>		<b>Analysis</b>
2005 - Residential Soil Study	Measured in conjunction with Residential Soil	Metals, VOCs, SVOCs, TPH, Pesticides, Herbicides, Dioxins, & Furans
<b>Miscellaneous Sampling</b>		<b>Analysis</b>
1995 - Hay	2 Locations	Metals
1995 - Miscellaneous Vegetation	12 Locations	Metals
1995 - Wheat	8 Locations	Metals
1995 - Slag	International Mill Service	Metals, Cr VI

TPH - Total Petroleum Hydrocarbons  
 VOCs - Volatile Organic Compounds  
 SVOCs - Semi-Volatile Organic Compounds  
 CrVI - Hexavalent chromium

Based on our current data, the TCEQ Toxicology Division (TD) does not have concerns regarding air quality in Midlothian. However, even though there is a very robust dataset for Midlothian, citizens of Midlothian are still concerned about the air quality in their city, especially with an Indeterminate Public Health Hazard finding from the draft Health Consultation. Therefore, in order to answer citizen questions and concerns with regard to air quality in their city since the release of the draft Health Consultation, as well as to potentially fill data gaps noted in the draft Health Consultation, the TCEQ funded a project for a third party to collect and analyze ambient air samples in Midlothian; *Ambient Air Sample Collection and Analytical Chemical Analysis*. The project was developed in conjunction with the citizens of Midlothian. A citizen advisory group, formed by the city, interacted with the TD to decide questions they wanted answered, what types of sampling they would like, what kinds of chemicals they would like analyzed, and where the sampling locations should be. DSHS was also included in these discussions to ensure necessary data gaps/concerns were addressed.

On May 9, 2008, the TCEQ TD issued a Request for Proposals (RFP) for the collection and analytical chemical analysis of ambient air samples in Midlothian. The contract was awarded to URS Corporation (hereafter referred to as URS) on August 22, 2008, and the sampling was completed by August 31, 2009.

Citizen questions/concerns identified by the focus group include:

- How are industries in Midlothian affecting air quality?
- Is the TCEQ every 6<sup>th</sup> day monitoring site an accurate representation of daily air concentrations in Midlothian?
- What is the air quality near schools and parks in Midlothian?
- What percentage of total chromium does hexavalent chromium represent in Midlothian?

Sampling for this project consisted of four separate events (quarters) over a one-year time span. For each sampling quarter, 24-hour samples were collected for five consecutive days at five different sampling locations. One sampling day each quarter coincided with the current every 6<sup>th</sup> day TCEQ sampling schedule at the TCEQ CAMS 52 sampling location in Midlothian. There were two types of sampling locations for this project; stationary and mobile. Stationary sites were sampled each of the four quarters while mobile sites were only sampled one of the four quarters.

Stationary sites included:

- Collocation with CAMS 52 (2725 Old Fort Worth Rd)
- Downwind of Gerdau Ameristeel (1291 E Wyatt Rd)
- Jaycee Park (1711 Meadow Ln)
- North of Ash Grove (Water Treatment Plant; 440 Tayman Dr)

Mobile sites included:

- Triangle Park (200 E Ave F)
- Midlothian High School (923 S 9th St)
- J.A. Vitovsky Elementary School (333 Church St)
- Mountain Peak Elementary School (5201 FM 663)

The original study design identified parks for all of the mobile sites; Triangle Park (200 E Ave G), Kimmel Park (801 W Ave F), Civic Center Park (224 S 11<sup>th</sup> St), and Hawkins Spring Park (1498 FM 1387). However, after the first sampling quarter, in which Triangle Park was sampled, the Midlothian School District Superintendent inquired about the possibility of changing sampling locations to include Midlothian area schools. With approval from the citizen advisory group the TCEQ authorized URS to replace the remaining mobile sites with three schools suggested by the Superintendent (listed above).

The 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> sampling quarters were completed December 6 – 10, 2008, February 26 – March 2, 2009, May 5 – 9, 2009, and July 3 – 7, 2009, respectively. *Sampling dates were not pre-determined, and were not publicly announced so that industry would not be privy to when the sampling was taking place.*

## Evaluation

For the purposes of this evaluation, the TD will only be evaluating and highlighting data collected during the *Midlothian, Texas Ambient Air Collection & Analytical Chemical Analysis* study. To maximize the amount of sampling for the available money, the study was bid by Tasks, in which the citizen advisory committee prioritized the sampling. The winning bid, by URS, was able to incorporate all Tasks requested. Table 4 shows each sampling site, they type of site it was, and the constituents that were measured. Ambient air concentrations of VOCs, aldehydes, and carbonyls (hereafter referred to collectively as VOCs) were measured at three of the four stationary sampling sites, as decided by the citizen advisory committee. The main concern of the citizen advisory committee for downwind of Gerdau Ameristeel was to measure metals; therefore, VOCs did not get bid in a Task for this location. Ambient air concentrations of metals were measured at all five of the stationary and all four of the mobile sampling sites.

**Table 4. Constituents Measured at Each Monitoring Site During Each Sampling Quarter.**

Monitor	Type	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
		VOCs	Metals	VOCs	Metals	VOCs	Metals	VOCs	Metals
Collocated with TCEQ CAMS 52	Stationary	✓	✓	✓	✓	✓	✓	✓	✓
Wyatt Rd	Stationary	x	✓	x	✓	x	✓	x	✓
Jaycee Park	Stationary	✓	✓	✓	✓	✓	✓	✓	✓
Water Treatment Plant	Stationary	✓	✓	✓	✓	✓	✓	✓	✓
Triangle Park	Mobile	✓	✓	x	x	x	x	x	x
Mountain Peak Elementary School	Mobile	x	x	✓	✓	x	x	x	x
JA Vitovsky Elementary School	Mobile	x	x	x	x	✓	✓	x	x
Midlothian High School	Mobile	x	x	x	x	x	x	✓	✓

✓ = Sampled and Analyzed For

x = Not Sampled or Analyzed For

Stationary = Sampled All 4 Quarters

Mobile = Sampled Only 1 of the 4 Quarters

The VOC data were compared to historical and current data, where possible, collected by the TCEQ at the CAMS 52 (Old Fort Worth Rd) monitoring site. There is currently a particulate matter less than 2.5 µm (PM<sub>2.5</sub>) sampler at the CAMS 52 site. However, the metals data collected for this study were particulate matter less than 10 µm (PM<sub>10</sub>), which is the fraction size DSHS suggested because generally the historical metals data for Midlothian are PM<sub>10</sub>. It is not technically accurate to compare PM<sub>10</sub> data to PM<sub>2.5</sub>. Therefore, the metals data were compared to historical levels at the former TCEQ CAMS 302 (also referred to as the Wyatt Rd site) monitoring site. Data evaluations included:

- Air Monitoring Comparison Value (AMCV) Screening
- Historical Data Comparisons
- Monitoring Site Comparisons
- Collocated Monitor Comparisons
- Directional Wind Rose Comparisons (metals only)
- School Comparisons
- Percent Hexavalent Chromium of Total Chromium (metals only)

For the purposes of this evaluation, only fifteen compounds will be highlighted below: 1,3-butadiene, benzene, ethylbenzene, toluene, *o*-xylene, *p*+*m*-xylene, acrolein, carbon disulfide, aluminum, total chromium, hexavalent chromium, manganese, lead, nickel, and mercury. The eight highlighted metals

represent the ones which citizens appear to be the most concerned about. The highlighted VOCs (i.e., BTEX compounds, 1,3-butadiene, acrolein, and carbon disulfide) represent the ones the public in general are concerned about, or the ones which showed slight exceedances of their respective AMCVs. Benzene is also a good benchmark chemical to use for all VOCs. Even though only fifteen compounds were highlighted, all compounds were evaluated from a health perspective.

For non-detected compounds, half the detection limit (DL) was used as a proxy value instead of zero (i.e., TD replaced all non-detects in the raw data with ½ their respective DL). *It is important to note that field blanks, field duplicates, and laboratory blanks indicate some level of metals are inherently present on the filters, which may bias all metals results high. However, all metals results are well below TCEQ health-based AMCVs; therefore, any bias this may introduce is not relevant to this evaluation.*

## Volatile Organic Compounds (VOCs)

### Air Monitoring Comparison Value (AMCV) Screening

For this study, the TD required a target compound list of 13 VOCs, based on the draft Health Consultation. However, URS subcontracted the analysis to Environmental Research Group (ERG), which analyzed the VOCs using EPA method TO-15, as required in the study contract. Since EPA method TO-15 analyzes for a full suite of 60 VOCs, the ERG lab reported all of the VOCs to URS. URS included all 60 analytes in the raw data given to TCEQ; therefore, even though only a few compounds are highlighted in this evaluation the TD did evaluate all 60 compounds. The full target analyte list can be found in Table 5 below. Ambient air concentrations of these 60 VOCs were measured at three of the four stationary sampling sites, as well as at all the mobile sites. All monitored concentrations were compared to TCEQ's health- and welfare-protective comparison values, including Effects Screening Levels (ESLs) and Reference Values (ReVs) or, collectively, air monitoring comparison values (AMCVs) where available. All measured concentrations of VOCs were well below their respective appropriate short- and long-term AMCVs, except for two short-term and three long-term exceedances of acrolein and one long-term exceedance of carbon disulfide.

**Table 5. Analyte list for VOCs and PM<sub>10</sub> Metals.**

VOCs			
1,1,1-Trichloroethane	Acrylonitrile	cis-1,3-Dichloropropene	n-Octane
1,1,2,2-Tetrachloroethane	Benzene	Dibromochloromethane	o-Dichlorobenzene
1,1,2-Trichloroethane	Bromochloromethane	Dichlorodifluoromethane	o-Xylene
1,1-Dichloroethane	Bromodichloromethane	Dichloromethane	p-Dichlorobenzene
1,1-Dichloroethene	Bromoform	Dichlorotetrafluoroethane	Propylene
1,2,4-Trichlorobenzene	Bromomethane	Ethyl Acrylate	Styrene
1,2,4-Trimethylbenzene	Carbon Disulfide	Ethyl tert-Butyl Ether	tert-Amyl Methyl Ether
1,2-Dibromoethane	Carbon Tetrachloride	Ethylbenzene	Tetrachloroethylene
1,2-Dichloroethane	Chlorobenzene	Hexachloro-1,3-butadiene	Toluene
1,2-Dichloropropane	Chloroethane	m,p-Xylene	trans-1,2-Dichloroethylene
1,3,5-Trimethylbenzene	Chloroform	m-Dichlorobenzene	trans-1,3-Dichloropropene
1,3-Butadiene	Chloromethane	Methyl Ethyl Ketone	Trichloroethylene
Acetonitrile	Chloromethylbenzene	Methyl Isobutyl Ketone	Trichlorofluoromethane
Acetylene	Chloroprene	Methyl Methacrylate	Trichlorotrifluoroethane
Acrolein	cis-1,2-Dichloroethylene	Methyl tert-Butyl Ether	Vinyl chloride
PM <sub>10</sub> Metals			
Aluminum	Chromium	Molybdenum	Uranium
Antimony	Cobalt	Nickel	Vanadium
Arsenic	Copper	Selenium	Zinc
Barium	Lead	Silver	
Beryllium	Manganese	Thallium	
Cadmium	Mercury	Thorium	

The TD uses AMCVs as an initial screening tool to determine a chemical's potential to cause short- and long-term adverse health effects, adverse vegetation effects, or odorous conditions. In general, the health-based AMCVs are set to provide a margin of safety, and are set well below levels at which adverse health effects are reported in the scientific literature. If a chemical concentration in ambient air is less than its comparison value, no adverse effects or odorous conditions are expected to occur. If a chemical concentration exceeds its comparison value, it does not necessarily mean that adverse effects will occur, but rather that further evaluation is warranted. Currently, AMCVs include interim ESLs, which are based on the generally conservative method of deriving health-protective air screening values historically used by TCEQ as well as some other states. However, in 2006 TCEQ adopted an updated ESL derivation process which incorporates the latest scientific methods and was peer reviewed by a panel of renowned external scientific experts. At some point in the future, updated ESLs will be derived for acrolein and carbon disulfide under that new process ([www.tceq.state.tx.us/comm\\_exec/forms\\_pubs/pubs/rg/rg-442.html/at\\_download/file](http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-442.html/at_download/file)). More detailed information on AMCVs may be accessed on the TCEQ public website: <http://www.tceq.state.tx.us/implementation/tox/AirToxics.html#amcv>.

### ***Acrolein***

The short-term AMCV for acrolein is 1 ppb<sub>v</sub>. There were two exceedances of the short-term AMCV. At the CAMS 52 collocated monitor (hereafter referred to as the Collocated monitor) on February 26, 2009, and at the Water Treatment Plant monitor on July 3, 2009, acrolein had measurements of 2.47 ppb<sub>v</sub> and 1.15 ppb<sub>v</sub>, respectively. The long-term AMCV for acrolein is 0.1 ppb<sub>v</sub>. There were three exceedances of the long-term AMCV when averaging all four quarters of data. At the Collocated monitor, at the Jaycee Park monitor, and at the Water Treatment Plant monitor, acrolein had overall study averages of 0.411 ppb<sub>v</sub>, 0.33 ppb<sub>v</sub>, and 0.314 ppb<sub>v</sub>, respectively. Since the mobile sites only collected five days of data and 5-day VOC data are not representative of long-term concentrations (i.e., annual averages at a minimum), these data cannot be appropriately evaluated using long-term comparison levels.

Acrolein is a very reactive component of ambient air that is formed from the breakdown of other organic chemicals. It can be emitted by several different types of sources (e.g., automobiles, power plants, natural and manmade fires, cigarettes) and due to its reactivity it is very difficult to reliably measure analytically in ambient air. The TCEQ currently utilizes two methods to analyze acrolein: with a 2,4-dinitrophenylhydrazine (DNPH) cartridge and with a SUMMA canister. The DNPH cartridge method has a large negative bias in the numbers and has approximately 40% recovery, but it is a stable, more precise method. The SUMMA canister method is overall more accurate but not as precise (40% low to 100% high). With this method, a large data set is ideal so that the average can be calculated, which will likely be close to the true concentration/accurate. Acrolein could be produced by reactions with other compounds in the canister, or could degrade within the canister and be lost. Therefore, when attempting to interpret one canister measurement, it is important to note that it could be very high or it could be very low.

Acrolein degrades quickly in water, soil, and air, and is therefore not expected to be environmentally persistent. According to the ATSDR<sup>8</sup>, average concentrations of acrolein at various ambient monitors range from 0.5 – 3.186 ppb. Urban background is generally 0.2 ppb, while as much as 5.6 ppb has been measured in large cities, and concentrations in the home can range from <0.02 – 12 ppb. Acute (short-term) exposure to sufficiently high concentrations of acrolein can cause nasal irritation; however, levels at which nasal irritation occurs are 300 ppb or greater. The two short-term exceedances of acrolein measured, which were 2.47 and 1.15 times higher than its AMCV, respectively, are well below the level

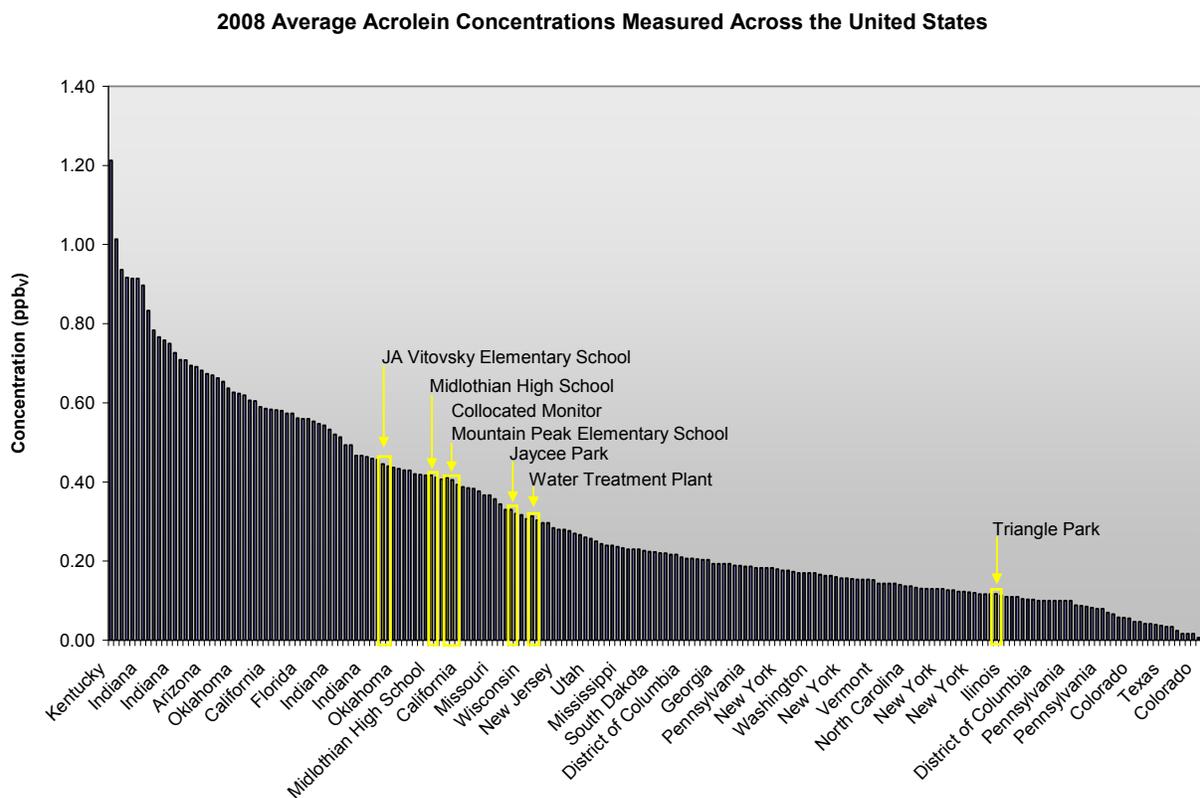
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<sup>8</sup> ATSDR. 2007. Toxicological Profile for Acrolein. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

at which a health effect would occur. *Therefore, we would not expect short-term exposures to these concentrations to be of a health concern.*

The EPA Schools Monitoring Initiative is also finding elevated levels of acrolein, relative to comparison levels, across the country. More information on acrolein from the EPA can be found here: <http://www.epa.gov/region09/air/schools-monitor/pdfs/Schools-Acrolein-Fact-Sheet.pdf>. The three long-term exceedances of acrolein measured, which were 4.11, 3.3, and 3.14 times higher than its AMCV, respectively, are within the range of average concentrations cited by ATSDR.

*When compared to averages of acrolein measured across the nation, the averages of acrolein from this study were also within the range of what is observed (Figure 2).*



**Figure 2. 2008 Average Acrolein Concentrations (ppbv) Measured Across the United States.** Data are from EPA's Air Quality System (AQS).

### ***Carbon Disulfide***

The long-term AMCV for carbon disulfide is 1 ppbv. There was one exceedance of the long-term AMCV at the Water Treatment Plant monitor, in which carbon disulfide had an overall study average of 1.69 ppbv. Since the mobile sites only collected five days of data, and 5-day VOC data are not representative of long-term concentrations (i.e., annual averages at a minimum), these data cannot be appropriately evaluated using long-term comparison levels.

The TCEQ's long-term AMCV for carbon disulfide is very conservative. This is evident when the long-term AMCV is compared to other agencies' long-term comparison values for carbon disulfide. These other values were derived using standard scientific, human health hazard assessment methodologies, as well as known effects levels. Table 6 presents long-term, health-protective air concentration comparison values derived by four other agencies. While these values differ in regard to their inherent level of conservativeness, they are all considered health-protective values for public exposure and demonstrate the greater conservativeness of TCEQ's long-term AMCV. However, the greater conservativeness of TCEQ's long-term AMCV should not be thought of as conferring a greater degree of health protection. If adverse health effects do not occur as a result of exposure to any of these health-protective levels, they may all be viewed as being associated with an equal level of human health protection.

**Table 6. Long-Term Health-Protective Air Concentration Comparison Values for Carbon Disulfide Derived by Agencies other than the TCEQ.**

Agency	Long-Term Comparison Value Name	Long-Term Comparison Value (ppb) <sup>a</sup>	Point-of-Departure <sub>HEC</sub> (ppb) <sup>b</sup>	Total Uncertainty Factor	Critical Study and Effect
ATSDR	Chronic Minimal Risk Level (MRL)	300	7,600 LOAEL [NOAEL (median) of 4,100 ppb]	30	Johnson et al. 1983 Nervous system/minimal decrease in nerve conduction velocity
CalEPA	Chronic Reference Exposure Level (REL)	300	2,540 BMCL <sub>05</sub>	10	See above
USEPA	Reference Concentration (RfC)	224	6,304 BMC <sub>10</sub> [NOAEL (mean) of 5,100 ppb]	30	See above
Health Canada	Tolerable Concentration (TC)	32	1,600 BMCL <sub>05</sub> [NOEL of 4,160 ppb]	50	See above

ATSDR = Agency for Toxic Substances and Disease Registry

CalEPA = California Environmental Protection Agency

USEPA = United States Environmental Protection Agency

LOAEL = lowest-observed-adverse-effect-level

BMC<sub>10</sub> = benchmark concentration at the 10% response level

BMCL<sub>05</sub> = benchmark concentration lower bound at the 5% response level

<sup>a</sup> Comparison values only given in µg/m<sup>3</sup> were converted to ppb using 1 µg/m<sup>3</sup> = 0.32 ppb.

<sup>b</sup> Human equivalent concentration point-of-departure (POD<sub>HEC</sub>) values only given in µg/m<sup>3</sup> were converted to ppb using 1 µg/m<sup>3</sup> = 0.32 ppb.

The long-term AMCV for carbon disulfide of 1 ppb is 32 – 300 times more conservative than the health-protective comparison values used by these other agencies. Additionally, the long-term AMCV is approximately 4,000 – 5,000 times lower than the no-observed-adverse-effect-levels (NOAELs) or no-observed-effect-levels (NOELs) identified by these agencies. The one long-term exceedance of carbon disulfide, which was 1.69 times higher than its AMCV, is well below the level at which a health effect would occur. *Therefore, we would not expect long-term exposures to these concentrations to be of a health concern.*

## Historical Data Comparisons

An important citizen question identified for this study includes: *How are industries in Midlothian affecting air quality?* During the course of the study, the TD was also made aware that citizens were concerned that the levels of chemicals released from the cement plant were much reduced as compared to what had been recently released due to the suspension of the operation of TXI's wet cement kilns. Just prior to the start of the study, TXI made the decision to idle their two operating wet cement kilns and continue to only operate their dry kiln. The decision, according to TXI, was due to the economic down turn, less demand for cement, and because the dry kiln produces larger yields and is more economical to operate.

In order to address the concerns of the citizens over the suspension of the operation of the two wet cement kilns, and to begin to answer the questions originally identified, the TD compared VOC levels to historical 24-hour every 6<sup>th</sup>-day VOC canister data from CAMS 52. Validated 24-hour canister data are currently available from March 29, 1997 to May 31, 2009. All historical VOC comparisons include this entire data range. Such a comparison can show if VOC levels at CAMS 52 have historically been higher than the measured levels for the study.

For this VOC evaluation, BTEX compounds (benzene, toluene, ethylbenzene, o-xylene, and p+m-xylene) and 1,3-butadiene were compared to their historical data. These six VOCs represent ones the public, in general, are concerned about, while benzene is also a good benchmark chemical to use for all VOCs because it's the national risk driver according to the USEPA National-Scale Air Toxics Assessment (NATA) as well as a multi-source chemical (i.e., mobile, industrial, natural). The TD conducted statistical comparisons (Figures 4 – 9; Appendix A) on all of the historical raw data versus all four quarters of the Collocated monitor raw data with Student's t-test using SigmaPlot v11.0 statistical graphing software. For an overview of the Student's t-test procedure, please see Figure 3.

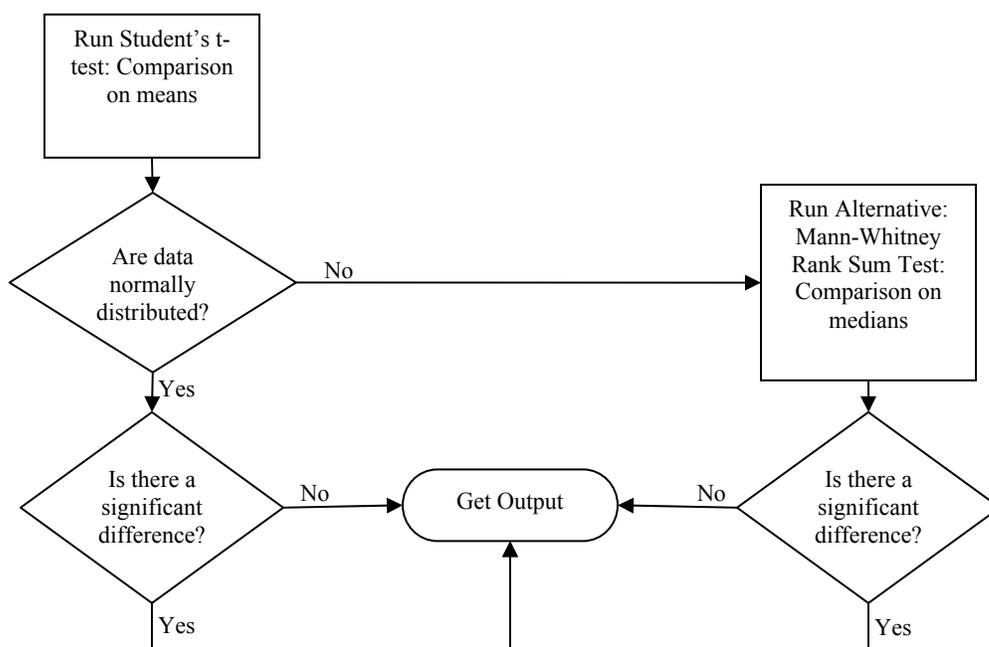


Figure 3. Flow-Chart of Student's t-test Statistical Comparisons.

When a Student's t-test is performed, if the data fails normality and/or the equal variance test ( $p < 0.05$ ), as an alternative, a Mann-Whitney Rank Sum Test is conducted. For this analysis data medians are compared and significant differences are determined if the difference in the median values between the compared groups are greater than would be expected by chance ( $p < 0.05$ ). If the data pass the normality test then data means are compared and significant differences are determined if the difference in the mean values between the compared groups are greater than would be expected by chance ( $p < 0.05$ ).

Eventhough all data failed the normality test ( $p < 0.05$ ) for this statistical comparison, which means there was not a normal distribution of the data, a non-parametric Mann-Whitney Rank Sum Test was used to determine statistical significance. According to this test, 1,3-butadiene and *o*-xylene historical data are significantly lower than the combined Collocated monitor data (Table 7). However, upon closer examination of the data the TCEQ method reporting limits (MRLs) for 1,3-butadiene and *o*-xylene are twice and 1.25 to 3 times higher, respectively, than the detection limits (DLs) achieved by the study's contract laboratory. For TCEQ data, a method detection limit (MDL) represents the point at which there is less than 99% confidence that the value is greater than background (or zero). The MRL is the value below which the instrument is not capable of measuring and reporting a value, and would be considered a non-detect. It is generally accepted that half of this value be used in place of zero for non-detected compounds (i.e., 0.005 ppb). Values below the MDL but above the MRL (i.e., "j-flagged" values) should be used without modification, because it is generally accepted that j-flagged values are better estimates than those provided by other methods. Approximately 91% and 53% of the TCEQ benzene and *o*-xylene data, respectively, are at or below the TCEQ MDLs. Essentially the comparisons between the data medians are unable to detect a true difference in data due to the majority of the TCEQ dataset being at or below the MDLs for these two chemicals.

The TD also conducted statistical comparisons (Figure 10; Appendix A) of the averages of the historical CAMS 52 monitor and the averages of each of the seven VOC monitoring sites using a One-Way Analysis of Variance (ANOVA). Based on this analysis, differences in the mean values among all of the monitoring sites were not great enough to exclude the possibility that differences were due to random sampling variability ( $\alpha = 0.05$ ), and therefore there were no significant differences observed between the CAMS 52 monitor and the seven VOC study monitors.

*Ultimately there were no significant differences found from these comparisons. Therefore, these analyses indicate that the measured concentrations of VOCs for the study are typical for this area as compared with the historical CAMS 52 monitor data. Since no differences were found between the historical data and all seven of the VOC monitors across Midlothian, these data also indicate that CAMS 52 is a good indicator of VOC measurements across Midlothian (Figure 11).*

**Table 7. Mann-Whitney Rank Sum Test comparing TCEQ CAMS 52 to the Collocated Study Monitor.**

VOC	Monitor	Median	Significantly Different	P-value
1,3-Butadiene	CAMS 52	0.005		
	Collocated Monitor	0.011	Yes	<0.001
Benzene	CAMS 52	0.200		
	Collocated Monitor	0.206	No	0.770
Toluene	CAMS 52	0.160		
	Collocated Monitor	0.150	No	0.285
Ethylbenzene	CAMS 52	0.0200		
	Collocated Monitor	0.0245	No	0.148
<i>p+m</i> -Xylene	CAMS 52	0.0600		
	Collocated Monitor	0.0525	No	0.730
<i>o</i> -Xylene	CAMS 52	0.010		
	Collocated Monitor	0.026	Yes	0.022

Significance level is  $P > 0.05$

Historical 1,3-Butadiene Concentrations at the TCEQ CAMS 52  
Ambient Air Monitor Compared to the Collocated Monitor

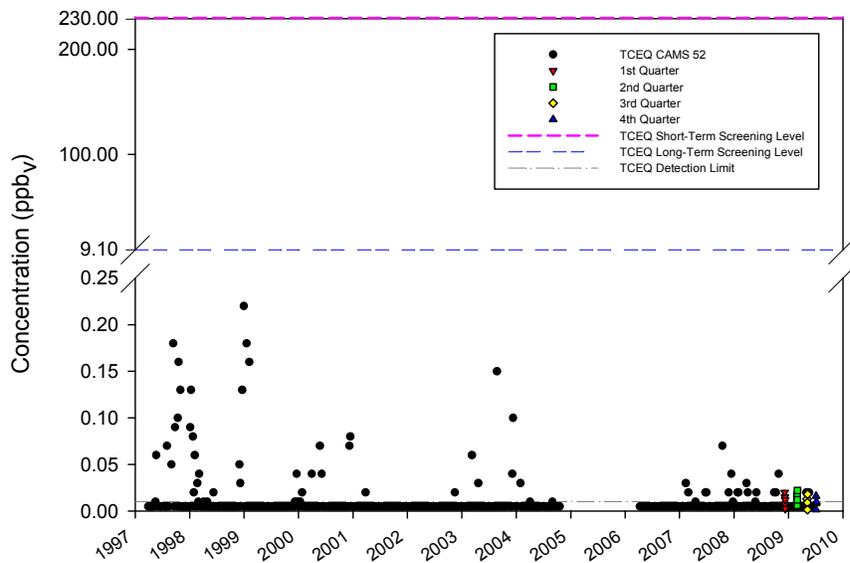


Figure 4. Historical 1,3-Butadiene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.

Historical Benzene Concentrations at the TCEQ CAMS 52  
Ambient Air Monitor Compared to the Collocated Monitor

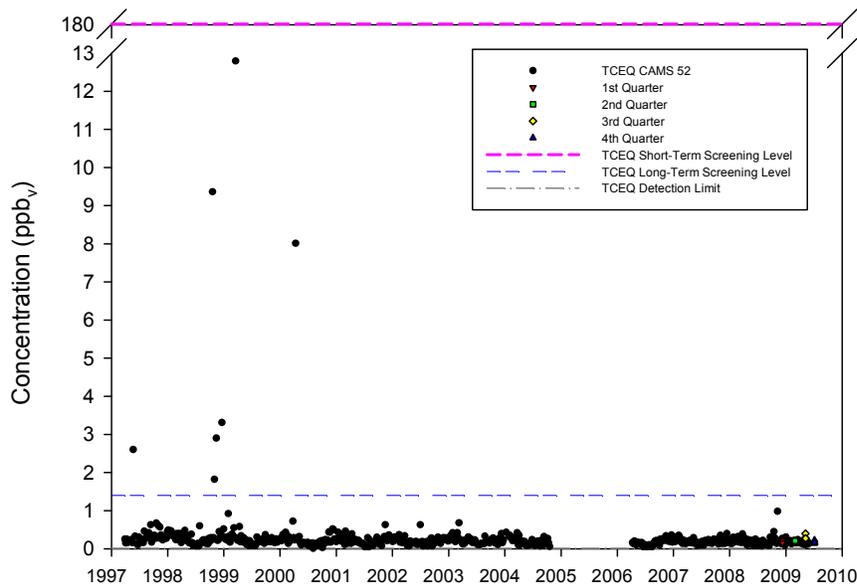
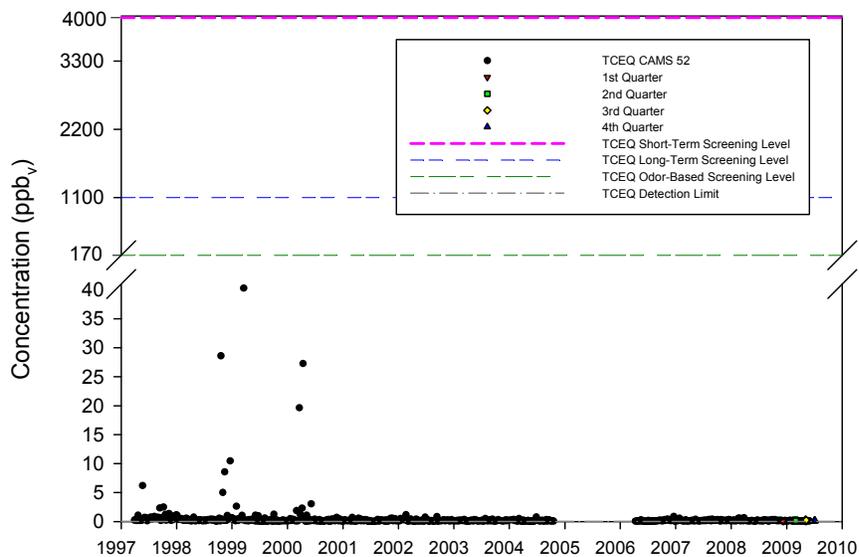


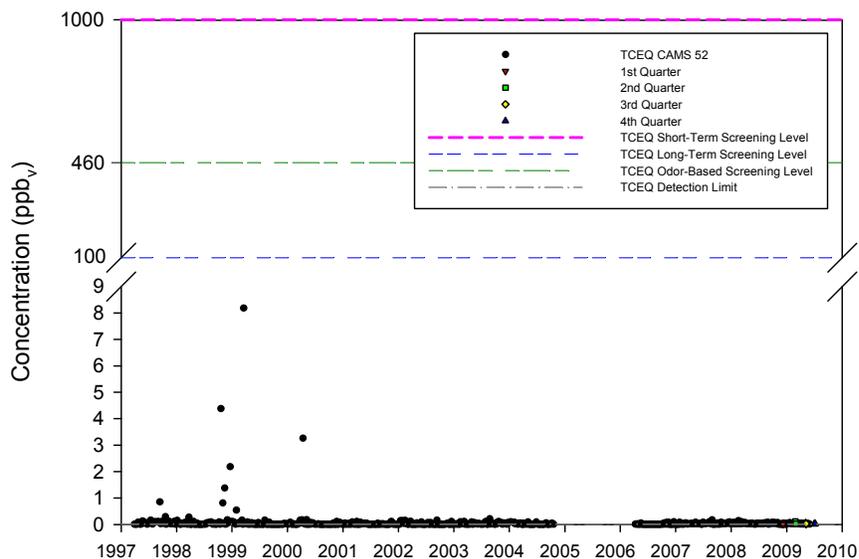
Figure 5. Historical Benzene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.

### Historical Toluene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor



**Figure 6. Historical Toluene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.**

### Historical Ethylbenzene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor



**Figure 7. Historical Ethylbenzene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.**

Historical *p+m*-Xylene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor

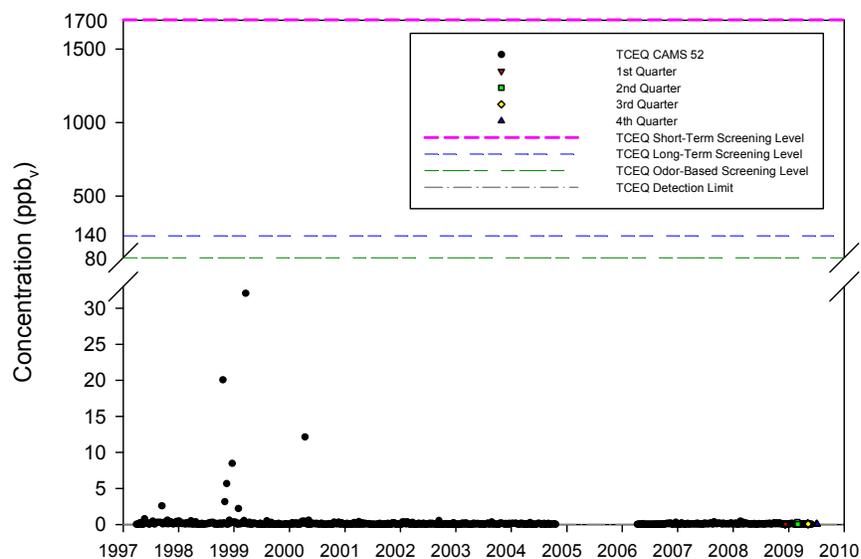


Figure 8. Historical *p+m*-Xylene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.

Historical *o*-Xylene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor

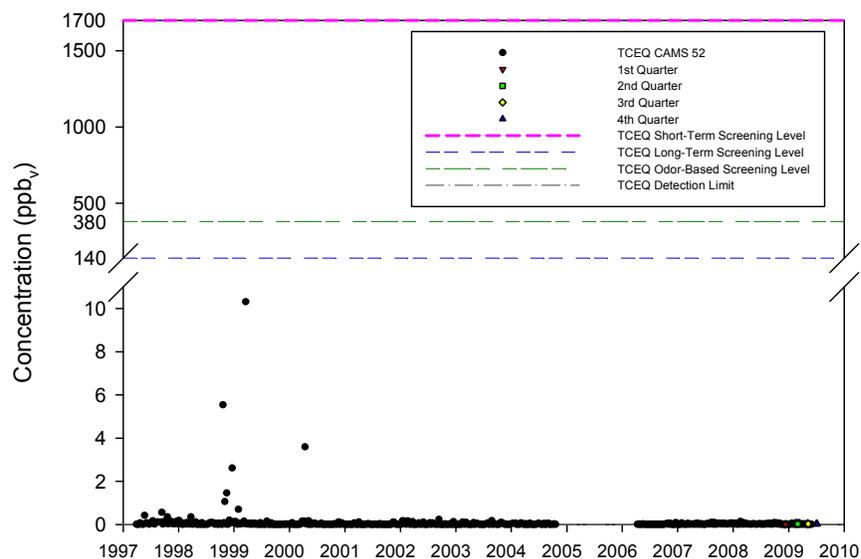


Figure 9. Historical *o*-Xylene Concentrations at the TCEQ CAMS 52 Ambient Air Monitor Compared to the Collocated Monitor.

Average Concentrations Measured at the TCEQ CAMS 52 Ambient Air Monitor and at Each Study Sampling Site

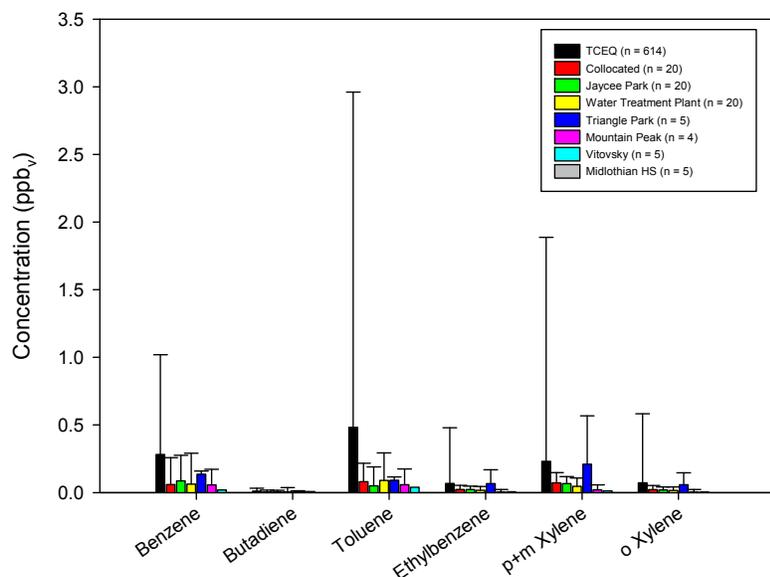


Figure 10. Average VOC Concentrations  $\pm$  Standard Deviation Measured at the TCEQ CAMS 52 Ambient Air Monitor and at Each Study Sampling Site.

Average Concentration Measured at the TCEQ CAMS 52 Ambient Air Monitor and at All Sampling Sites in the Study

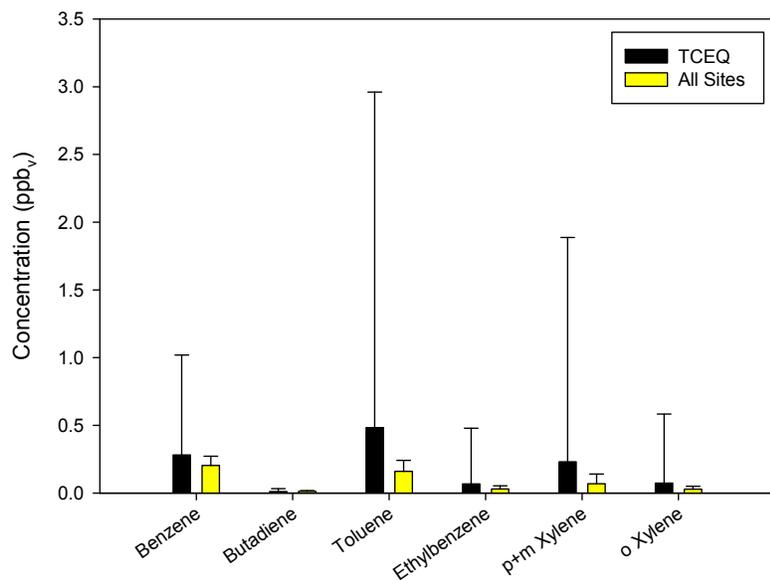


Figure 11. Average VOC Concentration  $\pm$  Standard Deviation Measured at the TCEQ CAMS 52 Ambient Air Monitor and at All Sampling Sites in the Study.

## Collocated Monitor Comparisons

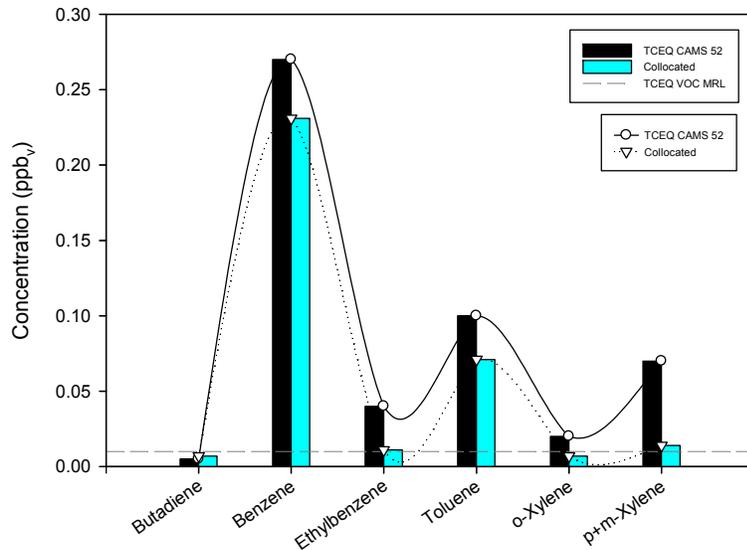
This comparison is designed to help answer, in regards to VOCs, the citizen question: *Is the TCEQ every 6<sup>th</sup> day monitoring site an accurate representation of daily air concentrations in Midlothian?* There are two interpretations for this question. The first is, are the data from the TCEQ CAMS 52 monitor representative of concentrations in the city? The second is, are the industries increasing emissions on non-regulatory sampling days? For this study, a monitor was collocated with the TCEQ CAMS 52 monitor, which is predominately downwind of TXI and Gerdau Ameristeel. One day out of each sampling quarter overlapped with the existing TCEQ every 6<sup>th</sup>-day ambient air monitoring schedule. The monitoring schedule is ongoing and predetermined by EPA; previous and current sampling calendars can be found here: <http://www.epa.gov/ttnamti1/calendar.html>. The overlapping sampling days and concentrations are listed in Table 8.

**Table 8. Overlapping TCEQ CAMS 52 and Collocated Monitor Sampling Days.**

Compound	December 8, 2008 Concentration (ppb <sub>v</sub> )		March 2, 2009 Concentration (ppb <sub>v</sub> )		May 7, 2009 Concentration (ppb <sub>v</sub> )		July 6, 2009 Concentration (ppb <sub>v</sub> )	
	TCEQ CAMS 52	Collocated	TCEQ CAMS 52	Collocated	TCEQ CAMS 52	Collocated	TCEQ CAMS 52	Collocated
1,3-Butadiene	0.005	0.007	0.005	0.022	0.005	0.009	0.005	0.009
Benzene	0.27	0.231	0.21	0.21	0.18	0.246	0.13	0.227
Ethylbenzene	0.04	0.011	0.03	0.028	0.02	0.024	0.04	0.019
Toluene	0.1	0.071	0.17	0.173	0.1	0.142	0.19	0.11
<i>o</i> -Xylene	0.02	0.007	0.03	0.026	0.005	0.033	0.04	0.017
<i>p+m</i> -Xylene	0.07	0.014	0.08	0.06	0.04	0.056	0.09	0.012

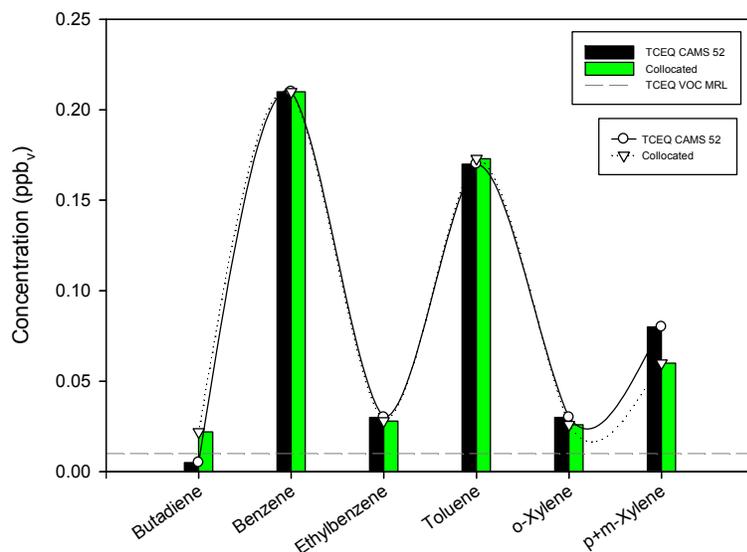
Since there were only two samples collected on the overlapping sampling day, one from each monitor, a statistical analysis of the individual data pairs could not be performed. However, a comparison could be conducted on a grouping of the four TCEQ every 6<sup>th</sup>-day samples as compared to the corresponding four Collocated monitor samples. Such a comparison would help show if any statistical differences existed between the two sample sets. Therefore, the TD conducted this statistical comparison (Appendix B) using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. Only one out of the six data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). The one that failed was run using the Mann-Whitney Rank Sum Test. Only one significant difference was found; according to the t-test the 1,3-butadiene Collocated monitor samples were significantly higher than the TCEQ samples. When looking closer at the data, all four TCEQ 1,3-butadiene samples were non-detect, in which case  $\frac{1}{2}$  the MRL was used for comparisons. Since all four TCEQ 1,3-butadiene samples are below the MRL, there is no way to know if this detected difference is actually statistically significant or not. Qualitatively, the pattern and concentrations of the two samples are very similar (Figures 12 – 15). *Since the only statistical difference was detected from a comparison on non-detect samples to detected samples, and all other comparisons found no statistical differences between the TCEQ CAMS 52 every 6<sup>th</sup>-day data and the corresponding Collocated monitor data, this indicates that the TCEQ CAMS 52 ambient air monitor is an accurate representation of VOC air concentrations measured at this site. Also, the assumption can be made that the Collocated monitor is a good representation of what the CAMS 52 monitor would measure.*

December 8, 2008  
 Comparison of TCEQ CAMS 52 Ambient Air Monitor  
 with the Collocated Monitor



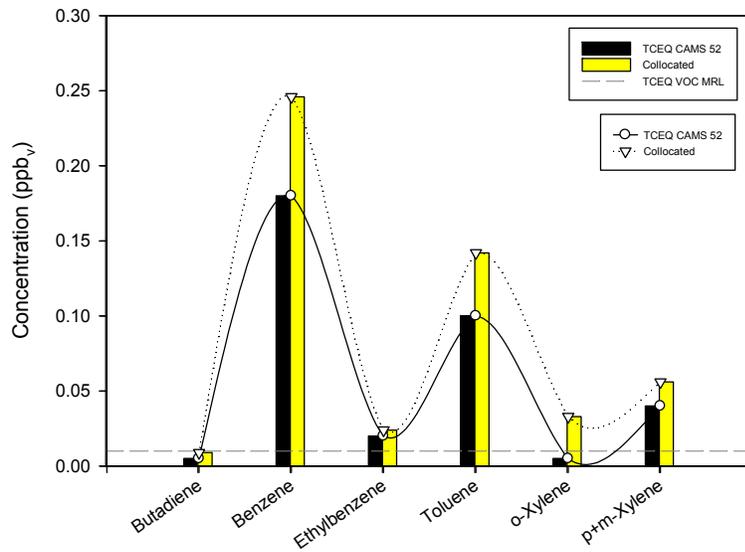
**Figure 12. December 8, 2008 Comparison of TCEQ CAMS 52 Ambient Air Monitor with the Collocated Study Monitor.**

March 2, 2009  
 Comparison of TCEQ CAMS 52 Ambient Air Monitor  
 with the Collocated Monitor



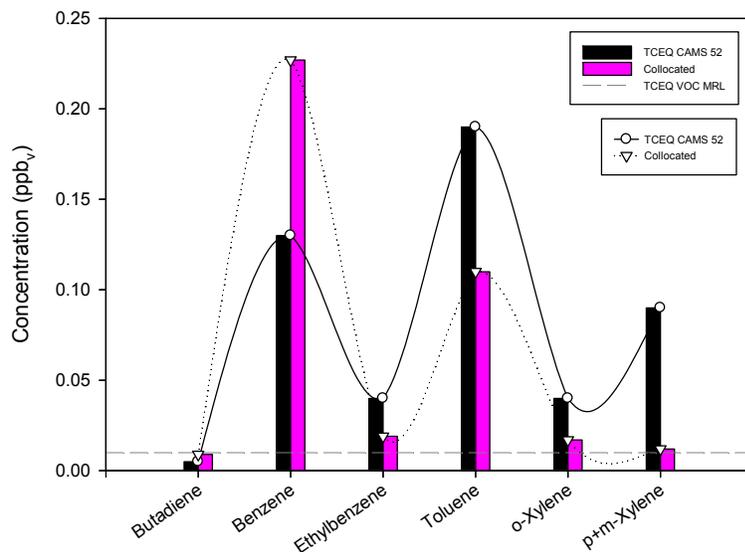
**Figure 13. March 2, 2009 Comparison of TCEQ CAMS 52 Ambient Air Monitor with the Collocated Study Monitor.**

May 7, 2009  
 Comparison of TCEQ CAMS 52 Ambient Air Monitor  
 with the Collocated Monitor



**Figure 14. May 7, 2009 Comparison of TCEQ CAMS 52 Ambient Air Monitor with the Collocated Study Monitor.**

July 6, 2009  
 Comparison of TCEQ CAMS 52 Ambient Air Monitor  
 with the Collocated Monitor



**Figure 15. July 6, 2009 Comparison of TCEQ CAMS 52 Ambient Air Monitor with the Collocated Study Monitor.**

Since there was only one every 6<sup>th</sup>-day sample corresponding to the five Collocated monitor samples per quarter a statistical analysis of the individual 6<sup>th</sup>-day sample paired with the surrounding four days of samples could not be performed. However, a comparison could be conducted on a grouping of the four TCEQ every 6<sup>th</sup>-day samples as compared to the surrounding sixteen Collocated monitor samples. Such a comparison would help show if any statistical differences existed between the two sample sets. Therefore, the TD conducted this statistical comparison (Appendix B) using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. All but one of the six data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. No significant differences were found between the every 6<sup>th</sup>-day samples and the other study sampling days. *The lack of significant difference between the TCEQ every 6<sup>th</sup>-day samples and the other sixteen days of surrounding Collocated monitor samples indicates that there is no difference between a regulatory every 6<sup>th</sup>-day sampling day and the other sampled days during this study. Since the sampling dates were not released publicly the assumption can be made that this is representative of typical conditions throughout the year.*

Using the assumption from above that the TCEQ CAMS 52 and the Collocated monitor data are similar, the TD conducted statistical comparisons (Appendix B) between the Collocated monitor data and all of the other six study VOC monitoring sites using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. All but four data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. Significant differences are as follows:

- Benzene
  - Collocated monitor *significantly higher than* Mountain Peak and Midlothian High School

When looking at the graphed data, the Mountain Peak and Midlothian High School data have a similar pattern to the Collocated monitor data, as well as similar daily wind patterns to the Collocated monitor data (Figure 16). Both the Mountain Peak and Midlothian High School benzene concentrations are lower than those measured at the Collocated monitor; the CAMS 52 monitoring site concentrations were significantly higher than at the other two monitoring sites. *Since only one VOC, benzene, showed any differences at two of the six sites compared to the Collocated monitor, these comparisons indicate that the CAMS 52 monitoring site is a good indicator of air quality in regards to VOCs in Midlothian.*

### Comparison of Statistically Significant Different Monitors: Collocated vs. Mountain Peak and Midlothian High School Benzene Data

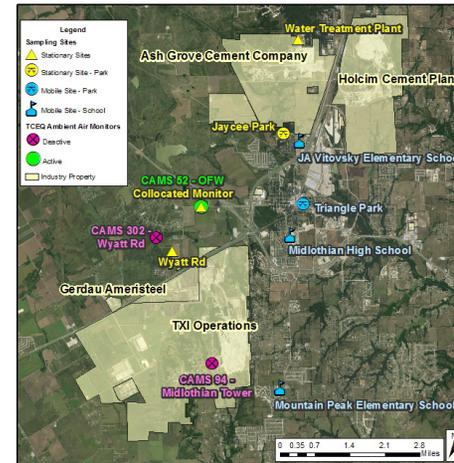
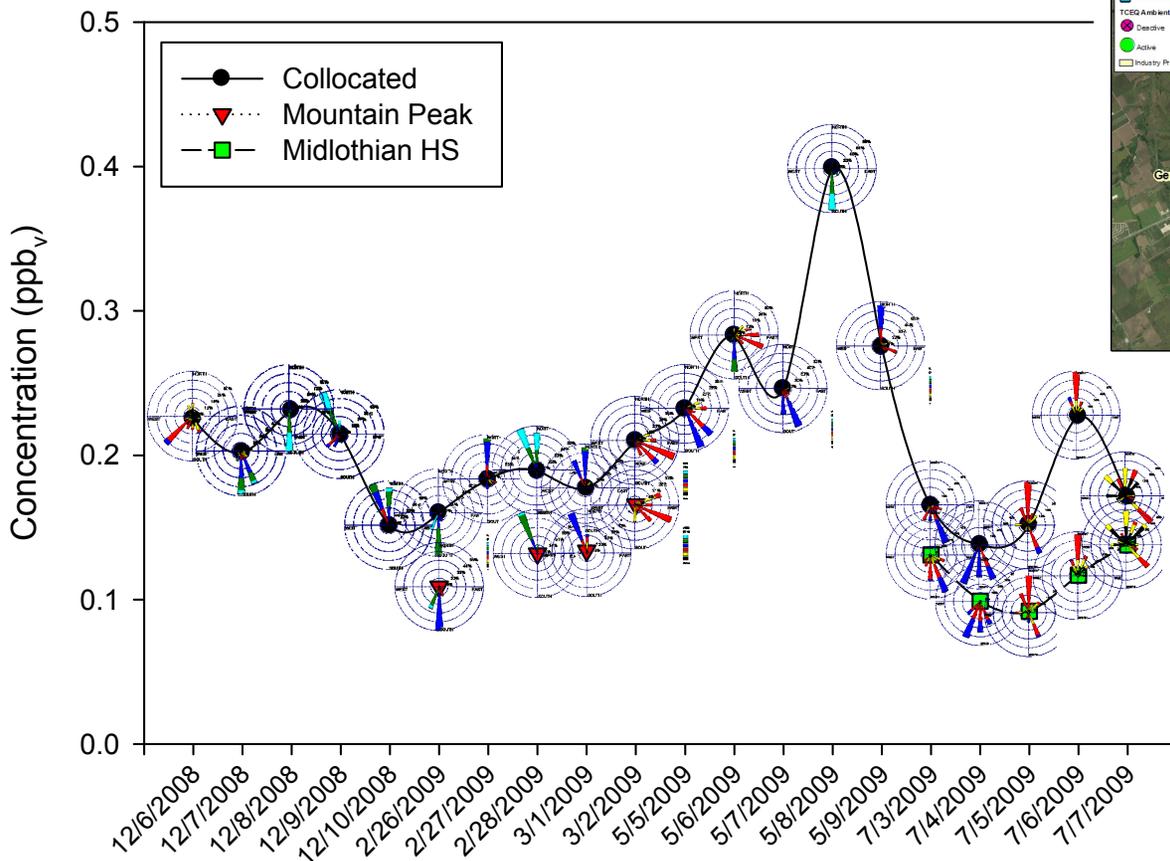


Figure 16. Observed Statistical Differences in Benzene Data for Collocated Monitor Comparisons with Daily Wind Rose Overlays.

## Monitoring Site Comparisons

Comparisons between the monitoring sites were designed to help answer, in regards to VOCs, the citizen question: *How are industries in Midlothian affecting air quality?* For this section, several different comparisons were conducted:

- Comparisons with all four quarters of data
  - Stationary sites
  - Mobile sites
  - All sites
- Comparisons of individual quarterly data
- Seasonal variation comparisons

### Comparisons with All Four Quarters of Data

Multiple comparisons with all four quarters of data were performed in order to identify statistical differences. The TD conducted statistical comparisons (Appendix C; Raw Data Figures K-1 – K-6) between the three stationary, four mobile, and all seven VOC monitoring sites using an ANOVA. For an overview of the ANOVA procedure, please see Figure 17.

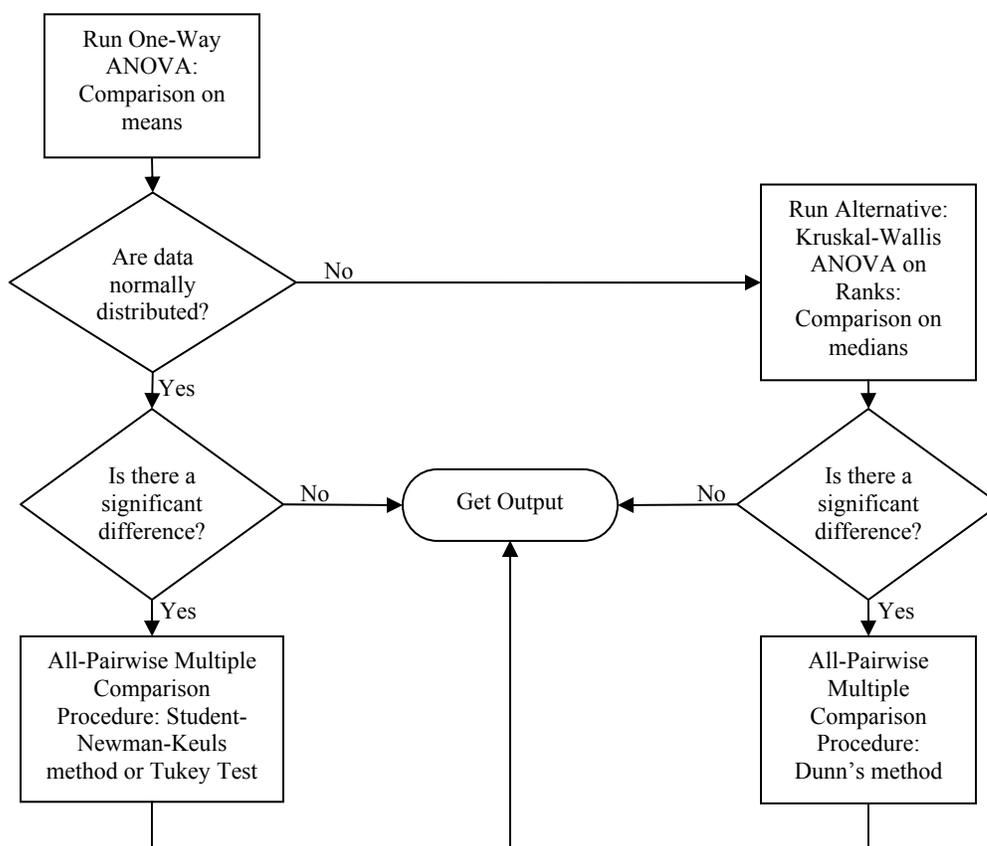


Figure 17. Flow-Chart of ANOVA Statistical Comparisons.

When an ANOVA is performed, if the data fails normality and/or the equal variance test ( $p < 0.05$ ), as an alternative, an ANOVA on Ranks is conducted using the Kruskal-Wallis One-Way Analysis of Variance

on Ranks. For this analysis data medians are compared and significant differences are determined if the difference in the median values between the compared groups are greater than would be expected by chance ( $p < 0.05$ ). If significant differences are found an All-Pairwise Multiple Comparison Procedure is performed using Dunn's Method. If the data pass the normality test then data means are compared and significant differences are determined if the difference in the mean values between the compared groups are greater than would be expected by chance ( $p < 0.05$ ). If a significant difference is found, the Holm-Sidak, Student-Newman-Keuls, or the Tukey Test methods are used to perform an All-Pairwise Multiple Comparison Procedure.

All but two data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on ranks. Significant differences are as follows:

- Benzene (Mobile Sites)
  - Midlothian HS *significantly lower than* Triangle Park and JA Vitovsky
- Benzene (All Sites)
  - Midlothian HS *significantly lower than* JA Vitovsky

The only significant differences that were observed were between data from mobile sites. Mobile site data were collected in different sampling quarters and therefore also have different wind directions. Because these data don't have common sampling conditions a comparison between mobile sites is not an apples-to-apples comparison. While this is not an apples-to-apples comparison, the comparison was still conducted to illustrate that differences would likely exist. When looking at the graphed data (Figure 18), the daily wind patterns are very different for all three sites, as would be expected since sampling was conducted in different months. The benzene patterns are also different between these monitors, which would also be expected due to sampling being conducted at different times. *Since only one VOC showed a difference between the mobile sites (benzene), the majority of these data indicate that there are no differences between the stationary sites and the stationary and mobile sites for VOCs in this area. This indicates the sources of benzene, and VOCs in general, are likely not the identified industry in Midlothian, and are potentially due to mobile source contributions.*

### Statistically Different Monitoring Sites: Benzene ANOVA

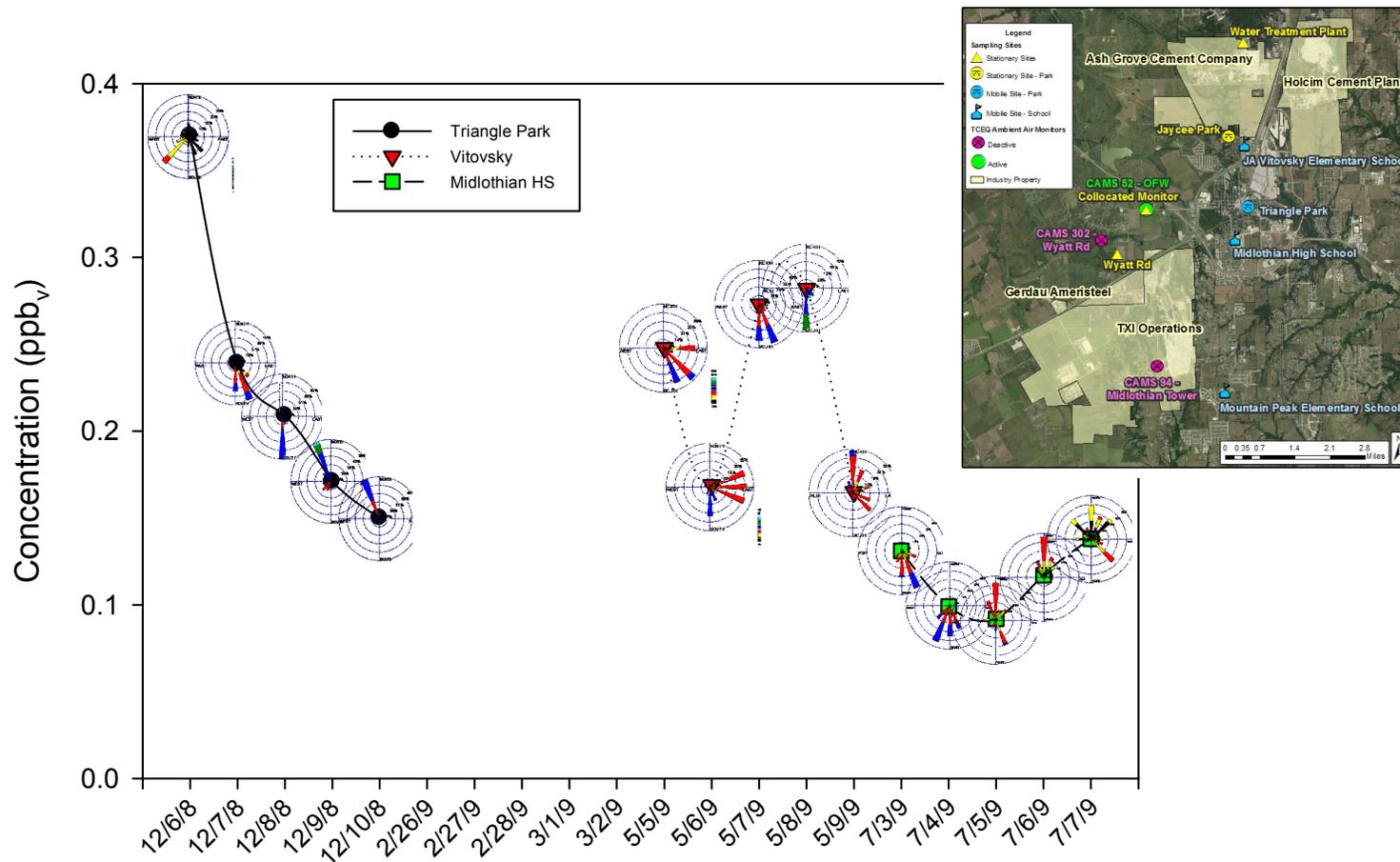


Figure 18. Observed Statistical Differences in Benzene Data ANOVA Analysis between Mobile and All Site Comparisons with Daily Wind Rose Overlays.

## Comparisons of Individual Quarterly Data

A comparison between all four sampling sites for each quarter was performed to determine any statistical differences. The TD conducted statistical comparisons (Appendix D; Raw Data Figures K-7 – K-30) between the four VOC monitoring sites for each quarter using an ANOVA. For an overview of the ANOVA procedure, please see Figure 17. Eleven of the twenty four data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences are as follows:

- Benzene (2<sup>nd</sup> Quarter)
  - Collocated monitor *significantly higher than* Water Treatment Plant and Mountain Peak
- Benzene (4<sup>th</sup> Quarter)
  - Midlothian High School *significantly lower than* Collocated and Water Treatment Plant

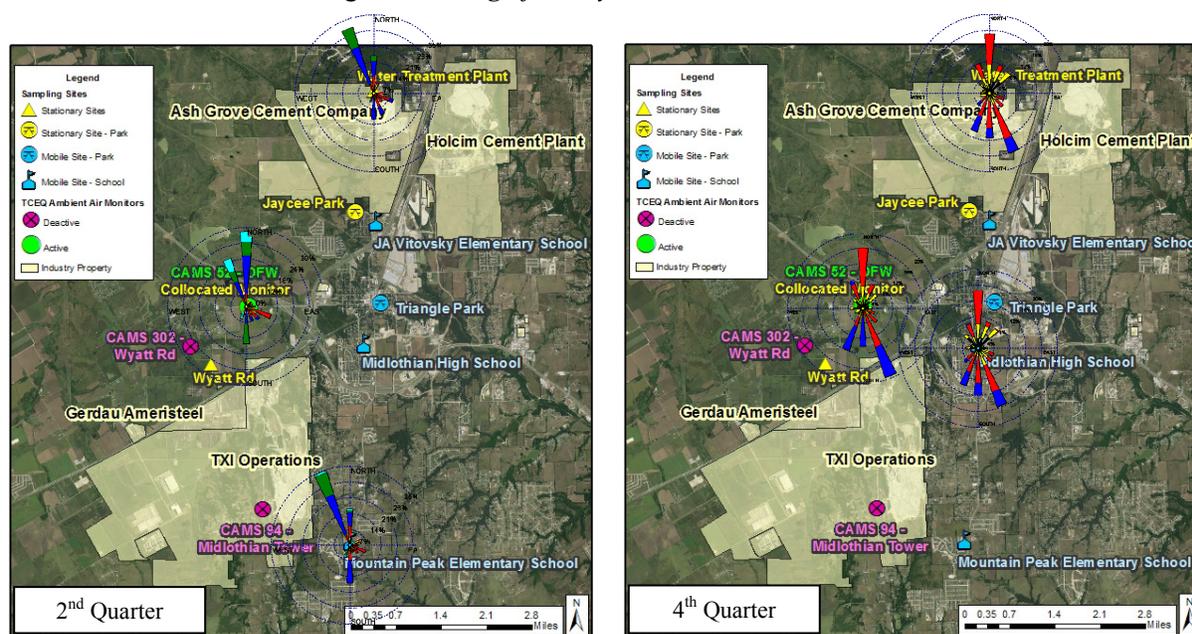


Figure 19. Maps Showing Quarterly Average Wind Directions for Significantly Different Monitoring Sites.

Figure 19 shows the quarterly average wind direction for the monitoring sites with significant differences. When looking at the graphed data for the second quarter (Figure 20), the Collocated, Water Treatment Plant and Mountain Peak monitors all have a similar pattern and daily wind patterns for this quarter. Both the Water Treatment Plant and the Mountain Peak Elementary School benzene concentrations are lower than those measured at the Collocated monitor. For the fourth quarter graphed data (Figure 21), the Midlothian High School benzene concentrations are lower than those measured at the Collocated and Water Treatment Plant monitors, which had a similar pattern in the data. While the benzene patterns at these monitors are similar, when looking at the wind direction the highest measurements do not necessarily correspond to days when the winds put the monitors downwind of industry. *This indicates the sources of benzene, and VOCs in general, are likely not the identified industry in Midlothian.*

### Statistically Different 2nd Quarter Sites: Collocated vs Water Treatment Plant & Mountain Peak Benzene ANOVA

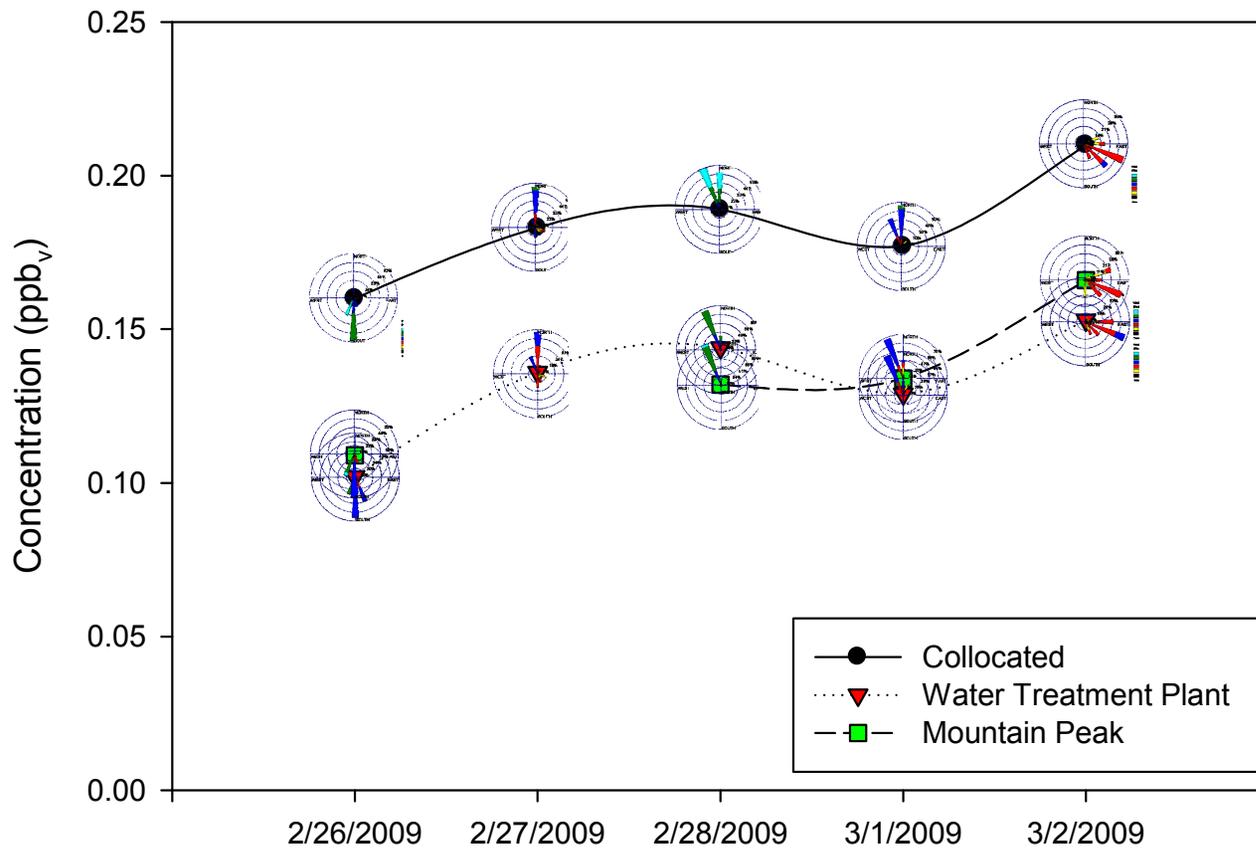


Figure 20. Statistically Different Second Quarter Monitoring Sites with Daily Wind Rose Overlays: Benzene.

### Statistically Different 4th Quarter Monitoring Sites: Collocated & Water Treatment Plant vs Midlothian HS Benzene ANOVA

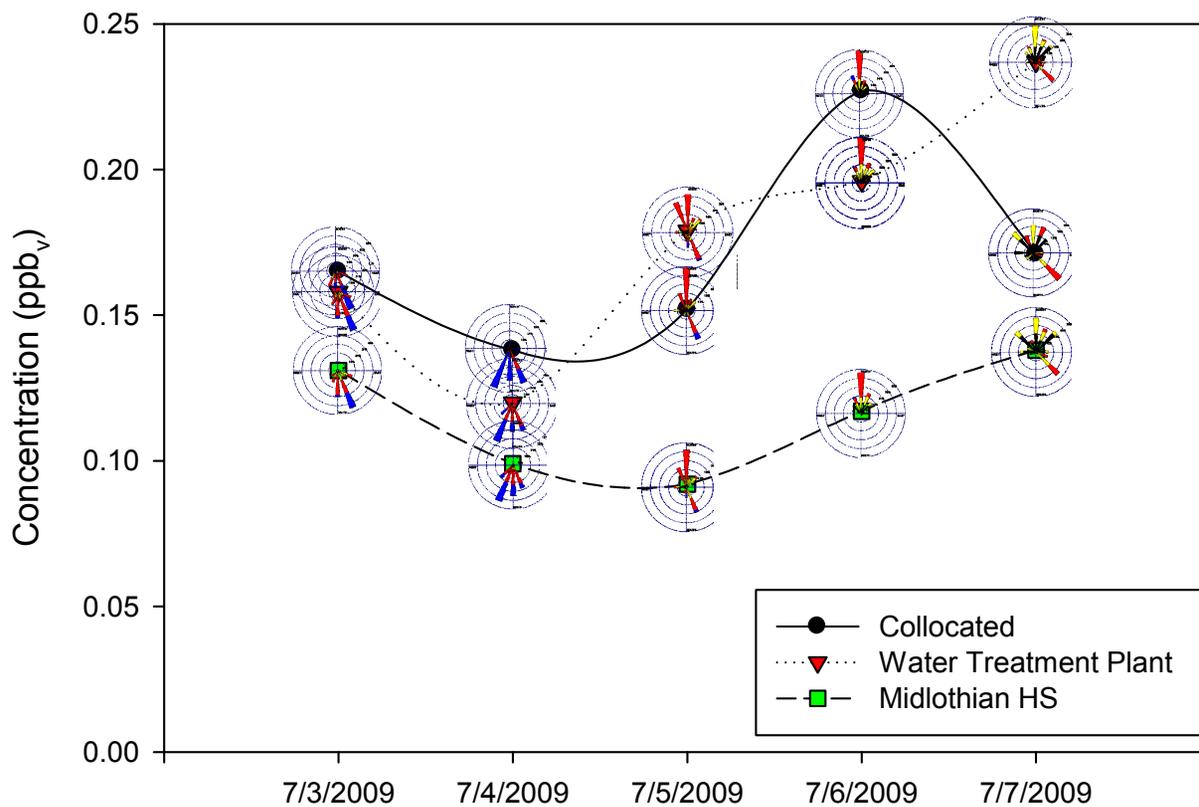


Figure 21. Statistically Different Fourth Quarter Monitoring Sites with Daily Wind Rose Overlays: Benzene.

## Seasonal Variation

Since this study was conducted over four different sampling quarters over the span of one year it stands to reason that wind direction may influence some observed differences in the data. Samples were collected in December, 2008 (1<sup>st</sup> quarter), February/March, 2009 (2<sup>nd</sup> quarter), May, 2009 (3<sup>rd</sup> Quarter), and July, 2009 (4<sup>th</sup> quarter). The span of the sampling months represents the winter, spring, and summer seasons. Typically, predominant wind directions in the summer are out of the southeast while in the winter more northerly winds are observed. The overall predominant wind direction for this area is out of the south. The question is, how does this affect the data comparisons; are there seasonal variations in the data due to differences in wind direction? This section is designed to provide insight into this question. The TD did a comparison of the quarterly data for each site to determine if there were any statistical differences observed between quarters using an ANOVA (Appendix E). For an overview of the ANOVA procedure, please see Figure 17. Nine of the eighteen data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences are as follows:

- Collocated monitor
  - Benzene:
    - 3<sup>rd</sup> Quarter data *significantly higher than* 1<sup>st</sup>, 2<sup>nd</sup>, and 4<sup>th</sup> Quarter data
- Jaycee Park
  - Benzene:
    - 3<sup>rd</sup> Quarter data *significantly higher than* 4<sup>th</sup> Quarter data
  - Ethylbenzene:
    - 2<sup>nd</sup> Quarter data *significantly higher than* 1<sup>st</sup> and 4<sup>th</sup> Quarter data
- Water Treatment Plant
  - Benzene:
    - 3<sup>rd</sup> Quarter data *significantly higher than* 1<sup>st</sup>, 2<sup>nd</sup>, and 4<sup>th</sup> Quarter data

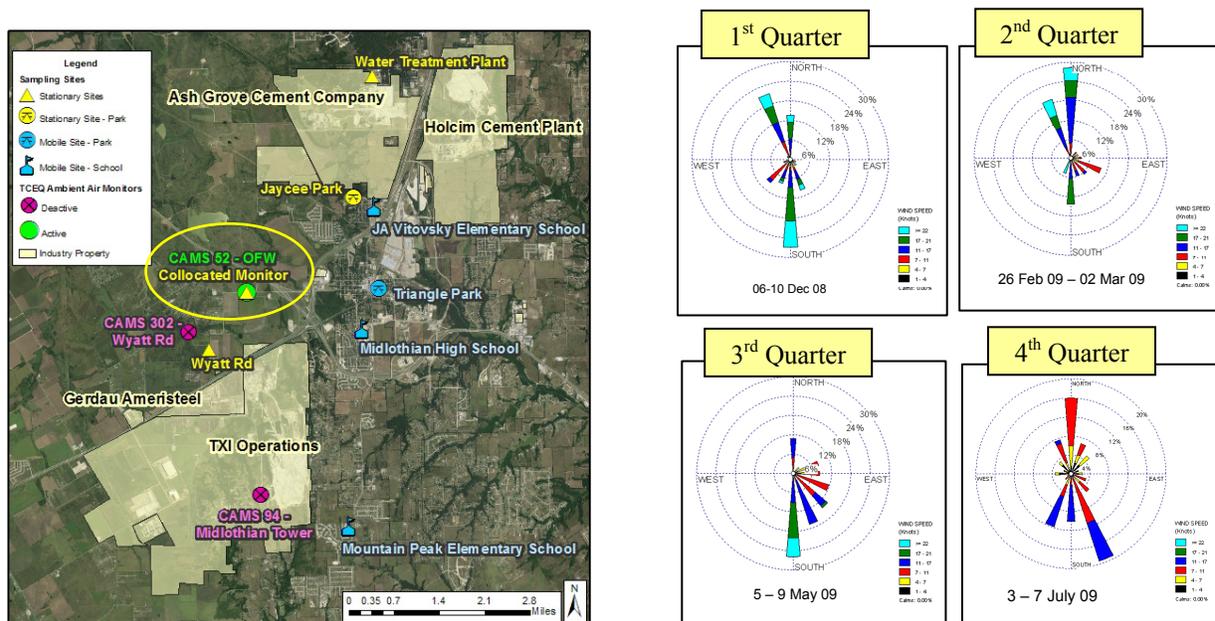


Figure 22. Map of Collocated Monitor Location and Quarterly Average Wind Directions.

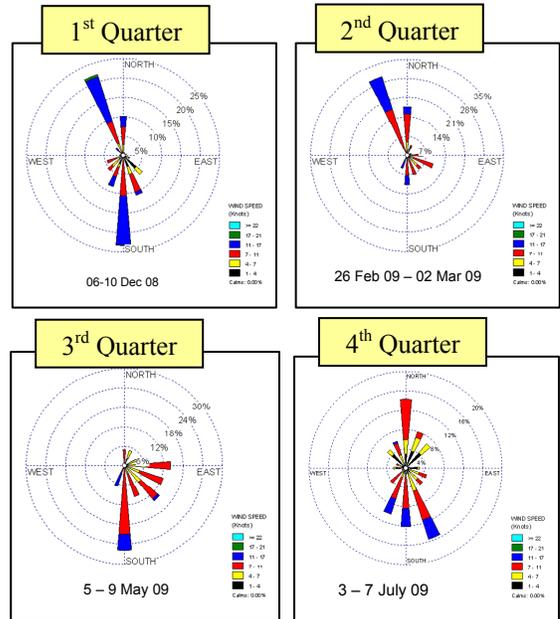
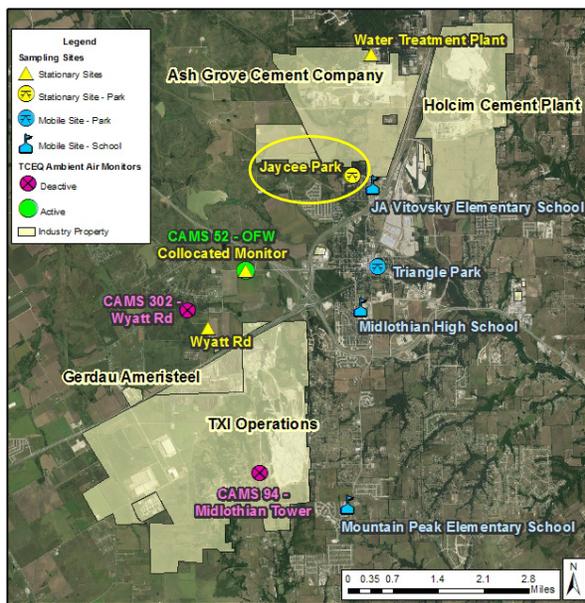


Figure 23. Map of Jaycee Park Monitor Location and Quarterly Average Wind Directions.

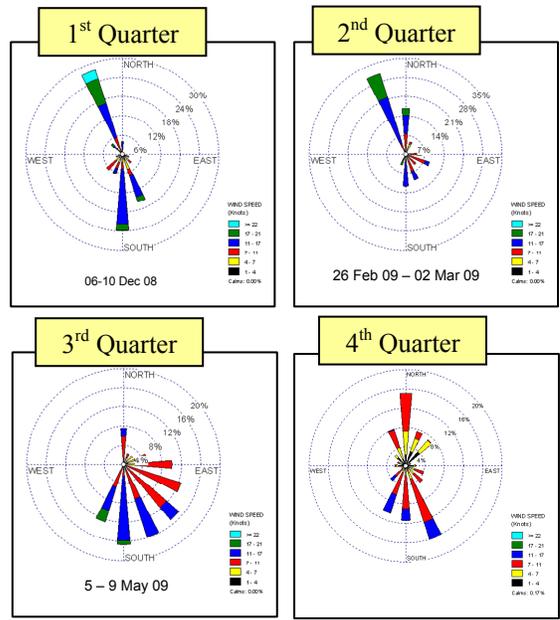
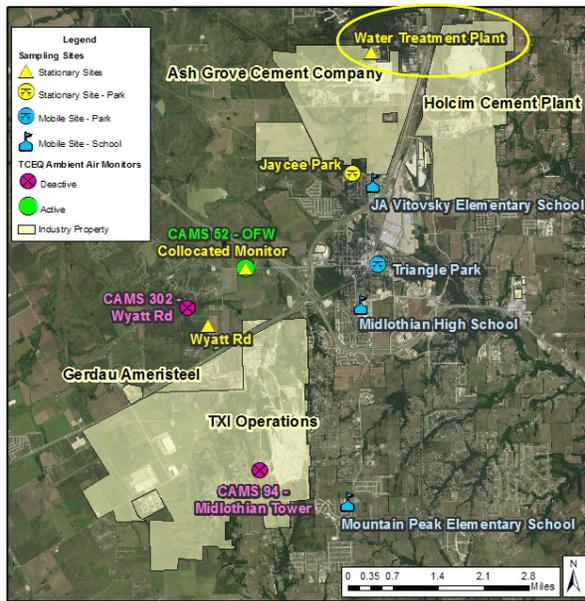


Figure 24. Map of Water Treatment Plant Monitor Location and Quarterly Average Wind Directions.

All three sites had statistical differences; out of eighteen comparisons, four showed statistical differences. Benzene was statistically higher in the 3<sup>rd</sup> quarter at all three compared sites while ethylbenzene was higher in the 2<sup>nd</sup> quarter. When looking at the average quarterly wind directions and the location of the monitors (Figures 22 – 24) the wind directions aren't what would be expected for the statistically higher quarters. The 3<sup>rd</sup> quarter seems to be predominantly southerly winds, the 1<sup>st</sup> and 2<sup>nd</sup> quarters seem to be predominantly northerly winds, and the 4<sup>th</sup> quarter seems to be predominantly southeast winds with northerly winds as well. Only two of the three monitors are located in a downwind position for southerly

winds, the Collocated monitor and the Water Treatment Plant. *Since only one VOC showed a difference at all three sites (benzene) and one other VOC (ethylbenzene) showed a difference at only one of the three sites, the majority of these data indicate that there are no seasonal differences for VOCs in this area. This is likely due to mobile sources contributing to the ambient concentrations of VOCs in this area.*

### School Comparisons

Three of the mobile sites were located at Midlothian area schools: Mountain Peak Elementary School, JA Vitovsky Elementary School, and Midlothian High School. Once focus of the mobile sites was shifted from area parks to area schools a question the citizens expressed was whether or not emissions from school buses, or other idling vehicles, have an impact on air quality at the schools. In an attempt to answer this question in regards to VOCs, at least one sampling day was conducted over the weekend. Since there are only five samples, one for each sampling day at each site, a statistical comparison could not be conducted on this data. However, a qualitative look at the data may also be informative. Figures 25 – 27 show the daily measured concentrations for the highlighted VOCs in this evaluation at each school. Based on the limited sampling it is difficult to get a clear picture of the potential differences between the weekend and the weekdays. When looking at the graphical data, some measured concentrations of VOCs appear to decrease during the weekend, while others appear to increase. In looking at the location of the schools versus the wind direction, some of the higher concentrations appear to be associated with wind directions that put the location downwind of industry. Conversely, some of the higher concentrations also appear to be associated with wind directions that put the location upwind of industry. Due to the limited dataset no clear discernable pattern can be observed and therefore no clear conclusions can be drawn.

Daily Measured VOC Concentrations at Mountain Peak Elementary School

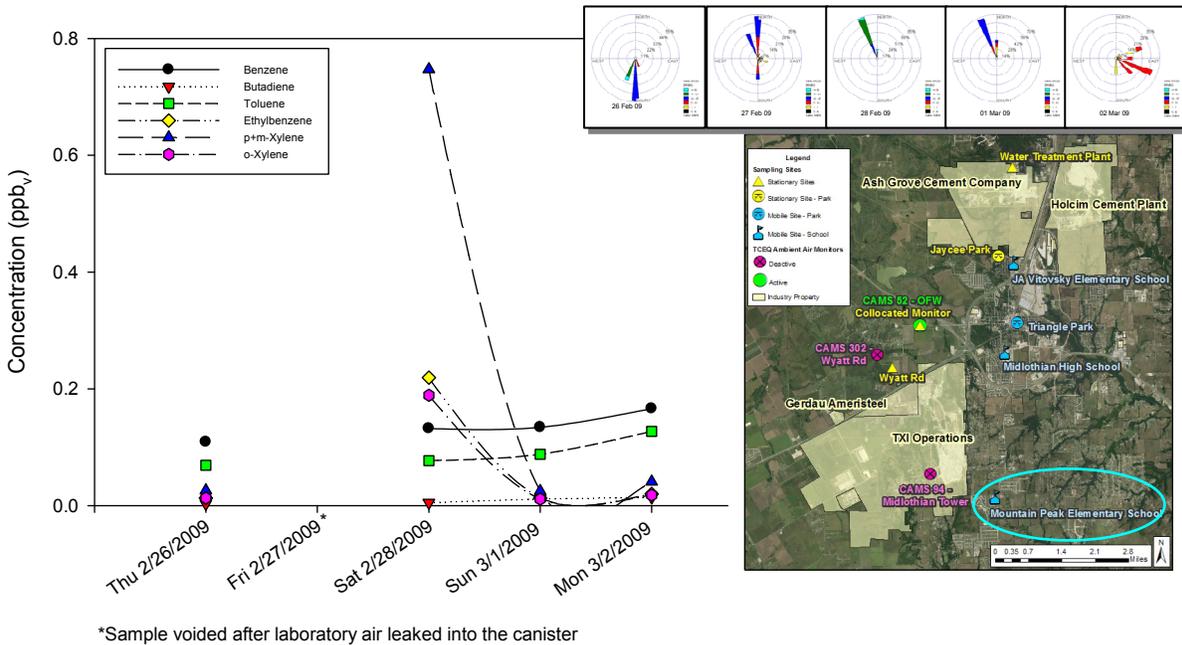


Figure 25. Daily Measured VOC Concentrations at Mountain Peak Elementary School with Daily Wind Direction.

Daily Measured VOC Concentrations at JA Vitovsky Elementary School

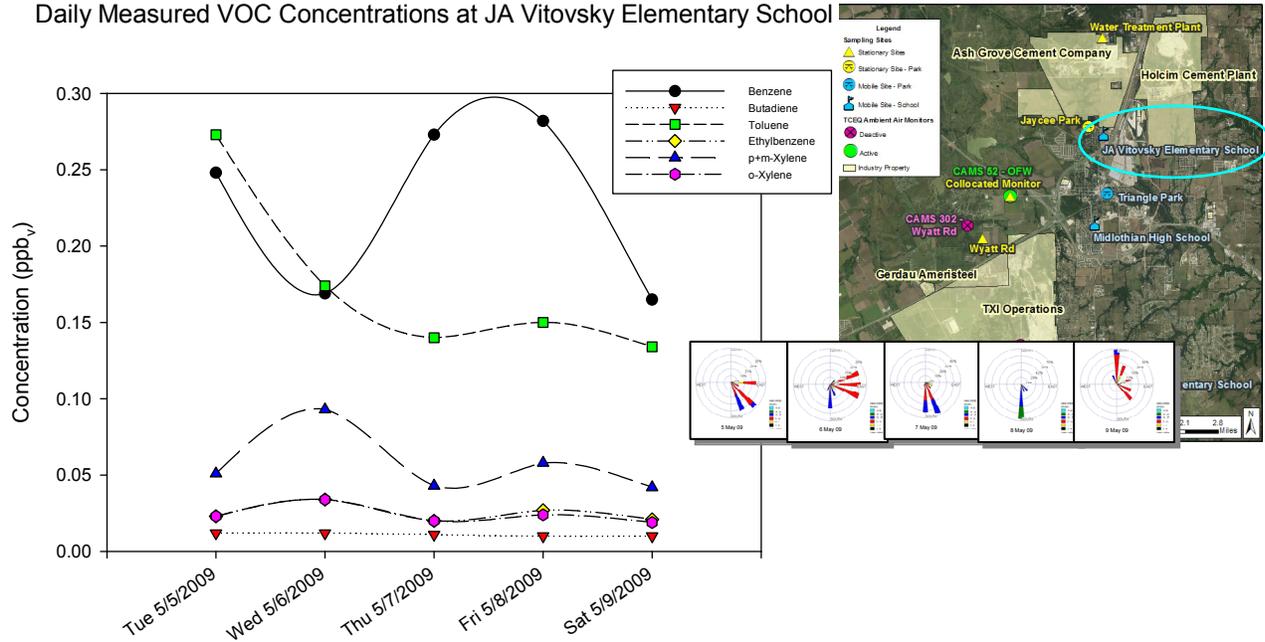


Figure 26. Daily Measured VOC Concentrations at JA Vitovsky Elementary School with Daily Wind Direction.

Daily Measured VOC Concentrations at Midlothian High School

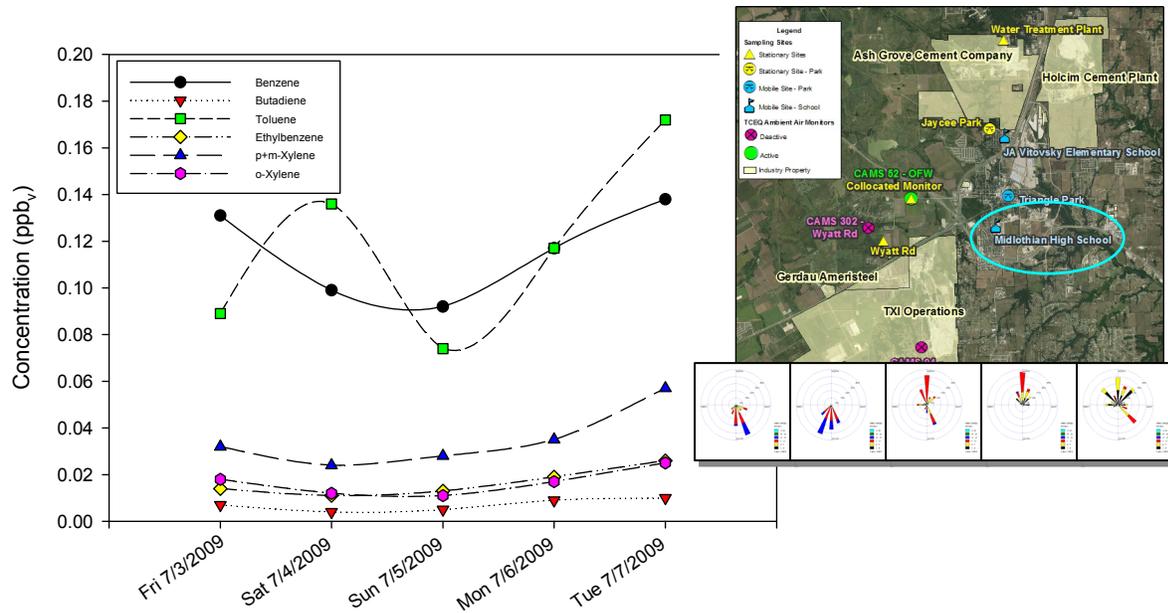


Figure 27. Daily Measured VOC Concentrations at Midlothian High School with Daily Wind Direction.

## ***Metals***

### **Air Monitoring Comparison Value (AMCV) Screening**

For this study, the sample collection and analyses for metals were required to be representative of PM<sub>10</sub>; the required methods were method 40 CFR part 50 Appendix J for sample collection and ICP/MS method IO-3.5 for analysis, except for hexavalent chromium (chromium six, or CrVI or Cr<sup>6+</sup>), which was to be sampled and analyzed by California Air Resources Board (CARB) method 049. As stated in the beginning of the *Evaluation* section, PM<sub>10</sub> is the size fraction that DSHS suggested and the citizen advisory committee agreed upon. A full target analyte list can be found in Table 4 (located in the VOC AMCV Screening section above). Ambient air concentrations of 21 metals were measured at all four of the stationary sampling sites, as well as at all the mobile sites. All monitored concentrations were compared to TCEQ's health- and welfare-protective comparison values, including ESLs and ReVs (where available) or, collectively, AMCVs. A discussion of AMCVs and their use can be found in the VOC AMCV Screening section above. All measured concentrations of PM<sub>10</sub> metals were well below their respective appropriate short- and long-term AMCVs. *Therefore, we would not expect short- or long-term exposures to these concentrations to be of a health concern.*

### **Historical Data Comparisons**

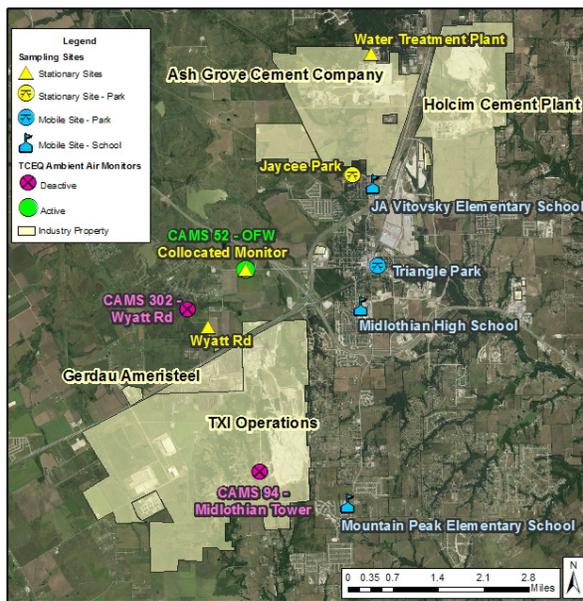
As mentioned above in the VOC Historical Data Comparisons section, an important citizen question identified for this study includes: *How are industries in Midlothian affecting air quality?* After the study began, citizens also had concerns on how the suspension of the operation of TXI's two operational wet kilns would affect the outcome of the study. In order to address these concerns, the TD compared PM<sub>10</sub> metals concentrations to historical 24-hour every 6<sup>th</sup> day PM<sub>10</sub> metals data. Since the metals fraction collected at CAMS 52 is PM<sub>2.5</sub>, it is not technically accurate to compare PM<sub>10</sub> data to PM<sub>2.5</sub> data; the only predominantly downwind PM<sub>10</sub> metals data available in Midlothian is from the former TCEQ CAMS 302 monitoring site (1241 E Wyatt Road), which collected samples from January 1, 2001 to June 26, 2004. This comparison can show what the PM<sub>10</sub> metals levels at CAMS 302 have historically been measured at compared to the measured levels for the study.

For this PM<sub>10</sub> metals evaluation, aluminum, chromium (total), manganese, lead, and nickel were compared to their historical data. These five PM<sub>10</sub> metals represent ones the public, in general, has shown concern for, and in which historical PM<sub>10</sub> data are available for Midlothian. The TD conducted statistical comparisons (Figures 29 – 33; Appendix F) on the historical data versus the Collocated monitor data with Student's t-test using SigmaPlot v11.0 statistical graphing software. For an overview of the Student's t-test procedure, please see Figure 3. All data failed the normality test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. According to this test, chromium, manganese, lead, and nickel historical data are significantly higher than the Collocated monitor data. *The historical data are higher than the study data; however, the TCEQ CAMS 302 monitor is closer to industry than the TCEQ CAMS 52 and Collocated monitors. A difference in monitored values is expected due to the location and proximity to industry, and is observed between the Collocated and Wyatt Rd study monitors.*

The TD also conducted statistical comparisons (Figure 34; Appendix F) of the averages of the historical CAMS 302 monitor and the averages of each of the eight PM<sub>10</sub> metals study monitoring sites using a one-way ANOVA. For an overview of the ANOVA procedure, please see Figure 17. Three of the five ANOVAs (aluminum, chromium, and lead) determined there was a significant difference; however, the All-Pairwise Multiple Comparison Procedures resulted in no significant differences or “do not test”. A result of “do not test” occurs for a comparison when no significant difference is found between two

means that enclose that comparison. It is to be noted that not testing the enclosed means is a procedural rule, and a result of “do not test” should be treated as if there is no significant difference between the means, even though one may appear to exist. Significant differences are as follows:

- Manganese
  - Wyatt Rd *significantly higher than* CAMS 302, Collocated monitor, Jaycee Park, Water Treatment Plant, Triangle Park, Mountain Peak, JA Vitovsky, and Midlothian HS (Figure 35)
- Nickel
  - CAMS 302 *significantly higher than* Collocated monitor, Wyatt Rd, Jaycee Park, Water Treatment Plant, Triangle Park, Mountain Peak, JA Vitovsky, and Midlothian HS (Figure 36)

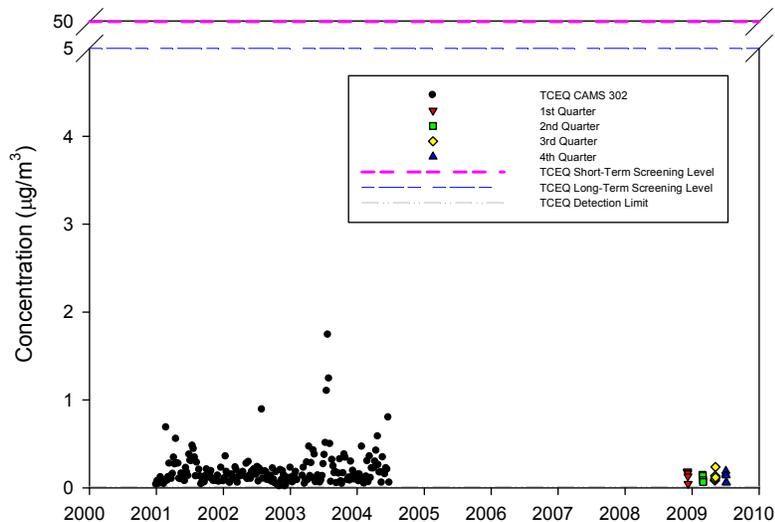


**Figure 28. Map of Monitor Locations.**

Figure 28 shows a map of the monitor locations in relation to the identified local industry. The difference in  $PM_{10}$  manganese observed between the averages of the CAMS 302 and the Wyatt Rd monitors (the closest monitor to the former CAMS 302 monitoring site) is 1.45 times; the Wyatt Rd site average is 1.45 times higher than the CAMS 302 historical average. For nickel, it is important to note that the TCEQ CAMS 302 data has a detection limit of  $0.004 \mu\text{g}/\text{m}^3$ , which is well above the detection limit for the study. Only six of the 196 historical samples were detected. This statistical difference is due to the difference in detection limits and not necessarily representative of an actual difference in data. It is impossible to draw any conclusions from this set of data.

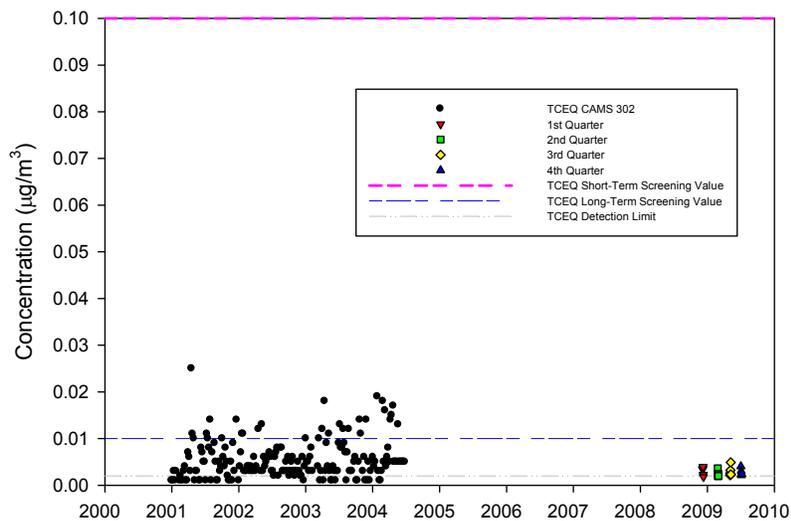
*These data indicate the only real observed difference in  $PM_{10}$  metals data was for manganese; however, that difference is small, with the historical data still well below the AMCV. These analyses indicate that the measured concentrations of  $PM_{10}$  metals are likely typical for this area as compared with the historical CAMS 302 monitor data. This also indicates that CAMS 302 and CAMS 52 are good indicators of metals measurements across Midlothian (Figure 37).*

Historical PM<sub>10</sub> Aluminum Concentrations at the TCEQ CAMS 302  
Ambient Air Monitor Compared to the Collocated Monitor



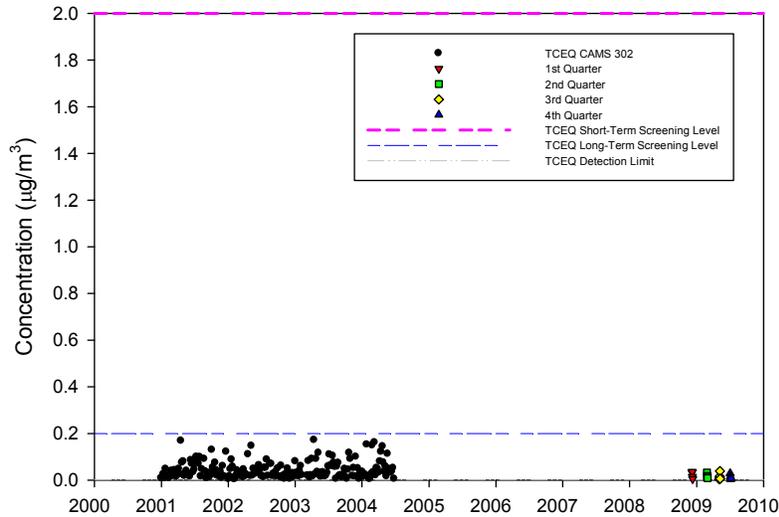
**Figure 29. Historical PM<sub>10</sub> Aluminum Concentrations at the TCEQ CAMS 302 Ambient Air Monitor Compared to the Collocated Monitor.**

Historical PM<sub>10</sub> Chromium Concentrations at the TCEQ CAMS 302  
Ambient Air Monitor Compared to the Collocated Monitor



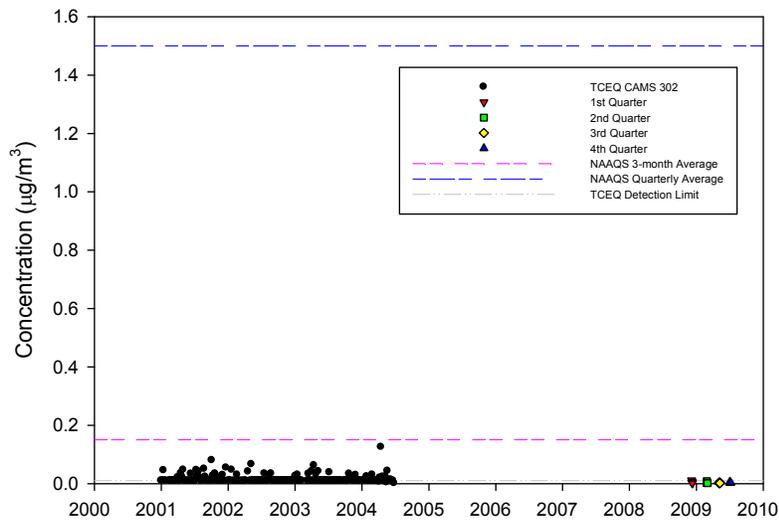
**Figure 30. Historical PM<sub>10</sub> Chromium Concentrations at the TCEQ CAMS 302 Ambient Air Monitor Compared to the Collocated Monitor.**

Historical PM<sub>10</sub> Manganese Concentrations at the TCEQ CAMS 302  
Ambient Air Monitor Compared to the Collocated Monitor



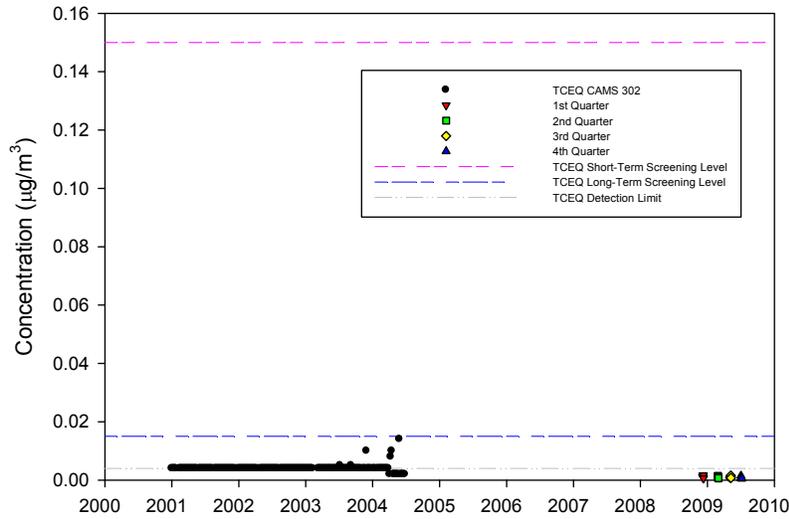
**Figure 31. Historical PM<sub>10</sub> Manganese Concentrations at the TCEQ CAMS 302 Ambient Air Monitor Compared to the Collocated Monitor.**

Historical PM<sub>10</sub> Lead Concentrations at the TCEQ CAMS 302  
Ambient Air Monitor Compared to the Collocated Monitor



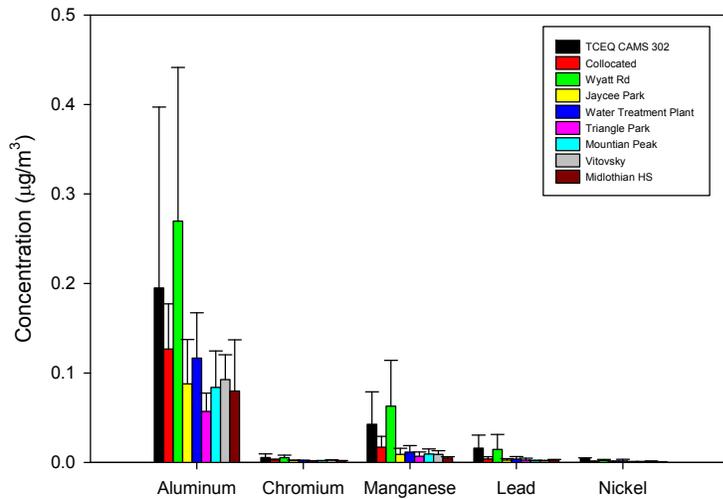
**Figure 32. Historical PM<sub>10</sub> Lead Concentrations at the TCEQ CAMS 302 Ambient Air Monitor Compared to the Collocated Monitor.**

Historical PM<sub>10</sub> Nickel Concentrations at the TCEQ CAMS 302  
Ambient Air Monitor Compared to the Collocated Monitor



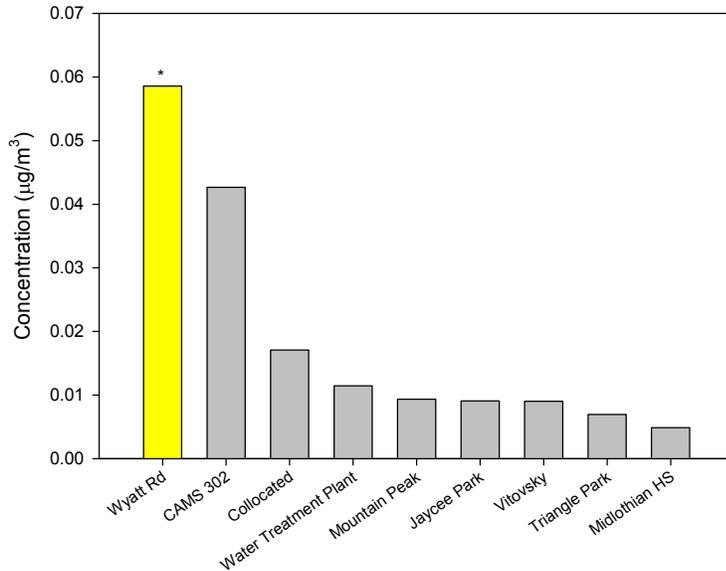
**Figure 33. Historical PM<sub>10</sub> Nickel Concentrations at the TCEQ CAMS 302 Ambient Air Monitor Compared to the Collocated Monitor.**

Average Concentration Measured at the TCEQ CAMS 302  
Ambient Air Monitor and at Each Study Sampling Site



**Figure 34. Average PM<sub>10</sub> Metals Concentrations Measured at the TCEQ CAMS 302 Ambient Air Monitor and at Each Sampling Site in the Study.**

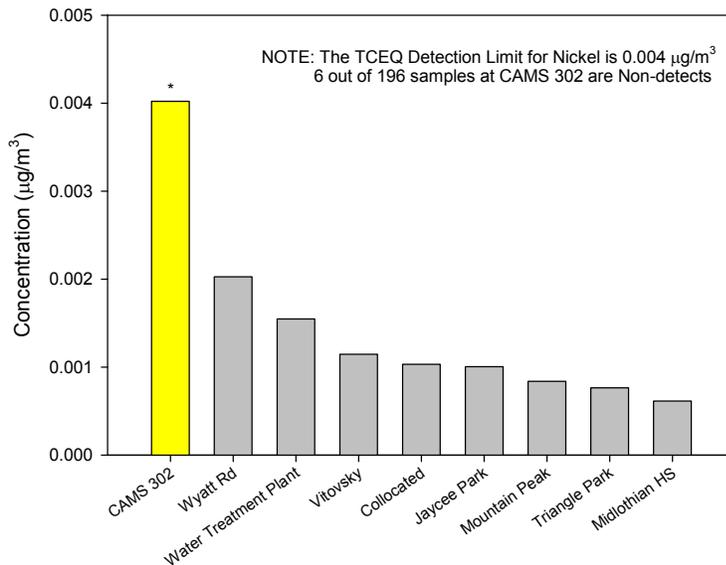
Statistically Different Average Concentrations:  
Wyatt Rd vs All Other Monitoring Sites  
Manganese ANOVA



\*Significantly ( $P = <0.001$ ) higher than all other monitoring locations.

**Figure 35. Statistically Different Average  $\text{PM}_{10}$  Manganese Site Concentrations.**

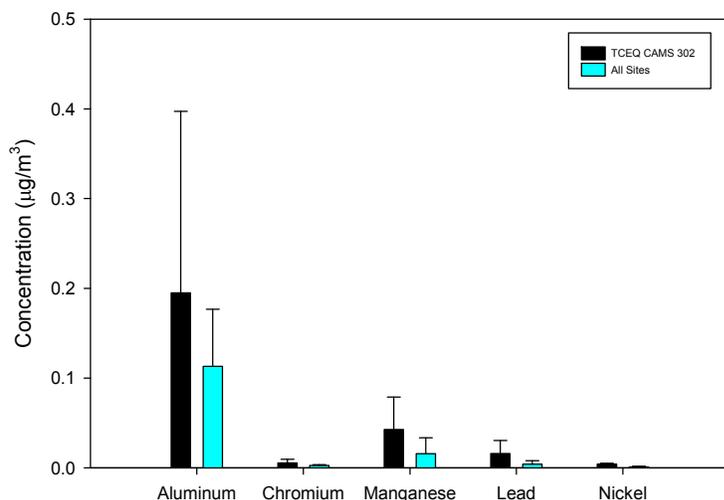
Statistically Different Site Averages:  
CAMS 302 vs All Other Monitoring Sites  
 $\text{PM}_{10}$  Nickel ANOVA



\*Significantly ( $P = <0.001$ ) higher than all other monitoring locations.

**Figure 36. Statistically Different Average  $\text{PM}_{10}$  Nickel Site Concentrations.**

Average Concentration Measured at the TCEQ CAMS 302 Ambient Air Monitor and at All Sampling Sites in the Study



**Figure 37. Average PM<sub>10</sub> Metals Concentrations Measured at the TCEQ CAMS 302 Ambient Air Monitor and at All Sampling Sites in the Study.**

### Collocated Monitor Comparisons

As with the VOC section above, this comparison is designed to help answer, in regards to PM<sub>10</sub> metals, the citizen question: *Is the TCEQ every 6<sup>th</sup> day monitoring site an accurate representation of daily air concentrations in Midlothian?* There are two interpretations for this question. The first is, are the data from the TCEQ CAMS 52 monitor representative of concentrations in the city? The second is, are the industries increasing emissions on non-regulatory sampling days? For this study, a monitor was collocated with the TCEQ CAMS 52 monitor, the Collocated monitor; one day out of each sampling quarter overlapped with the existing TCEQ every 6<sup>th</sup>-day ambient air monitoring schedule. Information on the EPA monitoring schedule and the overlapping sampling days can be found in the VOC Collocated Monitor Comparisons section above.

In the VOC Collocated Monitor Comparisons section above a comparison was conducted on a grouping of the four TCEQ every 6<sup>th</sup>-day samples as compared to the corresponding four Collocated monitor samples to show if any statistical differences existed between the two sample sets. Since the comparison indicated that the TCEQ CAMS 52 ambient air monitor is an accurate representation of VOC air concentrations measured at this site, the assumption can be made that the Collocated monitor is a good representation of what the CAMS 52 monitor would measure. Since comparisons in this section cannot be done with CAMS 52 PM<sub>10</sub> metals data, as none exist, the assumption is that the VOC findings extend to PM<sub>10</sub> metals, and therefore the Collocated monitor data may be used for these comparisons in lieu of CAMS 52 data since there are no CAMS 52 PM<sub>10</sub> metals data available. Therefore, in this section the Collocated monitor data will be used in statistical comparisons in lieu of TCEQ CAMS 52 data.

Since there was only one every 6<sup>th</sup>-day sample corresponding to the five Collocated monitor samples per quarter a statistical analysis of the individual 6<sup>th</sup>-day sample paired with the surrounding four days of samples could not be performed. However, a comparison could be conducted on a grouping of the four Collocated samples corresponding to the every 6<sup>th</sup>-day TCEQ samples as compared to the surrounding

sixteen Collocated monitor samples. Such a comparison would help show if any statistical differences existed between the two sample sets. Therefore, the TD conducted this statistical comparison (Appendix G) using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. All but two of the six data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. No significant differences were found between the every 6<sup>th</sup>-day samples and the other sampling days. *The lack of significant difference between the corresponding Collocated every 6<sup>th</sup>-day samples and the other sixteen days of surrounding Collocated monitor samples indicates that there is no difference between a regulatory every 6<sup>th</sup>-day sampling day and the other sampled days during this study. Since the sampling dates were not released publicly the assumption can be made that this is representative of typical conditions throughout the year.*

The TD also conducted statistical comparisons (Appendix G) between the Collocated data and all of the other seven study PM<sub>10</sub> metals monitoring sites using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. Only 13 out of the 42 data comparisons passed the normality test and the equal variance test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. Significant differences are as follows:

- Aluminum
  - Collocated monitor *significantly lower than* Wyatt Rd, Jaycee Park, and Triangle Park (Figure 38)
- Chromium
  - Collocated monitor *significantly lower than* Wyatt Rd (Figure 39)
  - Collocated monitor *significantly higher than* Jaycee Park, Water Treatment Plant, Triangle Park, Mountain Peak, and Midlothian HS (Figure 39)
- Manganese
  - Collocated monitor *significantly lower than* Wyatt Rd (Figure 40)
  - Collocated monitor *significantly higher than* Jaycee Park, and Midlothian HS (Figure 40)
- Lead
  - Collocated monitor *significantly lower than* Wyatt Rd (Figure 41)
  - Collocated monitor *significantly higher than* Mountain Peak, and JA Vitovsky (Figure 41)
- Nickel
  - Collocated monitor *significantly lower than* Wyatt Rd (Figure 42)
  - Collocated monitor *significantly higher than* Midlothian HS (Figure 42)
- Mercury
  - Collocated monitor *significantly lower than* Mountain Peak (Figure 43)
  - Collocated monitor *significantly higher than* Water Treatment Plant, JA Vitovsky, and Midlothian HS (Figure 43)

When looking at the graphed data, for all the data in which Wyatt Rd was significantly different than the Collocated monitor, Wyatt Rd was consistently higher than the Collocated monitor. However, for all the data other than Wyatt Rd that were significantly different than the Collocated monitor, those monitors were consistently lower than the Collocated monitor, with the exception of Jaycee Park and Triangle Park for aluminum. Wind patterns were similar for all sites during their respective sampling days. When the winds were such that the Wyatt Rd and the Collocated monitors were downwind of industry (south, southeast), those monitors typically measured higher concentrations of PM<sub>10</sub> metals than the other monitors. When winds were such that these monitors were upwind (northerly), they typically measured similar or lower concentrations of PM<sub>10</sub> metals than the other monitors. *While the concentrations varied*

*across the city at the different monitors, the Collocated and Wyatt Rd monitors consistently measured the highest levels when they were located downwind of industry as compared to the other monitors. Since the Collocated monitor is in the predominantly downwind location, and is generally measuring either higher concentrations than the other study monitors or similar concentrations, depending on wind, this site is a good indicator of air quality around Midlothian by measuring potentially worst-case concentrations that the other monitoring sites did not.*

### Statistically Different Monitoring Sites: Collocated vs Wyatt Rd, Jaycee Park, & Triangle Park PM<sub>10</sub> Aluminum t-Test

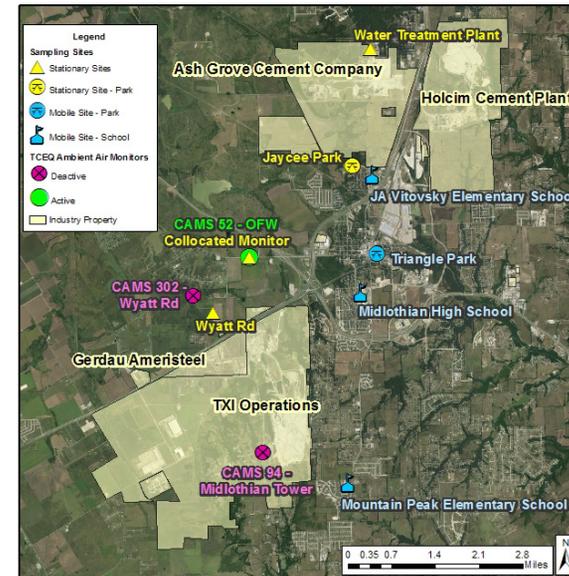
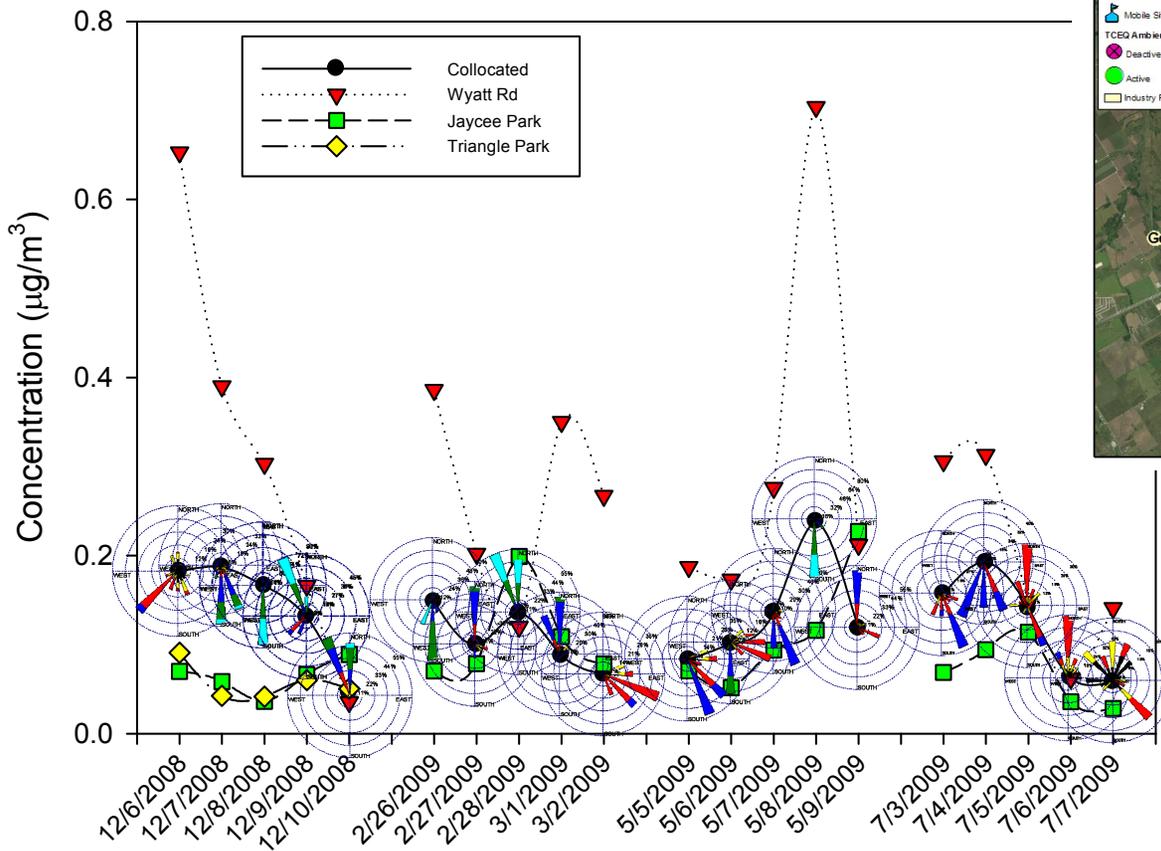


Figure 38. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Aluminum.

### Statistically Different Monitoring Sites: Collocated vs Wyatt Rd, Jaycee Park, Water Treatment Plant, Triangle Park, Mountain Peak, & Midlothian HS PM<sub>10</sub> Chromium t-Test

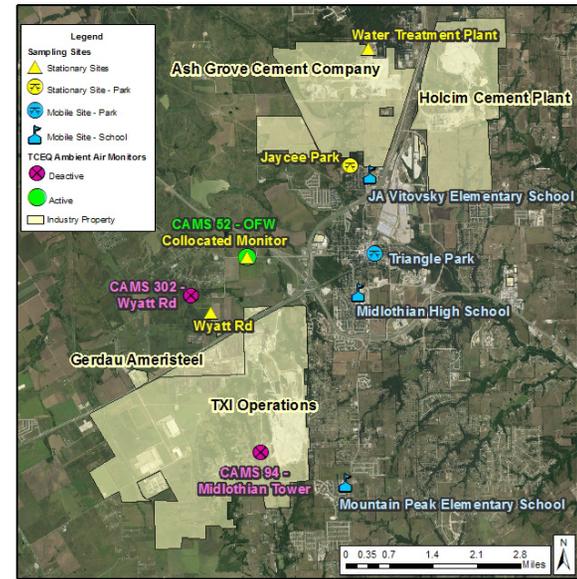
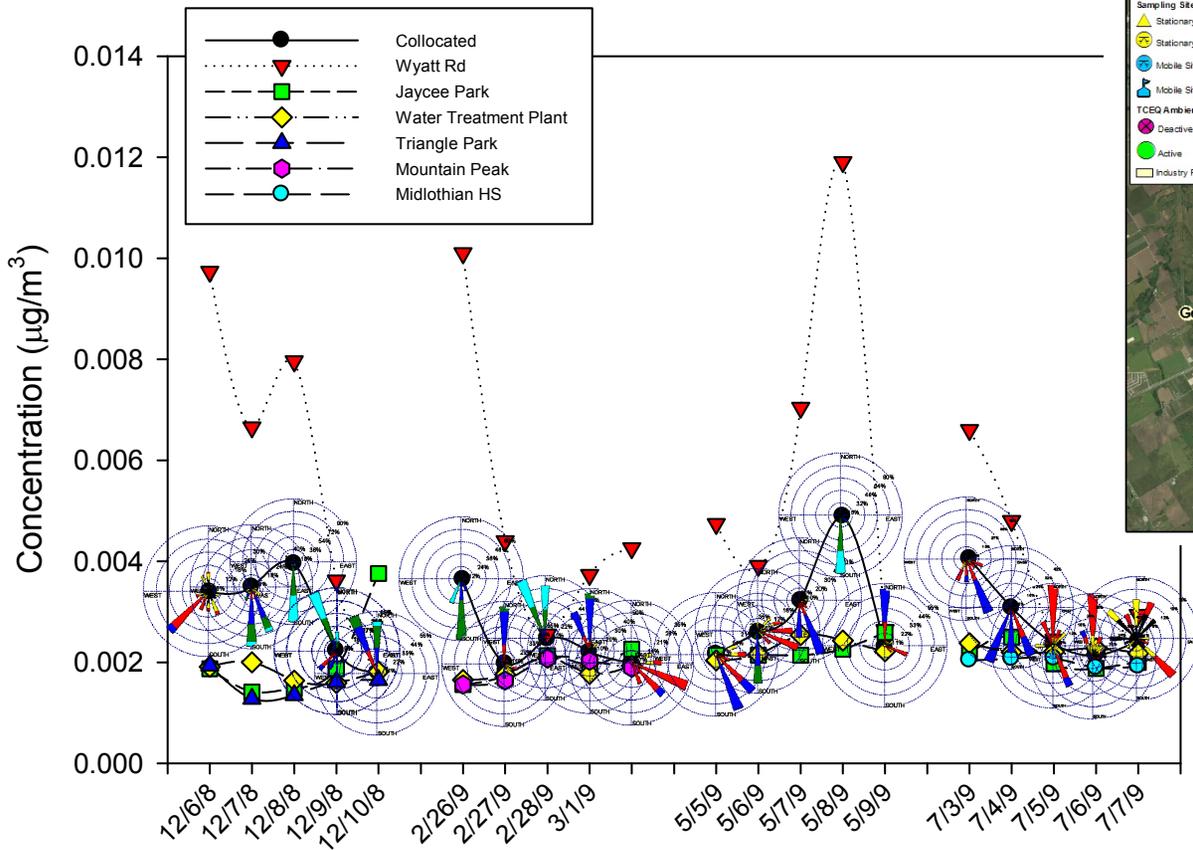


Figure 39. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Chromium.

### Statistically Different Monitoring Sites: Collocated vs Wyatt Rd, Jaycee Park, & Midlothian HS PM<sub>10</sub> Manganese t-Test

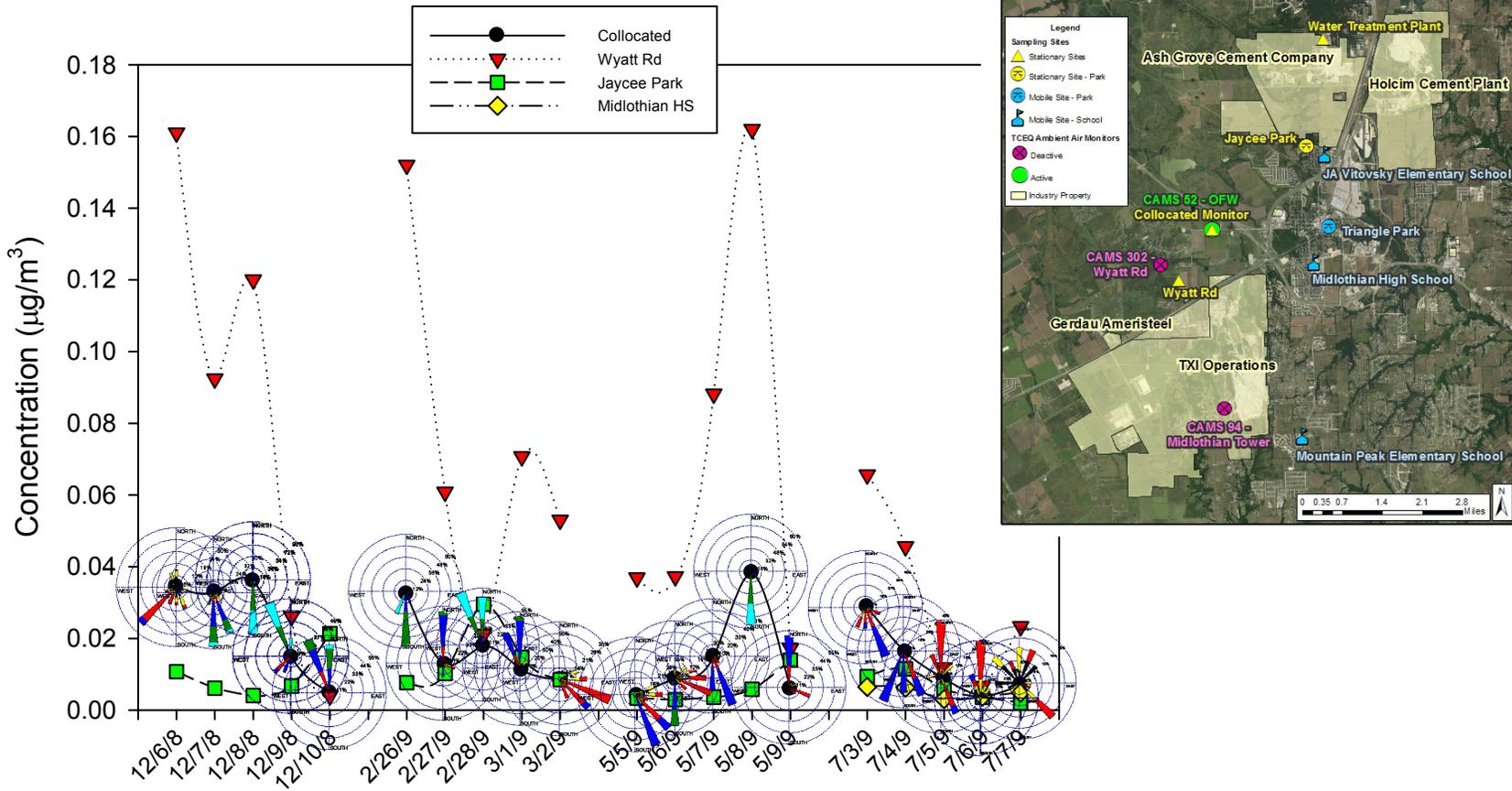


Figure 40. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Manganese.

### Statistically Different Monitoring Sites: Collocated vs Wyatt Rd, Mountain Peak, & Vitovsky PM<sub>10</sub> Lead t-Test

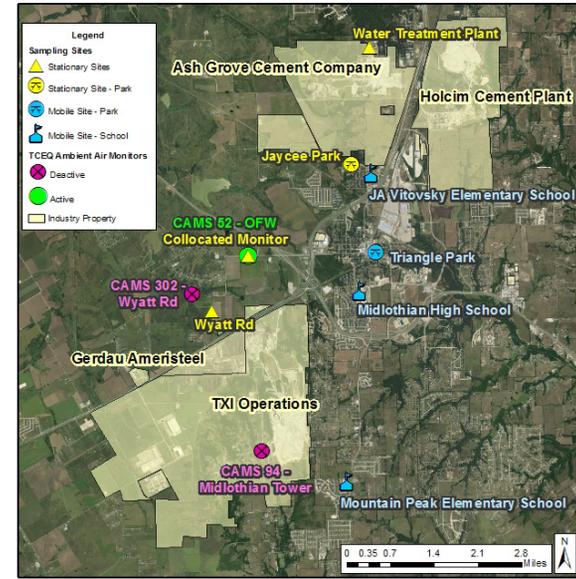
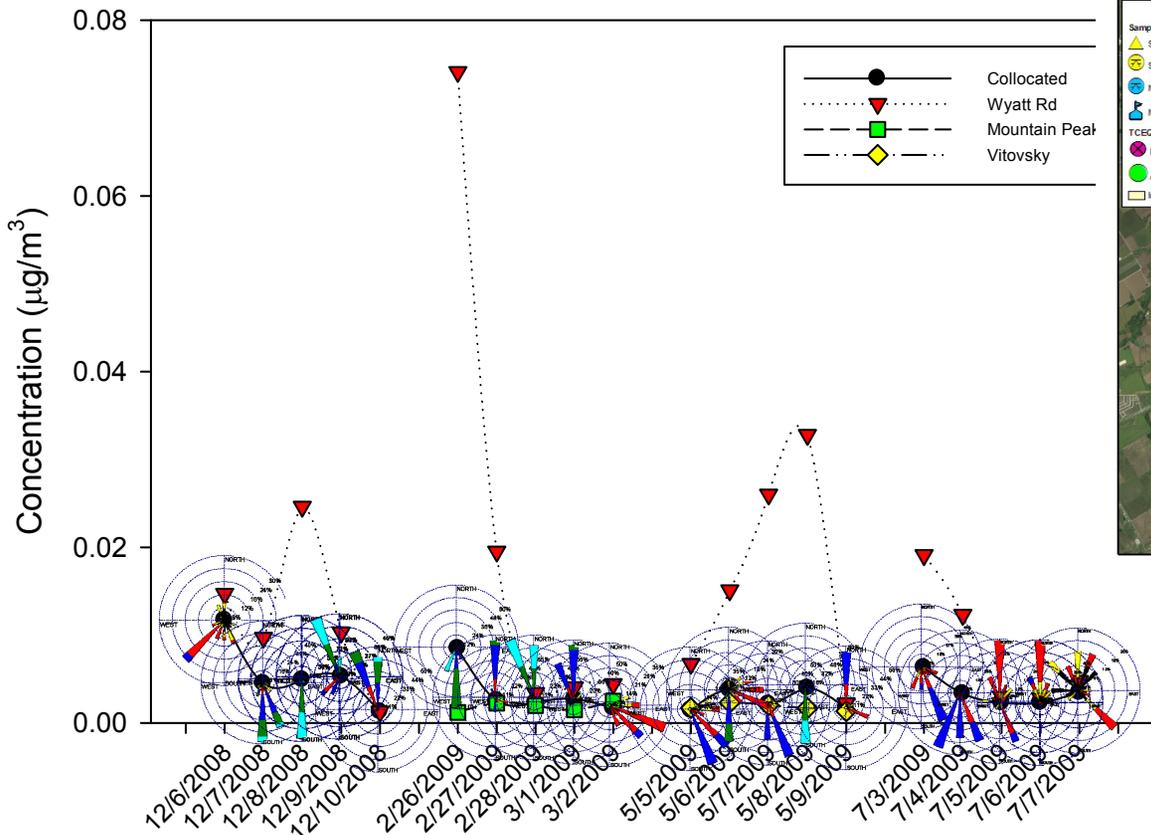


Figure 41. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Lead.

### Statistically Different Monitoring Sites: Collocated vs Wyatt Rd & Midlothian HS PM<sub>10</sub> Nickel t-Test

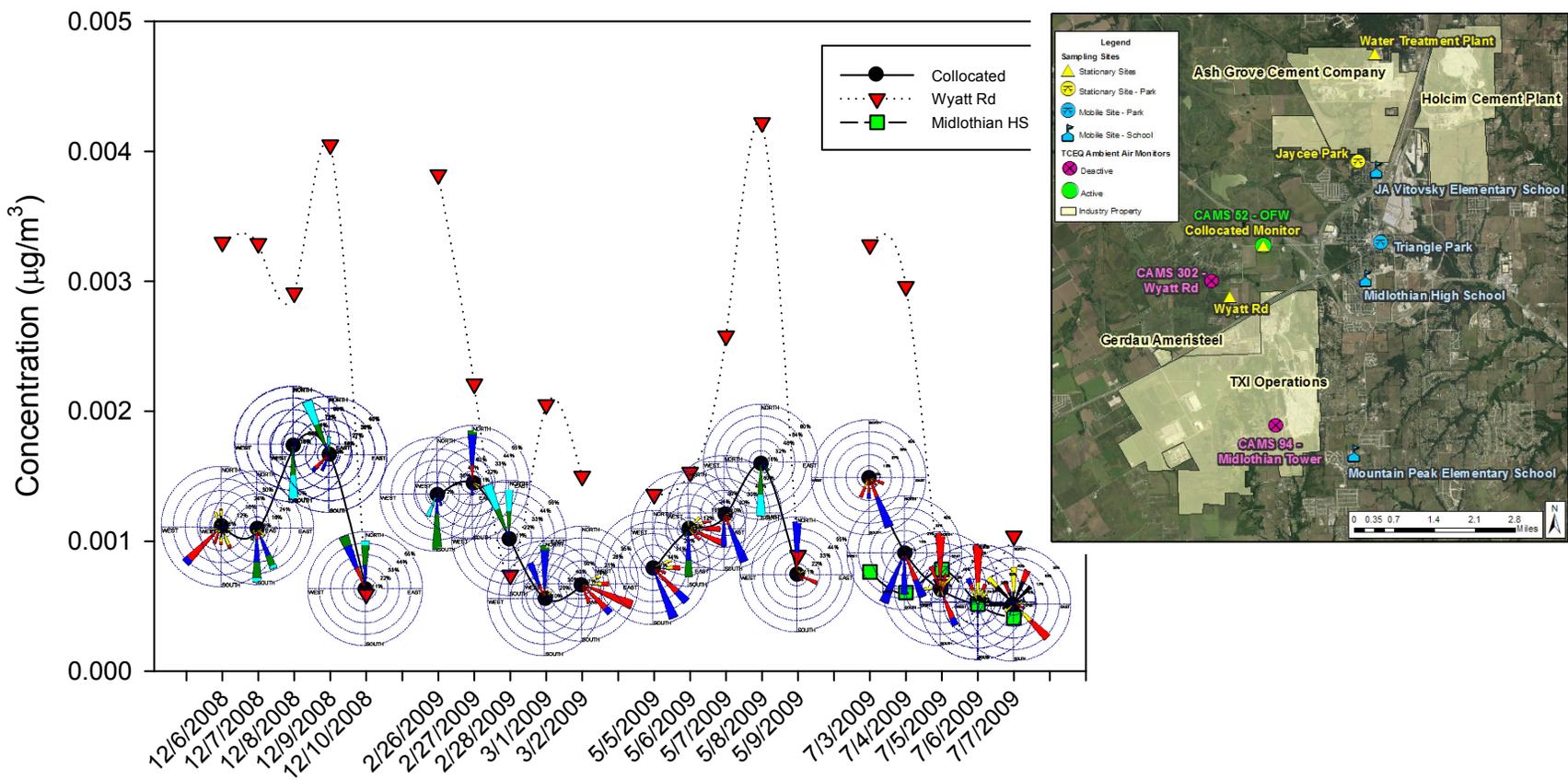


Figure 42. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Nickel.

### Statistically Different Monitoring Sites: Collocated vs Water Treatment Plant, Mountain Peak, Vitovsky, & Midlothian HS PM<sub>10</sub> Mercury t-Test

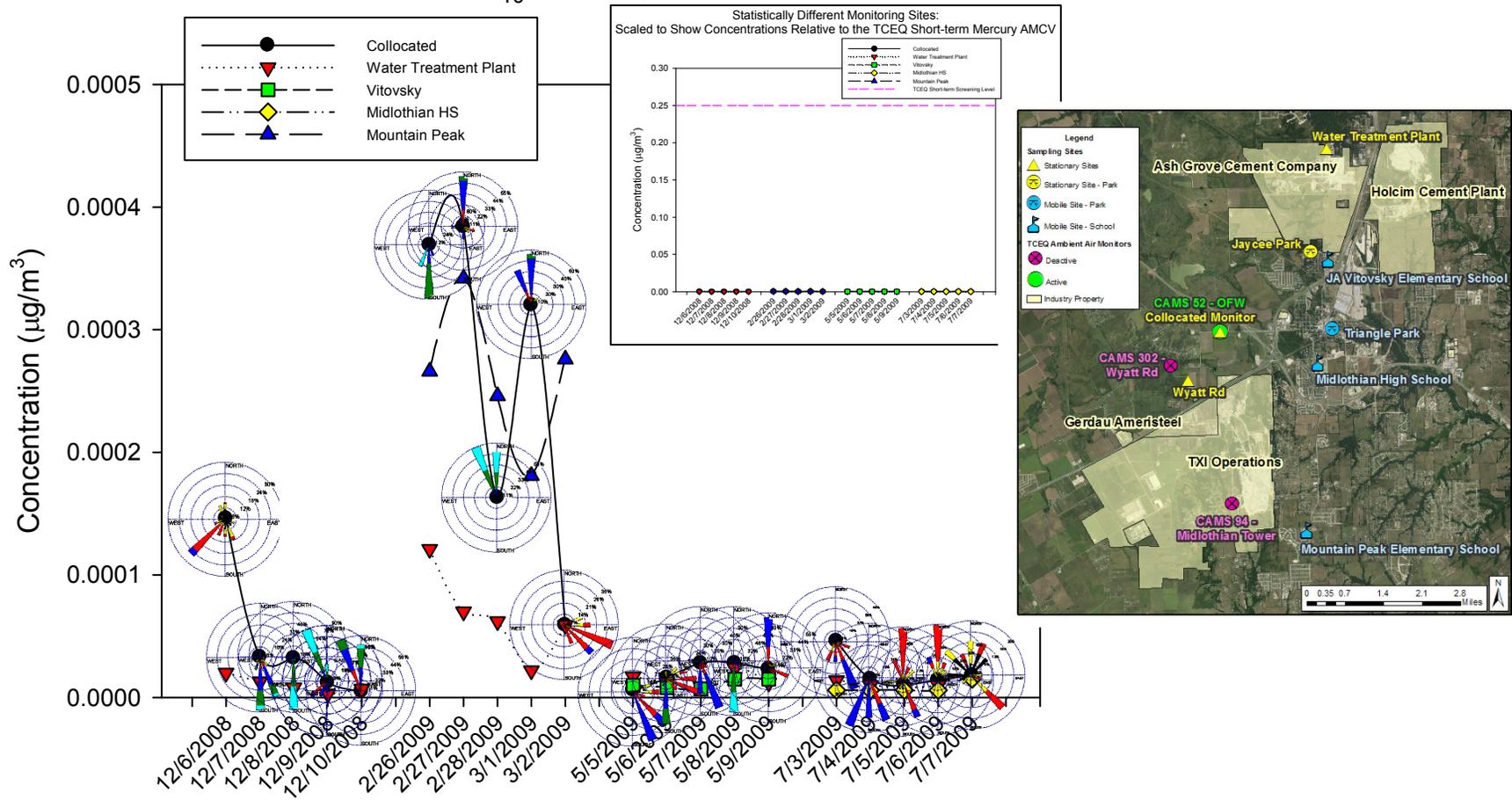


Figure 43. Statistically Different Sites as Compared to the Collocated Monitor: PM<sub>10</sub> Mercury. Inset graph shows monitored concentrations relative to the TCEQ mercury short-term AMCV of 0.25 µg/m<sup>3</sup>.

## Monitoring Site Comparisons

As stated above, comparisons between the monitoring sites were designed to help answer, in regards to PM<sub>10</sub> metals, the citizen question: *How are industries in Midlothian affecting air quality?* For this section, the same comparisons as stated in the VOC Monitoring Site Comparisons section above were conducted. While historical data for Midlothian are not available for mercury, which could not be included in the Historical Data Comparisons section above, mercury was included in this section as citizens have expressed concerns about this metal.

### *Comparisons with All Four Quarters of Data*

Multiple comparisons with all four quarters of PM<sub>10</sub> data were performed in order to determine statistical differences. The TD conducted statistical comparisons (Appendix H; Raw Data Figures K-31 – K-36) between the four stationary, four mobile, and all eight PM<sub>10</sub> metals monitoring sites using a one-way ANOVA. For an overview of the ANOVA procedure, please see Figure 17. All but two data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences for mobile sites are as follows:

- Chromium (Figure 44)
  - JA Vitovsky *significantly higher than* Triangle Park, Mountain Peak, and Midlothian HS
  - Midlothian HS *significantly higher than* Triangle Park
- Nickel
  - JA Vitovsky *significantly higher than* Triangle Park and Midlothian HS (Figure 45)
- Mercury
  - Mountain Peak *significantly higher than* Midlothian HS and JA Vitovsky (Figure 46)

Significant differences for mobile sites were observed between data from all four mobile sites. Mobile site data were collected in different sampling quarters and therefore also have different wind directions. Because these data don't have common sampling conditions a comparison between mobile sites is not an apples-to-apples comparison. While this is not an apples-to-apples comparison, the comparison was still conducted to illustrate that differences would likely exist. When looking at the graphed data, the daily wind patterns are very different for all three sites, as would be expected since sampling was conducted in different months. The PM<sub>10</sub> metals patterns are also different between these monitors, which would also be expected due to sampling being conducted at different times. *Even though three PM<sub>10</sub> metals showed differences between the mobile sites (chromium, nickel, and mercury), since these are not apples-to-apples comparisons the differences are likely attributed to the samples being collected on different dates, in different months, and with different wind directions.*

### Statistically Different Mobile Monitoring Sites: Vitovsky vs Triangle Park, Mountain Peak, & Midlothian High School Midlothian High School vs Triangle Park PM<sub>10</sub> Chromium ANOVA

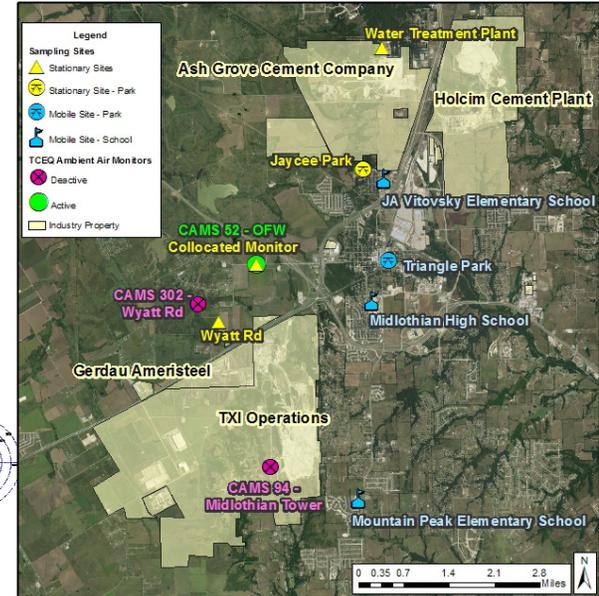
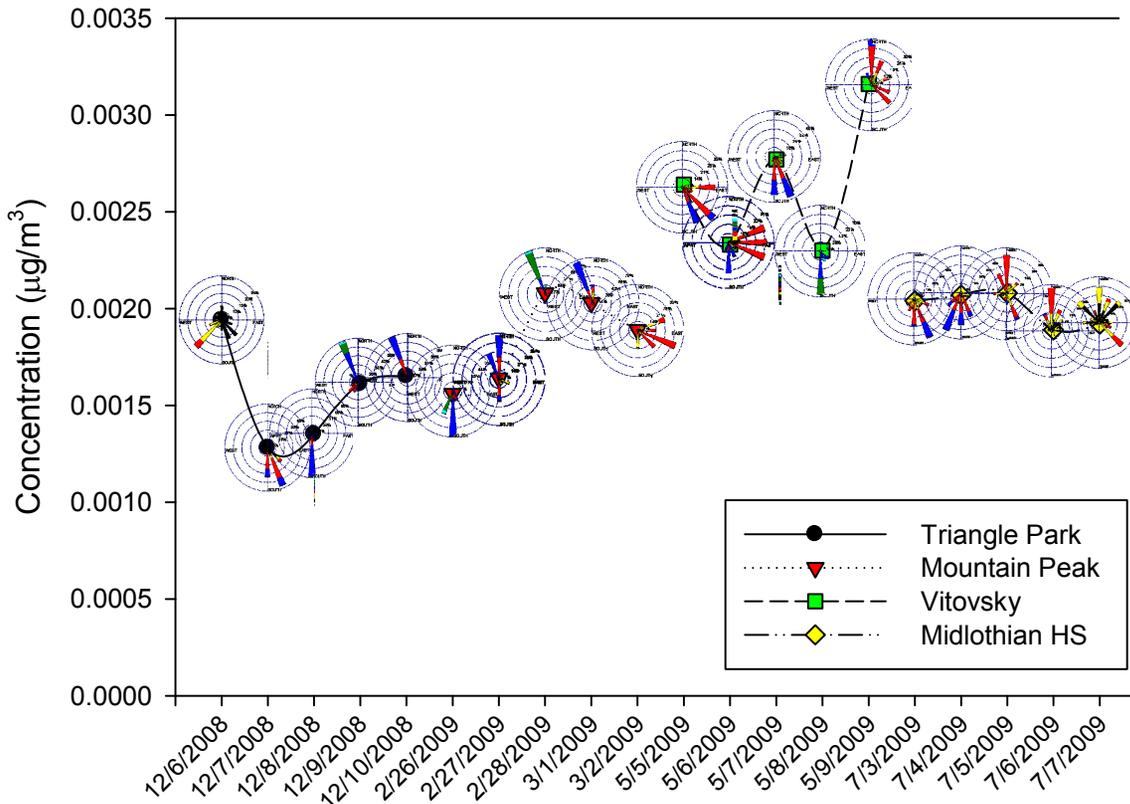


Figure 44. Observed Statistical Differences in PM<sub>10</sub> Chromium Data ANOVA Analysis between Mobile Site Comparisons.

### Statistically Different Mobile Sites: Vitovsky vs Triangle Park & Midlothian High School PM<sub>10</sub> Nickel ANOVA

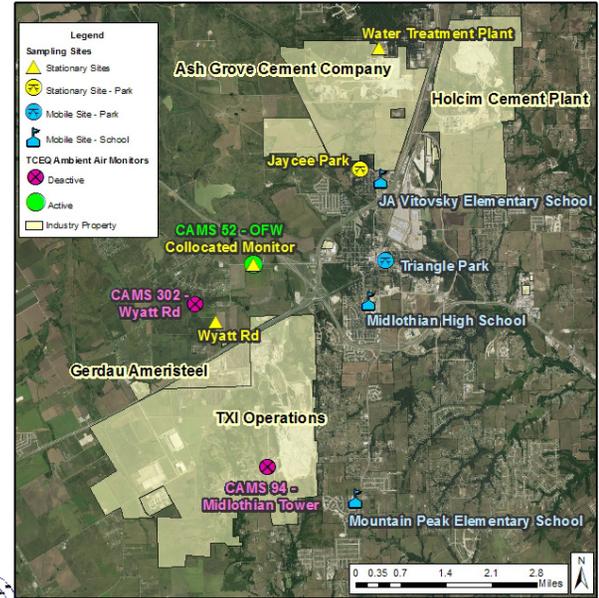
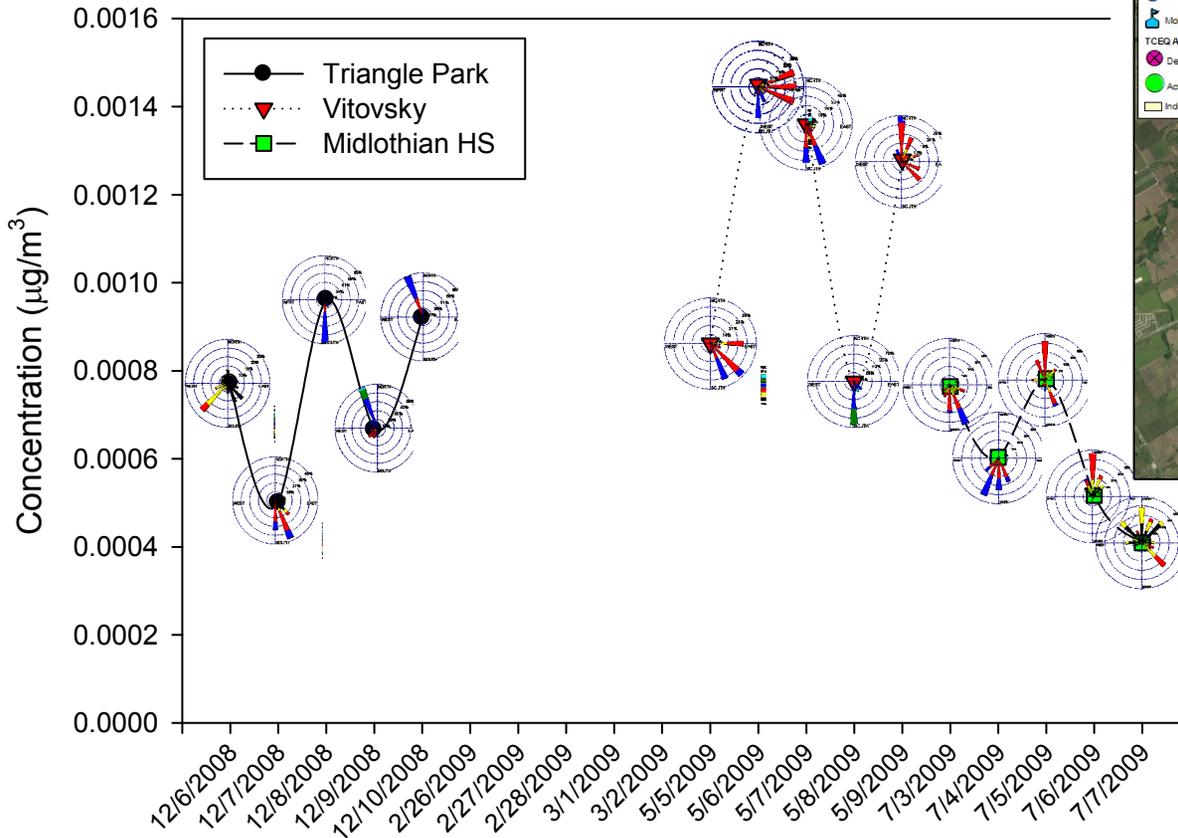


Figure 45. Observed Statistical Differences in PM<sub>10</sub> Nickel Data ANOVA Analysis between Mobile Site Comparisons.

### Statistically Different Mobile Sites: Mountain Peak vs Vitovsky and Midlothian HS PM<sub>10</sub> Mercury ANOVA

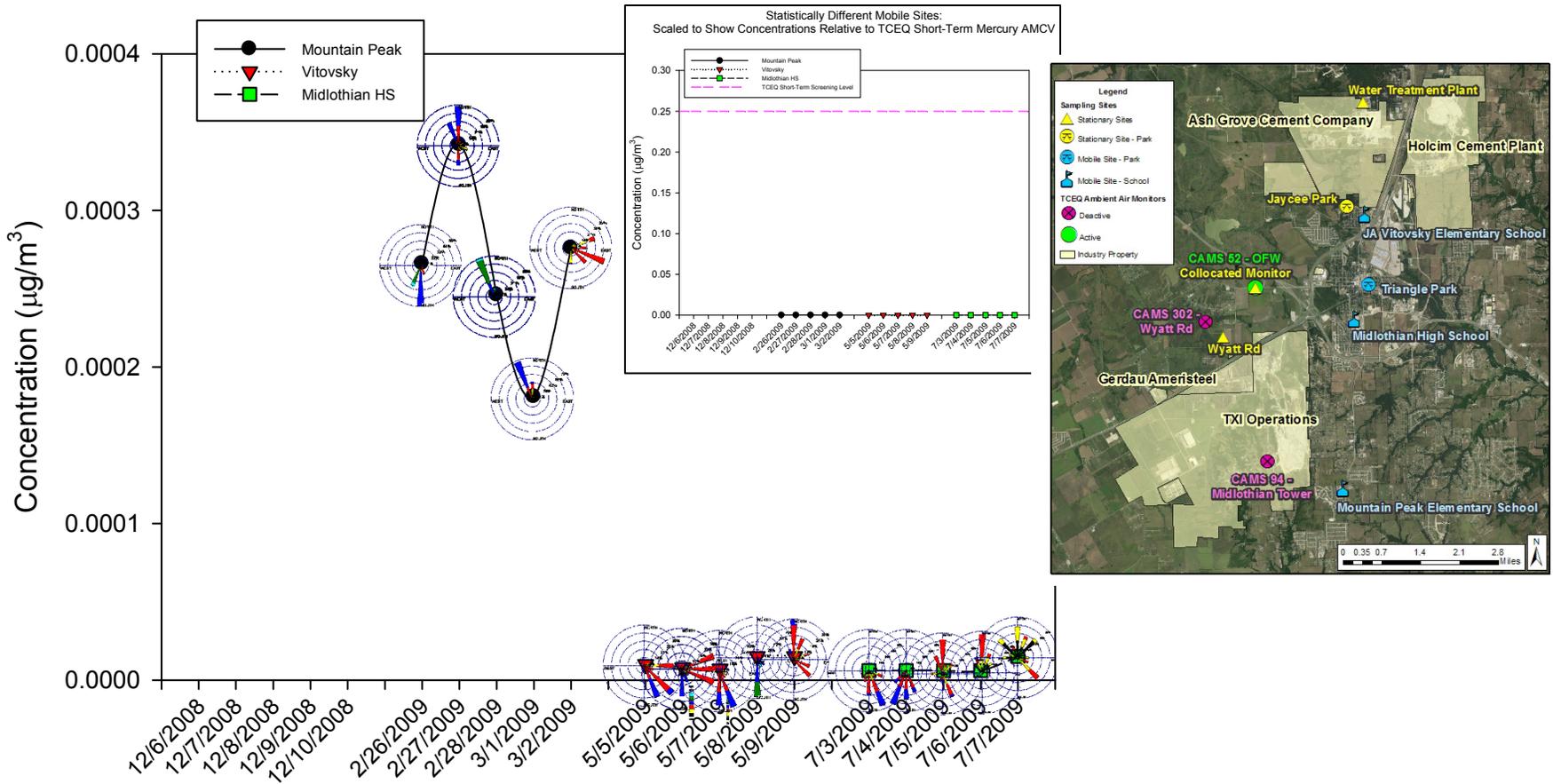


Figure 46. Observed Statistical Differences in PM<sub>10</sub> Mercury Data ANOVA Analysis between Mobile Site Comparisons. Inset graph shows monitored concentrations relative to the TCEQ mercury short-term AMCV of 0.25 µg/m<sup>3</sup>.

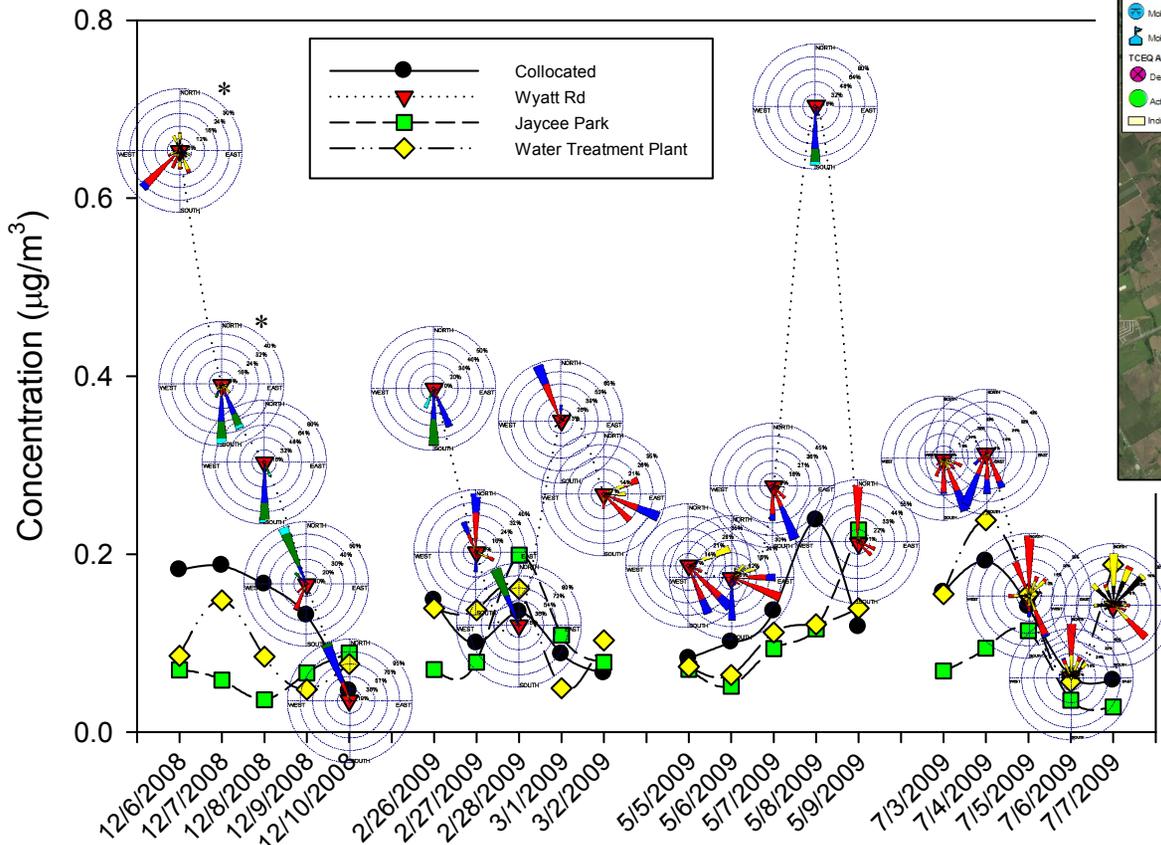
Significant differences for stationary sites are as follows:

- Aluminum
  - Wyatt Rd *significantly higher than* Collocated monitor, Jaycee Park, and Water Treatment Plant (Figure 47)
- Chromium (Figure 48)
  - Wyatt Rd *significantly higher than* Jaycee Park and Water Treatment Plant
  - Collocated monitor *significantly higher than* Jaycee Park and Water Treatment Plant
- Manganese
  - Wyatt Rd *significantly higher than* Collocated monitor, Jaycee Park, and Water Treatment Plant (Figure 49)
- Lead
  - Wyatt Rd *significantly higher than* Collocated monitor, Jaycee Park, and Water Treatment Plant (Figure 50)
- Nickel
  - Wyatt Rd *significantly higher than* Collocated monitor and Jaycee Park (Figures 51)
- Mercury
  - Wyatt Rd *significantly higher than* Water Treatment Plant (Figures 52)

When looking at the graphed data, Wyatt Rd is consistently higher than other sites for all PM<sub>10</sub> metals; for chromium the Collocated monitor is also consistently higher than the two other stationary sites. The Collocated monitor is approximately 1.1 miles north of TXI and 1.2 miles north, northeast of Gergau Ameristeel. The Wyatt Rd monitor is located closer to TXI (approximately 0.7 miles northwest) and Gerdau Ameristeel (approximately 0.5 miles north) than the Collocated monitor. It is expected that the levels measured at Wyatt Rd and at the Collocated monitor would be higher than levels in the community. This is because the center of the city is offwind from TXI and Gerdau Ameristeel and upwind of Ash Grove and Holcim. The term offwind refers to the fact that the city center is located approximately 2.4 miles to the northeast of TXI and Gerdau Ameristeel, which is off the wind path from TXI and Gerdau Ameristeel when winds are coming from the south and southeast. The term upwind refers to the fact that the city center is located approximately 2.5 miles to the south, southwest of Ash Grove and Holcim, in which case winds would be traveling from the city center toward the industries when winds are out of the south and southeast. Therefore, since the predominant wind direction is from the south and southeast in this area, and the city center is located northeast and southwest of the identified industries, the city is predominantly offwind or upwind of the local industries.

*These analyses indicate that the measured concentrations of PM<sub>10</sub> metals are different across Midlothian, with relatively higher levels measured closer to industry and lower levels measured within the community. This indicates that nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in Midlothian; however, those contributions are slight, all measured levels are still well below their respective AMCVs, and are not of health concern.*

### Statistically Different Stationary Sites: Wyatt Rd vs Collocated, Jaycee Park, & Water Treatment Plant PM<sub>10</sub> Aluminum ANOVA



\*Collocated Wind Rose used due to insufficient data from Wyatt Rd.

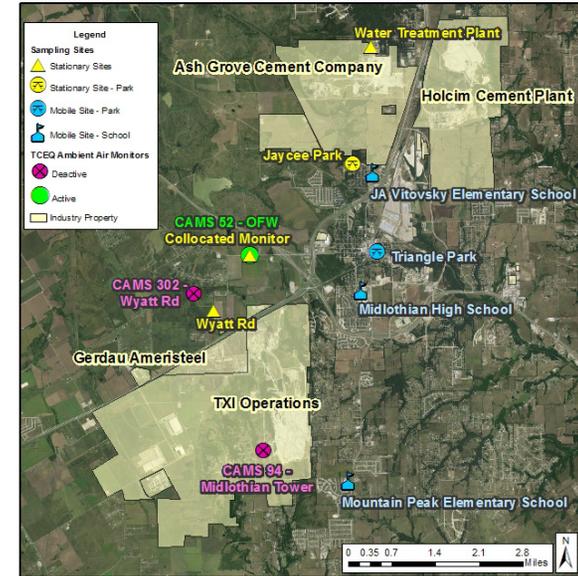
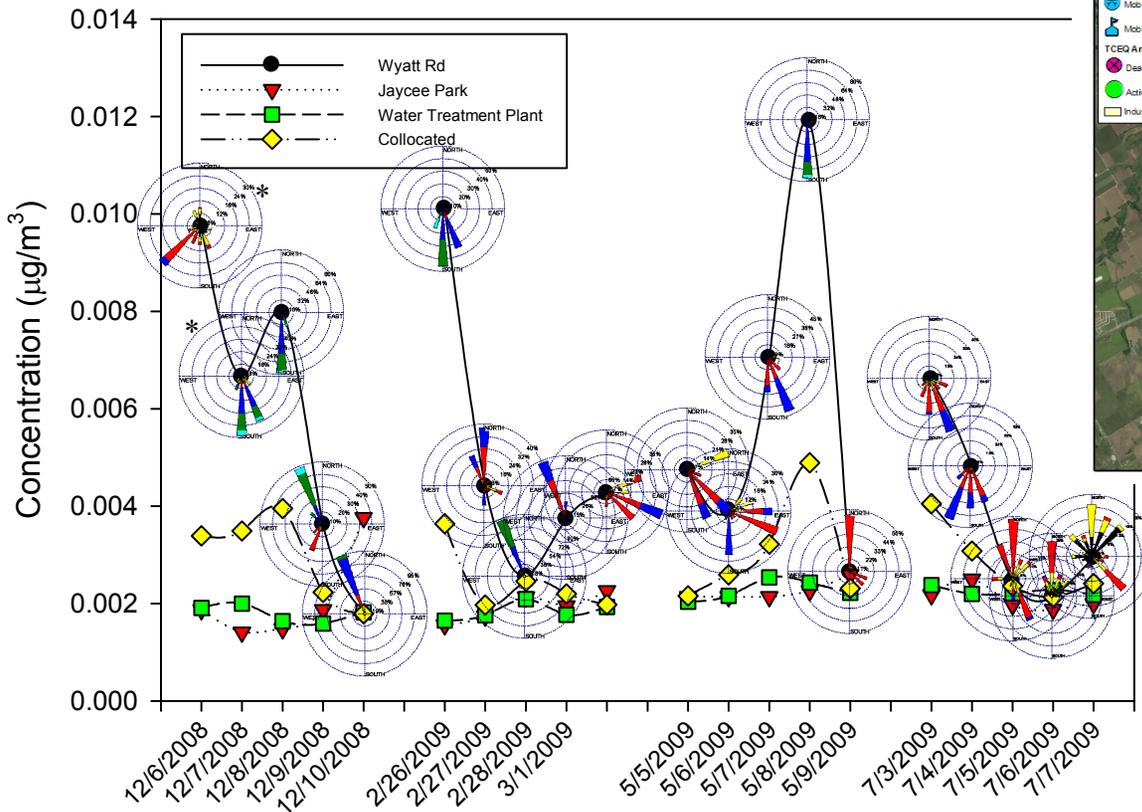


Figure 47. Observed Statistical Differences in PM<sub>10</sub> Aluminum Data ANOVA Analysis between Stationary Site Comparisons.

### Statistically Different Stationary Sites: Wyatt Rd vs Jaycee Park & Water Treatment Plant Collocated vs Jaycee Park & Water Treatment Plant PM<sub>10</sub> Chromium ANOVA



\*Collocated Wind Rose used due to insufficient data from Wyatt Rd.

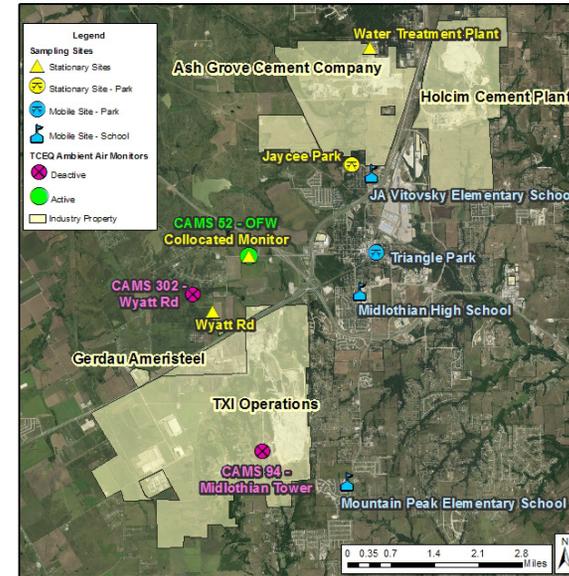


Figure 48. Observed Statistical Differences in PM<sub>10</sub> Chromium Data ANOVA Analysis between Stationary Site Comparisons.

## Statistically Different Stationary Sites: Wyatt Rd vs Collocated, Jaycee Park & Water Treatment Plant PM<sub>10</sub> Manganese ANOVA

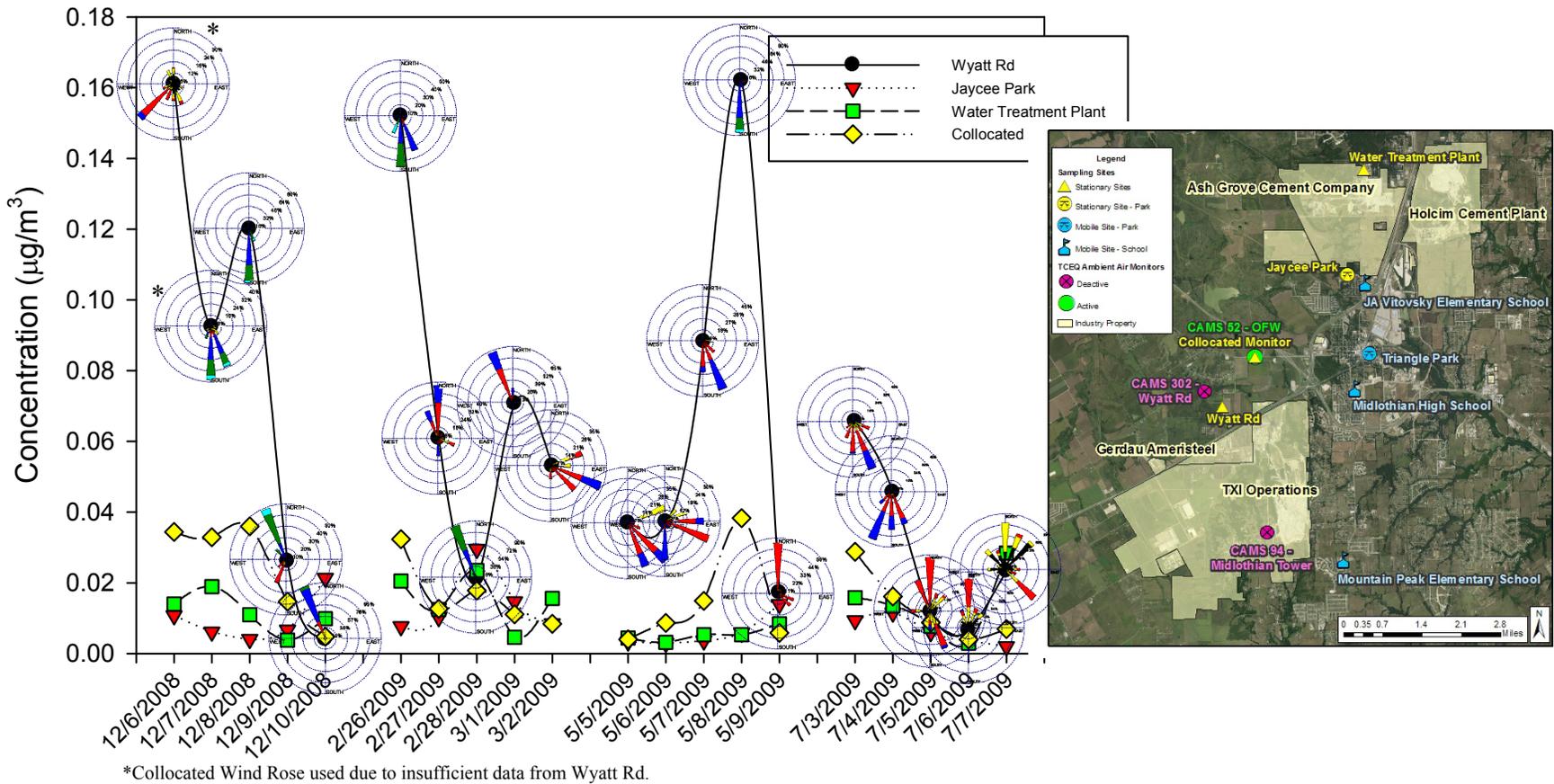


Figure 49. Observed Statistical Differences in PM<sub>10</sub> Manganese Data ANOVA Analysis between Stationary Site Comparisons.

### Statistically Different Stationary Sites: Wyatt Rd vs Jaycee Park & Water Treatment Plant PM<sub>10</sub> Lead ANOVA

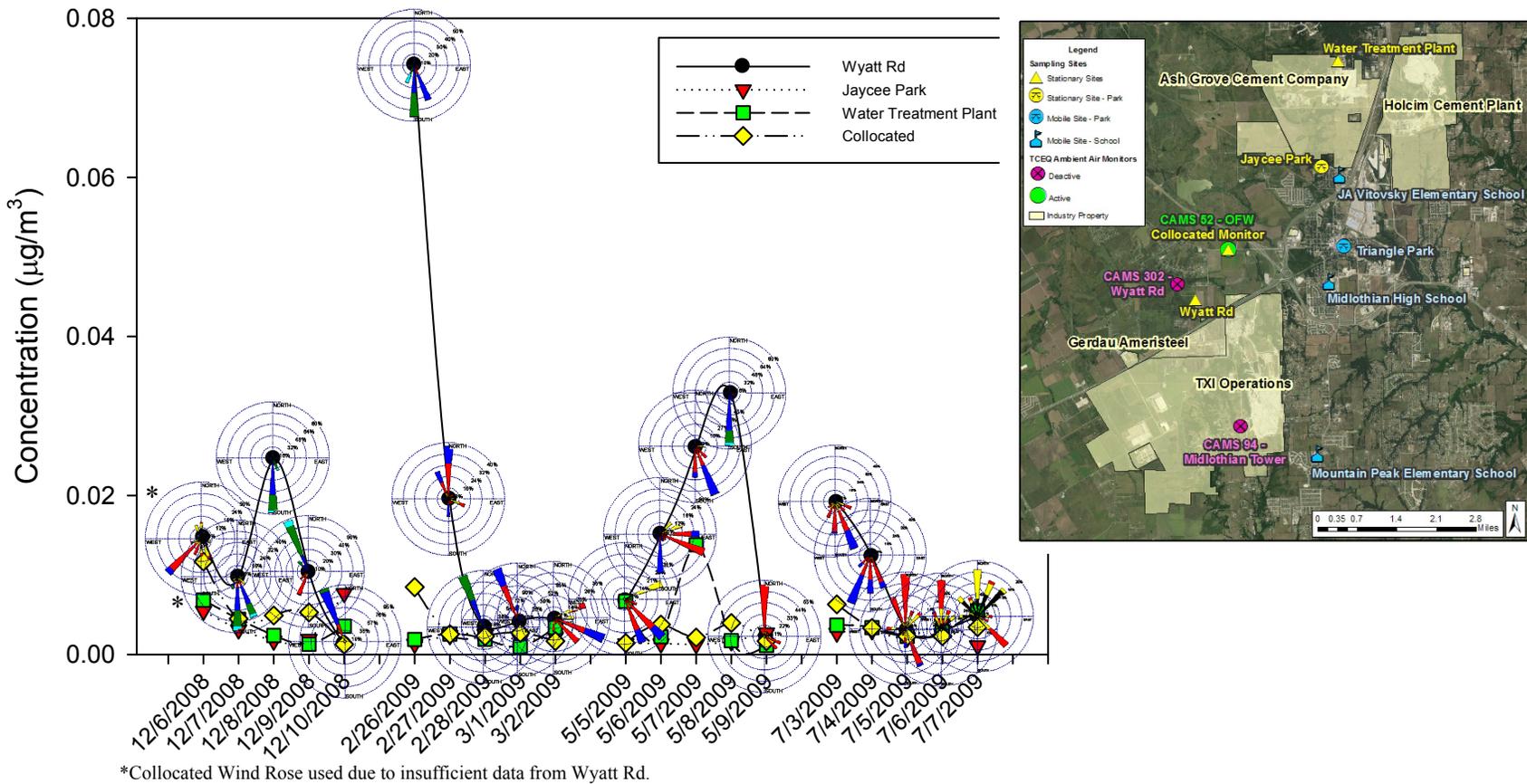


Figure 50. Observed Statistical Differences in PM<sub>10</sub> Lead Data ANOVA Analysis between Stationary Site Comparisons.

### Statistically Different Stationary Sites: Wyatt Rd vs Collocated & Jaycee Park PM<sub>10</sub> Nickel ANOVA

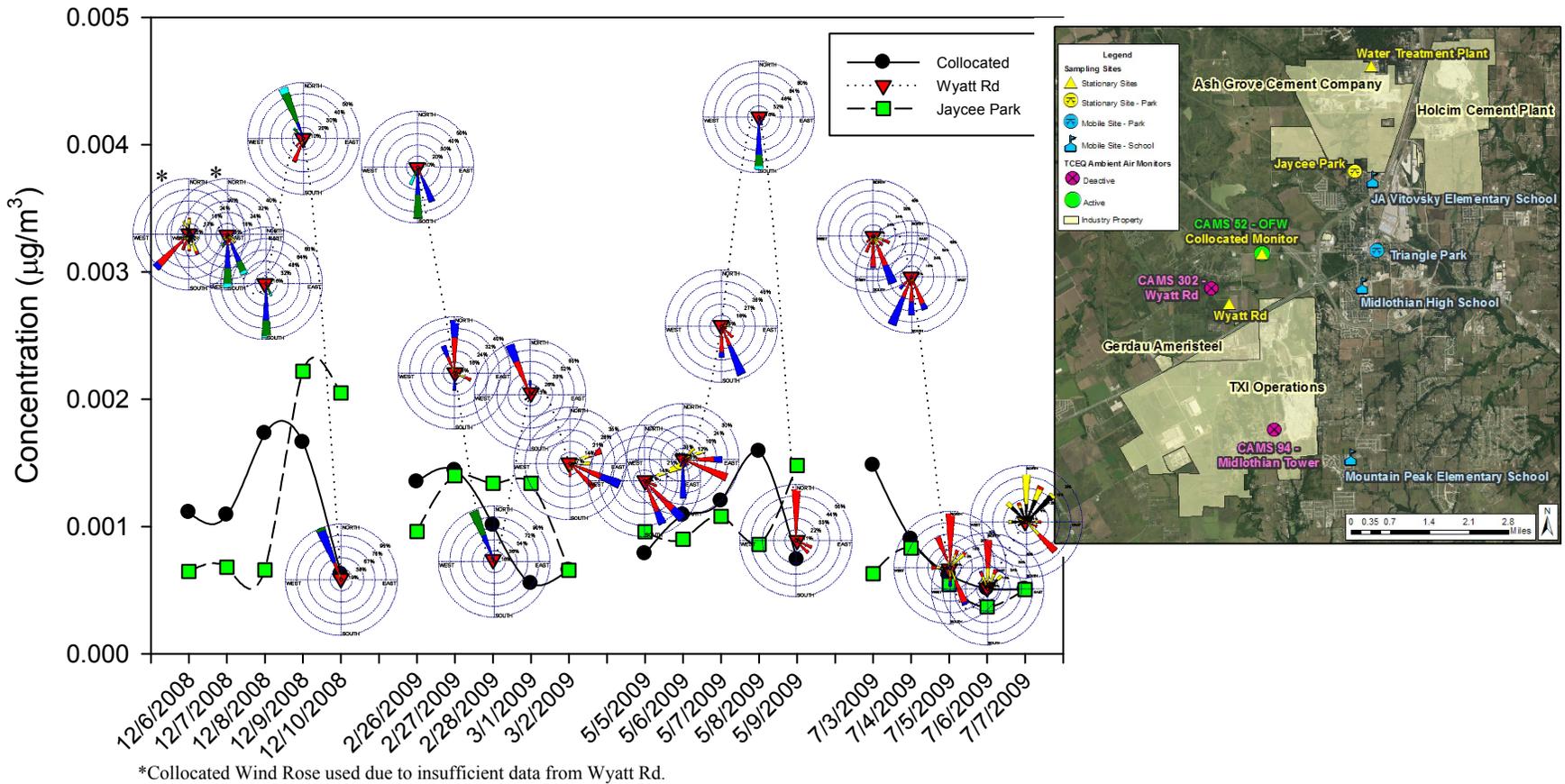


Figure 51. Observed Statistical Differences in PM<sub>10</sub> Nickel Data ANOVA Analysis between Stationary Site Comparisons.

### Statistically Different Stationary Sites: Wyatt Rd vs Water Treatment Plant PM<sub>10</sub> Mercury ANOVA

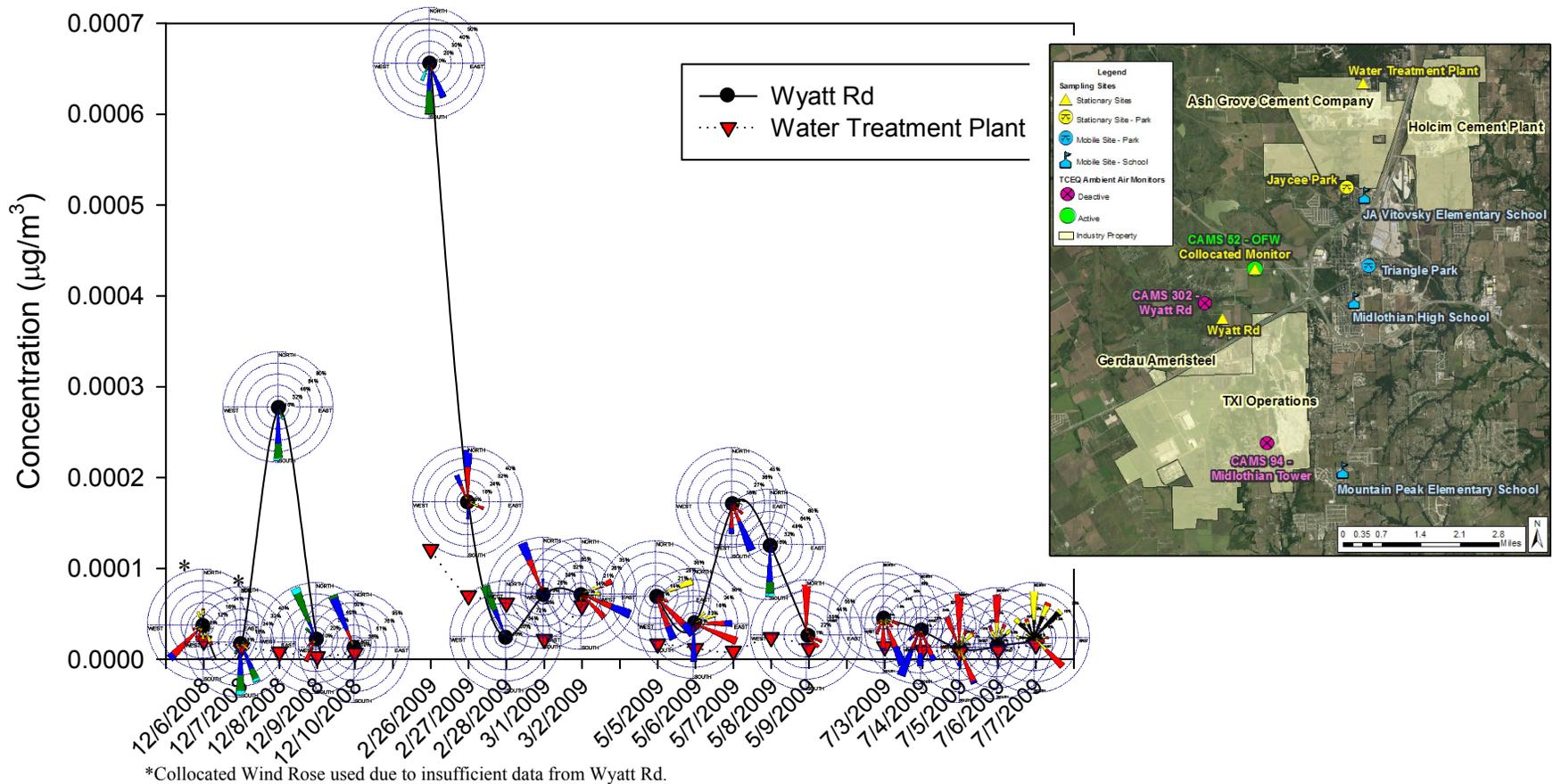


Figure 52. Observed Statistical Differences in PM<sub>10</sub> Mercury Data ANOVA Analysis between Stationary Site Comparisons.

Significant differences for all sites are as follows:

- Aluminum
  - Wyatt Rd *significantly higher than* Triangle Park and Midlothian HS (Figure 53)
- Chromium
  - Wyatt Rd *significantly higher than* Jaycee Park, Water Treatment Plant, Triangle Park, Mountain Peak, and Midlothian HS (Figure 54)
  - Triangle Park *significantly lower than* Collocated monitor and JA Vitovsky (Figure 55)
- Manganese
  - Wyatt Rd *significantly higher than* Jaycee Park, Triangle Park, and Midlothian HS (Figure 56)
- Lead
  - Wyatt Rd *significantly higher than* Mountain Peak and JA Vitovsky (Figure 57)
- Nickel
  - Wyatt Rd *significantly higher than* Midlothian HS (Figure 58)
- Mercury
  - Mountain Peak *significantly higher than* Jaycee Park, Water Treatment Plant, JA Vitovsky, and Midlothian HS (Figure 59)

When looking at the graphed data, Wyatt Rd is consistently higher than other sites for all PM<sub>10</sub> metals; for chromium the Collocated monitor is also consistently higher. The Collocated monitor is approximately 1.1 miles north of TXI and 1.2 miles north, northeast of Gergau Ameristeel. The Wyatt Rd monitor is located closer to TXI (approximately 0.7 miles northwest) and Gergau Ameristeel (approximately 0.5 miles north) than the Collocated monitor. It is expected that the levels measured at Wyatt Rd and at the Collocated monitor would be higher than levels in the community. This is because the center of the city is offwind from TXI and Gergau Ameristeel and upwind of Ash Grove and Holcim. The term offwind refers to the fact that the city center is located approximately 2.4 miles to the northeast of TXI and Gergau Ameristeel, which is off the wind path from TXI and Gergau Ameristeel when winds are coming from the south and southeast. The term upwind refers to the fact that the city center is located approximately 2.5 miles to the south, southwest of Ash Grove and Holcim, in which case winds would be traveling from the city center toward the industries when winds are out of the south and southeast. Therefore, since the predominant wind direction is from the south and southeast in this area, and the city center is located northeast and southwest of the identified industries, the city is predominantly offwind or upwind of the local industries. However, Mountain Peak has relatively higher levels of mercury as compared to most other monitors. When looking at this graphically, all but two of the other monitors have differences due to different sampling days. While there were statistical differences observed on the same sampling days, Mountain Peak levels were similar to, or slightly below, those at Wyatt Rd and the Collocated monitor. Due to a large variance in wind direction those five days, there is no clear source for the relatively higher levels. Nonetheless, all measured levels were well below the short-term AMCV of 0.25 µg/m<sup>3</sup> for mercury and are not of a health concern.

*These analyses indicate that the measured concentrations of PM<sub>10</sub> metals are different across Midlothian, with relatively higher levels measured closer to industry and lower levels measured within the community. This indicates that nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in Midlothian; however, those contributions are slight, all measured levels are still well below their respective AMCVs, and are not of health concern.*

### Statistically Different Sites: Wyatt Rd vs Triangle Park & Midlothian HS PM<sub>10</sub> Aluminum ANOVA

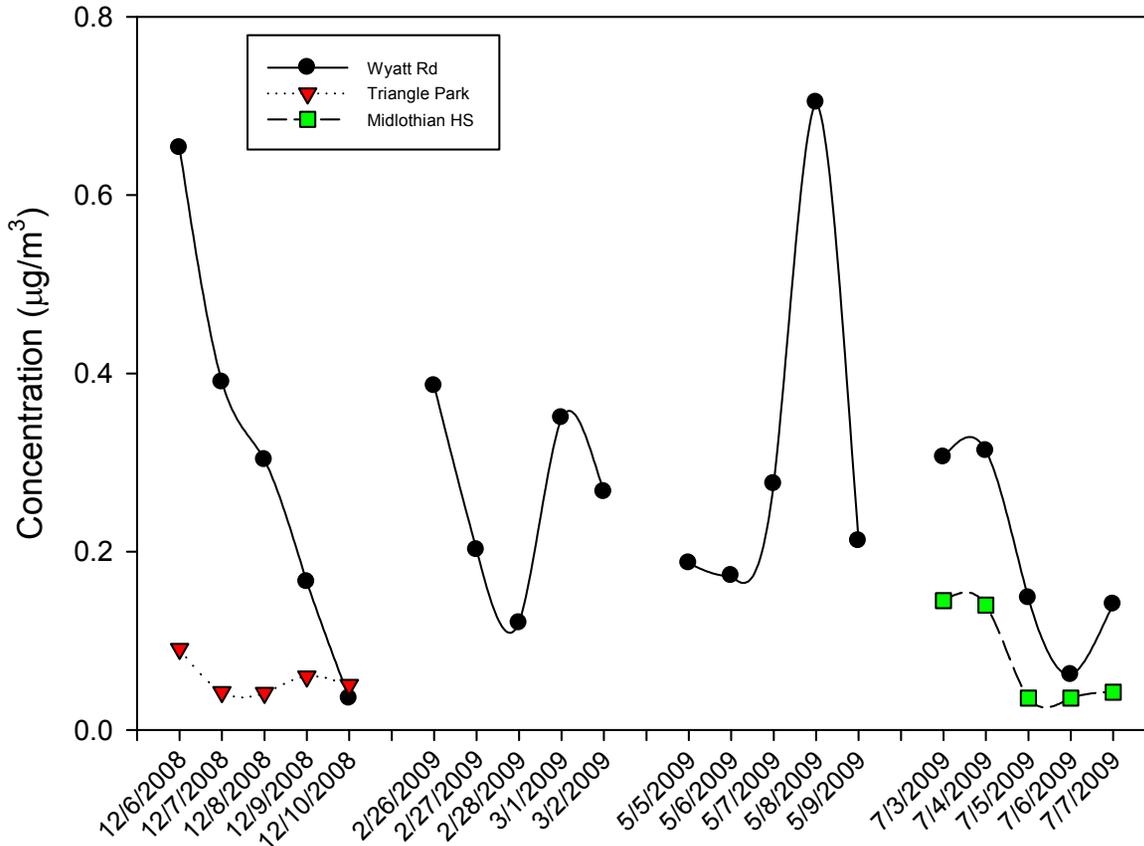


Figure 53. Observed Statistical Differences in PM<sub>10</sub> Aluminum Data ANOVA Analysis between All Site Comparisons.

Statistically Different Sites:  
 Wyatt Rd vs Jaycee Park, Water Treatment Plant, Triangle Park,  
 Mountain Peak, Midlothian HS  
 PM<sub>10</sub> Chromium ANOVA

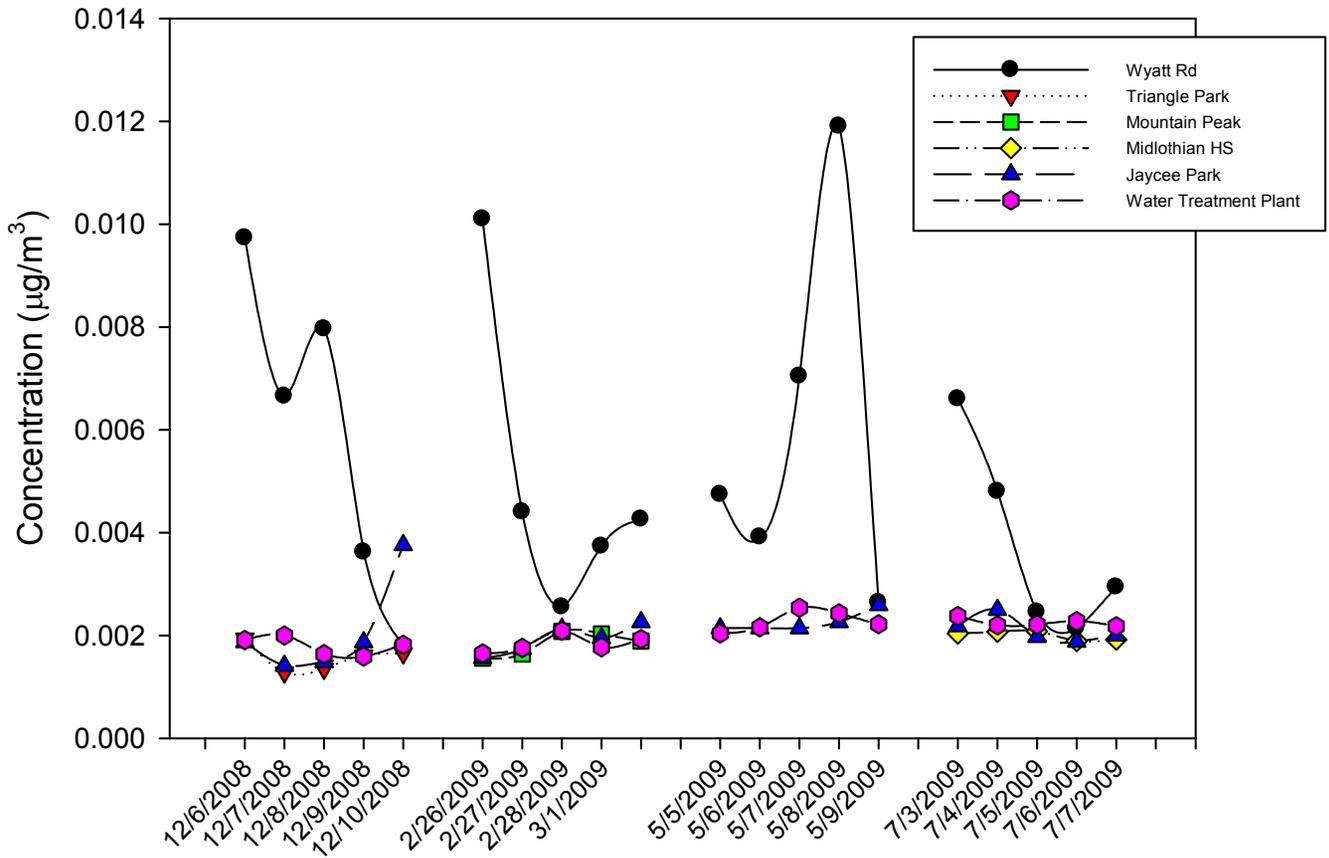


Figure 54. Observed Statistical Differences in PM<sub>10</sub> Chromium Data ANOVA Analysis between All Site Comparisons.

### Statistically Different Sites: Triangle Park vs Collocated & Vitovsky PM<sub>10</sub> Chromium ANOVA

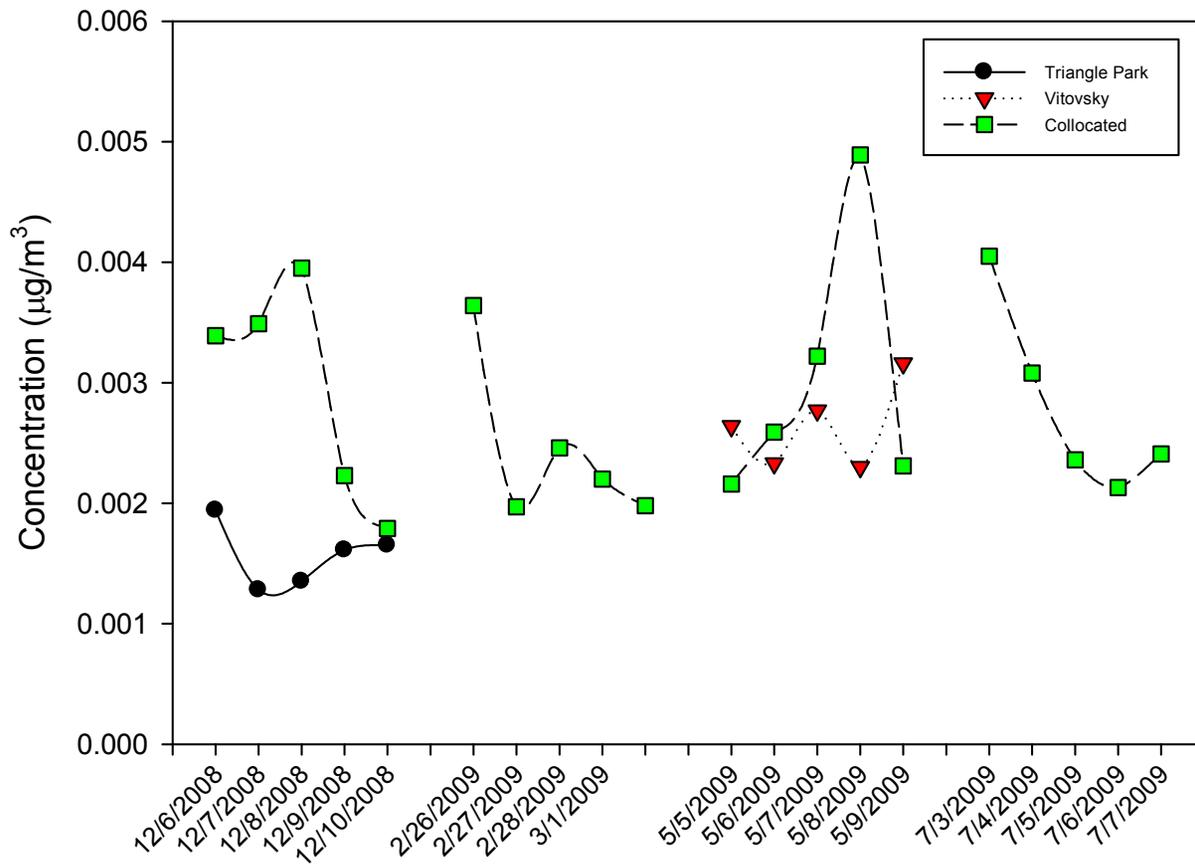


Figure 55. Observed Statistical Differences in PM<sub>10</sub> Chromium Data ANOVA Analysis between All Site Comparisons.

Statistically Different Sites:  
Wyatt Rd vs Jaycee Park, Triangle Park, & Midlothian HS  
PM<sub>10</sub> Manganese ANOVA

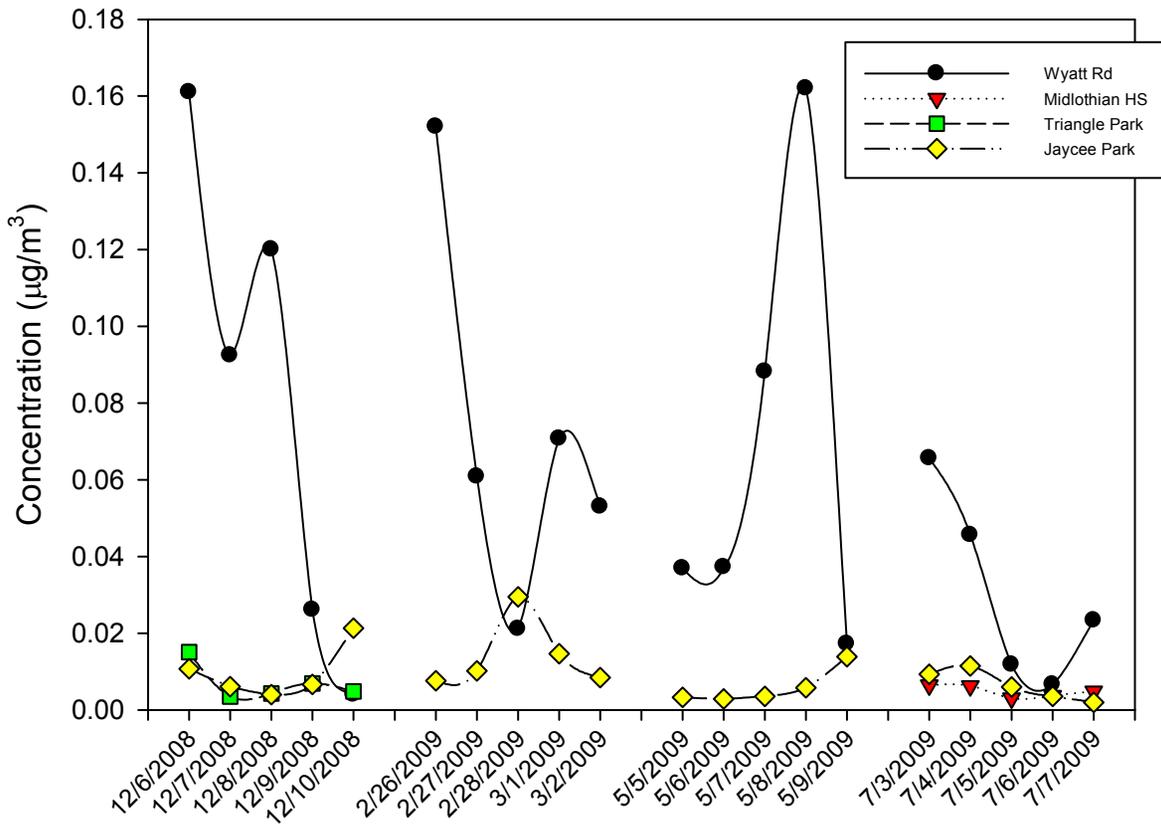


Figure 56. Observed Statistical Differences in PM<sub>10</sub> Manganese Data ANOVA Analysis between All Site Comparisons.

### Statistically Different Sites: Wyatt Rd vs Vitovsky & Mountain Peak PM<sub>10</sub> Lead ANOVA

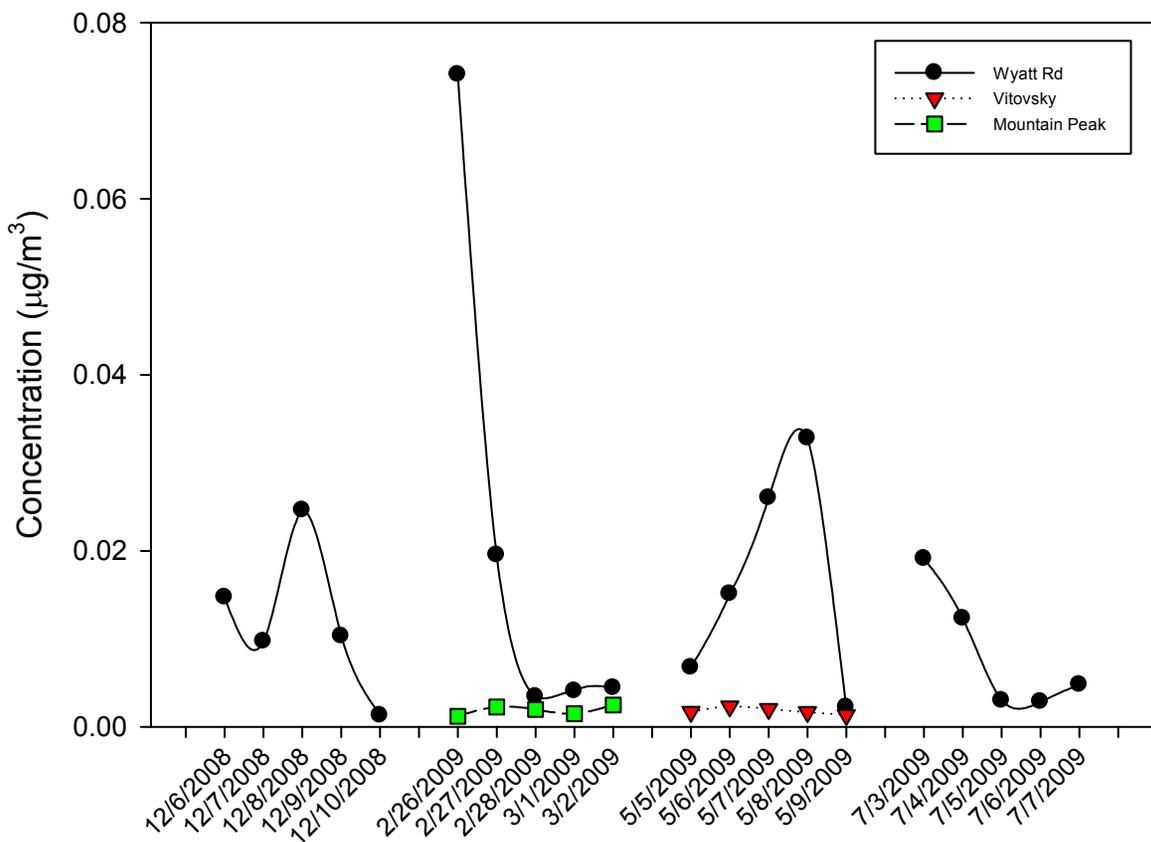


Figure 57. Observed Statistical Differences in PM<sub>10</sub> Lead Data ANOVA Analysis between All Site Comparisons.

### Statistically Different Sites: Wyatt Rd vs Midlothian HS PM<sub>10</sub> Nickel ANOVA

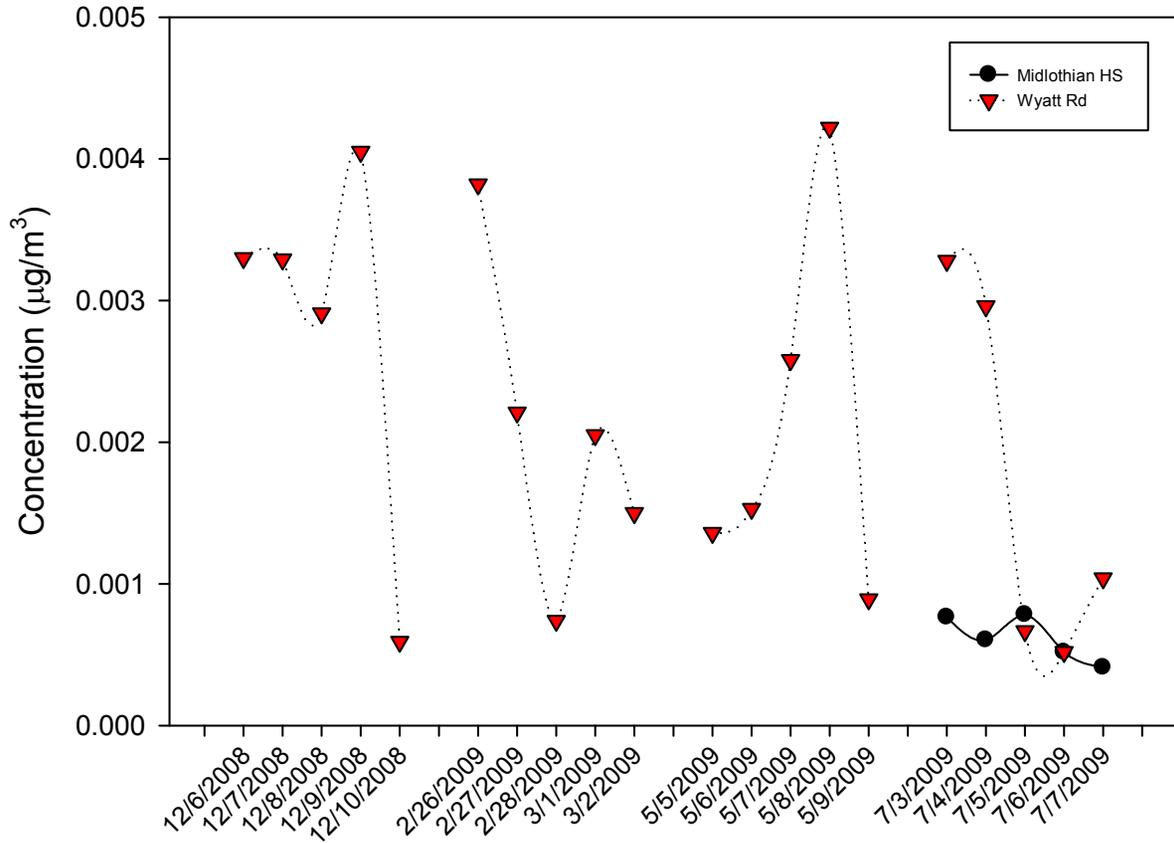


Figure 58. Observed Statistical Differences in PM<sub>10</sub> Nickel Data ANOVA Analysis between All Site Comparisons.

Statistically Different Sites:  
 Mountain Peak vs Jaycee Park, Water Treatment Plant, Vitovsky, & Midlothian HS  
 PM<sub>10</sub> Mercury ANOVA

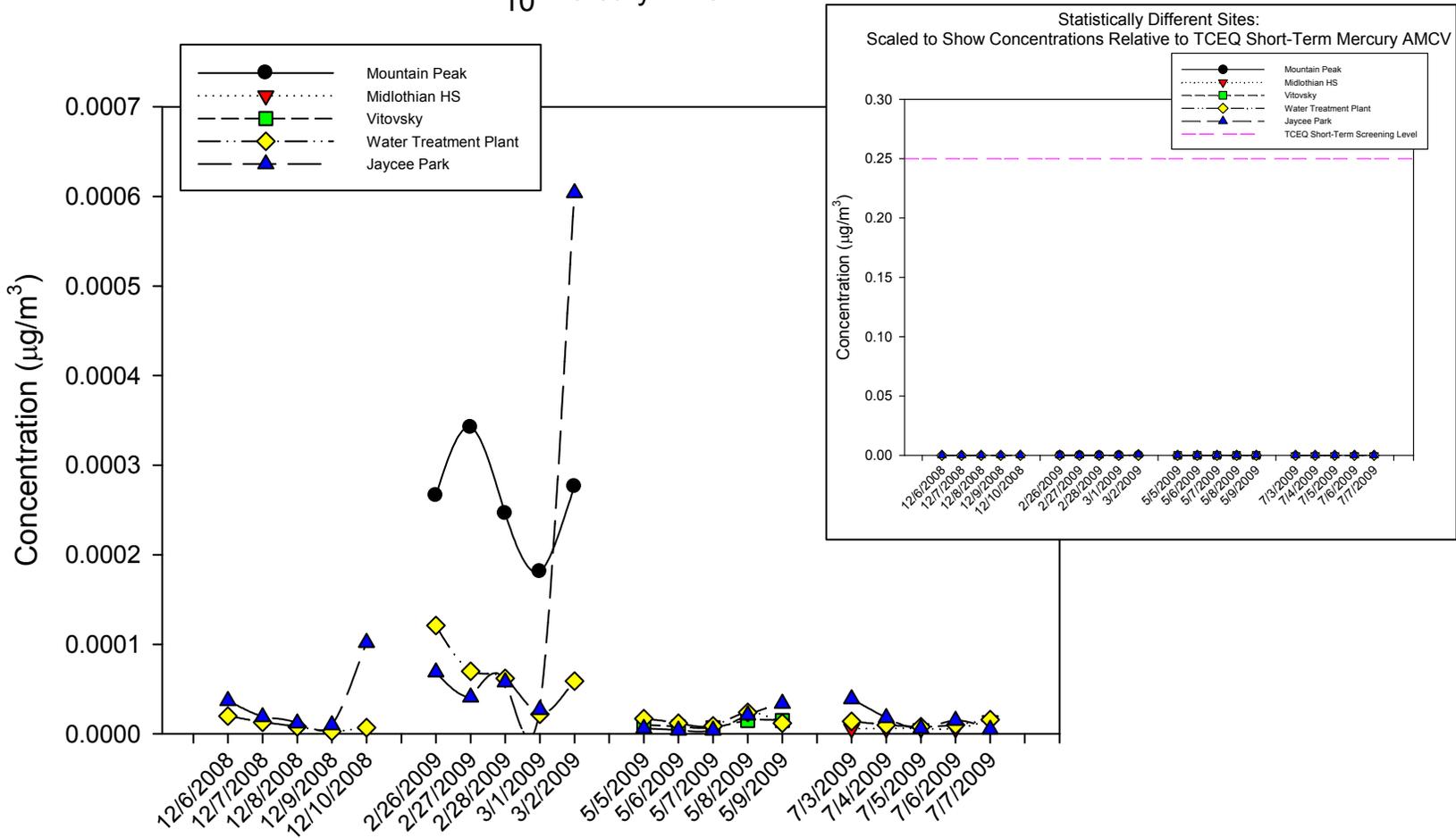


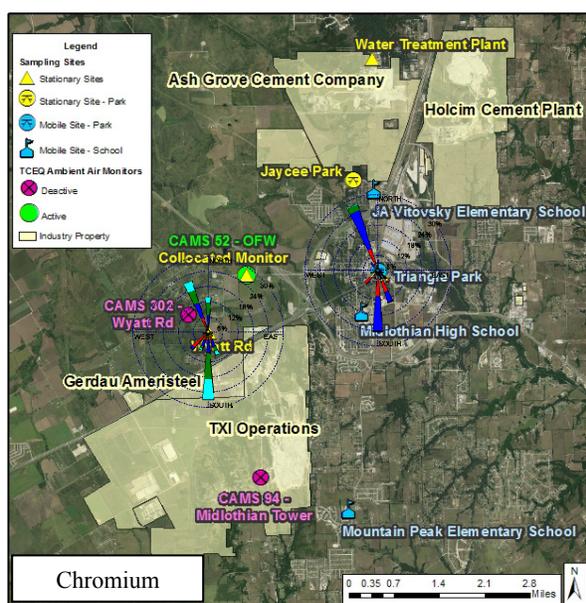
Figure 59. Observed Statistical Differences in PM<sub>10</sub> Mercury Data ANOVA Analysis between All Site Comparisons. Inset graph shows monitored concentrations relative to the TCEQ mercury short-term AMCV of 0.25 µg/m<sup>3</sup>.

### Comparisons of Individual Quarterly Data

A comparison between all four sampling sites for each quarter was performed on the PM<sub>10</sub> metals data to determine any statistical differences. The TD conducted statistical comparisons (Appendix I; Raw Data Figures K-37 – K-60) between the five PM<sub>10</sub> metals monitoring sites for each quarter using a one-way ANOVA. For an overview of the ANOVA procedure, please see Figure 17. Only two of the twenty four data comparisons passed the normality test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences are as follows:

#### 1<sup>st</sup> Quarter significant differences:

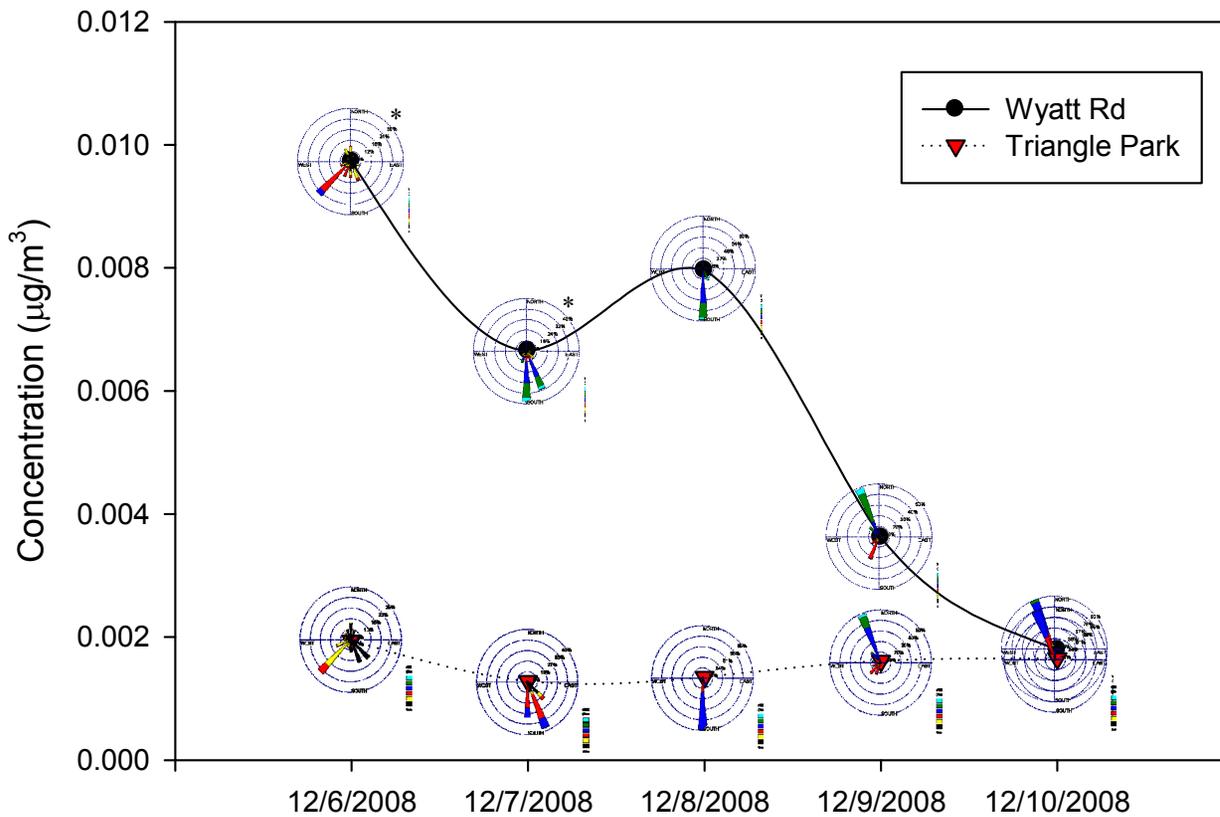
- Chromium
  - Wyatt Rd significantly higher than Triangle Park (Figure 61)



CAMS 52 Wind data used for Wyatt Rd due to insufficient data collection at Wyatt Rd

Figure 60. Map Showing 1<sup>st</sup> Quarter Average Wind Directions for Significantly Different Monitoring Sites.

### Statistically Different 1st Quarter Sites: Wyatt Rd vs Triangle Park PM<sub>10</sub> Chromium ANOVA



\*No met data available for CAMS 302 on these days; CAMS 52 used as a surrogate

Figure 61. Statistically Different First Quarter Monitoring Sites with Daily Wind Rose Overlays: PM<sub>10</sub> Chromium

2<sup>nd</sup> Quarter significant differences:

- Aluminum
  - Wyatt Rd *significantly higher than* Collocated monitor, Jaycee Park, Water Treatment Plant, and Mountain Peak (Figure 63)
- Chromium
  - Wyatt Rd *significantly higher than* Jaycee Park, Water Treatment Plant, and Mountain Peak (Figure 64)
- Manganese
  - Wyatt Rd *significantly higher than* Mountain Peak (Figure 65)
- Lead
  - Wyatt Rd *significantly higher than* Mountain Peak and Jaycee Park (Figure 66)

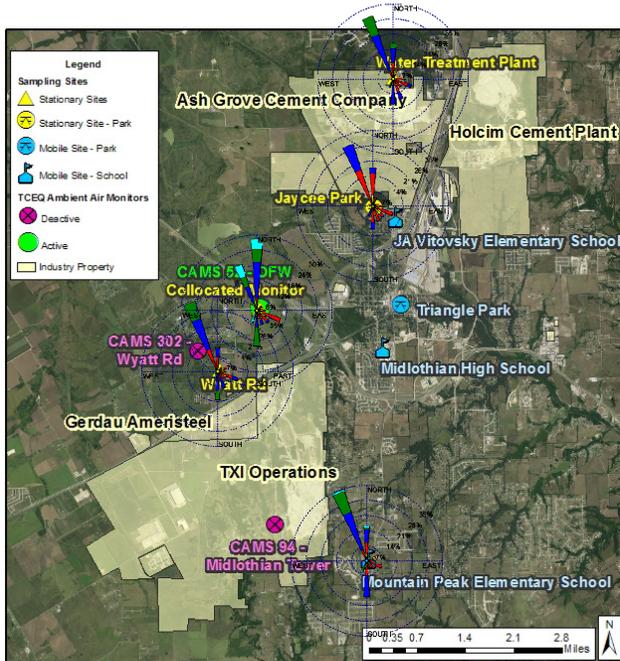


Figure 62. Map Showing 2<sup>nd</sup> Quarter Average Wind Directions for Significantly Different Monitoring Sites.

### Statistically Different 2nd Quarter Sites: Wyatt Rd. vs Collocated, Jaycee Park, Water Treatment Plant, & Mountain Peak PM<sub>10</sub> Aluminum ANOVA

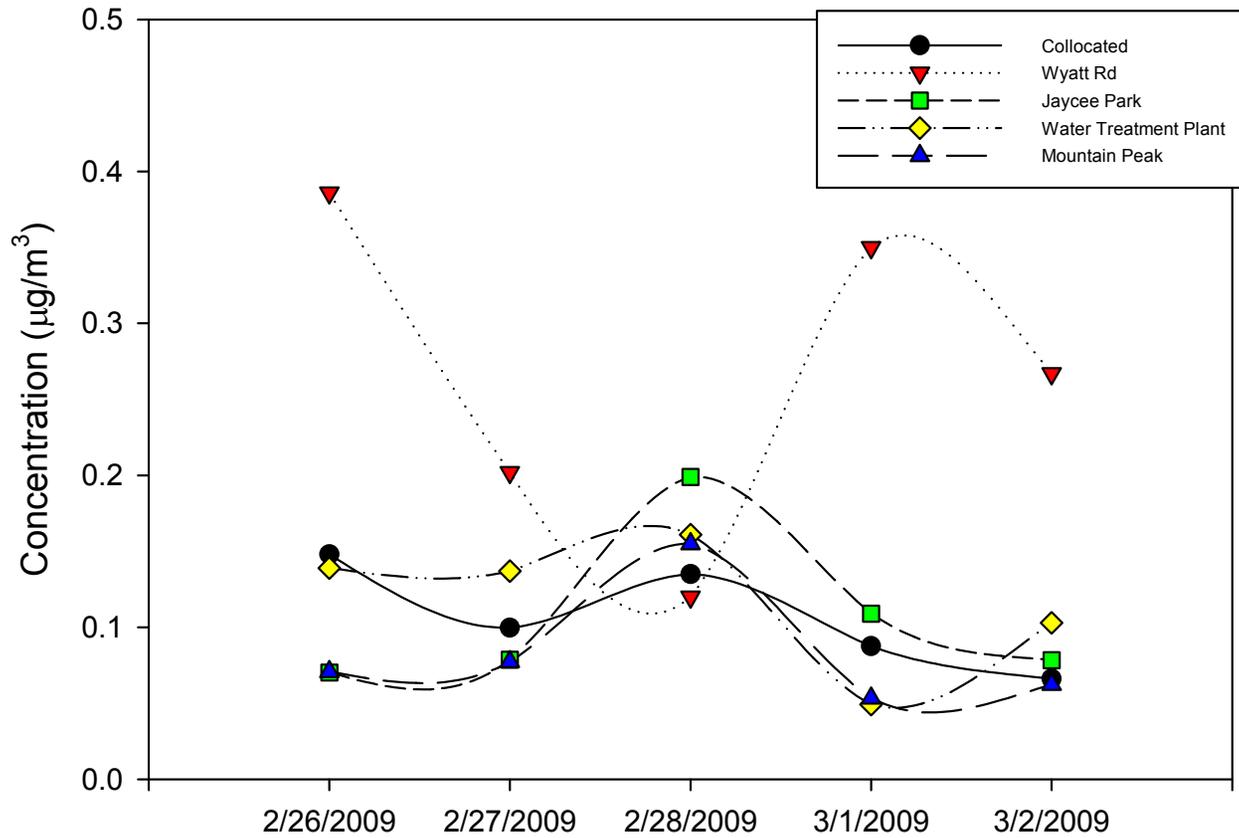


Figure 63. Statistically Different Second Quarter Monitoring Sites: PM<sub>10</sub> Aluminum.

### Statistically Different 2nd Quarter Sites: Wyatt Rd vs Jaycee Park, Water Treatment Plant, & Mountain Peak PM<sub>10</sub> Chromium ANOVA

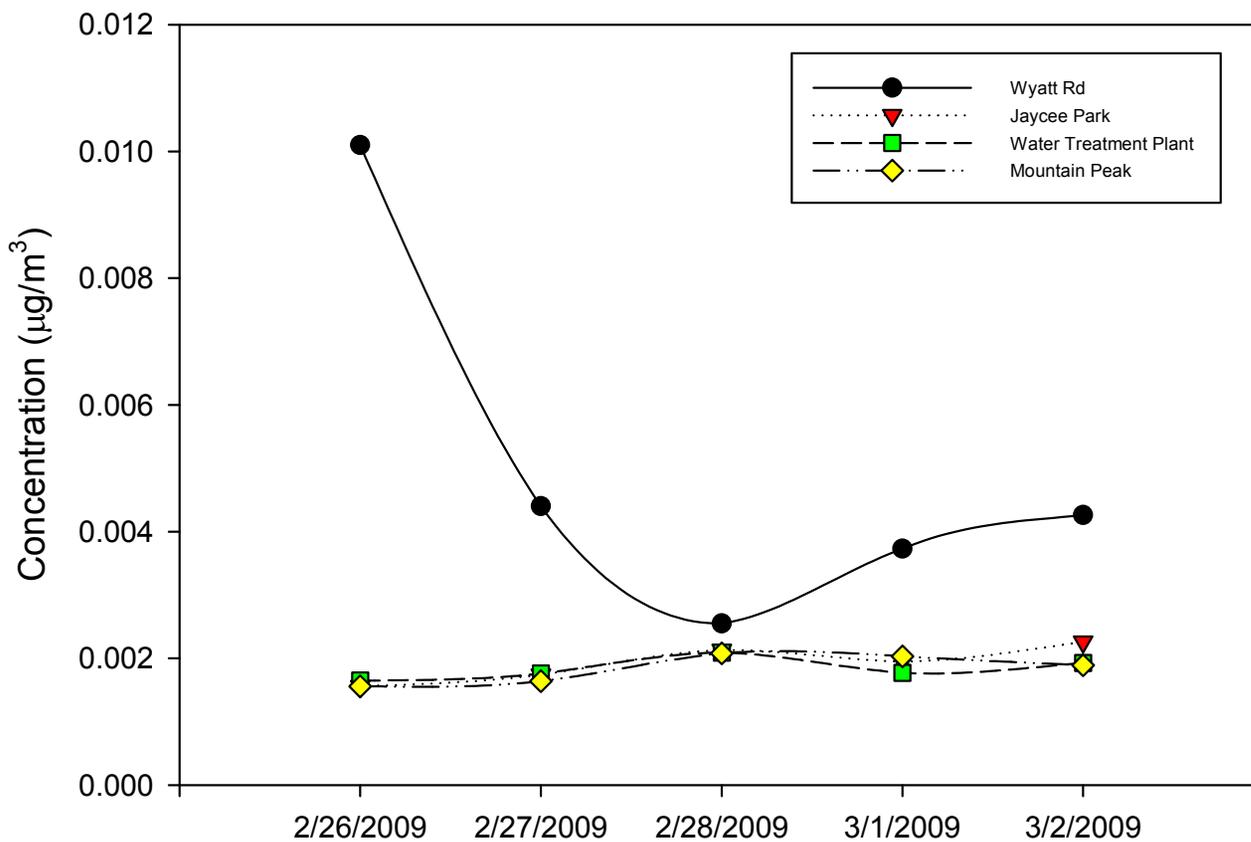


Figure 64. Statistically Different Second Quarter Monitoring Sites: PM<sub>10</sub> Chromium.

### Statistically Different 2nd Quarter Sites: Wyatt Rd vs Mountain Peak PM<sub>10</sub> Manganese ANOVA

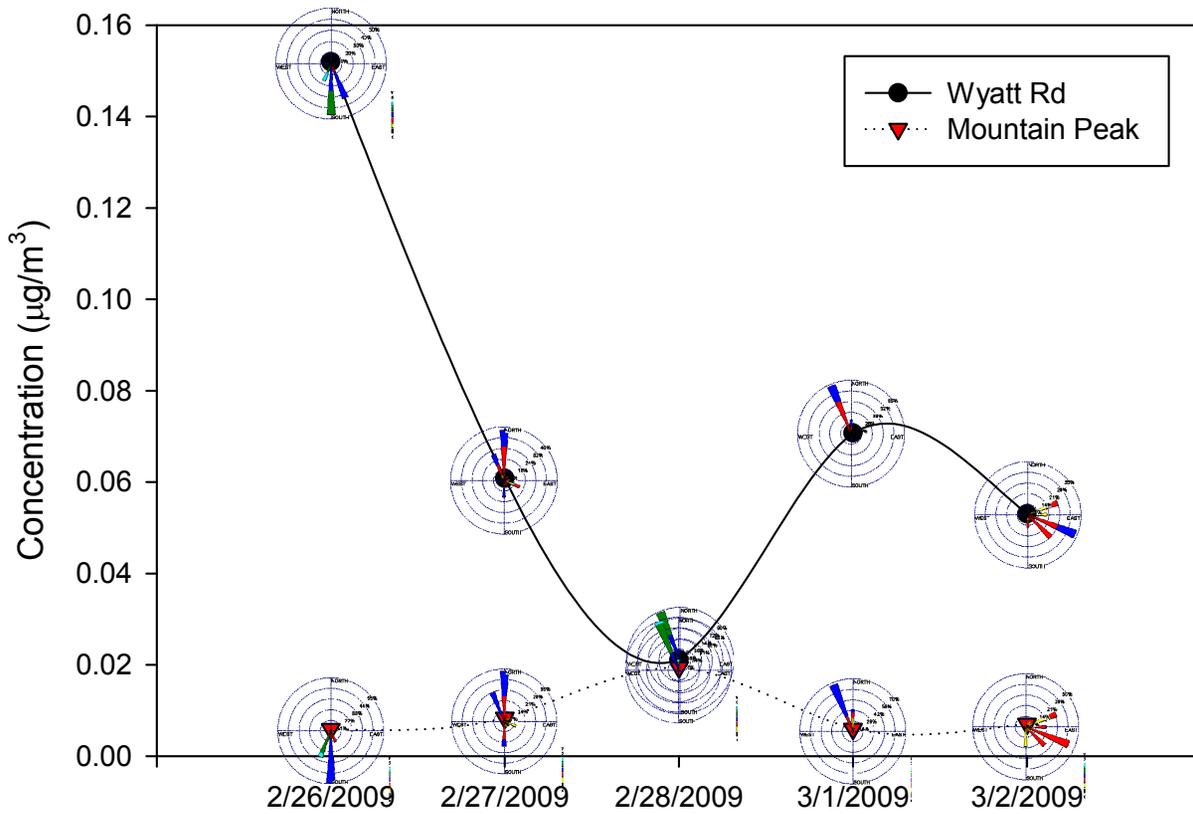


Figure 65. Statistically Different Second Quarter Monitoring Sites with Daily Wind Rose Overlays: PM<sub>10</sub> Manganese.

### Statistically Different 2nd Quarter Sites: Wyatt Rd vs Jaycee Park & Mountain Peak PM<sub>10</sub> Lead ANOVA

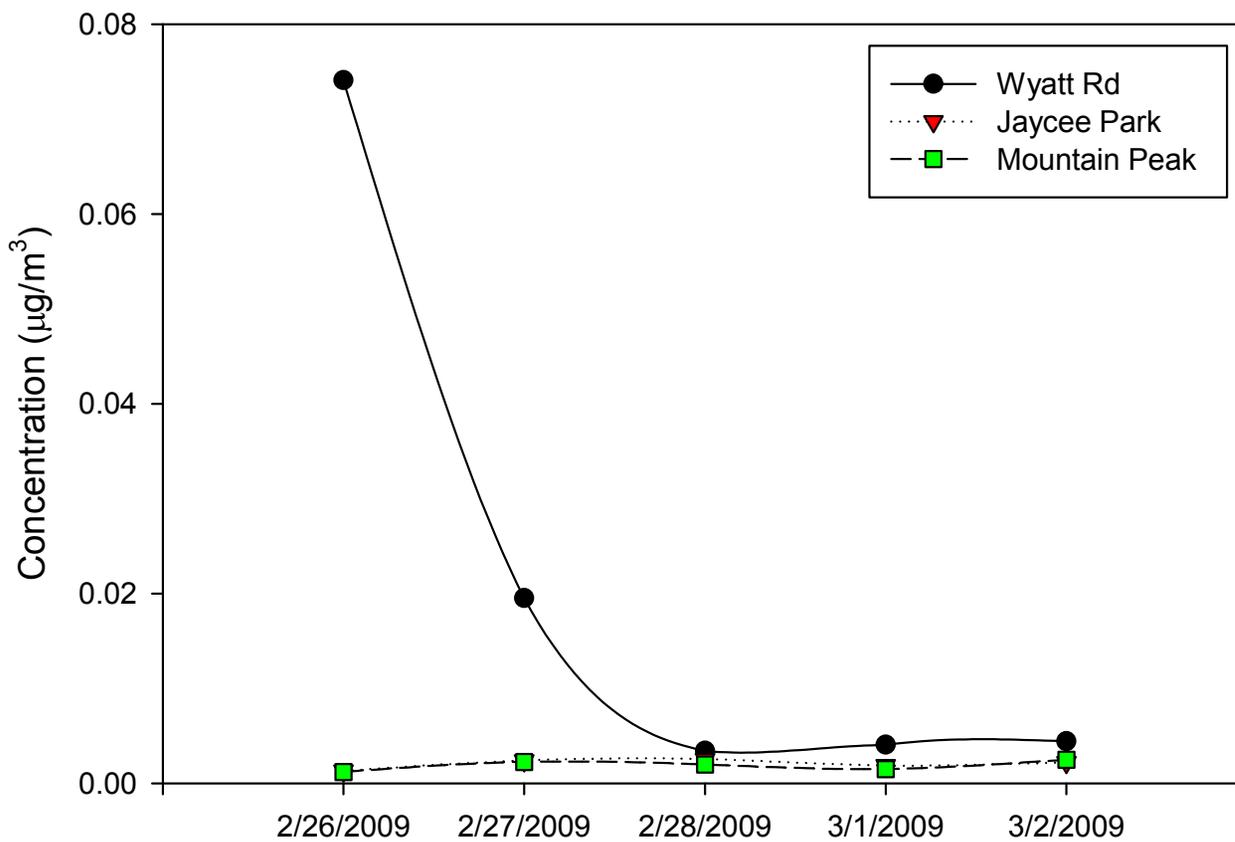


Figure 66. Statistically Different Second Quarter Monitoring Sites: PM<sub>10</sub> Lead.

3<sup>rd</sup> Quarter significant differences:

- Aluminum
  - Wyatt Rd *significantly higher than* Vitovsky (Figure 68)
- Chromium
  - Wyatt Rd *significantly higher than* Jaycee Park and Water Treatment Plant (Figure 69)
- Manganese
  - Wyatt Rd *significantly higher than* Jaycee Park and Water Treatment Plant (Figure 70)
- Lead
  - Wyatt Rd *significantly higher than* Jaycee Park (Figure 71)
- Mercury
  - Wyatt Rd *significantly higher than* Jaycee Park and Vitovsky (Figure 72)

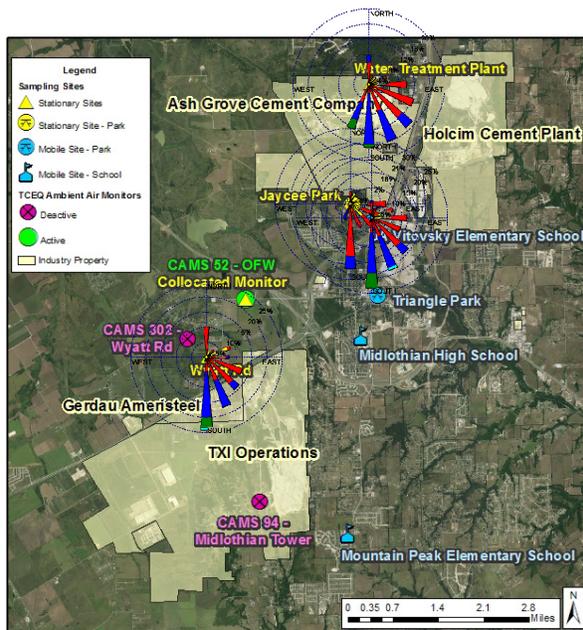


Figure 67. Map Showing 3<sup>rd</sup> Quarter Average Wind Directions for Significantly Different Monitoring Sites.

### Statistically Different 3rd Quarter Sites: Wyatt Rd vs Vitovsky PM<sub>10</sub> Aluminum ANOVA

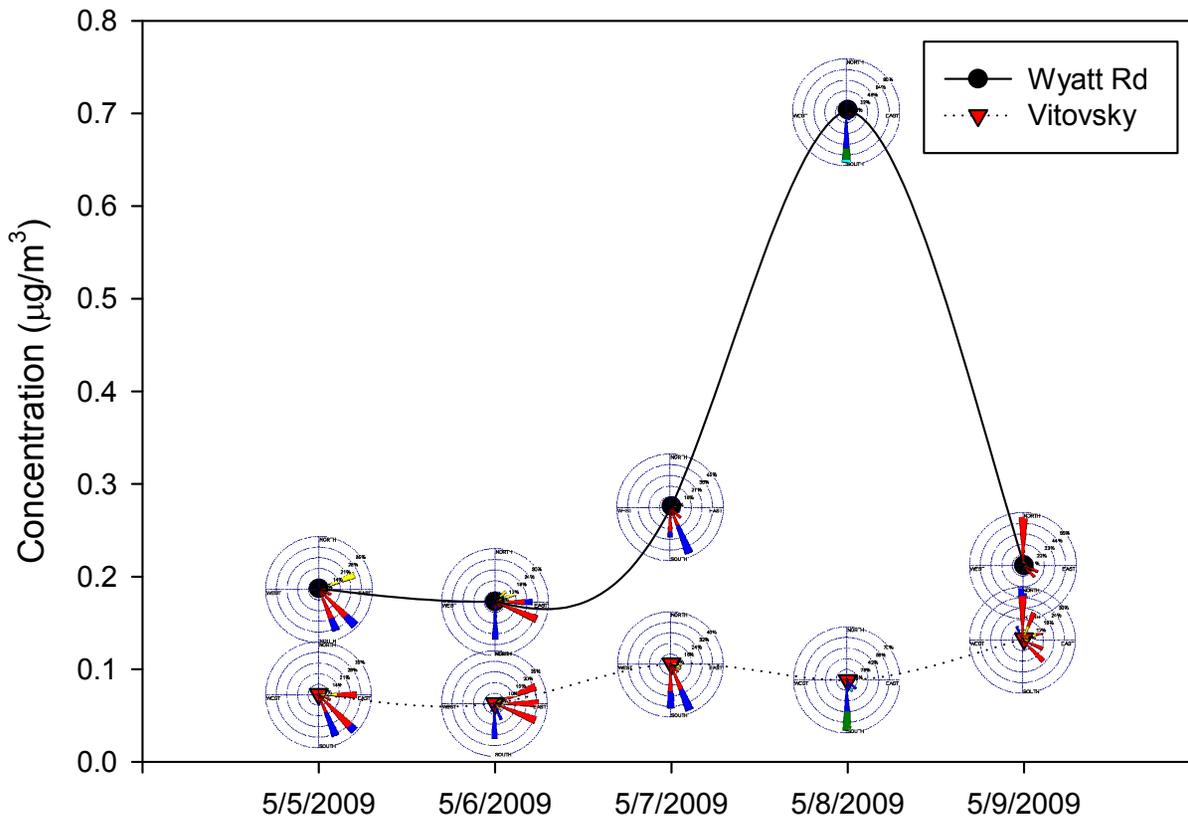


Figure 68. Statistically Different Third Quarter Monitoring Sites with Daily Wind Rose Overlays: PM<sub>10</sub> Aluminum.

### Statistically Different 3rd Quarter Sites: Wyatt Rd vs Jaycee Park & Water Treatment Plant PM<sub>10</sub> Chromium ANOVA

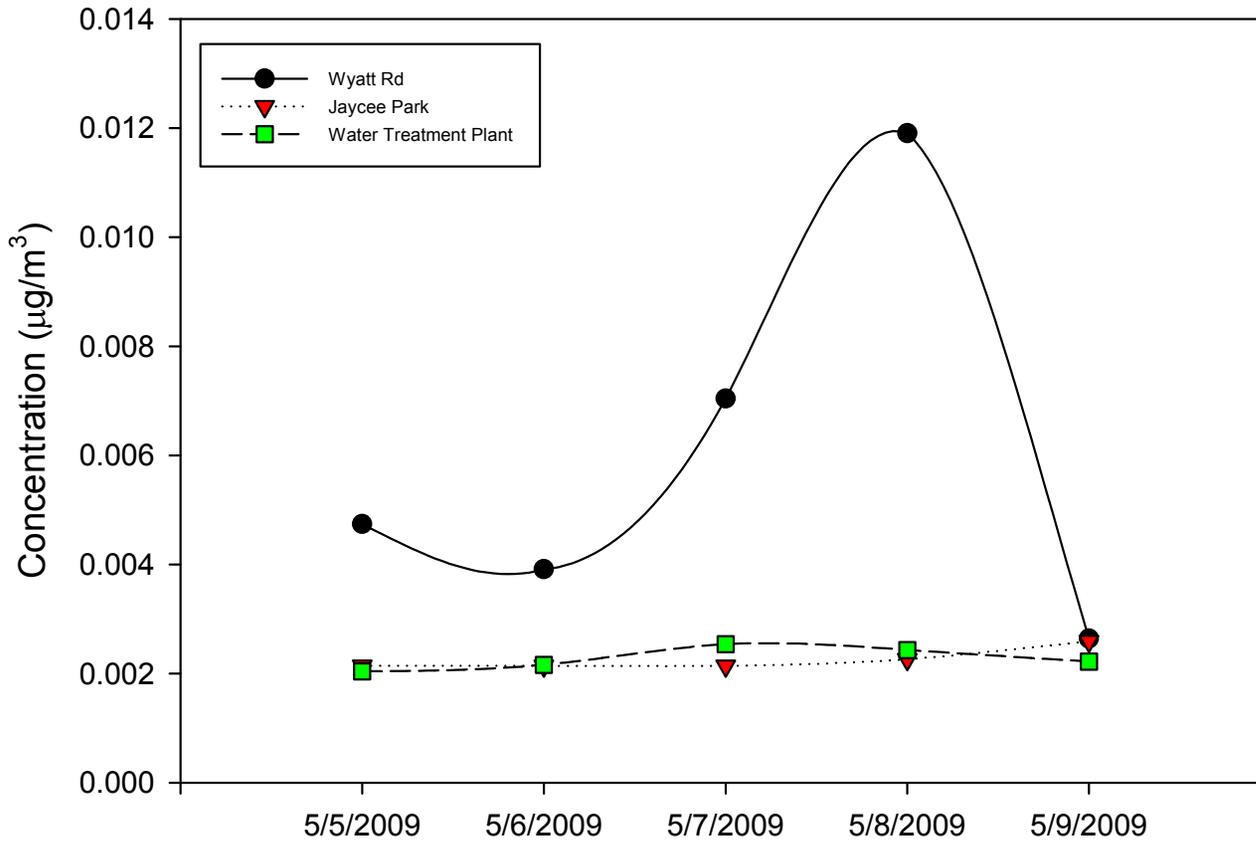


Figure 69. Statistically Different Third Quarter Monitoring Sites: PM<sub>10</sub> Chromium.

### Statistically Different 3rd Quarter Sites: Wyatt Rd vs Jaycee Park & Water Treatment Plant PM<sub>10</sub> Manganese ANOVA

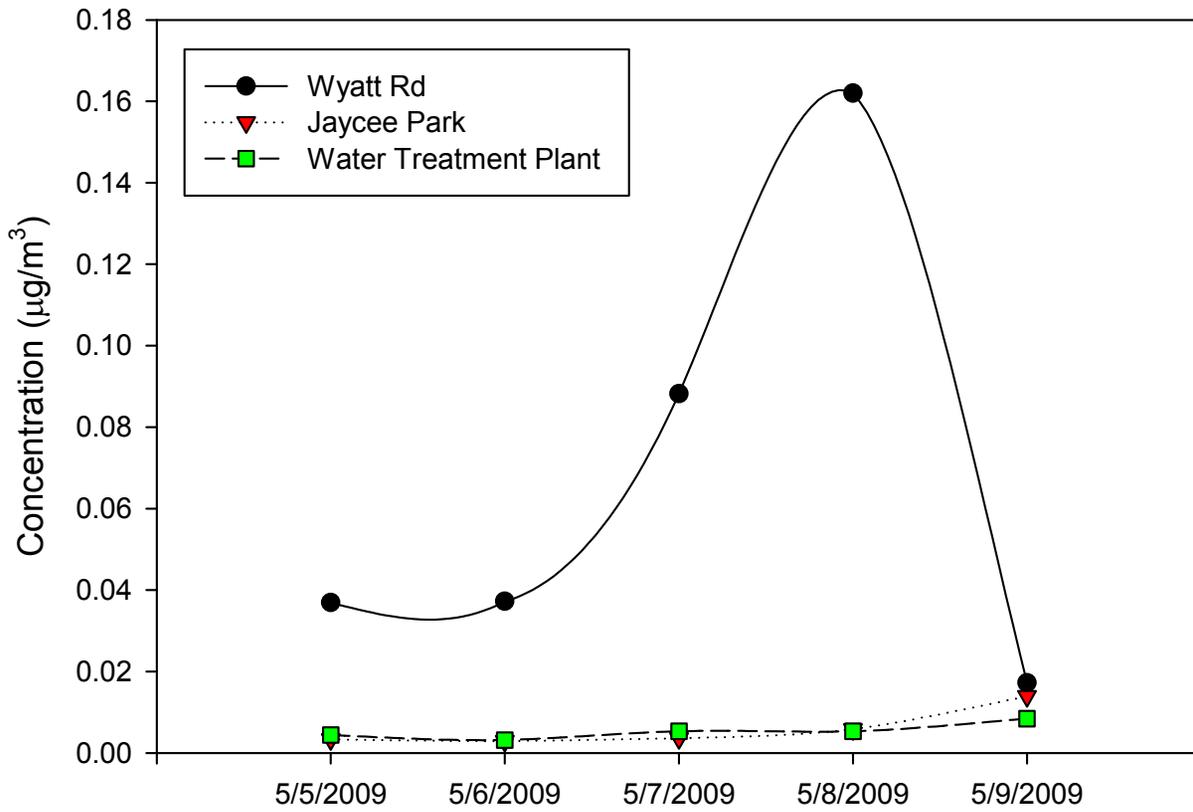


Figure 70. Statistically Different Third Quarter Monitoring Sites: PM<sub>10</sub> Manganese.

### Statistically Different 3rd Quarter Sites: Wyatt Rd vs Jaycee Park PM<sub>10</sub> Lead ANOVA

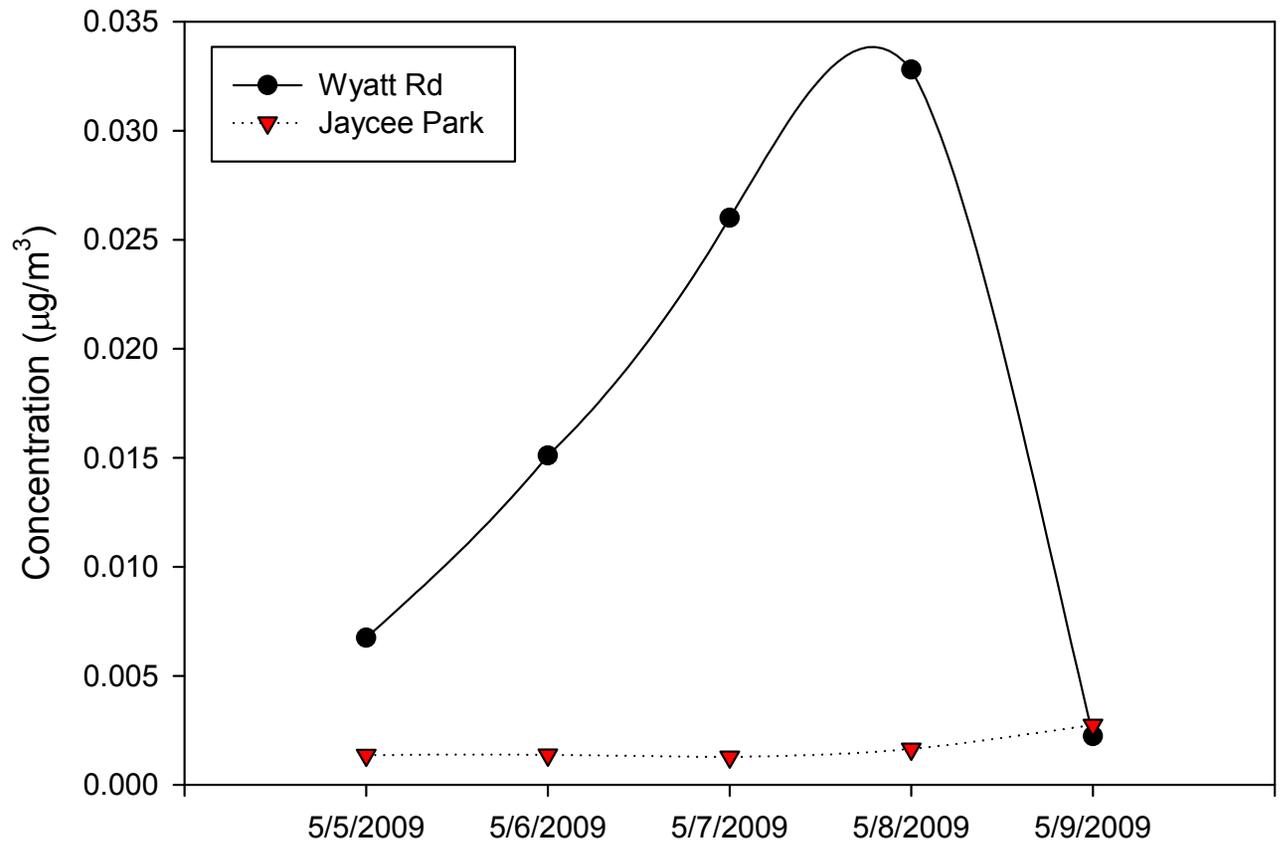


Figure 71. Statistically Different Third Quarter Monitoring Sites: PM<sub>10</sub> Lead.

### Statistically Different 3rd Quarter Sites: Wyatt Rd vs Jaycee Park & Vitovsky PM<sub>10</sub> Mercury ANOVA

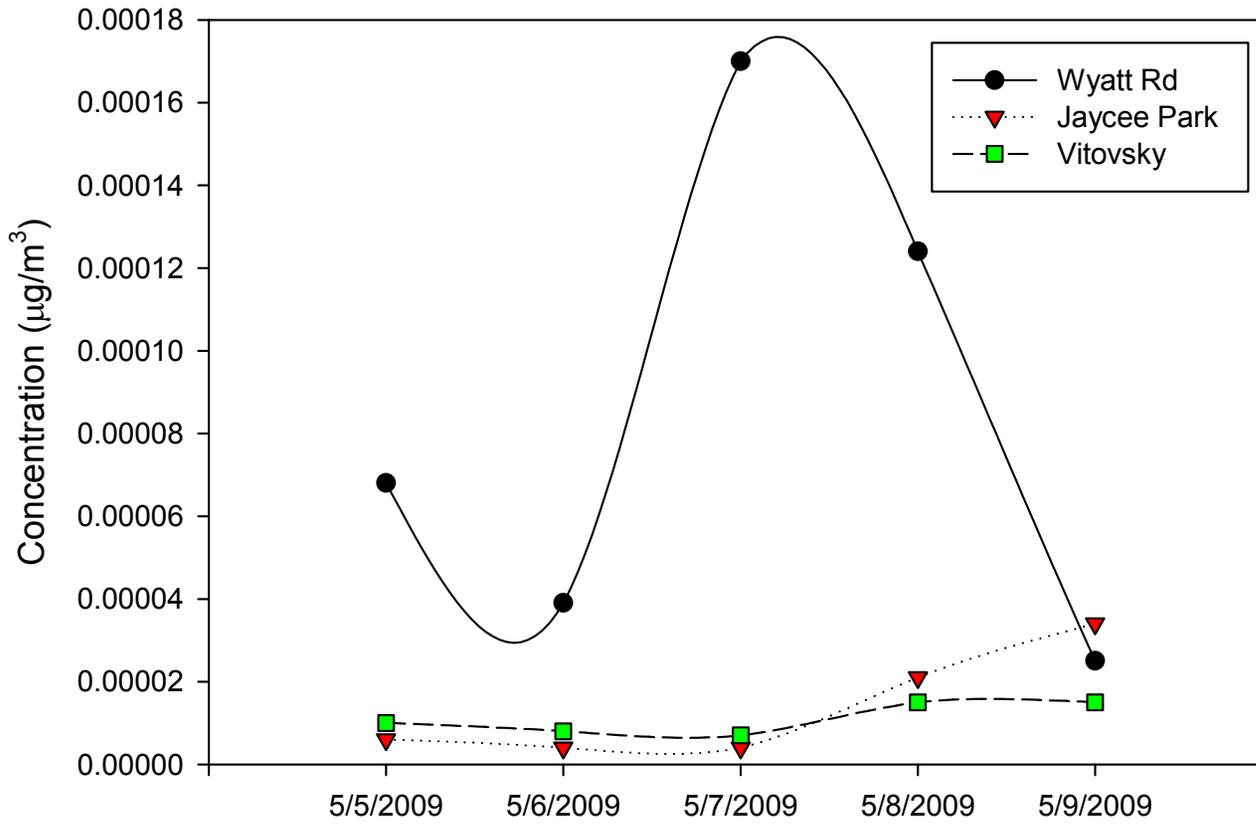
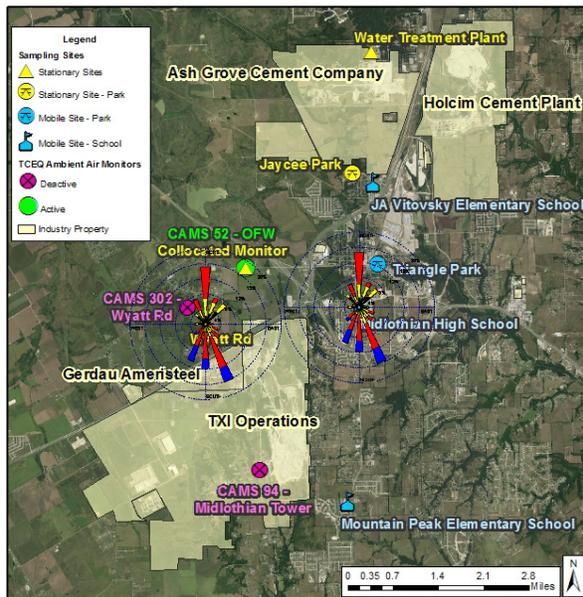


Figure 72. Statistically Different Third Quarter Monitoring Sites: PM<sub>10</sub> Mercury.

#### 4<sup>th</sup> Quarter significant differences:

- Chromium
  - Wyatt Rd *significantly higher than* Midlothian High School (Figure 74)
- Manganese
  - Wyatt Rd *significantly higher than* Midlothian High School (Figure 75)



**Figure 73. Map Showing 4<sup>th</sup> Quarter Average Wind Directions for Significantly Different Monitoring Sites.**

Figures 60, 62, 67, and 73 show the quarterly average wind directions for monitoring sites with significant differences. When looking at the differences in all quarters graphically, Wyatt Rd typically has higher concentrations of PM<sub>10</sub> metals as compared to the monitors where significant differences were observed. The Collocated monitor is approximately 1.1 miles north of TXI and 1.2 miles north, northeast of Gergau Ameristeel. The Wyatt Rd monitor is located closer to TXI (approximately 0.7 miles northwest) and Gerdau Ameristeel (approximately 0.5 miles north) than the Collocated monitor. It is expected that the levels measured at Wyatt Rd and at the Collocated monitor would be higher than levels in the community. This is because the center of the city is offwind from TXI and Gerdau Ameristeel and upwind of Ash Grove and Holcim. The term offwind refers to the fact that the city center is located approximately 2.4 miles to the northeast of TXI and Gerdau Ameristeel, which is off the wind path from TXI and Gerdau Ameristeel when winds are coming from the south and southeast. The term upwind refers to the fact that the city center is located approximately 2.5 miles to the south, southwest of Ash Grove and Holcim, in which case winds would be traveling from the city center toward the industries when winds are out of the south and southeast. Therefore, since the predominant wind direction is from the south and southeast in this area, and the city center is located northeast and southwest of the identified industries, the city is predominantly offwind or upwind of the local industries. *These analyses also indicate that the measured concentrations of PM<sub>10</sub> are different across Midlothian, with relatively higher levels measured closer to industry and lower levels measured within the community. This indicates that nearby industry does have a measurable impact on the levels of PM<sub>10</sub> metals detected in the ambient air in Midlothian; however, those contributions are slight, all measured levels are still well below their respective AMCVs, and are not of health concern.*

### Statistically Different 4th Quarter Sites: Wyatt Rd vs Midlothian High School PM<sub>10</sub> Chromium ANOVA

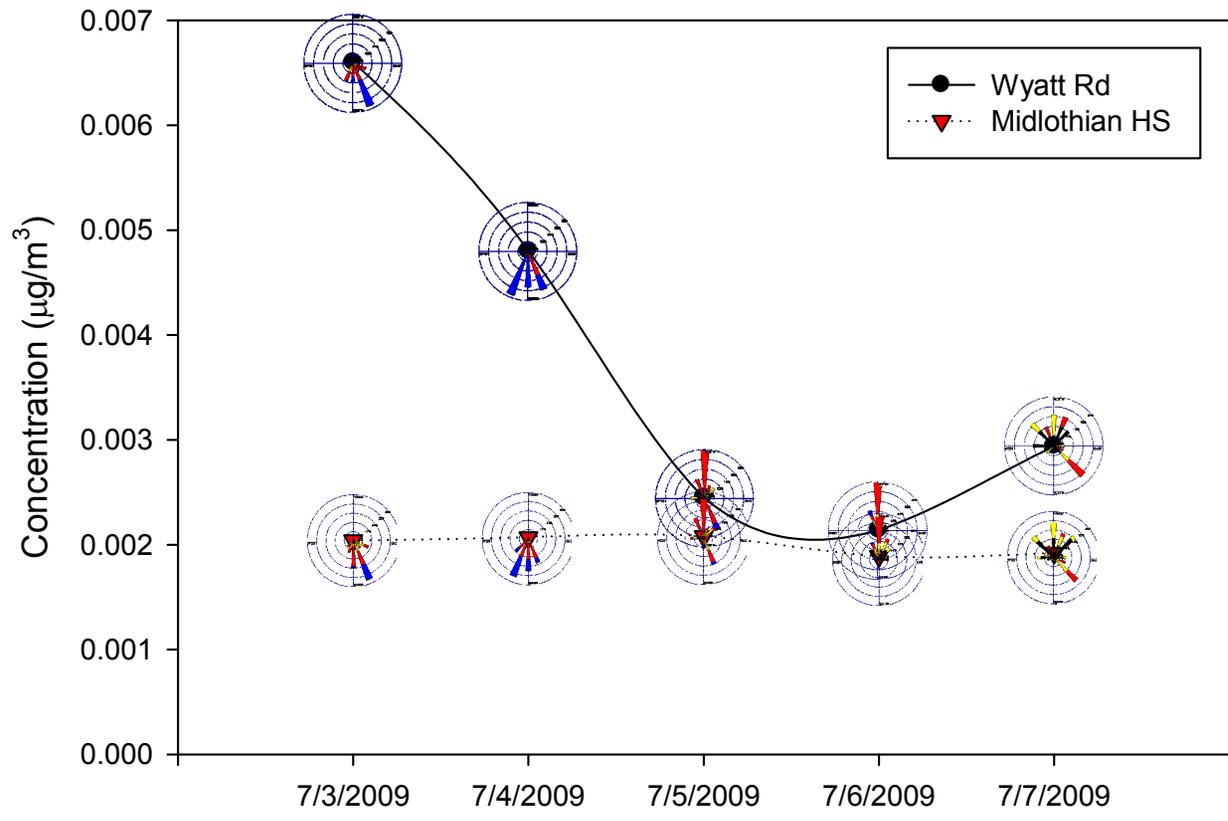


Figure 74. Statistically Different Fourth Quarter Monitoring Sites with Daily Wind Rose Overlays: PM<sub>10</sub> Chromium.

### Statistically Different 4th Quarter Sites: Wyatt Rd vs Midlothian High School PM<sub>10</sub> Manganese ANOVA

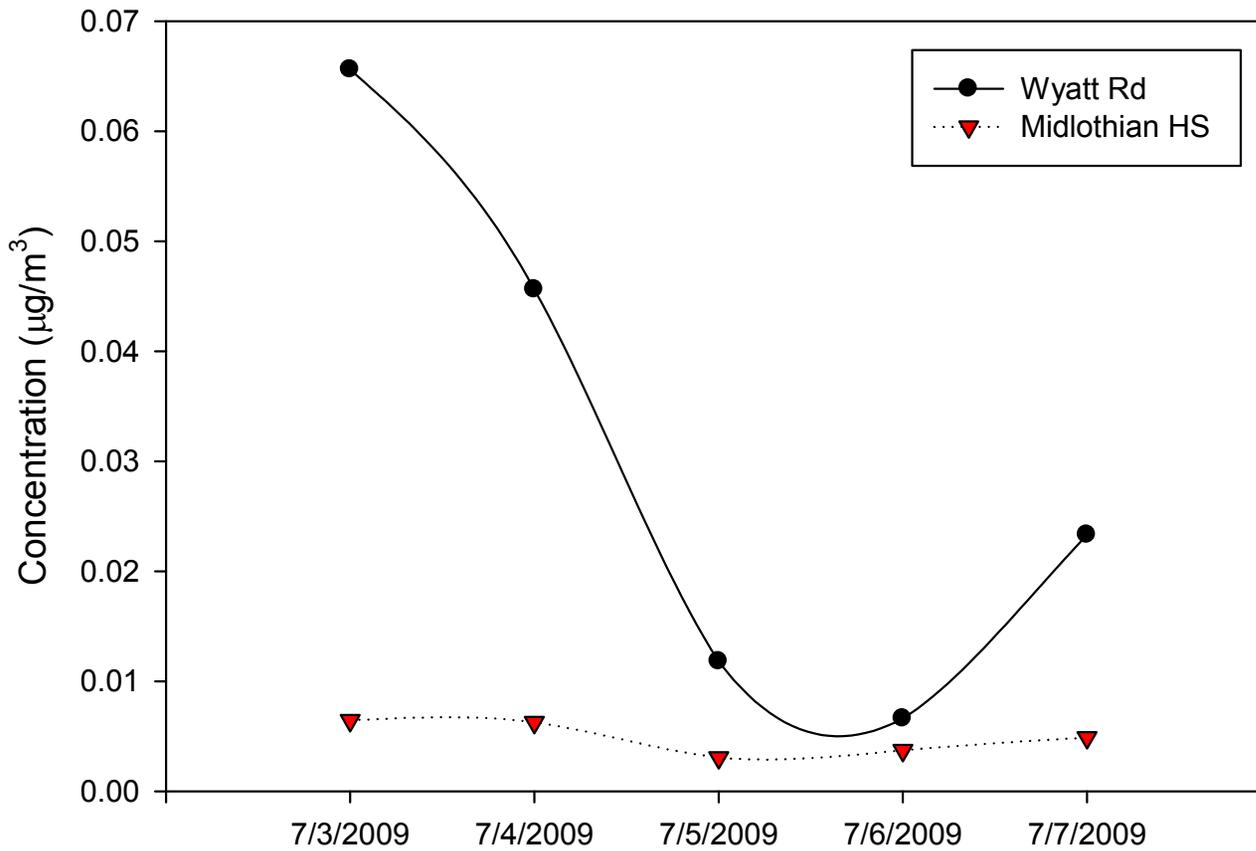


Figure 75. Statistically Different Fourth Quarter Monitoring Sites: PM<sub>10</sub> Manganese.

## Seasonal Variation

Since this study was conducted over four different sampling quarters over the span of one year it stands to reason that wind direction may influence some observed differences in the data. Samples were collected in December, 2008 (1<sup>st</sup> quarter), February/March, 2009 (2<sup>nd</sup> quarter), May, 2009 (3<sup>rd</sup> Quarter), and July, 2009 (4<sup>th</sup> quarter). The span of the sampling months represents the winter, spring, and summer seasons. Typically, predominant wind directions in the summer are out of the southeast while in the winter more northerly winds are observed. The overall predominant wind direction for this area is out of the south. The question is, how does this affect the data comparisons; are there seasonal variations in the data due to differences in wind direction? This section is designed to provide insight into this question. The TD did a comparison of the quarterly data for each site to determine if there were any statistical differences observed between quarters using an ANOVA (Appendix J). For an overview of the ANOVA procedure, please see Figure 17. Fourteen of the twenty four data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences are as follows:

- Collocated monitor
  - Mercury:
    - 2<sup>nd</sup> Quarter data *significantly higher than* 3<sup>rd</sup> and 4<sup>th</sup> Quarter data
- Jaycee Park
  - Mercury:
    - 2<sup>nd</sup> Quarter data *significantly higher than* 3<sup>rd</sup> Quarter data
- Water Treatment Plant
  - Chromium:
    - 3<sup>rd</sup> Quarter data *significantly higher than* 1<sup>st</sup> and 2<sup>nd</sup> Quarter data
    - 4<sup>th</sup> Quarter data *significantly higher than* 1<sup>st</sup> and 2<sup>nd</sup> Quarter data
  - Mercury:
    - 2<sup>nd</sup> Quarter data *significantly higher than* 1<sup>st</sup> and 4<sup>th</sup> Quarter data

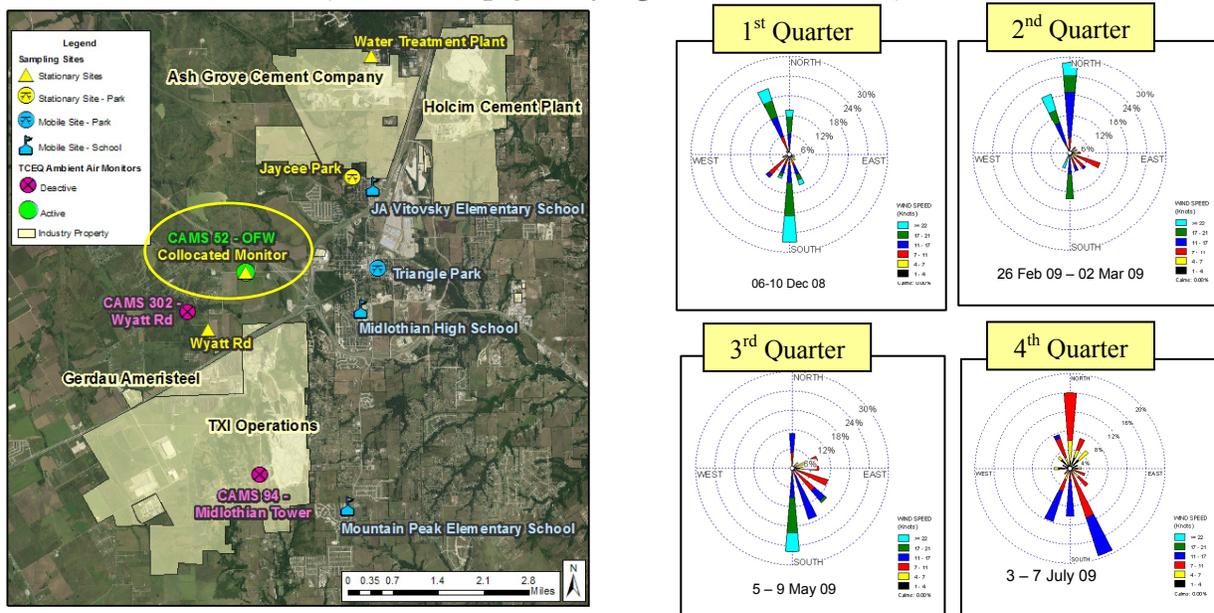


Figure 76. Map of Collocated Monitor Location and Quarterly Average Wind Directions.

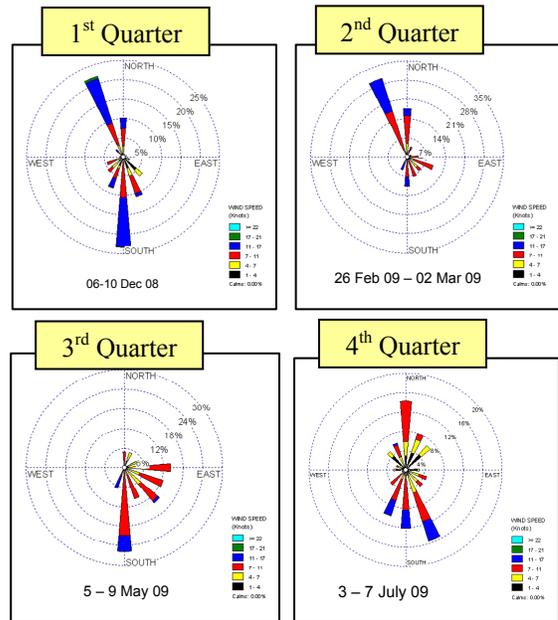
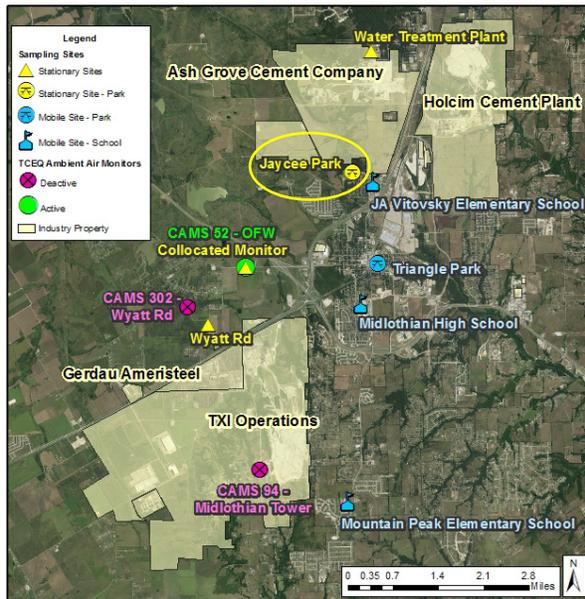


Figure 77. Map of Jaycee Park Monitor Location and Quarterly Average Wind Directions.

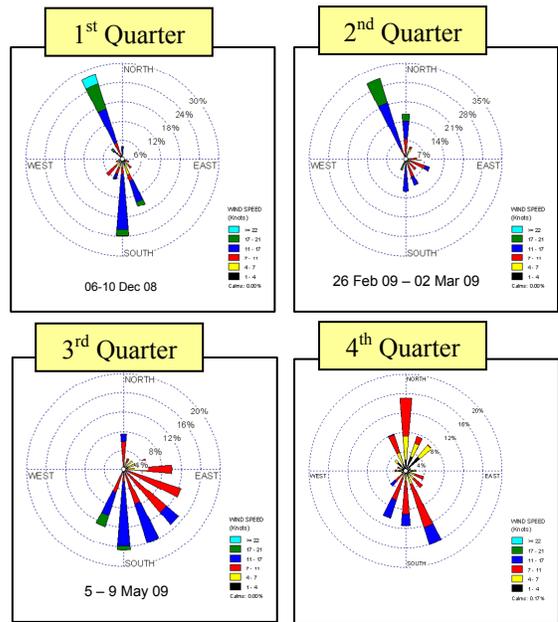
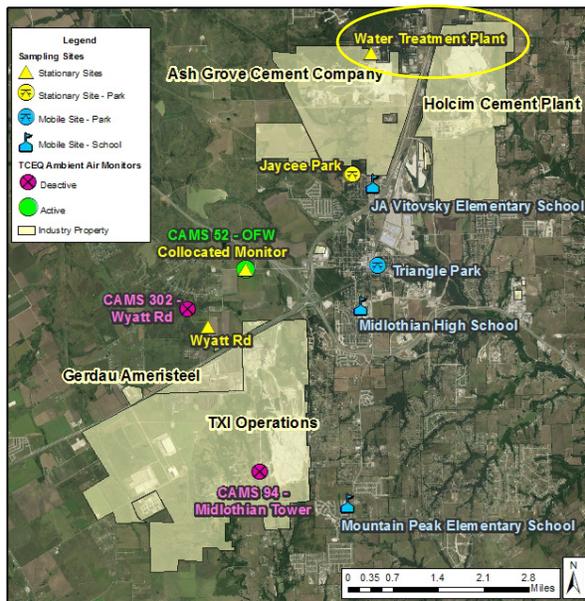


Figure 78. Map of Water Treatment Plant Monitor Location and Quarterly Average Wind Directions.

All three sites had statistical differences; out of twenty four comparisons, four showed statistical differences. Mercury was statistically higher in the 2<sup>nd</sup> quarter at all three compared sites while chromium was higher in the 3<sup>rd</sup> and 4<sup>th</sup> quarters. When looking at the average quarterly wind directions and the location of the monitors (Figures 76 – 78) the wind directions aren't what would be expected for statistically higher mercury concentrations in the 2<sup>nd</sup> quarter at the three locations. The 2<sup>nd</sup> quarter is

predominantly north, northwesterly winds while the other quarters are predominantly northerly or mixed northerly and southerly winds. Based on the positions of the Collocated and Water Treatment Plant monitors they are offwind or upwind for northerly winds and are downwind for southerly winds; the Jaycee Park monitor is offwind of north westerly winds and downwind of south westerly winds. Therefore, it is not known why mercury would be measured at higher concentrations when winds put the monitors offwind or upwind of industry. The same is true when looking at the daily wind directions and measured concentrations, it appears as though the mercury concentrations may not be related to the identified industries. The chromium differences make sense based on wind direction and monitor location. The higher concentrations were measured in quarters where the average wind directions included southerly winds, which put the Water Treatment Plant in a downwind location from the surrounding identified industries. *Even though one PM<sub>10</sub> metal showed a difference at all three sites (mercury), the higher concentrations can not be attributed to the identified industry based on the wind direction and it is unknown why there is variation at all monitors in the 3<sup>rd</sup> quarter. Chromium did show a difference that could be explained by wind direction; however, the difference was only observed at one of the three sites. The majority of these data indicate that there are no seasonal differences for PM<sub>10</sub> metals in this area.*

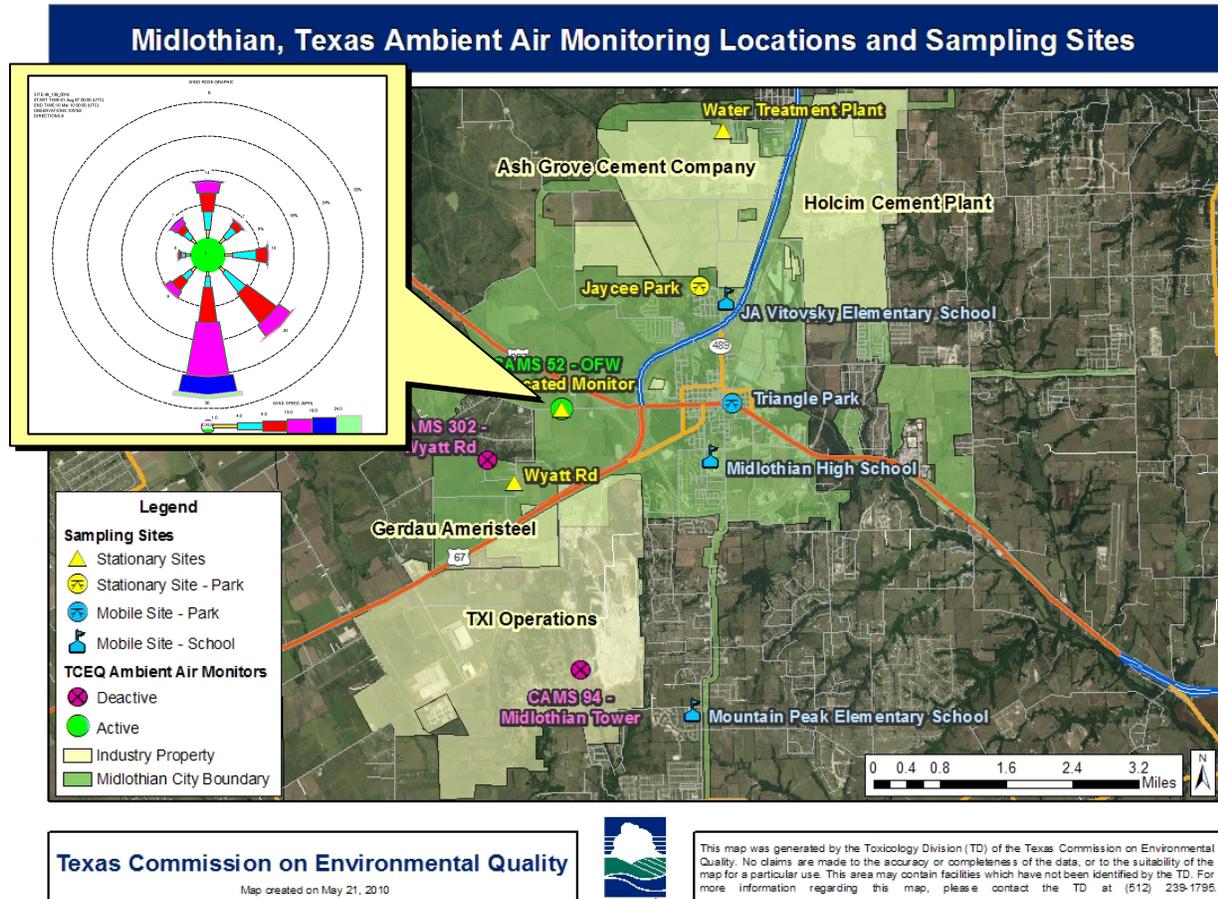
### **Directional Wind Rose Comparisons**

Meteorological data is a very important component of any evaluation of ambient air data. Wind roses can help determine the direction from which the measured pollutants came. It is important to have a monitor in a predominantly downwind and upwind location in order to be able to make predictions of the directional source of a pollutant. However, it is important to note that such predictions with canister data alone are difficult and that auto gas chromatograph (auto GC) data are much better to handle such predictions. One of the questions raised by the citizens is whether or not the TCEQ stationary monitor is in an appropriate location for detecting pollutants from industry. For this study there were five canister monitors operating each of the four quarters, with a total of eight locations utilized during the study. Eventhough this data is canister data, since there were several monitors positioned throughout the area and representing upwind, downwind, and offwind locations, comparisons between the several different monitor locations should help show if the TCEQ stationary monitor is in an appropriate location. Since there were no statistical differences found among the detected VOCs, and the levels across Midlothian are similar, using that data for directional comparisons would not be as informative as using the PM<sub>10</sub> metals data, which showed some statistical differences and varied across Midlothian.

Monitoring sites measure wind direction and speed as the wind comes toward the monitor. Therefore, the meteorological information collected from the monitors indicates which direction the wind came from. Figure 79 shows a wind rose produced from the average of the resultant wind direction and speed for August, 1997 to March, 2010. This wind rose indicates the overall predominant wind direction in Midlothian is from the south, southeast. The TCEQ CAMS 52 is positioned in a predominantly downwind location with respect to TXI and Gerdau Ameristeel. The seasonal variation comparison concluded that overall there were no seasonal differences in the data. However, that data does not answer the same question as looking at individual sites and wind direction. The PM<sub>10</sub> metals data at the monitors closest to industry, when winds put them in the downwind category, clearly measure higher concentrations than monitors that are offwind or upwind. Figures 80 through 83 show the differences in detected concentrations of PM<sub>10</sub> total chromium at the four sampling sites for each of the four quarters as compared to the average Collocated monitor wind direction for each day. As expected, when the wind direction is predominantly out of the south, higher concentrations are measured at the Wyatt Rd and Collocated monitor sites. However, when the wind direction shifts to out of the north, the detected

concentrations at the Wyatt Rd and Collocated monitor sites decrease and are subsequently similar to the detected concentrations at the monitors located closer to/within the city, which are offwind or upwind of the identified industries when winds are from the south and southeast.

*These comparisons indicate that the TCEQ CAMS 52 monitor is positioned downwind of TXI and Gerdau Ameristeel when winds are southerly (the predominant wind direction) and that the measurable impact local industry has on the ambient levels of PM<sub>10</sub> metals detected in Midlothian can, and will be, measured by the TCEQ CAMS 52 monitor.*



**Figure 79. Wind Rose Showing the Predominant Wind Direction (S, SE) in Midlothian (CAMS 52) from August, 1997 to March, 2010.**

Wind Direction vs Site Location  
 PM<sub>10</sub> Chromium 1st Quarter

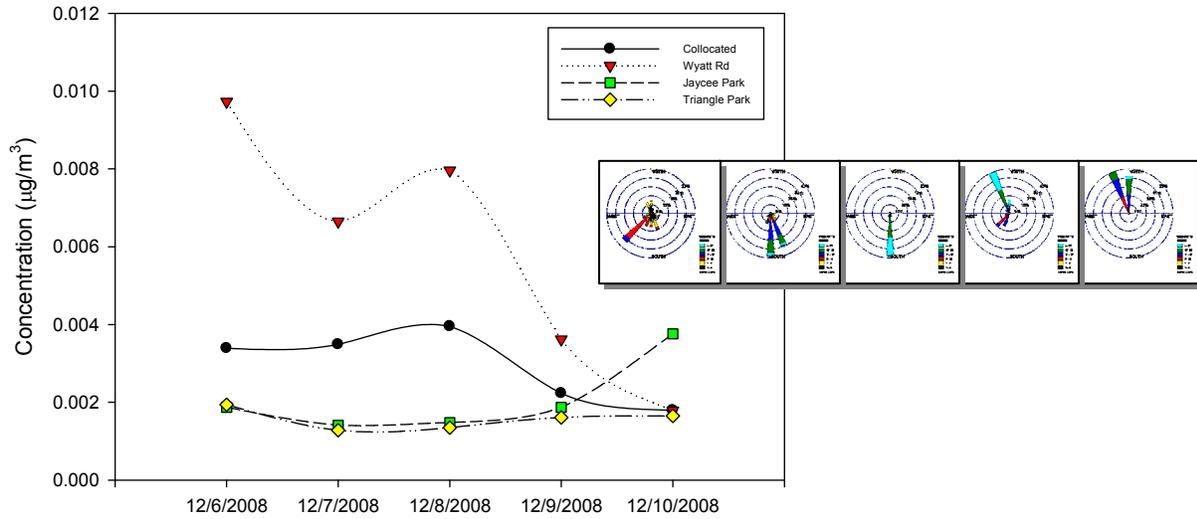


Figure 80. Wind Direction and Site Location: 1<sup>st</sup> Quarter Daily PM<sub>10</sub> Chromium Data with Daily Wind Averages.

Wind Direction vs Site Location  
 PM<sub>10</sub> Chromium 2nd Quarter

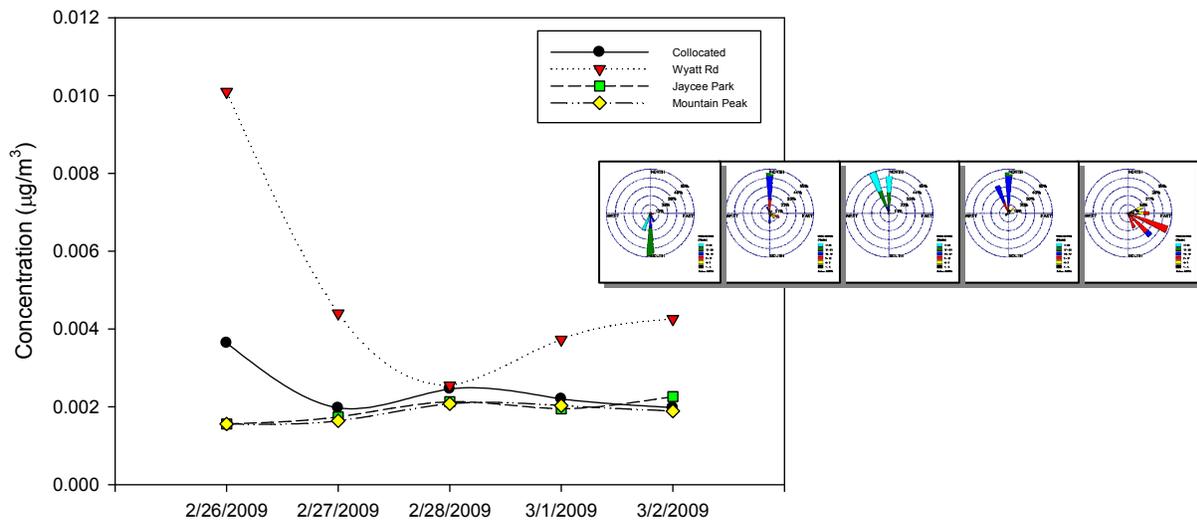


Figure 81. Wind Direction and Site Location: 2<sup>nd</sup> Quarter Daily PM<sub>10</sub> Chromium Data with Daily Wind Averages.

Wind Direction vs Site Location:  
PM<sub>10</sub> Chromium 3rd Quarter

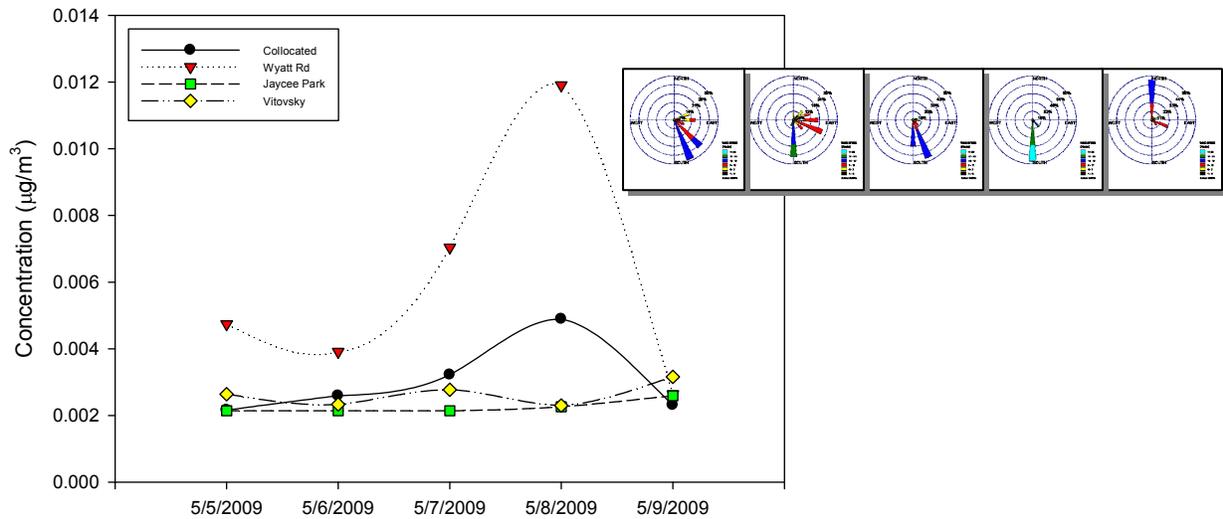


Figure 82. Wind Direction and Site Location: 3<sup>rd</sup> Quarter Daily PM<sub>10</sub> Chromium Data with Daily Wind Averages.

Wind Direction vs Site Location  
PM<sub>10</sub> Chromium 4th Quarter

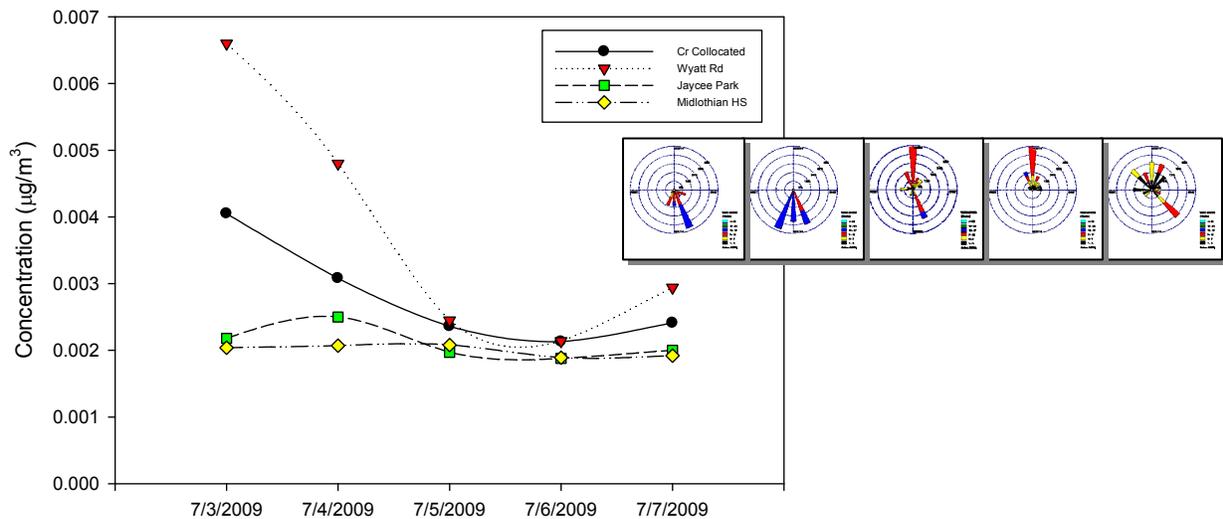
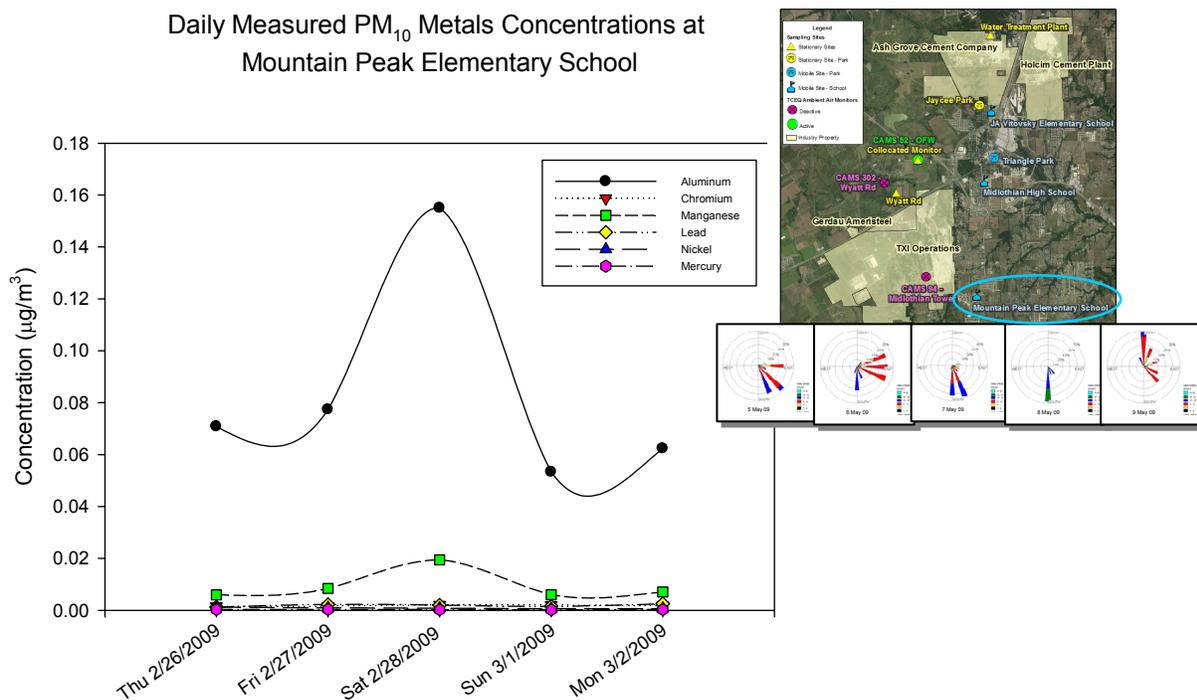


Figure 83. Wind Direction and Site Location: 4<sup>th</sup> Quarter Daily PM<sub>10</sub> Chromium Data with Daily Wind Averages.

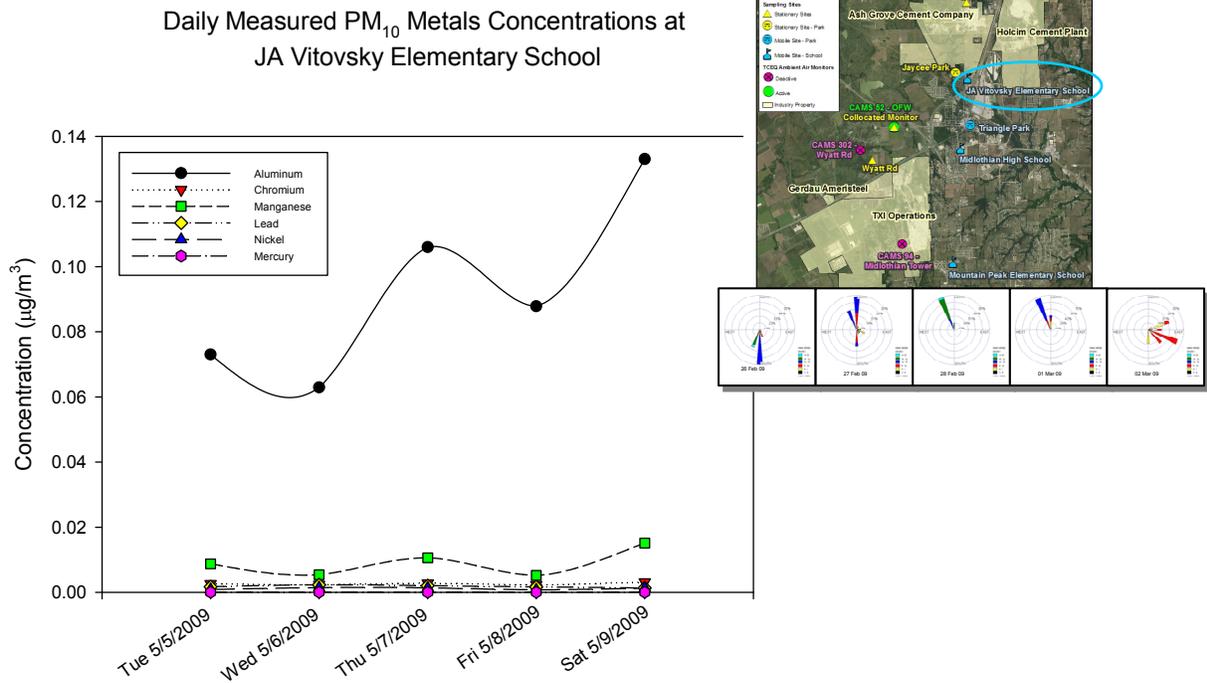
## School Comparisons

As stated in the VOC School Comparisons section above, three of the mobile sites were located at Midlothian area schools: Mountain Peak Elementary School, JA Vitovsky Elementary School, and Midlothian High School. The question this section is trying to address is whether or not emissions from school buses, or other idling vehicles, have an impact on air quality at the schools. In an attempt to answer this question in regards to PM<sub>10</sub> metals, at least one sampling day was conducted over the weekend. Since there are only five samples, one for each sampling day at each site, a statistical comparison could not be conducted for this data. However, a qualitative look at the data may also be informative. Figures 84 – 86 show the daily measured concentrations of the PM<sub>10</sub> metals highlighted in this report at each school. When looking at the graphical data, some measured concentrations of PM<sub>10</sub> metals appear to increase over the weekend, particularly on Saturday. Based on location and wind direction, the days with the increased measurements do not appear to be coming from the direction of the identified industries.

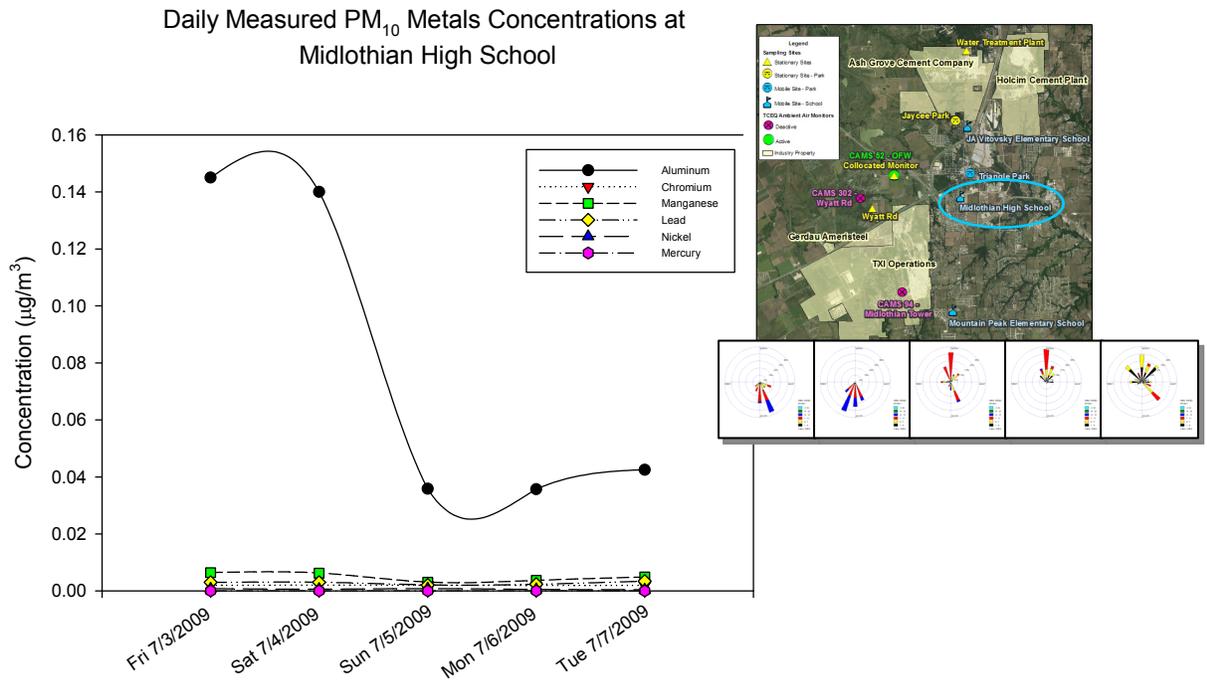
*PM<sub>10</sub> aluminum and manganese appear to have the most fluctuation; however, there is no clear discernable pattern observed at the schools for this very limited dataset of PM<sub>10</sub> metals.*



**Figure 84. Daily Measured PM<sub>10</sub> Metals Concentrations at Mountain Peak Elementary School with Daily Wind Direction.**



**Figure 85. Daily Measured PM<sub>10</sub> Metals Concentrations at JA Vitovsky Elementary School with Daily Wind Direction.**



**Figure 86. Daily Measured PM<sub>10</sub> Metals Concentrations at Midlothian High School with Daily Wind Direction.**

## Percent Hexavalent Chromium to Total Chromium Calculation

Hexavalent chromium ( $\text{Cr}^{6+}$ ) is a  $\text{PM}_{10}$  metal that the citizens of Midlothian showed concerned about. A lack of specific  $\text{Cr}^{6+}$  data for Midlothian is also one of the four reasons DSHS concluded an Indeterminate Public Health Hazard for their draft Health Consultation. One of the main goals of this study was to address any concerns and questions surrounding what levels of  $\text{Cr}^{6+}$  are present in Midlothian, as well as determine what percentage of total chromium  $\text{Cr}^{6+}$  represents in this area. It is important to note that there was a laboratory issue with the 3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  data. Due to a mixup with the Chain of Custody form in the laboratory individual samples could not be matched to their respective sampling date. More detailed information may be found in the URS Memorandum: *Midlothian Third Quarter Hexavalent Chromium ( $\text{Cr}^{6+}$ ) and Total Unspeciated Chromium ( $\text{Cr}_T$ ) Measurement Results* (Appendix N) and the letter from ERG to Al Hendler with URS dated June 9, 2009 (Appendix O). Therefore, for comparisons in this section 3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  samples were sorted from highest to lowest and were paired with 3<sup>rd</sup> Quarter total chromium samples sorted from lowest to highest to get the most conservative % $\text{Cr}^{6+}$  for the 3<sup>rd</sup> Quarter dataset.

## Comparisons with the Health Protective Values

Ambient air concentrations of total chromium and  $\text{Cr}^{6+}$  associated with  $\text{PM}_{10}$  were measured at each of the five sampling sites during all four quarters. The TCEQ short-term AMCV for  $\text{Cr}^{6+}$  is  $0.1 \mu\text{g}/\text{m}^3$ . All measured concentrations of  $\text{Cr}^{6+}$  were well below the short-term AMCV (range of  $3 \times 10^{-7}$  to  $3.79 \times 10^{-4} \mu\text{g}/\text{m}^3$ ). Although the most appropriate comparison to long-term health-protective values requires an average based on data for at least one year (or for multiple years if available), in this case valuable information is obtained from a comparison of these short-term measured values to the long-term health-protective value. The average as well as all measured concentrations of  $\text{Cr}^{6+}$  were well below the TCEQ long-term AMCV of  $0.01 \mu\text{g}/\text{m}^3$ , which protects over a lifetime of exposure. The  $\text{Cr}^{6+}$  short- and long-term AMCVs are currently under review; the TD is evaluating the most recent epidemiological data on  $\text{Cr}^{6+}$  and carcinogenicity. The USEPA has a long-term value of  $0.0008 \mu\text{g}/\text{m}^3$ , which is based on a 1 in 100,000 excess risk level. To meet or exceed this long-term (i.e., chronic) level, the daily concentration of  $\text{Cr}^{6+}$  would have to consistently be at or above  $0.0008 \mu\text{g}/\text{m}^3$ . All detected concentrations of  $\text{Cr}^{6+}$  are below the USEPA chronic value for  $\text{Cr}^{6+}$ .

A comparison with all four quarters of  $\text{PM}_{10}$   $\text{Cr}^{6+}$  and total Cr data were performed in order to determine if there were any statistical differences. The TD conducted statistical comparisons (Figure 87; Appendix L) between the overall average of  $\text{PM}_{10}$   $\text{Cr}^{6+}$  and the overall average of total Cr using a Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. According to this test, there was a significant difference observed between the  $\text{Cr}^{6+}$  and total Cr data averages ( $p < 0.001$ ). When looking at the graphed data, the overall mean for  $\text{Cr}^{6+}$  ( $0.0000327 \mu\text{g}/\text{m}^3$ ) is very small compared to the overall mean for total Cr ( $0.00275 \mu\text{g}/\text{m}^3$ ).

*Based on these data, we would not expect short-term exposures to these concentrations to be of a health concern. These short-term  $\text{Cr}^{6+}$  data also indicate that long-term comparison values are unlikely to be exceeded, and that when looking at the overall mean for total Cr as compared to  $\text{Cr}^{6+}$ ,  $\text{Cr}^{6+}$  represents only a small part of total Cr in Midlothian (Figures 87 & 88).*

Average Measured Concentrations of Total Cr and Cr<sup>6+</sup> at All Sampling Sites in the Study

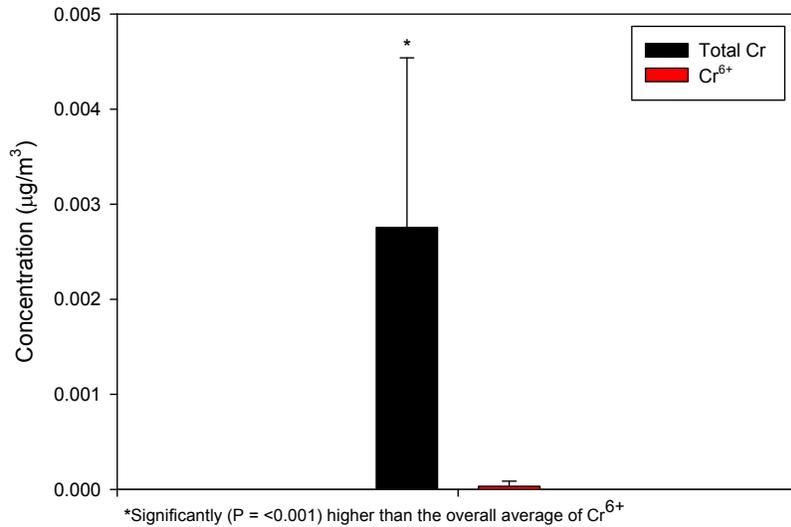


Figure 87. Overall Average Concentrations of PM<sub>10</sub> Total Cr Compared to Cr<sup>6+</sup>.

Average Concentration of Measured PM<sub>10</sub> Total Cr Compared to Cr<sup>6+</sup>

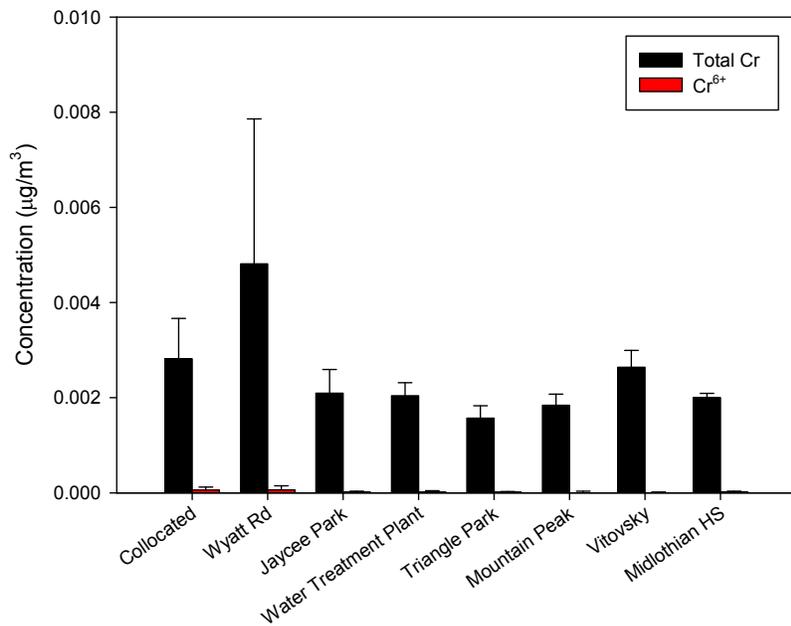


Figure 88. Site Average Concentrations of PM<sub>10</sub> Total Cr Compared to Cr<sup>6+</sup>.

### ***Collocated Monitor Comparisons***

As with the VOC section above, this comparison is designed to help answer, in regards to PM<sub>10</sub> metals, the citizen question: *Is the TCEQ every 6<sup>th</sup> day monitoring site an accurate representation of daily air concentrations in Midlothian?* As indicated in the VOC and Metals sections above, there are two interpretations for this question. The first is, are the data from the TCEQ CAMS 52 monitor representative of concentrations in the city? The second is, are the industries increasing emissions on non-regulatory sampling days? For this study, a monitor was collocated with the TCEQ CAMS 52 monitor, the Collocated monitor; one day out of each sampling quarter overlapped with the existing TCEQ every 6<sup>th</sup>-day ambient air monitoring schedule. Information on the EPA monitoring schedule and the overlapping sampling days can be found in the VOC Collocated Monitor Comparisons section above.

In the VOC Collocated Monitor Comparisons section above a comparison was conducted on a grouping of the four TCEQ every 6<sup>th</sup>-day samples as compared to the corresponding four Collocated monitor samples to show if any statistical differences existed between the two sample sets. Since the comparison indicated that the TCEQ CAMS 52 ambient air monitor is an accurate representation of VOC air concentrations measured at this site, the assumption can be made that the Collocated monitor is a good representation of what the CAMS 52 monitor would measure. Since comparisons in this section cannot be done with CAMS 52 PM<sub>10</sub> total Cr and Cr<sup>6+</sup> data, as none exist, the assumption is that the VOC findings extend to these PM<sub>10</sub> metals, and therefore the Collocated monitor data may be used for these comparisons in lieu of CAMS 52 data since there are no CAMS 52 PM<sub>10</sub> metals data available. Therefore, in this section the Collocated monitor data will be used in statistical comparisons in lieu of TCEQ CAMS 52 data.

Since there was only one every 6<sup>th</sup>-day sample corresponding to the five Collocated monitor samples per quarter a statistical analysis of the individual 6<sup>th</sup>-day sample paired with the surrounding four days of samples could not be performed. However, a comparison could be conducted on a grouping of the four Collocated samples corresponding to the every 6<sup>th</sup>-day TCEQ samples as compared to the surrounding sixteen Collocated monitor samples. Such a comparison would help show if any statistical differences existed between the two sample sets. Therefore, the TD conducted this statistical comparison (Appendix L) using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. The Cr<sup>6+</sup> data comparisons failed the normality test ( $p < 0.05$ ). Therefore, it was run using the Mann-Whitney Rank Sum Test. No significant differences were found between the every 6<sup>th</sup>-day sample and the other sampling days. *The lack of significant difference between the corresponding Collocated every 6<sup>th</sup>-day sample and the other sixteen days of surrounding Collocated monitor samples indicates that there is no difference between a regulatory every 6<sup>th</sup>-day sampling day and the other sampled days during this study. Since the sampling dates were not released publicly the assumption can be made that this is representative of typical conditions throughout the year.*

The TD also conducted statistical comparisons (Appendix L) between the Collocated monitor data and all of the other seven study PM<sub>10</sub> Cr<sup>6+</sup> monitoring sites using Student's t-test. For an overview of the Student's t-test procedure, please see Figure 3. All seven data comparisons failed the normality test and the equal variance test ( $p < 0.05$ ). Those that failed were run using the Mann-Whitney Rank Sum Test. According to these tests, no significant differences were observed between the Collocated monitor and compared sites.

*These analyses indicate that while the measured concentrations of PM<sub>10</sub> Cr<sup>6+</sup> are different, there is no statistical difference between the study monitoring sites and the Collocated monitor. All measured levels are well below their respective AMCVs, and are not of health concern.*

### ***Comparisons with All Four Quarters of Data***

Multiple comparisons with all four quarters of PM<sub>10</sub> Cr<sup>6+</sup> data were performed in order to determine statistical differences. The TD conducted statistical comparisons (Appendix L; Raw Data Figure K-61) between the four stationary, four mobile, and all eight PM<sub>10</sub> Cr<sup>6+</sup> monitoring sites using a one-way ANOVA. For an overview of the ANOVA procedure, please see Figure 17. All three data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. According to the ANOVA, no significant differences were observed between any of the stationary, mobile, or all sites combined ( $P = 0.051, 0.231, \text{ and } 0.075$ , respectively). The differences in the median values among the groups were not great enough to exclude the possibility that the differences were due to random sampling variability; there is not a statistically significant difference.

*These analyses indicate that while the measured concentrations of PM<sub>10</sub> Cr<sup>6+</sup> are different across Midlothian, with relatively higher levels typically measured closer to industry and lower levels typically measured within the community, there is no statistical difference between the detected levels. All measured levels are well below their respective AMCVs, and are not of health concern.*

### ***Comparisons with Individual Quarters of Data***

A comparison between all four sampling sites for each quarter was performed on the PM<sub>10</sub> Cr<sup>6+</sup> data to determine any statistical differences. The TD conducted statistical comparisons (Appendix L; Raw Data Figures K-62 – K-65) between the five PM<sub>10</sub> Cr<sup>6+</sup> monitoring sites for each quarter using a one-way ANOVA. For an overview of the ANOVA procedure, please see Figure 17. None of the four data comparisons passed the normality test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. For the first, second, and fourth quarters, the ANOVA indicated there were no significant differences. The third quarter ANOVA indicated the differences in the median values among the sites were greater than would be expected by chance ( $p = 0.043$ ); however, the All-Pairwise Multiple Comparison Procedures resulted in no significant differences or “do not test”. A result of “do not test” occurs for a comparison when no significant difference is found between two means that enclose that comparison. It is to be noted that not testing the enclosed means is a procedural rule, and a result of “do not test” should be treated as if there is no significant difference between the means, even though one may appear to exist.

*These analyses also indicate that while the measured concentrations of PM<sub>10</sub> Cr<sup>6+</sup> are different across Midlothian, with relatively higher levels typically measured closer to industry and lower levels typically measured within the community, there is no statistical difference between the detected levels. All measured levels are well below their respective AMCVs, and are not of health concern.*

### ***Seasonal Variation***

As stated in the VOC and Metals sections above, since this study was conducted over four different sampling quarters over the span of one year it stands to reason that wind direction may influence some observed differences in the data. Samples were collected in December, 2008 (1<sup>st</sup> quarter), February/March, 2009 (2<sup>nd</sup> quarter), May, 2009 (3<sup>rd</sup> Quarter), and July, 2009 (4<sup>th</sup> quarter). The span of the sampling months represents the winter, spring, and summer seasons. Typically, predominant wind directions in the summer are out of the southeast while in the winter more northerly winds are observed. The overall predominant wind direction for this area is out of the south. The question is, how does this

affect the data comparisons; are there seasonal variations in the data due to differences in wind direction? This section is designed to provide insight into this question. The TD did a comparison of the quarterly data for each site to determine if there were any statistical differences observed between quarters using an ANOVA (Appendix L). For an overview of the ANOVA procedure, please see Figure 17. Two of the four data comparisons failed the normality test and/or the equal variance test ( $p < 0.05$ ). Those that failed were run using an ANOVA on Ranks. Significant differences are as follows:

- Water Treatment Plant
  - Hexavalent Chromium:
    - 4<sup>th</sup> Quarter data significantly higher than 2<sup>nd</sup> Quarter data
    - 1<sup>st</sup> Quarter data significantly higher than 2<sup>nd</sup> Quarter data

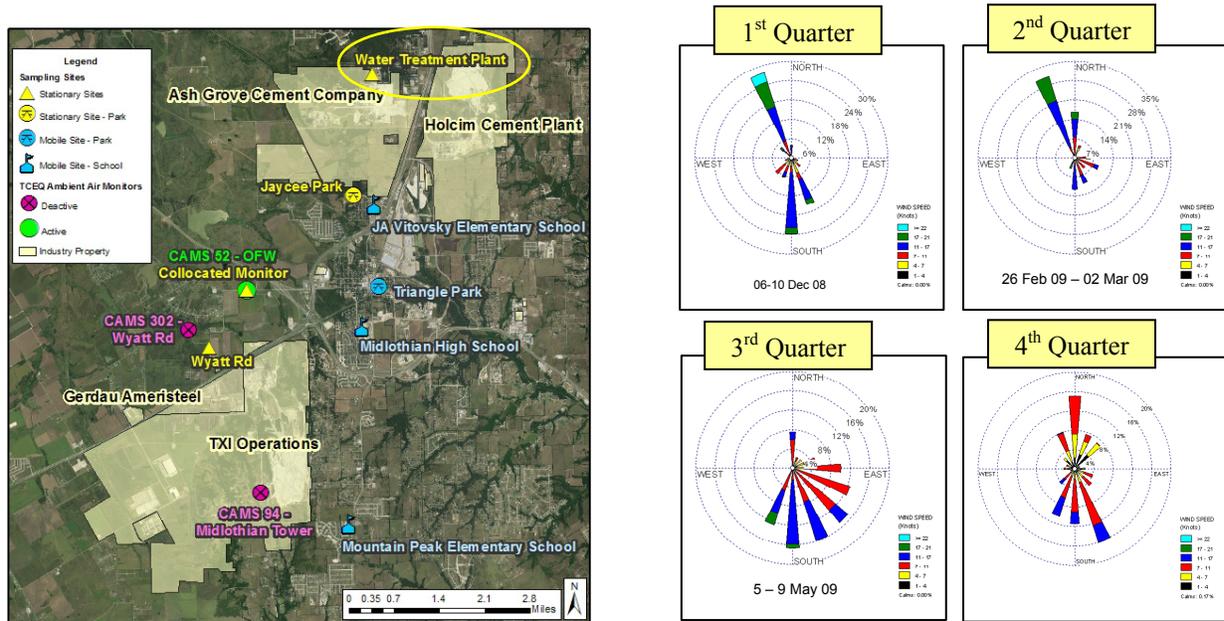


Figure 89. Map of Water Treatment Plant Monitor Location and Quarterly Average Wind Directions.

Only one site out of the four compared stationary sites showed a statistical difference.  $\text{Cr}^{6+}$  2<sup>nd</sup> quarter data was statistically lower than the 1<sup>st</sup> and 4<sup>th</sup> quarters. When looking at the average quarterly wind directions and the location of the monitors (Figures 89) The  $\text{Cr}^{6+}$  differences make sense based on wind direction and monitor location. The higher concentrations were measured in quarters where the average wind directions included southerly winds, which put the Water Treatment Plant in a downwind location from the surrounding identified industries. These findings are similar to those observed in the Metals section above for Cr at this site. However, only one  $\text{Cr}^{6+}$  comparison showed a difference at only one of the four stationary sites. This data combined with the  $\text{PM}_{10}$  metals comparisons above show that the majority of these data indicate that there are no seasonal differences for  $\text{PM}_{10}$  metals in this area.

### Hexavalent Chromium Percentage of Total Chromium

The TD calculated the percentage of total chromium that  $\text{Cr}^{6+}$  comprised for all four quarters of sampling data (Tables 9 & 10). The highest percentage of total chromium that  $\text{Cr}^{6+}$  represented for any one day measurement was 7.36% at the Collocated monitor on 12/7/2008. The highest daily average considering data from all sites was 2.81% for 7/4/2009. The highest average at any one site over the twenty monitored

days was 1.86% at the Collocated monitor. The overall average for all twenty sampling days over all eight sampling sites is 1.07% Cr<sup>6+</sup> of total chromium. These values are all well below the 100% Cr<sup>6+</sup> assumed by DSHS in their draft Health Consultation. They are also well below the suggested default assumption of 34%, which is used by USEPA in their National Air Toxics Assessment<sup>9</sup> (NATA). The ATSDR<sup>10</sup> estimates cement production to be associated with 0.2% of chromium emissions as Cr<sup>6+</sup> in their Toxicological Profile for chromium.

*These data indicate that while the ATSDR estimated percentage of chromium emission associated with Cr<sup>6+</sup> for cement production is 0.2%, the actual contribution in the Midlothian area is 1.07%, which is well below the USEPA default assumption of 34% as well as the DSHS assumption of 100% for their draft Health Consultation. These analyses indicate that PM<sub>10</sub> Cr<sup>6+</sup> represents a small percentage of the total chromium measured in the Midlothian area.*

**Table 9. Highest Daily, Daily Average, and Site Average, and the Overall Average Percent Cr<sup>6+</sup> Constitutes of Total Chromium.**

	<b>%Cr<sup>6+</sup> of Total Cr</b>
Highest Daily	7.36%
Highest Daily Average	2.81%
Highest Site Average	1.86%
Overall Average	1.07%

<sup>9</sup> USEPA. 1996. National Air Toxics Assessment (NATA) Appendix G: Health Effects Information used in Cancer and Noncancer Risk Characterization for the NATA 1996 National-Scale Assessment. United States Environmental Protection Agency, <http://earth1.epa.gov/ttn/atw/sab/appendix-g.pdf>.

<sup>10</sup> ATSDR. 2000. Toxicological Profile for Chromium. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

**Table 10. Daily, Daily Average, Site Average, and Overall Average Percent Cr<sup>6+</sup> Constitutes of Total Chromium.**

Date	WD		CAMS 52	Wyatt Road	Jaycee Park	Water Treatment Plant	Triangle Park	Mountain Peak Elem. School	Vitovsky Elem. School	Midlothian High School	DAILY AVERAGE
12/6/2008	SW	Cr <sup>6+</sup>	0.000677	0.000379	0.000179	0.000472	0.000305				
		Cr <sub>T</sub>	0.00339	0.00973	0.00187	0.00191	0.00194				
		%Cr <sup>6+</sup>	2.00%	3.90%	0.96%	2.47%	1.57%				2.18%
12/7/2008	S	Cr <sup>6+</sup>	0.000257	0.00016	0.000024	0.0000281	0.0000325				
		Cr <sub>T</sub>	0.00349	0.00665	0.00141	0.002	0.00128				
		%Cr <sup>6+</sup>	<b>7.36%</b>	2.41%	0.17%	1.41%	0.25%				2.32%
12/8/2008	S	Cr <sup>6+</sup>	0.000152	0.0000192	0.0000024	0.0000038	0.0000081				
		Cr <sub>T</sub>	0.00395	0.00796	0.00148	0.00164	0.00135				
		%Cr <sup>6+</sup>	3.85%	0.24%	0.16%	0.23%	0.60%				1.02%
12/9/2008	NNW	Cr <sup>6+</sup>	0.0000043	0.0000003	0.0000226	0.0000021	0.0000206				
		Cr <sub>T</sub>	0.00223	0.00362	0.00187	0.00159	0.00161				
		%Cr <sup>6+</sup>	0.19%	0.01%	1.21%	1.32%	1.28%				0.80%
12/10/2008	NNW	Cr <sup>6+</sup>	0.0000015	0.00000325	0.0000638	0.00000325	0.0000209				
		Cr <sub>T</sub>	0.00179	0.00179	0.00376	0.00182	0.00165				
		%Cr <sup>6+</sup>	0.08%	0.18%	1.70%	0.18%	1.27%				0.68%
2/26/2009	S	Cr <sup>6+</sup>	0.000106	0.0000609	0.00000215	0.00000215		0.00000215			
		Cr <sub>T</sub>	0.00364	0.0101	0.00156	0.00165		0.00156			
		%Cr <sup>6+</sup>	2.91%	0.60%	0.14%	0.13%		0.14%			0.78%
2/27/2009	N	Cr <sup>6+</sup>	0.0000449	0.0000736	0.00000215	0.00000215		0.00000215			
		Cr <sub>T</sub>	0.00197	0.0044	0.00174	0.00176		0.00164			
		%Cr <sup>6+</sup>	2.28%	1.67%	0.12%	0.12%		0.13%			0.87%
2/28/2009	NNW	Cr <sup>6+</sup>	0.00000215	0.00000215	0.0000226	0.00000215		0.0000392			
		Cr <sub>T</sub>	0.00246	0.00255	0.00213	0.00209		0.00208			
		%Cr <sup>6+</sup>	0.09%	0.08%	1.06%	0.10%		1.88%			0.64%
3/1/2009	N	Cr <sup>6+</sup>	0.0000511	0.00000215	0.00000215	0.00000215		0.00000215			
		Cr <sub>T</sub>	0.0022	0.00373	0.00195	0.00177		0.00203			
		%Cr <sup>6+</sup>	2.32%	0.06%	0.11%	0.12%		0.11%			0.54%
3/2/2009	ESE	Cr <sup>6+</sup>	0.00000215	0.000138	0.0000246	0.00000215		0.0000257			
		Cr <sub>T</sub>	0.00198	0.00426	0.00226	0.00193		0.00189			
		%Cr <sup>6+</sup>	0.11%	3.24%	1.09%	0.11%		1.36%			1.18%
7/3/2009	SSE	Cr <sup>6+</sup>	0.0000294	0.000103	0.0000342	0.0000128				0.000184	
		Cr <sub>T</sub>	0.00405	0.0066	0.00218	0.00238				0.00204	
		%Cr <sup>6+</sup>	0.73%	1.56%	1.57%	0.54%				0.90%	1.06%
7/4/2009	SSE	Cr <sup>6+</sup>	0.000121	0.0000473	0.0000454	0.00012				0.000389	
		Cr <sub>T</sub>	0.00308	0.0048	0.0025	0.0022				0.00207	
		%Cr <sup>6+</sup>	3.93%	0.99%	1.82%	5.45%				1.88%	<b>2.81%</b>
7/5/2009	N	Cr <sup>6+</sup>	0.0000569	0.00000215	0.00000215	0.0000204				0.000144	
		Cr <sub>T</sub>	0.00236	0.00245	0.00197	0.00221				0.00208	
		%Cr <sup>6+</sup>	2.41%	0.09%	0.11%	0.92%				0.69%	0.84%
7/6/2009	N	Cr <sup>6+</sup>	0.00000215	0.00000215	0.00000215	0.0000296				0.000203	
		Cr <sub>T</sub>	0.00213	0.00214	0.00188	0.00228				0.00189	
		%Cr <sup>6+</sup>	0.10%	0.10%	0.11%	1.30%				1.07%	0.54%
7/7/2009	SE	Cr <sup>6+</sup>	0.0000141	0.0000361	0.0000115	0.0000119				0.000148	
		Cr <sub>T</sub>	0.00241	0.00294	0.002	0.00218				0.00192	
		%Cr <sup>6+</sup>	0.59%	1.23%	0.58%	0.55%				0.77%	0.74%
3rd Quarter <sup>a</sup>		Cr <sup>6+</sup>	0.0000941	0.0000525	0.0000204	0.0000201			0.0000211		
		Cr <sub>T</sub>	0.00216	0.00474	0.00214	0.00204			0.00264		
		%Cr <sup>6+</sup>	4.36%	1.11%	0.95%	0.99%			0.80%		1.85%
3rd Quarter		Cr <sup>6+</sup>	0.0000626	0.0000395	0.0000177	0.0000197			0.0000215		
		Cr <sub>T</sub>	0.00231	0.00264	0.00214	0.00216			0.0023		
		%Cr <sup>6+</sup>	2.71%	1.50%	0.83%	0.91%			0.09%		1.49%
3rd Quarter		Cr <sup>6+</sup>	0.0000292	0.000034	0.0000169	0.00000215			0.00000215		
		Cr <sub>T</sub>	0.00259	0.00391	0.00214	0.00222			0.00233		
		%Cr <sup>6+</sup>	1.13%	0.87%	0.79%	0.10%			0.09%		0.72%
3rd Quarter		Cr <sup>6+</sup>	0.00000215	0.0000292	0.00000215	0.00000215			0.00000215		
		Cr <sub>T</sub>	0.00322	0.00704	0.00226	0.00243			0.00277		
		%Cr <sup>6+</sup>	0.07%	0.41%	0.10%	0.09%			0.08%		0.17%
3rd Quarter		Cr <sup>6+</sup>	0.00000215	0.0000199	0.00000215	0.00000215			0.00000215		
		Cr <sub>T</sub>	0.00489	0.0119	0.00259	0.00254			0.00316		
		%Cr <sup>6+</sup>	0.04%	0.17%	0.08%	0.08%			0.07%		0.09%
<b>SITE AVERAGE</b>			<b>1.86%</b>	1.02%	0.68%	0.86%	0.99%	0.72%	0.23%	1.06%	
<b>OVERALL AVERAGE</b>											<b>1.07%</b>

<sup>a</sup>3rd Quarter data individual samples could not be matched due to a mixup with the Chain of Custody form in the Lab. Cr<sup>6+</sup> samples are sorted from highest to lowest and are paired with total chromium samples sorted from lowest to highest to get the most conservative %Cr<sup>6+</sup>

WD = Wind Direction  
 Cr<sup>6+</sup> = hexavalent chromium  
 Cr<sub>T</sub> = total chromium  
 Measured Concentration units are µg/m<sup>3</sup>

## USA Today Report Summary

In December of 2008, USA Today released a special report, *The Smokestack Effect: Toxic Air and America's Schools*. Table 11 shows the ranks and chemicals identified by USA Today in their report for the three schools utilized in this study.

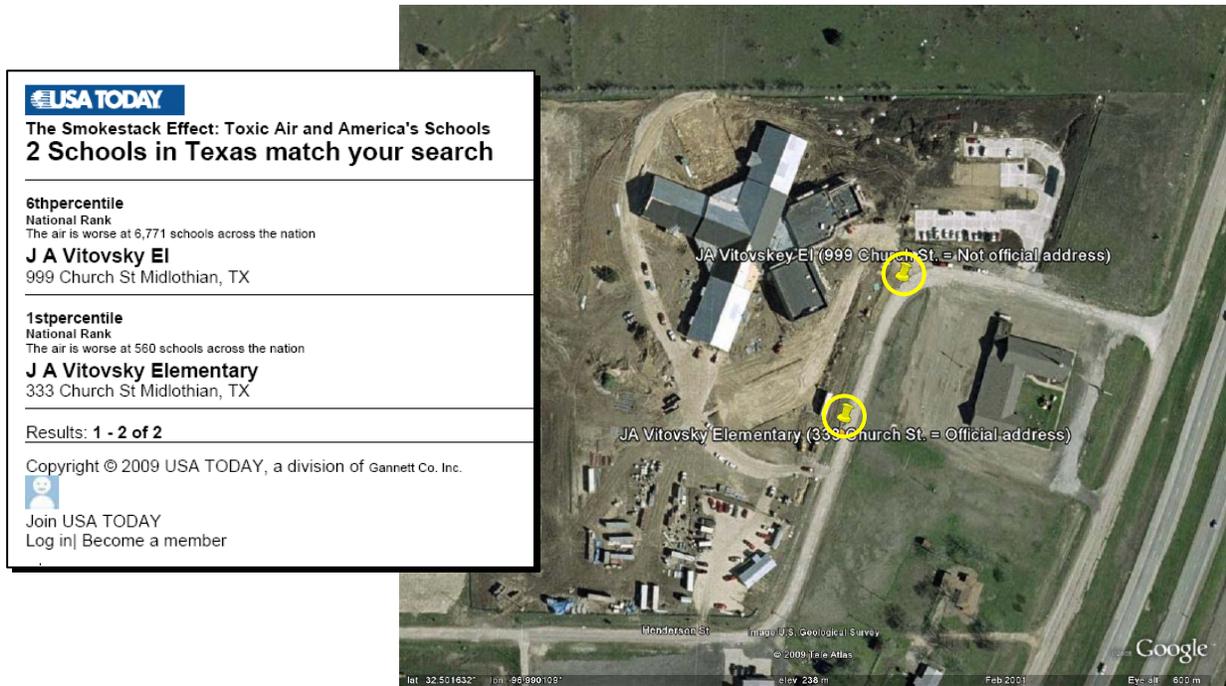
**Table 11. USA Today Ranks and Chemicals of Concern for the Midlothian Area School Study Monitoring Sites.**

School	Percentile	Rank (of 127,809 schools)	Chemical of Concern	% Contribution
Mountain Peak Elementary School	1st	175	Sulfuric Acid	85%
JA Vitovsky Elementary School (999 Church Street)	6th	6,772	Manganese	14%
JA Vitovsky Elementary School (333 Church Street)	1st	561	Sulfuric Acid	82%
			Manganese	16%
			Sulfuric Acid	79%
			Manganese	19%
			Chromium	2%
Midlothian High School	3rd	2,219	Sulfuric Acid	84%
			Manganese	15%

The USA Today report utilized the U.S. Environmental Protection Agency's (EPA's) Risk-Screening Environmental Indicators (RSEI) Model to determine the rankings and pollutants responsible. According to EPA, the RSEI model is not the right tool to determine the quality of the air outside of U.S. schools. The RSEI tool was designed to be the first step in a multi-step process to determine if potentially toxic emissions are released into the environment. RSEI was not intended to be used alone to determine the risk associated with these releases. Additional data and analysis would be necessary before an accurate assessment could be made, such as actual long-term ambient air data and a proper health effects evaluation.

As the state's environmental protection agency, the TCEQ takes its role in protecting public health very seriously, and knows of no schools in Texas where ambient concentrations of air toxics are unsafe. In order to conduct a thorough evaluation of the USA Today report, the TD requested the data that USA Today utilized in their article, but has not yet received that information. Based on the TD's preliminary evaluation, some concerns about the methodology utilized by USA Today have been identified. The rankings of Texas schools by USA Today are based on theoretical modeling results of emissions data, not on a health effects evaluation of actual measured ambient air concentrations from air monitors. The purpose of modeling is to attempt to predict air concentrations that a monitor actually measures. Since Texas has an extensive air monitoring network, Texas does not need to rely heavily on modeling results. The model developed by EPA was designed primarily for states without extensive monitoring capability. It also appears that USA Today did not attempt to validate the modeling results for Texas with any of the abundant and readily available ambient air data collected from monitors in Texas, even though some monitors are located at schools. The TCEQ has identified some schools in the Houston area which show significant differences between USA Today's results and agency staff conclusions based on actual air quality monitoring data. As a further example of why it appears USA Today neglected to ground-truth their modeling results for Texas, J.A. Vitovsky Elementary School is represented twice in the report (Table 11, Figure 90). First, it is represented as J A Vitovsky El (999 Church St) and ranked in the 6th percentile, while it is represented a second time as J A Vitovsky Elementary (333 Church St) and ranked in the 1st percentile. The distance between the two addresses amounts to 1/20th of a mile (264 feet);

however, one location is ranked in the 1st percentile while the second is ranked in the 6th percentile. There are also differences in the chemicals and industries USA Today reports as responsible and 6,211 schools are ranked in between the two representations. Further evidence showing no ground-truthing of the data; USA Today also identified Lyondell Chemical Co, Channelview, Texas as being one of the industries most responsible for pollution outside of JA Vitovsky Elementary (333 Church St. representation), Mountain Peak Elementary School, and Midlothian High School. The distance between Channelview, Texas and Midlothian, Texas is approximately 248 miles. Ironically, in USA Today's evaluations of these schools, Lyondell is not listed by USA Today as a polluter most responsible for toxics outside a Channelview school, which is less than 3 miles away from Lyondell and is in the predominant downwind direction. Clearly, USA Today's modeling results should not be relied upon exclusively to provide an accurate picture of air quality. Additional data and analyses are necessary for an accurate assessment (e.g., model validation with actual measurements, evaluation by environmental professionals who are knowledgeable about the areas, nearby sources, and toxicity of the chemicals being evaluated).



**Figure 90. Map of the Two USA Today Locations for JA Vitovsky Elementary School.**

The TCEQ CAMS 52 ambient air monitoring site is located approximately 3.9 miles northwest of Mountain Peak Elementary School, 2.4 miles southwest of JA Vitovsky Elementary School, and 1.9 miles northwest of Midlothian High School. Statistical analyses done on the VOCs (see previous sections) indicated CAMS 52 is a good representation of ambient air quality in the Midlothian area. While sulfuric acid is not monitored for, PM<sub>2.5</sub> manganese data collected at CAMS 52 from 1997 to 2009 indicate that levels of manganese are not of health concern in the Midlothian area (Figure 91). The data collected during this monitoring project also indicate that levels of PM<sub>10</sub> manganese are well below the long-term, health-based AMCV of 2 µg/m<sup>3</sup> (Figure 92), and are not of health concern. Therefore, we would not expect to see a health impact due to PM<sub>10</sub> or PM<sub>2.5</sub> manganese at the school.

Measured Concentrations of PM<sub>10</sub> & PM<sub>2.5</sub> Manganese in Midlothian

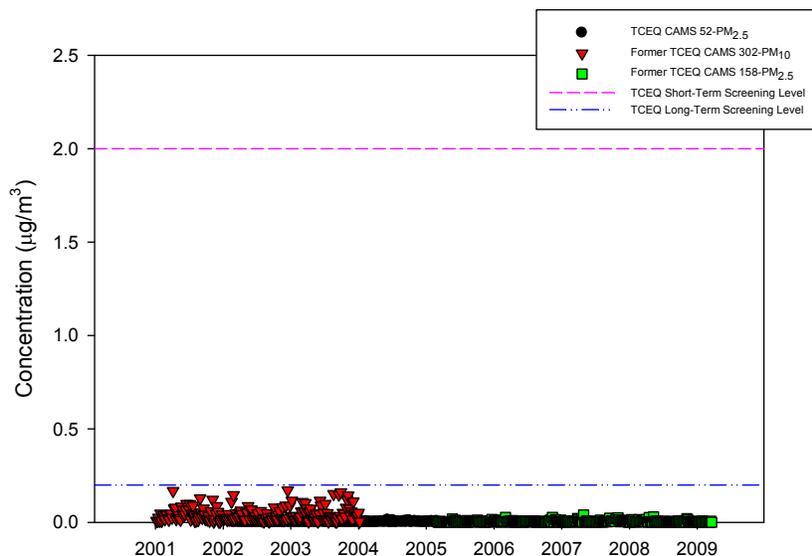


Figure 91. Historic PM<sub>10</sub> & PM<sub>2.5</sub> Manganese Concentrations Measured in Midlothian by TCEQ.

All Quarters of Data: PM<sub>10</sub> Manganese Concentrations at All Sites

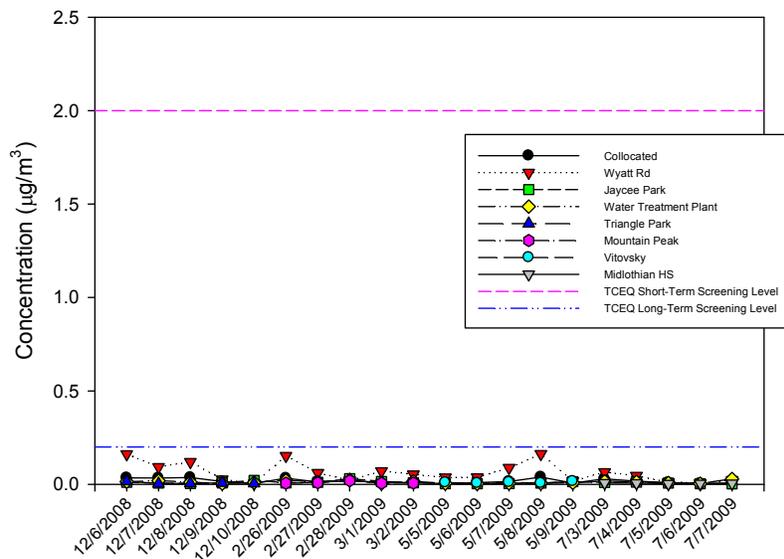


Figure 92. PM<sub>10</sub> Manganese Concentrations Measured at All Sites for All Four Quarters.

According to ATSDR (1998), sulfuric acid is formed in air as small droplets or attached to other small particles when sulfur dioxide is released from the burning of coal, oil, and gas. It is a very corrosive chemical and will cause irritation and local effects to the tissue that it directly comes in contact with (e.g.,

eyes, skin, respiratory tract, and gastrointestinal tract) when the tissue is exposed to sufficiently high concentrations. Effects of this chemical are thought to be a result of pH change rather than from the sulfate. Concentrated sulfuric acid has a pungent odor (odor threshold in air is 1,000  $\mu\text{g}/\text{m}^3$ ) and will irritate the nose. In the US, sulfuric acid levels in the atmosphere are generally below 5  $\mu\text{g}/\text{m}^3$ , although higher concentrations can occur (up to 700  $\mu\text{g}/\text{m}^3$ ). Currently, epidemiological studies do not provide clear evidence linking environmental exposure to sulfuric acid aerosols alone to adverse health effects in humans. The TCEQ does have a state standard for sulfuric acid: in summary, 30 TAC Chapter 112 says sulfuric acid concentrations may not exceed 1) a 24-hour average concentration of 15  $\mu\text{g}/\text{m}^3$ , 2) a 1-hour average concentration of 50  $\mu\text{g}/\text{m}^3$  not to be exceeded more than one time during 24-hours, or 3) a maximum of 100  $\mu\text{g}/\text{m}^3$  at any time. The air permitting process also has procedures in place to ensure that permitted emissions from a given facility are safe for the general public. Additionally, based on problems identified by TD with the USA Today modeling results, where TCEQ has data at or in close proximity to high-percentile ranking schools for some of the toxicity drivers identified, which show USA Today results to be unreliable in predicting air concentrations of health concern, we have no reason to believe the USA Today results for sulfuric acid would be any more reliable.

*The levels of manganese in Midlothian, both historically ( $PM_{2.5}$ ) and measured during this special study ( $PM_{10}$ ), indicate manganese is well below the TCEQ AMCVs. Therefore, we would not expect to see a health impact from the measured levels of  $PM_{2.5}$  or  $PM_{10}$  metals at the school. Since procedures are in place in the air permitting process to ensure permitted emissions are safe for the general public, and since the USA Today results are unreliable in cases where TCEQ has monitoring data at or in close proximity to schools, there is no reason to believe the USA Today results for sulfuric acid would be accurate or reliable in this case.*

## **APPENDICES**

## *Appendix A – TCEQ CAMS 52 VOC Historical Comparisons*

## A. Comparisons to Historical VOC Concentrations at CAMS 52

### I. 1,3-Butadiene

#### a. Comparison between collocated and historical

##### t-test

Monday, March 01, 2010, 2:36:24 PM

**Data source:** Data 1 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Monday, March 01, 2010, 2:36:24 PM

**Data source:** Data 1 in CAMS 52 Comparisons.JNB

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.00500	0.00500	0.00500
All Quarters	20	0	0.0110	0.00750	0.0155

Mann-Whitney U Statistic= 2812.500

T = 9677.500 n(small)= 20 n(big)= 614 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

### II. Benzene

#### a. Comparison between collocated and historical

##### t-test

Monday, March 01, 2010, 2:40:32 PM

**Data source:** Data 2 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Monday, March 01, 2010, 2:40:32 PM

**Data source:** Data 2 in CAMS 52 Comparisons.JNB

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.200	0.140	0.270
All Quarters	20	0	0.206	0.168	0.232

Mann-Whitney U Statistic= 5904.000

T = 6586.000 n(small)= 20 n(big)= 614 (P = 0.770)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.770)

### III. Toluene

#### a. Comparison between collocated and historical

##### t-test

Monday, March 01, 2010, 2:43:29 PM

**Data source:** Data 3 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Monday, March 01, 2010, 2:43:29 PM

**Data source:** Data 3 in CAMS 52 Comparisons.JNB

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.160	0.1000	0.280
All Quarters	20	0	0.150	0.0940	0.185

Mann-Whitney U Statistic= 5278.000

T = 5488.000 n(small)= 20 n(big)= 614 (P = 0.285)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.285)

### IV. Ethylbenzene

#### a. Comparison between collocated and historical

##### t-test

Monday, March 01, 2010, 2:45:32 PM

**Data source:** Data 4 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, March 01, 2010, 2:45:32 PM

**Data source:** Data 4 in CAMS 52 Comparisons.JNB

---

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.0200	0.00500	0.0500
All Quarters	20	0	0.0245	0.0165	0.0315

---

Mann-Whitney U Statistic= 5013.000

T = 7477.000 n(small)= 20 n(big)= 614 (P = 0.148)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.148)

## V. *p+m*-Xylene

### a. Comparison between collocated and historical

**t-test**

Monday, March 01, 2010, 2:47:12 PM

**Data source:** Data 5 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, March 01, 2010, 2:47:12 PM

**Data source:** Data 5 in CAMS 52 Comparisons.JNB

---

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.0600	0.00500	0.130
All Quarters	20	0	0.0525	0.0290	0.0715

---

Mann-Whitney U Statistic= 5864.500

T = 6074.500 n(small)= 20 n(big)= 614 (P = 0.730)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.730)

## VI. *o*-Xylene

### a. Comparison between collocated and historical

**t-test**

Monday, March 01, 2010, 2:48:49 PM

**Data source:** Data 6 in CAMS 52 Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, March 01, 2010, 2:48:49 PM

**Data source:** Data 6 in CAMS 52 Comparisons.JNB

---

Group	N	Missing	Median	25%	75%
TCEQ	614	0	0.01000	0.00500	0.0400
All Quarters	20	0	0.0260	0.0140	0.0345

---

Mann-Whitney U Statistic= 4394.500

T = 8095.500 n(small)= 20 n(big)= 614 (P = 0.022)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.022)

## B. Comparisons of Average Concentrations to Historical Average Concentrations

### I. Each site average

#### a. Comparison of Benzene Site Averages

##### One WayOne-Way Analysis of Variance

Monday, March 01, 2010, 3:11:02 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	614	0	0.282	0.737	0.0297
Collocated	20	0	0.211	0.0600	0.0134
Jaycee	20	0	0.197	0.0852	0.0191
WTP	20	0	0.190	0.0628	0.0140
Triangle	5	0	0.228	0.0866	0.0387
Mountain Peak	4	0	0.135	0.0234	0.0117
Vitovsky	5	0	0.227	0.0565	0.0253
Midlothian HS	5	0	0.115	0.0198	0.00887

Source of Variation	DF	SS	MS	F	P
Between Groups	7	0.597	0.0854	0.176	0.990
Residual	685	332.991	0.486		
Total	692	333.588			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.990).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### b. Comparison of 1,3-Butadiene Site Averages

##### One WayOne-Way Analysis of Variance

Monday, March 01, 2010, 3:14:36 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	614	0	0.0101	0.0220	0.000889
Collocated	20	0	0.0111	0.00594	0.00133
Jaycee	20	0	0.0117	0.00639	0.00143
WTP	20	0	0.00985	0.00509	0.00114
Triangle	5	0	0.0312	0.0363	0.0162
Mountain Peak	4	0	0.00825	0.00512	0.00256
Vitovsky	5	0	0.0110	0.001000	0.000447
Midlothian HS	5	0	0.00700	0.00255	0.00114

Source of Variation	DF	SS	MS	F	P
Between Groups	7	0.00234	0.000334	0.750	0.629
Residual	685	0.305	0.000445		
Total	692	0.307			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.629).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### c. Comparison of Toluene Site Averages

##### One WayOne-Way Analysis of Variance

Monday, March 01, 2010, 3:16:55 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
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Row 1	614	0	0.483	2.478	0.100
Row 2	20	0	0.160	0.0805	0.0180
Row 3	20	0	0.136	0.0496	0.0111
Row 4	20	0	0.140	0.0891	0.0199
Row 5	5	0	0.204	0.151	0.0674
Row 6	4	0	0.0902	0.0257	0.0129
Row 7	5	0	0.174	0.0573	0.0256
Row 8	5	0	0.118	0.0388	0.0173

Source of Variation	DF	SS	MS	F	P
Between Groups	7	7.966	1.138	0.207	0.984
Residual	685	3764.984	5.496		
Total	692	3772.949			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.984).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### d. Comparison of Ethylbenzene Site Averages

##### One WayOne-Way Analysis of Variance

Monday, March 01, 2010, 3:18:34 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	614	0	0.0672	0.412	0.0166
Row 2	20	0	0.0296	0.0225	0.00503
Row 3	20	0	0.0314	0.0221	0.00495
Row 4	20	0	0.0254	0.0164	0.00367
Row 5	5	0	0.0284	0.0176	0.00788
Row 6	4	0	0.0663	0.102	0.0509
Row 7	5	0	0.0250	0.00570	0.00255
Row 8	5	0	0.0166	0.00602	0.00269

Source of Variation	DF	SS	MS	F	P
Between Groups	7	0.105	0.0150	0.0991	0.998
Residual	685	103.880	0.152		
Total	692	103.985			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.998).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### e. Comparison of *p*+*m*-Xylene Site Averages

##### One WayOne-Way Analysis of Variance

Monday, March 01, 2010, 3:20:03 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	614	0	0.230	1.656	0.0668
Row 2	20	0	0.0684	0.0717	0.0160
Row 3	20	0	0.0761	0.0668	0.0149
Row 4	20	0	0.0508	0.0463	0.0104
Row 5	5	0	0.0616	0.0457	0.0204
Row 6	4	0	0.210	0.358	0.179

Row 7	5	0	0.0574	0.0209	0.00936
Row 8	5	0	0.0352	0.0129	0.00576

Source of Variation	DF	SS	MS	F	P
Between Groups	7	1.895	0.271	0.110	0.998
Residual	685	1681.428	2.455		
Total	692	1683.323			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.998).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Comparison of o-Xylene Site Averages

##### One Way One-Way Analysis of Variance

Monday, March 01, 2010, 3:21:25 PM

Data source: Av Data in CAMS 52 Comparisons.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	614	0	0.0724	0.510	0.0206
Row 2	20	0	0.0288	0.0210	0.00470
Row 3	20	0	0.0302	0.0194	0.00433
Row 4	20	0	0.0223	0.0150	0.00336
Row 5	5	0	0.0260	0.0182	0.00814
Row 6	4	0	0.0578	0.0875	0.0438
Row 7	5	0	0.0240	0.00596	0.00266
Row 8	5	0	0.0166	0.00559	0.00250

Source of Variation	DF	SS	MS	F	P
Between Groups	7	0.145	0.0207	0.0889	0.999
Residual	685	159.370	0.233		
Total	692	159.515			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.999).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

*Appendix B – VOC Site Comparisons to Collocated Monitor*

## Comparison of TCEQ to Collocated Every 6<sup>th</sup>-Day Samples

### I. Benzene

#### t-test

Friday, June 04, 2010, 9:57:37 AM

**Data source:** Benzene in TCEQ to Collocated Comparison.JNB

**Normality Test:** Passed (P = 0.649)

**Equal Variance Test:** Passed (P = 0.099)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.198	0.0585	0.0293
Collocated	4	0	0.229	0.0148	0.00740

Difference -0.0310

t = -1.027 with 6 degrees of freedom. (P = 0.344)

95 percent confidence interval for difference of means: -0.105 to 0.0429

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.344).

Power of performed test with alpha = 0.050: 0.053

The power of the performed test (0.053) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### II. 1,3-Butadiene

#### t-test

Friday, June 04, 2010, 9:57:58 AM

**Data source:** Butadiene in TCEQ to Collocated Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

#### Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 9:57:58 AM

**Data source:** Butadiene in TCEQ to Collocated Comparison.JNB

Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.00500	0.00500	0.00500
Collocated	4	0	0.00900	0.00800	0.0155

Mann-Whitney U Statistic= 0.000

T = 10.000 n(small)= 4 n(big)= 4 P(est.)= 0.020 P(exact)= 0.029

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.029)

### III. Toluene

#### t-test

Friday, June 04, 2010, 9:58:16 AM

**Data source:** Toluene in TCEQ to Collocated Comparison.JNB

**Normality Test:** Passed (P = 0.216)

**Equal Variance Test:** Passed (P = 0.589)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.140	0.0469	0.0235
Collocated	4	0	0.124	0.0437	0.0219

Difference 0.0160

t = 0.499 with 6 degrees of freedom. (P = 0.635)

95 percent confidence interval for difference of means: -0.0624 to 0.0944

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.635).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800. Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### IV. Ethylbenzene

##### t-test

Friday, June 04, 2010, 9:58:31 AM

**Data source:** Ethylbenzene in TCEQ to Collocated Comparison.JNB

**Normality Test:** Passed (P = 0.162)

**Equal Variance Test:** Passed (P = 0.549)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.0325	0.00957	0.00479
Collocated	4	0	0.0205	0.00733	0.00366

Difference 0.0120

t = 1.991 with 6 degrees of freedom. (P = 0.094)

95 percent confidence interval for difference of means: -0.00275 to 0.0267

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.094).

Power of performed test with alpha = 0.050: 0.298

The power of the performed test (0.298) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### V. p+m-Xylene

##### t-test

Friday, June 04, 2010, 9:58:48 AM

**Data source:** m+pX in TCEQ to Collocated Comparison.JNB

**Normality Test:** Passed (P = 0.157)

**Equal Variance Test:** Passed (P = 0.334)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.0700	0.0216	0.0108
Collocated	4	0	0.0355	0.0260	0.0130

Difference 0.0345

t = 2.039 with 6 degrees of freedom. (P = 0.088)

95 percent confidence interval for difference of means: -0.00690 to 0.0759

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.088).

Power of performed test with alpha = 0.050: 0.315

The power of the performed test (0.315) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### VI. o-Xylene

##### t-test

Friday, June 04, 2010, 10:43:41 AM

**Data source:** oX in TCEQ to Collocated Comparison.JNB

**Normality Test:** Passed (P = 0.762)

**Equal Variance Test:** Passed (P = 0.600)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.0238	0.0149	0.00747
Collocated	4	0	0.0208	0.0113	0.00563

Difference 0.00300

t = 0.321 with 6 degrees of freedom. (P = 0.759)

95 percent confidence interval for difference of means: -0.0199 to 0.0259

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.759).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## Comparison of Every 6<sup>th</sup>-Day TCEQ Samples to All Collocated Samples

### I. Benzene

#### t-test

Thursday, June 03, 2010, 5:37:19 PM

**Data source:** Benzene in 6th Day Sample Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

#### Mann-Whitney Rank Sum Test

Thursday, June 03, 2010, 5:37:19 PM

**Data source:** Benzene in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.195	0.155	0.240
Collocated	16	0	0.186	0.163	0.229

Mann-Whitney U Statistic= 30.000

T = 40.000 n(small)= 4 n(big)= 16 (P = 0.887)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.887)

### II. 1,3-Butadiene

#### t-test

Thursday, June 03, 2010, 5:42:16 PM

**Data source:** Butadiene in 6th Day Sample Comparisons.JNB

**Normality Test:** Passed (P = 0.429)

**Equal Variance Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

#### Mann-Whitney Rank Sum Test

Thursday, June 03, 2010, 5:42:16 PM

**Data source:** Butadiene in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.00500	0.00500	0.00500
Collocated	16	0	0.0120	0.00700	0.0155

Mann-Whitney U Statistic= 12.000

T = 22.000 n(small)= 4 n(big)= 16 (P = 0.064)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.064)

### III. Toluene

#### t-test

Thursday, June 03, 2010, 5:43:00 PM

**Data source:** Toluene in 6th Day Sample Comparisons.JNB

**Normality Test:** Passed (P = 0.133)

**Equal Variance Test:** Passed (P = 0.353)

Group Name	N	Missing	Mean	Std Dev	SEM
TCEQ	4	0	0.140	0.0469	0.0235
Collocated	16	0	0.169	0.0861	0.0215

Difference -0.0286

t = -0.632 with 18 degrees of freedom. (P = 0.535)

95 percent confidence interval for difference of means: -0.124 to 0.0664

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.535).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### IV. Ethylbenzene

t-test

Thursday, June 03, 2010, 5:43:43 PM

Data source: Ethylbenzene in 6th Day Sample Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Thursday, June 03, 2010, 5:43:43 PM

Data source: Ethylbenzene in 6th Day Sample Comparisons.JNB

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Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.0350	0.0250	0.0400
Collocated	16	0	0.0265	0.0165	0.0345

---

Mann-Whitney U Statistic= 23.000

T = 51.000 n(small)= 4 n(big)= 16 (P = 0.422)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.422)

#### V. p+m-Xylene

t-test

Thursday, June 03, 2010, 5:44:20 PM

Data source: m+p-X in 6th Day Sample Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Thursday, June 03, 2010, 5:44:20 PM

Data source: m+p-X in 6th Day Sample Comparisons.JNB

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Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.0750	0.0550	0.0850
Collocated	16	0	0.0525	0.0330	0.0780

---

Mann-Whitney U Statistic= 22.500

T = 51.500 n(small)= 4 n(big)= 16 (P = 0.395)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.395)

#### VI. o-Xylene

t-test

Friday, June 04, 2010, 10:38:20 AM

Data source: o-X in 6th Day Sample Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 10:38:20 AM

Data source: o-X in 6th Day Sample Comparisons.JNB

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Group	N	Missing	Median	25%	75%
TCEQ	4	0	0.0250	0.0125	0.0350
Collocated	16	0	0.0270	0.0140	0.0385

---

Mann-Whitney U Statistic= 27.500

T = 37.500 n(small)= 4 n(big)= 16 (P = 0.705)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.705)

## Comparison of Collocated Samples to All Other Sites

### I. Benzene

#### a. Collocated vs. Jaycee Park

t-test

Monday, January 11, 2010, 10:30:28 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:30:28 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Jaycee	20	0	0.165	0.148	0.212

Mann-Whitney U Statistic= 143.000

T = 467.000 n(small)= 20 n(big)= 20 (P = 0.126)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.126)

#### b. Collocated vs. Water Treatment Plant

t-test

Monday, January 11, 2010, 10:31:17 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:31:17 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Water Tmt Plant	20	0	0.184	0.146	0.224

Mann-Whitney U Statistic= 150.000

T = 460.000 n(small)= 20 n(big)= 20 (P = 0.181)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.181)

#### c. Collocated vs. Triangle Park

t-test

Monday, January 11, 2010, 10:31:49 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:31:49 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Triangle Park	5	0	0.209	0.166	0.272

Mann-Whitney U Statistic= 48.500

T = 66.500 n(small)= 5 n(big)= 20 (P = 0.946)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.946)

#### d. Collocated vs. Mountain Peak

t-test

Monday, January 11, 2010, 10:32:31 AM

Data source: Benzene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:32:31 AM

**Data source:** Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Mountain Peak	4	0	0.133	0.121	0.150

Mann-Whitney U Statistic= 5.000

T = 15.000 n(small)= 4 n(big)= 20 (P = 0.008)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.008)

#### e. Collocated vs. Vitovsky

**t-test**

Monday, January 11, 2010, 10:32:59 AM

**Data source:** Benzene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:32:59 AM

**Data source:** Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Vitovsky	5	0	0.248	0.168	0.275

Mann-Whitney U Statistic= 38.500

T = 76.500 n(small)= 5 n(big)= 20 (P = 0.455)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.455)

#### f. Collocated vs. Midlothian HS

**t-test**

Monday, January 11, 2010, 10:33:17 AM

**Data source:** Benzene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:33:17 AM

**Data source:** Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Mid HS	5	0	0.117	0.0973	0.133

Mann-Whitney U Statistic= 0.500

T = 15.500 n(small)= 5 n(big)= 20 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

## II. 1,3-Butadiene

#### a. Collocated vs. Jaycee Park

**t-test**

Monday, January 11, 2010, 10:39:53 AM

**Data source:** BD Site in VOC Site Comparison.JNB

**Normality Test:** Passed (P = 0.183)

**Equal Variance Test:** Passed (P = 0.718)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.0111	0.00594	0.00133
Jaycee Park	20	0	0.0117	0.00639	0.00143

Difference -0.000550

t = -0.282 with 38 degrees of freedom. (P = 0.779)

95 percent confidence interval for difference of means: -0.00450 to 0.00340

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.779).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### b. Collocated vs. Water Treatment Plant

t-test

Monday, January 11, 2010, 10:40:11 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.667)

Equal Variance Test: Passed (P = 0.359)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.0111	0.00594	0.00133
Water Treatment Plant	20	0	0.00985	0.00509	0.00114

Difference 0.00127

t = 0.729 with 38 degrees of freedom. (P = 0.470)

95 percent confidence interval for difference of means: -0.00227 to 0.00482

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.470).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### c. Collocated vs. Triangle Park

t-test

Monday, January 11, 2010, 10:41:15 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:41:15 AM

Data source: BD Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0110	0.00750	0.0155
Triangle Park	5	0	0.0150	0.0103	0.0460

Mann-Whitney U Statistic= 32.000

T = 83.000 n(small)= 5 n(big)= 20 (P = 0.233)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.233)

#### d. Collocated vs. Mountain Peak

t-test

Monday, January 11, 2010, 10:41:29 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.730)

Equal Variance Test: Passed (P = 0.710)

Group Name	N	Missing	Mean	Std Dev	SEM
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Collocated	20	0	0.0111	0.00594	0.00133
Mountain Peak	4	0	0.00825	0.00512	0.00256

Difference 0.00287

t = 0.899 with 22 degrees of freedom. (P = 0.378)

95 percent confidence interval for difference of means: -0.00375 to 0.00950

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.378).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### e. Collocated vs. Vitovsky

t-test

Monday, January 11, 2010, 10:41:48 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.803)

Equal Variance Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:41:48 AM

Data source: BD Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0110	0.00750	0.0155
Vitovsky	5	0	0.0110	0.01000	0.0120

Mann-Whitney U Statistic= 49.000

T = 66.000 n(small)= 5 n(big)= 20 (P = 0.973)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.973)

### f. Collocated vs. Midlothian HS

t-test

Monday, January 11, 2010, 10:42:01 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.861)

Equal Variance Test: Passed (P = 0.161)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.0111	0.00594	0.00133
Midlothian HS	5	0	0.00700	0.00255	0.00114

Difference 0.00412

t = 1.499 with 23 degrees of freedom. (P = 0.147)

95 percent confidence interval for difference of means: -0.00157 to 0.00982

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.147).

Power of performed test with alpha = 0.050: 0.177

The power of the performed test (0.177) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## III. Toluene

### a. Collocated vs. Jaycee Park

t-test

Monday, January 11, 2010, 10:44:33 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:44:33 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

---

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Jaycee Park	20	0	0.128	0.0950	0.179

---

Mann-Whitney U Statistic= 179.500

T = 430.500 n(small)= 20 n(big)= 20 (P = 0.588)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.588)

#### b. Collocated vs. Water Treatment Plant

**t-test**

Monday, January 11, 2010, 10:44:52 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:44:52 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

---

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Water Treatment Plant	20	0	0.110	0.0840	0.162

---

Mann-Whitney U Statistic= 162.000

T = 448.000 n(small)= 20 n(big)= 20 (P = 0.310)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.310)

#### c. Collocated vs. Triangle Park

**t-test**

Monday, January 11, 2010, 10:45:09 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:45:09 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

---

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Triangle Park	5	0	0.106	0.101	0.320

---

Mann-Whitney U Statistic= 45.000

T = 70.000 n(small)= 5 n(big)= 20 (P = 0.760)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.760)

#### d. Collocated vs. Mountain Peak

**t-test**

Monday, January 11, 2010, 10:45:33 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:45:33 AM

**Data source:** Toluene Site in VOC Site Comparison.JNB

---

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185

---

Mountain Peak 4 0 0.0825 0.0730 0.108

Mann-Whitney U Statistic= 15.500

T = 25.500 n(small)= 4 n(big)= 20 (P = 0.063)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.063)

#### e. Collocated vs. Vitovsky

t-test

Monday, January 11, 2010, 10:45:54 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:45:54 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Vitovsky	5	0	0.150	0.139	0.199

Mann-Whitney U Statistic= 43.000

T = 72.000 n(small)= 5 n(big)= 20 (P = 0.659)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.659)

#### f. Collocated vs. Midlothian HS

t-test

Monday, January 11, 2010, 10:46:09 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:46:09 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Midlothian HS	5	0	0.117	0.0853	0.145

Mann-Whitney U Statistic= 33.500

T = 48.500 n(small)= 5 n(big)= 20 (P = 0.277)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.277)

### IV. Ethylbenzene

#### a. Collocated vs. Jaycee Park

t-test

Monday, January 11, 2010, 10:48:18 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:48:18 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Jaycee Park	20	0	0.0245	0.0160	0.0360

Mann-Whitney U Statistic= 191.500

T = 401.500 n(small)= 20 n(big)= 20 (P = 0.828)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.828)

#### b. Collocated vs. Water Treatment Plant

t-test

Monday, January 11, 2010, 10:48:34 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:48:34 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Water Treatment Plant	20	0	0.0185	0.0160	0.0265

Mann-Whitney U Statistic= 165.000

T = 445.000 n(small)= 20 n(big)= 20 (P = 0.350)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.350)

#### c. Collocated vs. Triangle Park

t-test

Monday, January 11, 2010, 10:48:49 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:48:49 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Triangle Park	5	0	0.0190	0.0158	0.0410

Mann-Whitney U Statistic= 50.000

T = 65.000 n(small)= 5 n(big)= 20 (P = 0.973)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.973)

#### d. Collocated vs. Mountain Peak

t-test

Monday, January 11, 2010, 10:49:02 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:49:02 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Mountain Peak	4	0	0.0165	0.0130	0.120

Mann-Whitney U Statistic= 32.000

T = 42.000 n(small)= 4 n(big)= 20 (P = 0.561)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.561)

#### e. Collocated vs. Vitovsky

t-test

Monday, January 11, 2010, 10:49:20 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 10:49:20 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Vitovsky	5	0	0.0230	0.0208	0.0288

Mann-Whitney U Statistic= 49.000

T = 64.000 n(small)= 5 n(big)= 20 (P = 0.973)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.973)

#### f. Collocated vs. Midlothian HS

**t-test**

Monday, January 11, 2010, 10:49:38 AM

**Data source:** EB Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:49:38 AM

**Data source:** EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Midlothian HS	5	0	0.0140	0.0125	0.0207

Mann-Whitney U Statistic= 25.000

T = 40.000 n(small)= 5 n(big)= 20 (P = 0.096)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.096)

#### V. p+m-Xylene

##### a. Collocated vs. Jaycee Park

**t-test**

Monday, January 11, 2010, 10:51:31 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:51:31 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Jaycee Park	20	0	0.0545	0.0310	0.0855

Mann-Whitney U Statistic= 179.500

T = 389.500 n(small)= 20 n(big)= 20 (P = 0.588)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.588)

##### b. Collocated vs. Water Treatment Plant

**t-test**

Monday, January 11, 2010, 10:51:47 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 10:51:47 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Water Treatment Plant	20	0	0.0375	0.0280	0.0560

Mann-Whitney U Statistic= 162.500

T = 447.500 n(small)= 20 n(big)= 20 (P = 0.317)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.317)

#### c. Collocated vs. Triangle Park

**t-test** Monday, January 11, 2010, 10:52:04 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test** Monday, January 11, 2010, 10:52:04 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Triangle Park	5	0	0.0350	0.0333	0.0890

Mann-Whitney U Statistic= 48.000

T = 67.000 n(small)= 5 n(big)= 20 (P = 0.919)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.919)

#### d. Collocated vs. Mountain Peak

**t-test** Monday, January 11, 2010, 11:11:45 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test** Monday, January 11, 2010, 11:11:45 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Mountain Peak	4	0	0.0335	0.0255	0.394

Mann-Whitney U Statistic= 35.000

T = 45.000 n(small)= 4 n(big)= 20 (P = 0.727)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.727)

#### e. Collocated vs. Vitovsky

**t-test** Monday, January 11, 2010, 11:11:58 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test** Monday, January 11, 2010, 11:11:58 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Vitovsky	5	0	0.0510	0.0428	0.0668

Mann-Whitney U Statistic= 45.500

T = 69.500 n(small)= 5 n(big)= 20 (P = 0.786)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.786)

#### f. Collocated vs. Midlothian HS

**t-test** Monday, January 11, 2010, 11:12:12 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 11:12:12 AM

**Data source:** p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Midlothian HS	5	0	0.0320	0.0270	0.0405

Mann-Whitney U Statistic= 32.500

T = 47.500 n(small)= 5 n(big)= 20 (P = 0.248)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.248)

**VI. o-Xylene**

**a. Collocated vs. Jaycee Park**

**t-test**

Monday, January 11, 2010, 11:17:09 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 11:17:09 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Jaycee Park	20	0	0.0255	0.0160	0.0340

Mann-Whitney U Statistic= 189.500

T = 399.500 n(small)= 20 n(big)= 20 (P = 0.787)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.787)

**b. Collocated vs. Water Treatment Plant**

**t-test**

Monday, January 11, 2010, 11:17:26 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 11:17:26 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Water Treatment Plant	20	0	0.0175	0.0135	0.0215

Mann-Whitney U Statistic= 156.500

T = 453.500 n(small)= 20 n(big)= 20 (P = 0.244)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.244)

**c. Collocated vs. Triangle Park**

**t-test**

Monday, January 11, 2010, 11:17:40 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, January 11, 2010, 11:17:40 AM

**Data source:** o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345

Triangle Park 5 0 0.0150 0.0138 0.0385

Mann-Whitney U Statistic= 47.500

T = 62.500 n(small)= 5 n(big)= 20 (P = 0.892)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.892)

#### d. Collocated vs. Mountain Peak

t-test

Monday, January 11, 2010, 11:17:55 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 11:17:55 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Mountain Peak	4	0	0.0155	0.0120	0.103

Mann-Whitney U Statistic= 34.000

T = 44.000 n(small)= 4 n(big)= 20 (P = 0.670)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.670)

#### e. Collocated vs. Vitovsky

t-test

Monday, January 11, 2010, 11:18:17 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 11:18:17 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Vitovsky	5	0	0.0230	0.0198	0.0265

Mann-Whitney U Statistic= 49.000

T = 64.000 n(small)= 5 n(big)= 20 (P = 0.973)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.973)

#### f. Collocated vs. Midlothian HS

t-test

Monday, January 11, 2010, 11:18:38 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, January 11, 2010, 11:18:38 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Midlothian HS	5	0	0.0170	0.0118	0.0197

Mann-Whitney U Statistic= 28.500

T = 43.500 n(small)= 5 n(big)= 20 (P = 0.153)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.153)

*Appendix C – VOC Site Comparisons: All Four Quarters of Data*

## A. Benzene

### I. Comparison of Stationary Sites

#### One WayOne-Way Analysis of Variance

Wednesday, January 06, 2010, 5:40:18 PM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Wednesday, January 06, 2010, 5:40:18 PM

Data source: Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.206	0.168	0.232
Jaycee Park	20	0	0.165	0.148	0.212
Water Treatment Plant	20	0	0.184	0.146	0.224

H = 2.826 with 2 degrees of freedom. (P = 0.243)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.243)

### II. Comparison of Mobile Sites

#### One WayOne-Way Analysis of Variance

Wednesday, January 06, 2010, 5:43:54 PM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.178)

Equal Variance Test: Passed (P = 0.106)

Group Name	N	Missing	Mean	Std Dev	SEM
Col 14-Triangle	5	0	0.228	0.0866	0.0387
Col 15-Mt Peak	4	0	0.135	0.0234	0.0117
Col 16-Vitov.	5	0	0.227	0.0565	0.0253
Col 17-MHS	5	0	0.115	0.0198	0.00887

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0515	0.0172	5.599	0.009
Residual	15	0.0460	0.00307		
Total	18	0.0975			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.009).

Power of performed test with alpha = 0.050: 0.792

All PairwiseAll-Pairwise Multiple Comparison Procedures (Holm-Sidak method):

Overall significance level = 0.05

Comparisons for factor:

Comparison	Diff of Means	t	Unadjusted P	Critical Level	Significant?
Col 14 vs. Col 17	0.112	3.210	0.006	0.009	Yes
Col 16 vs. Col 17	0.112	3.198	0.006	0.010	Yes
Col 14 vs. Col 15	0.0925	2.492	0.025	0.013	No
Col 16 vs. Col 15	0.0921	2.481	0.025	0.017	No
Col 15 vs. Col 17	0.0199	0.534	0.601	0.025	No
Col 14 vs. Col 16	0.000400	0.0114	0.991	0.050	No

### III. Comparison of All Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:35:46 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Monday, January 11, 2010, 10:35:46 AM

Data source: Benzene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
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Collocated	20	0	0.206	0.168	0.232
Jaycee	20	0	0.165	0.148	0.212
Water Tmt Plant	20	0	0.184	0.146	0.224
Triangle Park	5	0	0.209	0.166	0.272
Mountain Peak	4	0	0.133	0.121	0.150
Vitovsky	5	0	0.248	0.168	0.275
Mid HS	5	0	0.117	0.0973	0.133

H = 21.010 with 6 degrees of freedom. (P = 0.002)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Vitovsky vs Mid HS	48.600	3.348	Yes
Vitovsky vs Mountain Peak	39.400	2.559	No
Vitovsky vs Jaycee	17.600	1.534	Do Not Test
Vitovsky vs Water Tmt Plant	16.900	1.473	Do Not Test
Vitovsky vs Collocated	6.975	0.608	Do Not Test
Vitovsky vs Triangle Park	5.200	0.358	Do Not Test
Triangle Park vs Mid HS	43.400	2.990	No
Triangle Park vs Mountain Peak	34.200	2.222	Do Not Test
Triangle Park vs Jaycee	12.400	1.081	Do Not Test
Triangle Park vs Water Tmt Pla	11.700	1.020	Do Not Test
Triangle Park vs Collocated	1.775	0.155	Do Not Test
Collocated vs Mid HS	41.625	3.628	Do Not Test
Collocated vs Mountain Peak	32.425	2.580	Do Not Test
Collocated vs Jaycee	10.625	1.464	Do Not Test
Collocated vs Water Tmt Plant	9.925	1.368	Do Not Test
Water Tmt Plant vs Mid HS	31.700	2.763	Do Not Test
Water Tmt Pla vs Mountain Peak	22.500	1.790	Do Not Test
Water Tmt Plant vs Jaycee	0.700	0.0965	Do Not Test
Jaycee vs Mid HS	31.000	2.702	Do Not Test
Jaycee vs Mountain Peak	21.800	1.734	Do Not Test
Mountain Peak vs Mid HS	9.200	0.598	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## B. 1,3-Butadiene

### I. Comparisons of Stationary Sites

#### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 10:38:35 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Monday, January 11, 2010, 10:38:35 AM

Data source: BD Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0110	0.00750	0.0155
Jaycee Park	20	0	0.0115	0.00700	0.0130
Water Treatment Plant	20	0	0.00950	0.00600	0.0125
Triangle Park	5	0	0.0150	0.0103	0.0460
Mountain Peak	4	0	0.00800	0.00400	0.0125
Vitovsky	5	0	0.0110	0.01000	0.0120
Midlothian HS	5	0	0.00700	0.00475	0.00925

H = 7.453 with 6 degrees of freedom. (P = 0.281)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.281)

## II. Comparisons of Mobile Sites

### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:39:13 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:39:13 AM

Data source: BD Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0150	0.0103	0.0460
Mountain Peak	4	0	0.00800	0.00400	0.0125
Vitovsky	5	0	0.0110	0.01000	0.0120
Midlothian HS	5	0	0.00700	0.00475	0.00925

H = 6.993 with 3 degrees of freedom. (P = 0.072)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.072)

## III. Comparisons of All Sites

### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:39:36 AM

Data source: BD Site in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.070)

Equal Variance Test: Passed (P = 0.727)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.0111	0.00594	0.00133
Jaycee Park	20	0	0.0117	0.00639	0.00143
Water Treatment Plant	20	0	0.00985	0.00509	0.00114

Source of Variation	DF	SS	MS	F	P
Between Groups	2	0.0000351	0.0000175	0.516	0.600
Residual	57	0.00194	0.0000340		
Total	59	0.00197			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.600).

Power of performed test with alpha = 0.050: 0.049

The power of the performed test (0.049) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## C. Toluene

### I. Comparisons of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:43:26 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:43:26 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Jaycee Park	20	0	0.128	0.0950	0.179
Water Treatment Plant	20	0	0.110	0.0840	0.162
Triangle Park	5	0	0.106	0.101	0.320
Mountain Peak	4	0	0.0825	0.0730	0.108
Vitovsky	5	0	0.150	0.139	0.199
Midlothian HS	5	0	0.117	0.0853	0.145

H = 7.958 with 6 degrees of freedom. (P = 0.241)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.241)

### II. Comparisons of Mobile Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:43:57 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:43:57 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.150	0.0940	0.185
Jaycee Park	20	0	0.128	0.0950	0.179
Water Treatment Plant	20	0	0.110	0.0840	0.162

H = 1.216 with 2 degrees of freedom. (P = 0.545)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.545)

### III. Comparisons of All Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:44:11 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:44:11 AM

Data source: Toluene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.106	0.101	0.320
Mountain Peak	4	0	0.0825	0.0730	0.108
Vitovsky	5	0	0.150	0.139	0.199
Midlothian HS	5	0	0.117	0.0853	0.145

H = 7.320 with 3 degrees of freedom. (P = 0.062)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.062)

## D. Ethylbenzene

### I. Comparisons of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:47:25 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:47:25 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Jaycee Park	20	0	0.0245	0.0160	0.0360
Water Treatment Plant	20	0	0.0185	0.0160	0.0265
Triangle Park	5	0	0.0190	0.0158	0.0410
Mountain Peak	4	0	0.0165	0.0130	0.120
Vitovsky	5	0	0.0230	0.0208	0.0288
Midlothian HS	5	0	0.0140	0.0125	0.0207

H = 5.911 with 6 degrees of freedom. (P = 0.433)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.433)

### II. Comparisons of Mobile Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:47:43 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:47:43 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0245	0.0165	0.0315
Jaycee Park	20	0	0.0245	0.0160	0.0360
Water Treatment Plant	20	0	0.0185	0.0160	0.0265

H = 1.466 with 2 degrees of freedom. (P = 0.480)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.480)

### III. Comparisons of All Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:47:59 AM

Data source: EB Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:47:59 AM

Data source: EB Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0190	0.0158	0.0410
Mountain Peak	4	0	0.0165	0.0130	0.120
Vitovsky	5	0	0.0230	0.0208	0.0288
Midlothian HS	5	0	0.0140	0.0125	0.0207

H = 4.331 with 3 degrees of freedom. (P = 0.228)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.228)

## E. p+m-Xylene

### I. Comparisons of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:50:44 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:50:44 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Jaycee Park	20	0	0.0545	0.0310	0.0855
Water Treatment Plant	20	0	0.0375	0.0280	0.0560
Triangle Park	5	0	0.0350	0.0333	0.0890
Mountain Peak	4	0	0.0335	0.0255	0.394
Vitovsky	5	0	0.0510	0.0428	0.0668
Midlothian HS	5	0	0.0320	0.0270	0.0405

H = 5.378 with 6 degrees of freedom. (P = 0.496)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.496)

### II. Comparisons of Mobile Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:51:02 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:51:02 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0525	0.0290	0.0715
Jaycee Park	20	0	0.0545	0.0310	0.0855
Water Treatment Plant	20	0	0.0375	0.0280	0.0560

H = 2.612 with 2 degrees of freedom. (P = 0.271)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.271)

### III. Comparisons of All Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 10:51:17 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 10:51:17 AM

Data source: p+m Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0350	0.0333	0.0890
Mountain Peak	4	0	0.0335	0.0255	0.394
Vitovsky	5	0	0.0510	0.0428	0.0668
Midlothian HS	5	0	0.0320	0.0270	0.0405

H = 4.196 with 3 degrees of freedom. (P = 0.241)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.241)

## F. o-Xylene

### I. Comparisons of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 11:16:18 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 11:16:18 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Jaycee Park	20	0	0.0255	0.0160	0.0340
Water Treatment Plant	20	0	0.0175	0.0135	0.0215
Triangle Park	5	0	0.0150	0.0138	0.0385
Mountain Peak	4	0	0.0155	0.0120	0.103
Vitovsky	5	0	0.0230	0.0198	0.0265
Midlothian HS	5	0	0.0170	0.0118	0.0197

H = 5.657 with 6 degrees of freedom. (P = 0.463)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.463)

### II. Comparisons of Mobile Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 11:16:37 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 11:16:37 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0260	0.0140	0.0345
Jaycee Park	20	0	0.0255	0.0160	0.0340
Water Treatment Plant	20	0	0.0175	0.0135	0.0215

H = 2.700 with 2 degrees of freedom. (P = 0.259)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.259)

### III. Comparisons of All Sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 11:16:52 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 11:16:52 AM

Data source: o Xylene Site in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0150	0.0138	0.0385
Mountain Peak	4	0	0.0155	0.0120	0.103
Vitovsky	5	0	0.0230	0.0198	0.0265
Midlothian HS	5	0	0.0170	0.0118	0.0197

H = 3.154 with 3 degrees of freedom. (P = 0.368)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.368)

*Appendix D – VOC Site Comparisons: Individual Quarters of Data*

## A. 1<sup>st</sup> Quarter VOC Data

### I. Benzene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:01:23 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.138)

Equal Variance Test: Passed (P = 0.307)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.205	0.0319	0.0143
Jaycee Park	5	0	0.189	0.0408	0.0183
Water Treatment Plant	5	0	0.190	0.0404	0.0181
Triangle Park	5	0	0.228	0.0866	0.0387

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00481	0.00160	0.542	0.660
Residual	16	0.0473	0.00295		
Total	19	0.0521			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.660).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### II. 1,3-Butadiene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:02:20 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:02:20 PM

Data source: Data 7 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0120	0.00588	0.0163
Jaycee Park	5	0	0.0110	0.00588	0.0158
Water Treatment Plant	5	0	0.00900	0.00250	0.0170
Triangle Park	5	0	0.0150	0.0103	0.0460

H = 2.227 with 3 degrees of freedom. (P = 0.527)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.527)

### III. Toluene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:03:01 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:03:01 PM

Data source: Data 7 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.136	0.0883	0.166
Jaycee Park	5	0	0.0930	0.0803	0.165
Water Treatment Plant	5	0	0.103	0.0890	0.247

Triangle Park	5	0	0.106	0.101	0.320
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H = 1.567 with 3 degrees of freedom. (P = 0.667)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.667)

#### IV. Ethylbenzene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:03:35 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:03:35 PM

Data source: Data 7 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0220	0.0133	0.0260
Jaycee Park	5	0	0.0160	0.0150	0.0270
Water Treatment Plant	5	0	0.0170	0.0155	0.0360
Triangle Park	5	0	0.0190	0.0158	0.0410

H = 0.856 with 3 degrees of freedom. (P = 0.836)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.836)

#### V. p+m-Xylene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:04:10 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:04:10 PM

Data source: Data 7 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0420	0.0230	0.0508
Jaycee Park	5	0	0.0280	0.0275	0.0530
Water Treatment Plant	5	0	0.0280	0.0133	0.0513
Triangle Park	5	0	0.0350	0.0333	0.0890

H = 2.157 with 3 degrees of freedom. (P = 0.541)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.541)

#### VI. o-Xylene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:05:19 PM

Data source: Data 7 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:05:19 PM

Data source: Data 7 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0180	0.01000	0.0230
Jaycee Park	5	0	0.0140	0.0120	0.0240
Water Treatment Plant	5	0	0.0130	0.0120	0.0292
Triangle Park	5	0	0.0150	0.0138	0.0385

H = 1.366 with 3 degrees of freedom. (P = 0.714)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.714)

## B. 2<sup>nd</sup> Quarter VOC Data

### I. Benzene

#### a. Comparison between sites

##### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 12:06:35 PM

Data source: Data 8 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.357)

Equal Variance Test: Passed (P = 0.967)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.184	0.0182	0.00814
Jaycee Park	5	0	0.158	0.0241	0.0108
Water Treatment Plant	5	0	0.133	0.0194	0.00868
Mountain Peak	5	1	0.135	0.0234	0.0117

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00819	0.00273	6.017	0.007
Residual	15	0.00680	0.000453		
Total	18	0.0150			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.007).

Power of performed test with alpha = 0.050: 0.830

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Collocated vs. Water Treatm	0.0510	4	5.355	0.009	Yes
Collocated vs. Mountain Peak	0.0486	3	4.807	0.011	Yes
Collocated vs. Jaycee Park	0.0254	2	2.667	0.079	No
Jaycee Park vs. Water Treatm	0.0256	3	2.688	0.173	No
Jaycee Park vs. Mountain Peak	0.0232	2	2.292	0.126	Do Not Test
Mountain Pea vs. Water Treatm	0.00245	2	0.243	0.866	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

## II. 1,3-Butadiene

### a. Comparison between sites

##### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 12:07:53 PM

Data source: Data 8 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.826)

Equal Variance Test: Passed (P = 0.796)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.0144	0.00594	0.00266
Jaycee Park	5	0	0.0126	0.00643	0.00287
Water Treatment Plant	5	0	0.00880	0.00383	0.00171
Mountain Peak	5	1	0.00825	0.00512	0.00256

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000125	0.0000415	1.403	0.281

Residual	15	0.000444	0.0000296
Total	18	0.000569	

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.281).

Power of performed test with alpha = 0.050: 0.110

The power of the performed test (0.110) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### III. Toluene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:08:25 PM

Data source: Data 8 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.182)

Equal Variance Test: Passed (P = 0.207)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.172	0.0941	0.0421
Jaycee Park	5	0	0.155	0.0480	0.0215
Water Treatment Plant	5	0	0.102	0.0444	0.0199
Mountain Peak	5	1	0.0902	0.0257	0.0129

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0223	0.00743	2.042	0.151
Residual	15	0.0546	0.00364		
Total	18	0.0768			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.151).

Power of performed test with alpha = 0.050: 0.222

The power of the performed test (0.222) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### IV. Ethylbenzene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:08:57 PM

Data source: Data 8 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 12:08:57 PM

Data source: Data 8 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0280	0.0172	0.0510
Jaycee Park	5	0	0.0370	0.0268	0.0882
Water Treatment Plant	5	0	0.0180	0.0153	0.0377
Mountain Peak	5	1	0.0165	0.0130	0.120

H = 3.397 with 3 degrees of freedom. (P = 0.334)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.334)

### V. p+m-Xylene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 12:09:22 PM

Data source: Data 8 in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, January 11, 2010, 12:09:22 PM

**Data source:** Data 8 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0600	0.0335	0.140
Jaycee Park	5	0	0.0960	0.0582	0.248
Water Treatment Park	5	0	0.0430	0.0308	0.0998
Mountain Peak	5	1	0.0335	0.0255	0.394

H = 3.314 with 3 degrees of freedom. (P = 0.346)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.346)

## VI. o-Xylene

### a. Comparison between sites

**One WayOne-Way Analysis of Variance**

Monday, January 11, 2010, 12:09:52 PM

**Data source:** Data 8 in VOC Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, January 11, 2010, 12:09:52 PM

**Data source:** Data 8 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0260	0.0145	0.0500
Jaycee Park	5	0	0.0320	0.0238	0.0762
Water Treatment Plant	5	0	0.0180	0.0150	0.0338
Mountain Peak	5	1	0.0155	0.0120	0.103

H = 2.321 with 3 degrees of freedom. (P = 0.509)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.509)

## C. 3<sup>rd</sup> Quarter VOC Data

### I. Benzene

#### a. Comparison between sites

**One WayOne-Way Analysis of Variance**

Monday, January 11, 2010, 1:11:45 PM

**Data source:** Data 9 in VOC Site Comparison.JNB

**Normality Test:** Passed (P = 0.427)

**Equal Variance Test:** Passed (P = 0.538)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.287	0.0660	0.0295
Jaycee Park	5	0	0.302	0.107	0.0480
Water Treatment Plant	5	0	0.259	0.0677	0.0303
Vitovsky	5	0	0.227	0.0565	0.0253

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0163	0.00543	0.917	0.455
Residual	16	0.0947	0.00592		
Total	19	0.111			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.455).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## II. 1,3-Butadiene

### a. Comparison between sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:12:15 PM

Data source: Data 9 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.061)

Equal Variance Test: Passed (P = 0.118)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.00990	0.00613	0.00274
Jaycee Park	5	0	0.0142	0.00217	0.000970
Water Treatment Plant	5	0	0.0124	0.00270	0.00121
Vitovsky	5	0	0.0110	0.001000	0.000447

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000517	0.0000172	1.365	0.289
Residual	16	0.000202	0.0000126		
Total	19	0.000254			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.289).

Power of performed test with alpha = 0.050: 0.104

The power of the performed test (0.104) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## III. Toluene

### a. Comparison between sites

#### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:12:40 PM

Data source: Data 9 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 1:12:40 PM

Data source: Data 9 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.183	0.123	0.270
Jaycee Park	5	0	0.142	0.115	0.171
Water Treatment Plant	5	0	0.112	0.101	0.168
Vitovsky	5	0	0.150	0.139	0.199

H = 2.879 with 3 degrees of freedom. (P = 0.411)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.411)

#### IV. Ethylbenzene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:13:12 PM

Data source: Data 9 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 1:13:12 PM

Data source: Data 9 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0320	0.0213	0.0488
Jaycee Park	5	0	0.0280	0.0243	0.0407
Water Treatment Plant	5	0	0.0230	0.0187	0.0313
Vitovsky	5	0	0.0230	0.0208	0.0288

H = 2.716 with 3 degrees of freedom. (P = 0.438)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.438)

#### V. p+m-Xylene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:13:39 PM

Data source: Data 9 in VOC Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, January 11, 2010, 1:13:39 PM

Data source: Data 9 in VOC Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0650	0.0483	0.121
Jaycee Park	5	0	0.0650	0.0528	0.104
Water Treatment Plant	5	0	0.0460	0.0360	0.0603
Vitovsky	5	0	0.0510	0.0428	0.0668

H = 3.156 with 3 degrees of freedom. (P = 0.368)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.368)

#### VI. o-Xylene

##### a. Comparison between sites

###### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:14:00 PM

Data source: Data 9 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.268)

Equal Variance Test: Passed (P = 0.360)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.0336	0.0141	0.00631
Jaycee Park	5	0	0.0340	0.0116	0.00521
Water Treatment Plant	5	0	0.0226	0.00871	0.00389
Vitovsky	5	0	0.0240	0.00596	0.00266

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000557	0.000186	1.665	0.214
Residual	16	0.00178	0.000111		
Total	19	0.00234			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.214).

Power of performed test with alpha = 0.050: 0.156

The power of the performed test (0.156) is below the desired power of 0.800. Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### D. 4<sup>th</sup> Quarter VOC Data

##### I. Benzene

###### a. Comparison between sites

###### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 1:14:29 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.704)

Equal Variance Test: Passed (P = 0.502)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.171	0.0340	0.0152
Jaycee Park	5	0	0.138	0.0252	0.0113
Water Treatment Plant	5	0	0.178	0.0435	0.0195
Midlothian HS	5	0	0.115	0.0198	0.00887

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0127	0.00423	4.150	0.024
Residual	16	0.0163	0.00102		
Total	19	0.0290			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.024).

Power of performed test with alpha = 0.050: 0.615

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Water Treatm vs. Midlothian H	0.0626	4	4.384	0.032	Yes
Water Treatm vs. Jaycee Park	0.0396	3	2.773	0.154	No
Water Treatm vs. Collocated	0.00740	2	0.518	0.719	Do Not Test
Collocated vs. Midlothian HS	0.0552	3	3.866	0.037	Yes
Collocated vs. Jaycee Park	0.0322	2	2.255	0.131	Do Not Test
Jaycee Park vs. Midlothian HS	0.0230	2	1.611	0.272	No

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

##### II. 1,3-Butadiene

###### a. Comparison between sites

###### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 1:15:16 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.383)

Equal Variance Test: Passed (P = 0.601)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.00890	0.00518	0.00232
Jaycee Park	5	0	0.00760	0.00270	0.00121
Water Treatment Plant	5	0	0.00780	0.00303	0.00136
Midlothian HS	5	0	0.00700	0.00255	0.00114

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000944	0.00000315	0.253	0.858

Residual	16	0.000199	0.0000124
Total	19	0.000209	

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.858).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### III. Toluene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:15:38 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.169)

Equal Variance Test: Passed (P = 0.441)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.139	0.0641	0.0286
Jaycee Park	5	0	0.119	0.0534	0.0239
Water Treatment Plant	5	0	0.138	0.0495	0.0221
Midlothian HS	5	0	0.118	0.0388	0.0173

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00207	0.000690	0.253	0.858
Residual	16	0.0436	0.00273		
Total	19	0.0457			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.858).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### IV. Ethylbenzene

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Monday, January 11, 2010, 1:15:58 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.808)

Equal Variance Test: Passed (P = 0.590)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.0234	0.0104	0.00465
Jaycee Park	5	0	0.0184	0.00709	0.00317
Water Treatment Plant	5	0	0.0184	0.00581	0.00260
Midlothian HS	5	0	0.0166	0.00602	0.00269

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000128	0.0000428	0.749	0.539
Residual	16	0.000915	0.0000572		
Total	19	0.00104			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.539).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## V. *p+m*-Xylene

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 1:16:19 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.619)

Equal Variance Test: Passed (P = 0.142)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.0454	0.0291	0.0130
Jaycee Park	5	0	0.0408	0.0197	0.00879
Water Treatment Plant	5	0	0.0368	0.0212	0.00948
Midlothian HS	5	0	0.0352	0.0129	0.00576

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000311	0.000104	0.225	0.878
Residual	16	0.00738	0.000461		
Total	19	0.00769			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.878).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## VI. *o*-Xylene

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Monday, January 11, 2010, 1:16:44 PM

Data source: Data 10 in VOC Site Comparison.JNB

Normality Test: Passed (P = 0.961)

Equal Variance Test: Passed (P = 0.061)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	5	0	0.0270	0.0144	0.00644
Jaycee Park	5	0	0.0222	0.0112	0.00499
Water Treatment Plant	5	0	0.0168	0.00455	0.00203
Midlothian HS	5	0	0.0166	0.00559	0.00250

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000370	0.000123	1.283	0.314
Residual	16	0.00154	0.0000961		
Total	19	0.00191			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.314).

Power of performed test with alpha = 0.050: 0.091

The power of the performed test (0.091) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## *Appendix E – VOCs Seasonal Variation Comparisons*

## I. Collocated

### a. Benzene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:16:43 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.052)

Equal Variance Test: Passed (P = 0.462)

Group Name	N	Missing	Mean	Std Dev	SEM
Benzene-1st Quarter	5	0	0.205	0.0319	0.0143
2nd Quarter	5	0	0.184	0.0182	0.00814
3rd Quarter	5	0	0.287	0.0660	0.0295
4th Quarter	5	0	0.171	0.0340	0.0152

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0409	0.0136	7.957	0.002
Residual	16	0.0274	0.00171		
Total	19	0.0684			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.002).

Power of performed test with alpha = 0.050: 0.944

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
3rd Quarter vs. 4th Quarter	0.116	4	6.285	0.002	Yes
3rd Quarter vs. 2nd Quarter	0.103	3	5.572	0.003	Yes
3rd Quarter vs. Benzene-1st	0.0824	2	4.449	0.006	Yes
Benzene-1st vs. 4th Quarter	0.0340	3	1.836	0.417	No
Benzene-1st vs. 2nd Quarter	0.0208	2	1.123	0.439	Do Not Test
2nd Quarter vs. 4th Quarter	0.0132	2	0.713	0.621	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

### b. 1,3-Butadiene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:33:24 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.260)

Equal Variance Test: Passed (P = 0.826)

Group Name	N	Missing	Mean	Std Dev	SEM
BD-1st Q	5	0	0.0113	0.00682	0.00305
2nd Q	5	0	0.0144	0.00594	0.00266
3rd Q	5	0	0.00990	0.00613	0.00274
4th Q	5	0	0.00890	0.00518	0.00232

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000860	0.0000287	0.785	0.520
Residual	16	0.000584	0.0000365		
Total	19	0.000670			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.520).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### c. Toluene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:34:04 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.464)

Equal Variance Test: Passed (P = 0.531)

Group Name	N	Missing	Mean	Std Dev	SEM
Toluene-1st Q	5	0	0.129	0.0472	0.0211
2nd Q	5	0	0.172	0.0941	0.0421
3rd Q	5	0	0.198	0.109	0.0488
4th Q	5	0	0.139	0.0641	0.0286

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0148	0.00493	0.727	0.551
Residual	16	0.108	0.00678		
Total	19	0.123			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.551).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### d. Ethylbenzene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:34:43 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:34:43 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
EB-1st Q	5	0	0.0220	0.0133	0.0260
2nd Q	5	0	0.0280	0.0172	0.0510
3rd Q	5	0	0.0320	0.0213	0.0488
4th Q	5	0	0.0240	0.0165	0.0302

H = 2.389 with 3 degrees of freedom. (P = 0.496)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.496)

### e. m+p-Xylene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:35:11 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:35:11 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
mpX-1st Q	5	0	0.0420	0.0230	0.0508
2nd Q	5	0	0.0600	0.0335	0.140
3rd Q	5	0	0.0650	0.0483	0.121
4th Q	5	0	0.0470	0.0187	0.0703

H = 3.423 with 3 degrees of freedom. (P = 0.331)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.331)

#### f. o-Xylene

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:35:58 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:35:58 AM

Data source: Collocated-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
oX-1st Q	5	0	0.0180	0.01000	0.0230
2nd Q	5	0	0.0260	0.0145	0.0500
3rd Q	5	0	0.0330	0.0257	0.0435
4th Q	5	0	0.0280	0.0150	0.0382

H = 3.989 with 3 degrees of freedom. (P = 0.263)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.263)

## II. Jaycee Park

### a. Benzene

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:39:15 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.059)

Equal Variance Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:39:15 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Benzene-1st Quarter	5	0	0.194	0.149	0.224
2nd Quarter	5	0	0.158	0.145	0.170
3rd Quarter	5	0	0.322	0.202	0.359
4th Quarter	5	0	0.132	0.119	0.163

H = 11.091 with 3 degrees of freedom. (P = 0.011)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.011)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
3rd Quarter vs 4th Quarter	58.500	4.422	Yes
3rd Quarter vs 2nd Quarter	46.500	3.515	No
3rd Quarter vs Benzene-1st Q	29.000	2.192	Do Not Test
Benzene-1st Q vs 4th Quarter	29.500	2.230	No
Benzene-1st Q vs 2nd Quarter	17.500	1.323	Do Not Test
2nd Quarter vs 4th Quarter	12.000	0.907	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule,

and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### b. 1,3-Butadiene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:40:06 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:40:06 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
BD-1st Q	5	0	0.0110	0.00588	0.0158
2nd Q	5	0	0.0120	0.00825	0.0155
3rd Q	5	0	0.0130	0.0128	0.0163
4th Q	5	0	0.00700	0.00575	0.00900

H = 6.802 with 3 degrees of freedom. (P = 0.078)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.078)

### c. Toluene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:40:37 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.109)

Equal Variance Test: Passed (P = 0.848)

Group Name	N	Missing	Mean	Std Dev	SEM
Toluene-1st Q	5	0	0.125	0.0662	0.0296
2nd Q	5	0	0.155	0.0480	0.0215
3rd Q	5	0	0.145	0.0327	0.0146
4th Q	5	0	0.119	0.0534	0.0239

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00426	0.00142	0.535	0.665
Residual	16	0.0424	0.00265		
Total	19	0.0467			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.665).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### d. Ethylbenzene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:41:07 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.246)

Equal Variance Test: Passed (P = 0.067)

Group Name	N	Missing	Mean	Std Dev	SEM
EB-1st Q	5	0	0.0212	0.00909	0.00407
2nd Q	5	0	0.0526	0.0333	0.0149
3rd Q	5	0	0.0332	0.0133	0.00593
4th Q	5	0	0.0184	0.00709	0.00317

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00363	0.00121	3.409	0.043

Residual 16 0.00568 0.000355  
 Total 19 0.00930

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.043).

Power of performed test with alpha = 0.050: 0.489

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
2nd Q vs. 4th Q	0.0342	4	4.060	0.049	Yes
2nd Q vs. EB-1st Q	0.0314	3	3.728	0.045	Yes
2nd Q vs. 3rd Q	0.0194	2	2.303	0.123	No
3rd Q vs. 4th Q	0.0148	3	1.757	0.447	No
3rd Q vs. EB-1st Q	0.0120	2	1.425	0.329	Do Not Test
EB-1st Q vs. 4th Q	0.00280	2	0.332	0.817	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

### e. m+p-Xylene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:42:14 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.162)

Equal Variance Test: Passed (P = 0.070)

Group Name	N	Missing	Mean	Std Dev	SEM
mpX-1st Q	5	0	0.0416	0.0241	0.0108
2nd Q	5	0	0.141	0.101	0.0451
3rd Q	5	0	0.0810	0.0421	0.0188
4th Q	5	0	0.0408	0.0197	0.00879

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0332	0.0111	3.431	0.042
Residual	16	0.0517	0.00323		
Total	19	0.0849			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.042).

Power of performed test with alpha = 0.050: 0.493

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
2nd Q vs. 4th Q	0.1000	4	3.935	0.058	No
2nd Q vs. mpX-1st Q	0.0992	3	3.904	0.035	Do Not Test
2nd Q vs. 3rd Q	0.0598	2	2.353	0.116	Do Not Test
3rd Q vs. 4th Q	0.0402	3	1.582	0.517	Do Not Test
3rd Q vs. mpX-1st Q	0.0394	2	1.551	0.289	Do Not Test
mpX-1st Q vs. 4th Q	0.000800	2	0.0315	0.983	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not

Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

### f. o-Xylene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:42:44 AM

Data source: Jaycee Park-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.523)

Equal Variance Test: Passed (P = 0.109)

Group Name	N	Missing	Mean	Std Dev	SEM
oX-1st Q	5	0	0.0184	0.00896	0.00401
2nd Q	5	0	0.0460	0.0293	0.0131
3rd Q	5	0	0.0340	0.0116	0.00521
4th Q	5	0	0.0222	0.0112	0.00499

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00234	0.000779	2.598	0.088
Residual	16	0.00480	0.000300		
Total	19	0.00713			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.088).

Power of performed test with alpha = 0.050: 0.333

The power of the performed test (0.333) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### III. Water Treatment Plant

#### a. Benzene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:43:59 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.547)

Equal Variance Test: Passed (P = 0.179)

Group Name	N	Missing	Mean	Std Dev	SEM
Benzene-1st Quarter	5	0	0.190	0.0404	0.0181
2nd Quarter	5	0	0.133	0.0194	0.00868
3rd Quarter	5	0	0.259	0.0677	0.0303
4th Quarter	5	0	0.178	0.0435	0.0195

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0409	0.0136	6.426	0.005
Residual	16	0.0339	0.00212		
Total	19	0.0748			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.005).

Power of performed test with alpha = 0.050: 0.868

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
3rd Quarter vs. 2nd Quarter	0.126	4	6.128	0.003	Yes
3rd Quarter vs. 4th Quarter	0.0810	3	3.933	0.034	Yes
3rd Quarter vs. Benzene-1st	0.0686	2	3.331	0.032	Yes
Benzene-1st vs. 2nd Quarter	0.0576	3	2.797	0.150	No
Benzene-1st vs. 4th Quarter	0.0124	2	0.602	0.676	Do Not Test
4th Quarter vs. 2nd Quarter	0.0452	2	2.195	0.140	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

### b. 1,3-Butadiene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:44:27 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.053)

Equal Variance Test: Passed (P = 0.161)

Group Name	N	Missing	Mean	Std Dev	SEM
BD-1st Q	5	0	0.0104	0.00876	0.00392
2nd Q	5	0	0.00880	0.00383	0.00171
3rd Q	5	0	0.0124	0.00270	0.00121
4th Q	5	0	0.00780	0.00303	0.00136

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000606	0.0000202	0.748	0.539
Residual	16	0.000431	0.0000270		
Total	19	0.000492			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.539).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### c. Toluene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:45:01 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:45:01 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Toluene-1st Q	5	0	0.103	0.0890	0.247
2nd Q	5	0	0.0850	0.0772	0.122
3rd Q	5	0	0.112	0.101	0.168
4th Q	5	0	0.131	0.105	0.165

H = 2.200 with 3 degrees of freedom. (P = 0.532)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.532)

### d. Ethylbenzene

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:45:32 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:45:32 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
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EB-1st Q	5	0	0.0170	0.0155	0.0360
2nd Q	5	0	0.0180	0.0153	0.0377
3rd Q	5	0	0.0230	0.0187	0.0313
4th Q	5	0	0.0170	0.0142	0.0225

H = 1.795 with 3 degrees of freedom. (P = 0.616)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.616)

#### e. m+p-Xylene

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:46:01 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:46:01 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
mpX-1st Q	5	0	0.0280	0.0133	0.0513
2nd Q	5	0	0.0430	0.0308	0.0998
3rd Q	5	0	0.0460	0.0360	0.0603
4th Q	5	0	0.0380	0.0225	0.0540

H = 2.725 with 3 degrees of freedom. (P = 0.436)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.436)

#### f. o-Xylene

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:46:37 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:46:37 AM

Data source: Water Treatment Plant-VOC in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
oX-1st Q	5	0	0.0130	0.0120	0.0292
2nd Q	5	0	0.0180	0.0150	0.0338
3rd Q	5	0	0.0200	0.0177	0.0245
4th Q	5	0	0.0170	0.0135	0.0188

H = 1.842 with 3 degrees of freedom. (P = 0.606)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.606)

*Appendix F – TCEQ CAMS 302 PM<sub>10</sub> Metals Historical Comparisons*

## A. Comparisons to Historical PM<sub>10</sub> Concentrations at CAMS 302

### I. Aluminum

#### a. Comparison between collocated and historical

##### t-test

Tuesday, January 19, 2010, 4:02:05 PM

**Data source:** Data 1 in Wyatt Rd Metals Comp.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Tuesday, January 19, 2010, 4:02:05 PM

**Data source:** Data 1 in Wyatt Rd Metals Comp.JNB

Group	N	Missing	Median	25%	75%
TCEQ	196	0	0.137	0.0845	0.226
All Quarters	20	0	0.133	0.0851	0.162

Mann-Whitney U Statistic= 1664.500

T = 1874.500 n(small)= 20 n(big)= 196 (P = 0.268)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.268)

### II. Chromium

#### a. Comparison between collocated and historical

##### t-test

Tuesday, January 19, 2010, 4:02:28 PM

**Data source:** Copy of Data 1 in Wyatt Rd Metals Comp.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Tuesday, January 19, 2010, 4:02:28 PM

**Data source:** Copy of Data 1 in Wyatt Rd Metals Comp.JNB

Group	N	Missing	Median	25%	75%
TCEQ	196	0	0.00400	0.00300	0.00700
All Quarters	20	0	0.00243	0.00218	0.00344

Mann-Whitney U Statistic= 1170.000

T = 1380.000 n(small)= 20 n(big)= 196 (P = 0.003)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.003)

### III. Manganese

#### a. Comparison between collocated and historical

##### t-test

Tuesday, January 19, 2010, 4:02:56 PM

**Data source:** Copy (2) of Data 1 in Wyatt Rd Metals Comp.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

##### Mann-Whitney Rank Sum Test

Tuesday, January 19, 2010, 4:02:56 PM

**Data source:** Copy (2) of Data 1 in Wyatt Rd Metals Comp.JNB

Group	N	Missing	Median	25%	75%
TCEQ	196	0	0.0300	0.0170	0.0575
All Quarters	20	0	0.0137	0.00766	0.0306

Mann-Whitney U Statistic= 929.500

T = 1139.500 n(small)= 20 n(big)= 196 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

### IV. Lead

#### a. Comparison between collocated and historical

##### t-test

Tuesday, January 19, 2010, 4:03:19 PM

**Data source:** Copy (3) of Data 1 in Wyatt Rd Metals Comp.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Tuesday, January 19, 2010, 4:03:19 PM

**Data source:** Copy (3) of Data 1 in Wyatt Rd Metals Comp.JNB

Group	N	Missing	Median	25%	75%
TCEQ	196	0	0.01000	0.01000	0.01000
All Quarters	20	0	0.00302	0.00221	0.00469

Mann-Whitney U Statistic= 180.000

T = 390.000 n(small)= 20 n(big)= 196 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

## V. Nickel

### a. Comparison between collocated and historical

**t-test**

Tuesday, January 19, 2010, 4:03:39 PM

**Data source:** Copy (4) of Data 1 in Wyatt Rd Metals Comp.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Tuesday, January 19, 2010, 4:03:39 PM

**Data source:** Copy (4) of Data 1 in Wyatt Rd Metals Comp.JNB

Group	N	Missing	Median	25%	75%
TCEQ	196	0	0.00400	0.00400	0.00400
All Quarters	20	0	0.00105	0.000639	0.00140

Mann-Whitney U Statistic= 0.000

T = 210.000 n(small)= 20 n(big)= 196 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

## B. Comparisons of Average Concentrations to Historical Average Concentrations

### I. Each site average

#### a. Comparison of Aluminum Site Averages

**One WayOne-Way Analysis of Variance**

Tuesday, April 20, 2010, 12:16:09 PM

**Data source:** Data 2 in Wyatt Rd Metals Comp.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	196	0	0.195	0.202	0.0145
Row 2	20	0	0.127	0.0504	0.0113
Row 3	20	0	0.270	0.172	0.0384
Row 4	20	0	0.0877	0.0496	0.0111
Row 5	20	0	0.117	0.0505	0.0113
Row 6	5	0	0.0570	0.0203	0.00910
Row 7	5	0	0.0837	0.0408	0.0183
Row 8	5	0	0.0925	0.0278	0.0125
Row 9	5	0	0.0798	0.0573	0.0256

Source of Variation	DF	SS	MS	F	P
Between Groups	8	0.714	0.0893	2.942	0.004
Residual	287	8.712	0.0304		
Total	295	9.426			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.004).

Power of performed test with alpha = 0.050: 0.806

All PairwiseAll-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Row 3 vs. Row 6	0.213	9	3.453	0.261	No
Row 3 vs. Row 9	0.190	8	3.083	0.364	Do Not Test
Row 3 vs. Row 7	0.186	7	3.019	0.332	Do Not Test
Row 3 vs. Row 4	0.182	6	4.671	0.012	Do Not Test
Row 3 vs. Row 8	0.177	5	2.876	0.250	Do Not Test
Row 3 vs. Row 5	0.153	4	3.927	0.028	Do Not Test
Row 3 vs. Row 2	0.143	3	3.670	0.026	Do Not Test
Row 3 vs. Row 1	0.0748	2	2.587	0.067	Do Not Test
Row 1 vs. Row 6	0.138	8	2.472	0.656	Do Not Test
Row 1 vs. Row 9	0.115	7	2.063	0.769	Do Not Test
Row 1 vs. Row 7	0.111	6	1.992	0.722	Do Not Test
Row 1 vs. Row 4	0.107	5	3.705	0.067	Do Not Test
Row 1 vs. Row 8	0.102	4	1.834	0.565	Do Not Test
Row 1 vs. Row 5	0.0782	3	2.703	0.135	Do Not Test
Row 1 vs. Row 2	0.0682	2	2.357	0.096	Do Not Test
Row 2 vs. Row 6	0.0697	7	1.132	0.985	Do Not Test
Row 2 vs. Row 9	0.0469	6	0.762	0.995	Do Not Test
Row 2 vs. Row 7	0.0430	5	0.698	0.988	Do Not Test
Row 2 vs. Row 4	0.0390	4	1.001	0.894	Do Not Test
Row 2 vs. Row 8	0.0342	3	0.555	0.919	Do Not Test
Row 2 vs. Row 5	0.0100	2	0.257	0.856	Do Not Test
Row 5 vs. Row 6	0.0597	6	0.970	0.984	Do Not Test
Row 5 vs. Row 9	0.0369	5	0.599	0.993	Do Not Test
Row 5 vs. Row 7	0.0330	4	0.535	0.982	Do Not Test
Row 5 vs. Row 4	0.0290	3	0.744	0.859	Do Not Test
Row 5 vs. Row 8	0.0242	2	0.392	0.781	Do Not Test
Row 8 vs. Row 6	0.0356	5	0.456	0.998	Do Not Test
Row 8 vs. Row 9	0.0127	4	0.164	0.999	Do Not Test
Row 8 vs. Row 7	0.00880	3	0.113	0.996	Do Not Test
Row 8 vs. Row 4	0.00481	2	0.0780	0.956	Do Not Test
Row 4 vs. Row 6	0.0308	4	0.499	0.985	Do Not Test
Row 4 vs. Row 9	0.00793	3	0.129	0.995	Do Not Test
Row 4 vs. Row 7	0.00399	2	0.0649	0.963	Do Not Test
Row 7 vs. Row 6	0.0268	3	0.343	0.968	Do Not Test
Row 7 vs. Row 9	0.00394	2	0.0506	0.971	Do Not Test
Row 9 vs. Row 6	0.0228	2	0.293	0.836	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

#### b. Comparison of Chromium site averages

##### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 12:22:16 PM

Data source: Data 2 in Wyatt Rd Metals Comp.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	196	0	0.00539	0.00418	0.000299
Row 2	20	0	0.00281	0.000849	0.000190

Row 3	20	0	0.00520	0.00290	0.000649
Row 4	20	0	0.00209	0.000498	0.000111
Row 5	20	0	0.00204	0.000276	0.0000616
Row 6	5	0	0.00157	0.000263	0.000118
Row 7	5	0	0.00184	0.000232	0.000104
Row 8	5	0	0.00264	0.000353	0.000158
Row 9	5	0	0.00200	0.0000886	0.0000396

Source of Variation	DF	SS	MS	F	P
Between Groups	8	0.000585	0.0000731	5.845	<0.001
Residual	287	0.00359	0.0000125		
Total	295	0.00417			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.999

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Row 1 vs. Row 6	0.00382	9	3.375	0.291	No
Row 1 vs. Row 7	0.00355	8	3.133	0.342	Do Not Test
Row 1 vs. Row 9	0.00339	7	2.991	0.343	Do Not Test
Row 1 vs. Row 5	0.00335	6	5.703	<0.001	Do Not Test
Row 1 vs. Row 4	0.00330	5	5.615	<0.001	Do Not Test
Row 1 vs. Row 8	0.00275	4	2.426	0.315	Do Not Test
Row 1 vs. Row 2	0.00257	3	4.383	0.006	Do Not Test
Row 1 vs. Row 3	0.000190	2	0.324	0.819	Do Not Test
Row 3 vs. Row 6	0.00363	8	2.904	0.445	Do Not Test
Row 3 vs. Row 7	0.00336	7	2.685	0.481	Do Not Test
Row 3 vs. Row 9	0.00320	6	2.557	0.460	Do Not Test
Row 3 vs. Row 5	0.00316	5	3.993	0.038	Do Not Test
Row 3 vs. Row 4	0.00311	4	3.928	0.028	Do Not Test
Row 3 vs. Row 8	0.00256	3	2.045	0.317	Do Not Test
Row 3 vs. Row 2	0.00238	2	3.013	0.033	Do Not Test
Row 2 vs. Row 6	0.00125	7	0.999	0.992	Do Not Test
Row 2 vs. Row 7	0.000975	6	0.780	0.994	Do Not Test
Row 2 vs. Row 9	0.000815	5	0.652	0.991	Do Not Test
Row 2 vs. Row 5	0.000775	4	0.980	0.900	Do Not Test
Row 2 vs. Row 4	0.000723	3	0.915	0.794	Do Not Test
Row 2 vs. Row 8	0.000175	2	0.140	0.921	Do Not Test
Row 8 vs. Row 6	0.00107	6	0.679	0.997	Do Not Test
Row 8 vs. Row 7	0.000800	5	0.506	0.997	Do Not Test
Row 8 vs. Row 9	0.000640	4	0.405	0.992	Do Not Test
Row 8 vs. Row 5	0.000600	3	0.480	0.939	Do Not Test
Row 8 vs. Row 4	0.000548	2	0.439	0.756	Do Not Test
Row 4 vs. Row 6	0.000526	5	0.420	0.998	Do Not Test
Row 4 vs. Row 7	0.000251	4	0.201	0.999	Do Not Test
Row 4 vs. Row 9	0.0000915	3	0.0732	0.999	Do Not Test
Row 4 vs. Row 5	0.0000515	2	0.0651	0.963	Do Not Test
Row 5 vs. Row 6	0.000474	4	0.379	0.993	Do Not Test
Row 5 vs. Row 7	0.000200	3	0.160	0.993	Do Not Test
Row 5 vs. Row 9	0.0000400	2	0.0320	0.982	Do Not Test
Row 9 vs. Row 6	0.000434	3	0.274	0.979	Do Not Test
Row 9 vs. Row 7	0.000160	2	0.101	0.943	Do Not Test

Row 7 vs. Row 6      0.000274      2      0.173      0.903      Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). **Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.**

**c. Comparison of Manganese site averages**

**One Way One-Way Analysis of Variance**

Tuesday, April 20, 2010, 12:22:38 PM

Data source: Data 2 in Wyatt Rd Metals Comp.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	196	0	0.0427	0.0361	0.00258
Row 2	20	0	0.0171	0.0120	0.00268
Row 3	20	0	0.0628	0.0513	0.0115
Row 4	20	0	0.00906	0.00679	0.00152
Row 5	20	0	0.0115	0.00731	0.00163
Row 6	5	0	0.00694	0.00473	0.00212
Row 7	5	0	0.00936	0.00570	0.00255
Row 8	5	0	0.00900	0.00410	0.00184
Row 9	5	0	0.00486	0.00150	0.000672

Source of Variation	DF	SS	MS	F	P
Between Groups	8	0.0729	0.00912	8.468	<0.001
Residual	287	0.309	0.00108		
Total	295	0.382			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Row 3 vs. Row 9	0.0579	9	4.992	0.012	Yes
Row 3 vs. Row 6	0.0558	8	4.812	0.015	Yes
Row 3 vs. Row 8	0.0538	7	4.635	0.018	Yes
Row 3 vs. Row 4	0.0537	6	7.320	<0.001	Yes
Row 3 vs. Row 7	0.0534	5	4.604	0.010	Yes
Row 3 vs. Row 5	0.0513	4	6.995	<0.001	Yes
Row 3 vs. Row 2	0.0457	3	6.229	<0.001	Yes
Row 3 vs. Row 1	0.0201	2	3.694	0.009	Yes
Row 1 vs. Row 9	0.0378	8	3.596	0.178	No
Row 1 vs. Row 6	0.0357	7	3.398	0.197	Do Not Test
Row 1 vs. Row 8	0.0337	6	3.202	0.209	Do Not Test
Row 1 vs. Row 4	0.0336	5	6.167	<0.001	Do Not Test
Row 1 vs. Row 7	0.0333	4	3.169	0.112	Do Not Test
Row 1 vs. Row 5	0.0312	3	5.729	<0.001	Do Not Test
Row 1 vs. Row 2	0.0256	2	4.698	<0.001	Do Not Test
Row 2 vs. Row 9	0.0122	7	1.052	0.990	Do Not Test
Row 2 vs. Row 6	0.0101	6	0.872	0.990	Do Not Test
Row 2 vs. Row 8	0.00806	5	0.695	0.988	Do Not Test
Row 2 vs. Row 4	0.00800	4	1.091	0.867	Do Not Test
Row 2 vs. Row 7	0.00771	3	0.665	0.885	Do Not Test
Row 2 vs. Row 5	0.00561	2	0.765	0.588	Do Not Test

Row 5 vs. Row 9	0.00659	6	0.568	0.999	Do Not Test
Row 5 vs. Row 6	0.00451	5	0.388	0.999	Do Not Test
Row 5 vs. Row 8	0.00245	4	0.211	0.999	Do Not Test
Row 5 vs. Row 4	0.00239	3	0.326	0.971	Do Not Test
Row 5 vs. Row 7	0.00209	2	0.181	0.898	Do Not Test
Row 7 vs. Row 9	0.00449	5	0.306	1.000	Do Not Test
Row 7 vs. Row 6	0.00241	4	0.164	0.999	Do Not Test
Row 7 vs. Row 8	0.000354	3	0.0241	1.000	Do Not Test
Row 7 vs. Row 4	0.000295	2	0.0254	0.986	Do Not Test
Row 4 vs. Row 9	0.00420	4	0.362	0.994	Do Not Test
Row 4 vs. Row 6	0.00212	3	0.182	0.991	Do Not Test
Row 4 vs. Row 8	0.0000590	2	0.00509	0.997	Do Not Test
Row 8 vs. Row 9	0.00414	3	0.282	0.978	Do Not Test
Row 8 vs. Row 6	0.00206	2	0.140	0.921	Do Not Test
Row 6 vs. Row 9	0.00208	2	0.142	0.920	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

#### d. Comparison of Lead site averages

##### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 12:23:06 PM

Data source: Data 2 in Wyatt Rd Metals Comp.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	196	0	0.0159	0.0145	0.00104
Row 2	20	0	0.00380	0.00259	0.000580
Row 3	20	0	0.0145	0.0167	0.00373
Row 4	20	0	0.00257	0.00159	0.000356
Row 5	20	0	0.00363	0.00293	0.000654
Row 6	5	0	0.00267	0.00190	0.000851
Row 7	5	0	0.00189	0.000529	0.000236
Row 8	5	0	0.00181	0.000370	0.000166
Row 9	5	0	0.00278	0.000540	0.000241

Source of Variation	DF	SS	MS	F	P
Between Groups	8	0.00952	0.00119	7.313	<0.001
Residual	287	0.0467	0.000163		
Total	295	0.0562			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Row 1 vs. Row 8	0.0141	9	3.454	0.261	No
Row 1 vs. Row 7	0.0140	8	3.436	0.227	Do Not Test
Row 1 vs. Row 4	0.0133	7	6.304	<0.001	Do Not Test
Row 1 vs. Row 6	0.0132	6	3.243	0.197	Do Not Test
Row 1 vs. Row 9	0.0131	5	3.218	0.153	Do Not Test
Row 1 vs. Row 5	0.0123	4	5.806	<0.001	Do Not Test
Row 1 vs. Row 2	0.0121	3	5.724	<0.001	Do Not Test

Row 1 vs. Row 3	0.00137	2	0.649	0.646	Do Not Test
Row 3 vs. Row 8	0.0127	8	2.824	0.484	Do Not Test
Row 3 vs. Row 7	0.0127	7	2.807	0.424	Do Not Test
Row 3 vs. Row 4	0.0120	6	4.198	0.035	Do Not Test
Row 3 vs. Row 6	0.0119	5	2.633	0.338	Do Not Test
Row 3 vs. Row 9	0.0118	4	2.610	0.252	Do Not Test
Row 3 vs. Row 5	0.0109	3	3.828	0.019	Do Not Test
Row 3 vs. Row 2	0.0107	2	3.767	0.008	Do Not Test
Row 2 vs. Row 8	0.00199	7	0.441	1.000	Do Not Test
Row 2 vs. Row 7	0.00192	6	0.425	1.000	Do Not Test
Row 2 vs. Row 4	0.00123	5	0.430	0.998	Do Not Test
Row 2 vs. Row 6	0.00113	4	0.250	0.998	Do Not Test
Row 2 vs. Row 9	0.00103	3	0.227	0.986	Do Not Test
Row 2 vs. Row 5	0.000172	2	0.0602	0.966	Do Not Test
Row 5 vs. Row 8	0.00182	6	0.403	1.000	Do Not Test
Row 5 vs. Row 7	0.00174	5	0.387	0.999	Do Not Test
Row 5 vs. Row 4	0.00106	4	0.370	0.994	Do Not Test
Row 5 vs. Row 6	0.000956	3	0.212	0.988	Do Not Test
Row 5 vs. Row 9	0.000854	2	0.189	0.894	Do Not Test
Row 9 vs. Row 8	0.000964	5	0.169	1.000	Do Not Test
Row 9 vs. Row 7	0.000890	4	0.156	1.000	Do Not Test
Row 9 vs. Row 4	0.000202	3	0.0449	0.999	Do Not Test
Row 9 vs. Row 6	0.000102	2	0.0179	0.990	Do Not Test
Row 6 vs. Row 8	0.000862	4	0.151	1.000	Do Not Test
Row 6 vs. Row 7	0.000788	3	0.138	0.995	Do Not Test
Row 6 vs. Row 4	0.000101	2	0.0223	0.987	Do Not Test
Row 4 vs. Row 8	0.000761	3	0.169	0.992	Do Not Test
Row 4 vs. Row 7	0.000687	2	0.152	0.914	Do Not Test
Row 7 vs. Row 8	0.0000740	2	0.0130	0.993	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

#### e. Comparison of Nickel site averages

##### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 12:23:32 PM

Data source: Data 2 in Wyatt Rd Metals Comp.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1	196	0	0.00402	0.00110	0.0000789
Row 2	20	0	0.00103	0.000406	0.0000907
Row 3	20	0	0.00218	0.00125	0.000279
Row 4	20	0	0.00101	0.000499	0.000112
Row 5	20	0	0.00155	0.00195	0.000437
Row 6	5	0	0.000764	0.000189	0.0000845
Row 7	5	0	0.000837	0.000240	0.000107
Row 8	5	0	0.00115	0.000306	0.000137
Row 9	5	0	0.000615	0.000160	0.0000715
Source of Variation	DF	SS	MS	F	P
Between Groups	8	0.000507	0.0000634	52.225	<0.001
Residual	287	0.000349	0.00000121		

Total 295 0.000856

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Row 1 vs. Row 9	0.00341	9	9.649	<0.001	Yes
Row 1 vs. Row 6	0.00326	8	9.227	<0.001	Yes
Row 1 vs. Row 7	0.00318	7	9.019	<0.001	Yes
Row 1 vs. Row 4	0.00302	6	16.483	<0.001	Yes
Row 1 vs. Row 2	0.00299	5	16.338	<0.001	Yes
Row 1 vs. Row 8	0.00288	4	8.146	<0.001	Yes
Row 1 vs. Row 5	0.00247	3	13.514	<0.001	Yes
Row 1 vs. Row 3	0.00185	2	10.086	<0.001	Yes
Row 3 vs. Row 9	0.00156	8	4.005	0.087	No
Row 3 vs. Row 6	0.00141	7	3.622	0.138	Do Not Test
Row 3 vs. Row 7	0.00134	6	3.434	0.146	Do Not Test
Row 3 vs. Row 4	0.00117	5	4.748	0.007	Do Not Test
Row 3 vs. Row 2	0.00114	4	4.641	0.006	Do Not Test
Row 3 vs. Row 8	0.00103	3	2.643	0.148	Do Not Test
Row 3 vs. Row 5	0.000627	2	2.544	0.072	Do Not Test
Row 5 vs. Row 9	0.000933	7	2.396	0.620	Do Not Test
Row 5 vs. Row 6	0.000784	6	2.013	0.713	Do Not Test
Row 5 vs. Row 7	0.000711	5	1.825	0.697	Do Not Test
Row 5 vs. Row 4	0.000543	4	2.204	0.403	Do Not Test
Row 5 vs. Row 2	0.000517	3	2.096	0.299	Do Not Test
Row 5 vs. Row 8	0.000403	2	1.034	0.465	Do Not Test
Row 8 vs. Row 9	0.000530	6	1.076	0.974	Do Not Test
Row 8 vs. Row 6	0.000381	5	0.774	0.982	Do Not Test
Row 8 vs. Row 7	0.000308	4	0.625	0.971	Do Not Test
Row 8 vs. Row 4	0.000140	3	0.360	0.965	Do Not Test
Row 8 vs. Row 2	0.000114	2	0.292	0.837	Do Not Test
Row 2 vs. Row 9	0.000417	5	1.070	0.943	Do Not Test
Row 2 vs. Row 6	0.000268	4	0.687	0.962	Do Not Test
Row 2 vs. Row 7	0.000194	3	0.499	0.934	Do Not Test
Row 2 vs. Row 4	0.0000265	2	0.108	0.939	Do Not Test
Row 4 vs. Row 9	0.000390	4	1.002	0.894	Do Not Test
Row 4 vs. Row 6	0.000241	3	0.619	0.900	Do Not Test
Row 4 vs. Row 7	0.000168	2	0.431	0.761	Do Not Test
Row 7 vs. Row 9	0.000222	3	0.451	0.945	Do Not Test
Row 7 vs. Row 6	0.0000734	2	0.149	0.916	Do Not Test
Row 6 vs. Row 9	0.000149	2	0.302	0.831	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

*Appendix G – PM<sub>10</sub> Metals Site Comparisons to Collocated Monitor*

## Comparison of Every 6<sup>th</sup>-Day TCEQ Samples to All Collocated Samples

### I. Aluminum

#### t-test

Friday, June 04, 2010, 9:38:19 AM

**Data source:** Aluminum in 6th Day Sample Comparisons.JNB

**Normality Test:** Passed (P = 0.809)

**Equal Variance Test:** Passed (P = 0.885)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated 6th-day	4	0	0.108	0.0516	0.0258
All other days	16	0	0.131	0.0522	0.0130

Difference -0.0238

t = -0.819 with 18 degrees of freedom. (P = 0.424)

95 percent confidence interval for difference of means: -0.0850 to 0.0373

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.424).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### II. Chromium

#### t-test

Friday, June 04, 2010, 9:39:08 AM

**Data source:** Chromium in 6th Day Sample Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

#### Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 9:39:08 AM

**Data source:** Chromium in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
Collocated 6th-day	4	0	0.00268	0.00206	0.00359
All other days	16	0	0.00243	0.00222	0.00344

Mann-Whitney U Statistic= 29.000

T = 39.000 n(small)= 4 n(big)= 16 (P = 0.813)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.813)

### III. Manganese

#### t-test

Friday, June 04, 2010, 9:39:40 AM

**Data source:** Manganese in 6th Day Sample Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

#### Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 9:39:40 AM

**Data source:** Manganese in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
Collocated 6th-day	4	0	0.0117	0.00620	0.0255
All other days	16	0	0.0137	0.00778	0.0306

Mann-Whitney U Statistic= 28.000

T = 38.000 n(small)= 4 n(big)= 16 (P = 0.741)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.741)

#### IV. Lead

t-test

Friday, June 04, 2010, 9:40:12 AM

Data source: Lead in 6th Day Sample Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 9:40:12 AM

Data source: Lead in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
Collocated 6th-day	4	0	0.00222	0.00192	0.00360
All other days	16	0	0.00338	0.00229	0.00490

Mann-Whitney U Statistic= 22.000

T = 32.000 n(small)= 4 n(big)= 16 (P = 0.369)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.369)

#### V. Nickel

t-test

Friday, June 04, 2010, 9:40:47 AM

Data source: Nickel in 6th Day Sample Comparisons.JNB

Normality Test: Passed (P = 0.155)

Equal Variance Test: Passed (P = 0.301)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated 6th-day	4	0	0.00102	0.000557	0.000278
All other days	16	0	0.00103	0.000383	0.0000957

Difference -0.0000101

t = -0.0432 with 18 degrees of freedom. (P = 0.966)

95 percent confidence interval for difference of means: -0.000500 to 0.000480

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.966).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### VI. Mercury

t-test

Friday, June 04, 2010, 9:41:19 AM

Data source: Mercury in 6th Day Sample Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, June 04, 2010, 9:41:19 AM

Data source: Mercury in 6th Day Sample Comparisons.JNB

Group	N	Missing	Median	25%	75%
Collocated 6th-day	4	0	0.0000300	0.0000210	0.0000455
All other days	16	0	0.0000255	0.0000135	0.000155

Mann-Whitney U Statistic= 31.500

T = 42.500 n(small)= 4 n(big)= 16 (P = 1.000)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 1.000)

#### VII. Hexavalent Chromium

t-test

Friday, June 04, 2010, 9:41:58 AM

**Data source:** Hexavalent Chromium in 6th Day Sample Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, June 04, 2010, 9:41:58 AM

**Data source:** Hexavalent Chromium in 6th Day Sample Comparisons.JNB

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<b>Group</b>	<b>N</b>	<b>Missing</b>	<b>Median</b>	<b>25%</b>	<b>75%</b>
Collocated 6th-day	4	0	0.00000215	0.00000215	0.0000771
All other days	16	0	0.0000480	0.00000920	0.0000809

---

Mann-Whitney U Statistic= 21.000

T = 31.000 n(small)= 4 n(big)= 16 (P = 0.317)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.317)

## Comparison of Collocated Samples to All Other Sites

### I. Aluminum

#### a. Collocated vs. Wyatt Rd

t-test

Monday, March 29, 2010, 3:52:40 PM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, March 29, 2010, 3:52:40 PM

Data source: Al Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.133	0.0851	0.162
Wyatt Rd	20	0	0.239	0.157	0.332

Mann-Whitney U Statistic= 76.000

T = 286.000 n(small)= 20 n(big)= 20 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

#### b. Collocated vs. Jaycee Park

t-test

Friday, January 22, 2010, 11:05:25 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, January 22, 2010, 11:05:25 AM

Data source: Al Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.133	0.0851	0.162
Jaycee	20	0	0.0745	0.0625	0.102

Mann-Whitney U Statistic= 111.000

T = 499.000 n(small)= 20 n(big)= 20 (P = 0.017)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.017)

#### c. Collocated vs. Water Treatment Plant

t-test

Friday, January 22, 2010, 11:05:42 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.233)

Equal Variance Test: Passed (P = 0.993)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.127	0.0516	0.0115
Water Tmt Plant	20	0	0.117	0.0505	0.0113

Difference 0.0100

t = 0.620 with 38 degrees of freedom. (P = 0.539)

95 percent confidence interval for difference of means: -0.0227 to 0.0427

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.539).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### d. Collocated vs. Triangle Park

t-test

Friday, January 22, 2010, 11:05:56 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.941)

Equal Variance Test: Passed (P = 0.127)

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Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.127	0.0516	0.0115
Triangle Park	5	0	0.0570	0.0203	0.00910

---

Difference 0.0697

t = 2.926 with 23 degrees of freedom. (P = 0.008)

95 percent confidence interval for difference of means: 0.0204 to 0.119

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.008).

Power of performed test with alpha = 0.050: 0.759

#### e. Collocated vs. Mountain Peak Elementary School

t-test

Friday, January 22, 2010, 11:06:12 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.844)

Equal Variance Test: Passed (P = 0.476)

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Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.127	0.0516	0.0115
Mountain Peak	5	0	0.0837	0.0408	0.0183

---

Difference 0.0430

t = 1.722 with 23 degrees of freedom. (P = 0.098)

95 percent confidence interval for difference of means: -0.00864 to 0.0946

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.098).

Power of performed test with alpha = 0.050: 0.255

The power of the performed test (0.255) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Collocated vs. J.A. Vitovsky Elementary School

t-test

Friday, January 22, 2010, 11:06:26 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.926)

Equal Variance Test: Passed (P = 0.321)

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Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.127	0.0516	0.0115
Vitovsky	5	0	0.0925	0.0278	0.0125

---

Difference 0.0342

t = 1.414 with 23 degrees of freedom. (P = 0.171)

95 percent confidence interval for difference of means: -0.0158 to 0.0842

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.171).

Power of performed test with alpha = 0.050: 0.150

The power of the performed test (0.150) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### g. Collocated vs. Midlothian High School

**t-test**

Friday, March 19, 2010, 11:08:46 AM

**Data source:** Al Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.340)

**Equal Variance Test:** Passed (P = 0.532)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.127	0.0516	0.0115
Mid HS	5	0	0.0798	0.0573	0.0256

Difference 0.0469

t = 1.782 with 23 degrees of freedom. (P = 0.088)

95 percent confidence interval for difference of means: -0.00754 to 0.101

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.088).

Power of performed test with alpha = 0.050: 0.278

The power of the performed test (0.278) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

## II. Chromium

### a. Collocated vs. Wyatt Rd

**t-test**

Monday, March 29, 2010, 4:15:42 PM

**Data source:** Cr Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Monday, March 29, 2010, 4:15:42 PM

**Data source:** Cr Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00243	0.00218	0.00344
Wyatt Rd	20	0	0.00433	0.00279	0.00685

Mann-Whitney U Statistic= 84.500

T = 294.500 n(small)= 20 n(big)= 20 (P = 0.002)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

### b. Collocated vs. Jaycee Park

**t-test**

Friday, January 22, 2010, 11:10:49 AM

**Data source:** Cr Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:10:49 AM

**Data source:** Cr Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00243	0.00218	0.00344
Jaycee	20	0	0.00207	0.00187	0.00222

Mann-Whitney U Statistic= 82.500

T = 527.500 n(small)= 20 n(big)= 20 (P = 0.002)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

### c. Collocated vs. Water Treatment Plant

t-test

Friday, January 22, 2010, 11:11:02 AM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, January 22, 2010, 11:11:02 AM

Data source: Cr Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00243	0.00218	0.00344
Water Tmt Plant	20	0	0.00207	0.00179	0.00222

Mann-Whitney U Statistic= 76.000

T = 534.000 n(small)= 20 n(big)= 20 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

### d. Collocated vs. Triangle Park

t-test

Friday, January 22, 2010, 11:11:13 AM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.064)

Equal Variance Test: Passed (P = 0.213)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00282	0.000849	0.000190
Triangle Park	5	0	0.00157	0.000263	0.000118

Difference 0.00125

t = 3.204 with 23 degrees of freedom. (P = 0.004)

95 percent confidence interval for difference of means: 0.000443 to 0.00206

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.004).

Power of performed test with alpha = 0.050: 0.845

### e. Collocated vs. Mountain Peak

t-test

Friday, January 22, 2010, 11:11:26 AM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.067)

Equal Variance Test: Passed (P = 0.199)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00282	0.000849	0.000190
Mountain Peak	5	0	0.00184	0.000232	0.000104

Difference 0.000975

t = 2.507 with 23 degrees of freedom. (P = 0.020)

95 percent confidence interval for difference of means: 0.000170 to 0.00178

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.020).

Power of performed test with alpha = 0.050: 0.593

### f. Collocated vs. JA Vitovsky

t-test

Friday, January 22, 2010, 11:11:38 AM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.051)

Equal Variance Test: Passed (P = 0.318)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00282	0.000849	0.000190
Vitovsky	5	0	0.00264	0.000353	0.000158

Difference 0.000175

t = 0.445 with 23 degrees of freedom. (P = 0.660)

95 percent confidence interval for difference of means: -0.000638 to 0.000988

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.660).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### g. Collocated vs. Midlothian HS

t-test

Friday, January 22, 2010, 11:11:50 AM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.075)

Equal Variance Test: Passed (P = 0.092)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00282	0.000849	0.000190
Mid HS	5	0	0.00200	0.0000886	0.0000396

Difference 0.000815

t = 2.109 with 23 degrees of freedom. (P = 0.046)

95 percent confidence interval for difference of means: 0.0000157 to 0.00161

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.046).

Power of performed test with alpha = 0.050: 0.416

### C. Manganese

#### a. Collocated vs. Wyatt Rd

t-test

Monday, March 29, 2010, 4:52:33 PM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, March 29, 2010, 4:52:33 PM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Wyatt Rd	20	0	0.0493	0.0222	0.0903

Mann-Whitney U Statistic= 73.500

T = 283.500 n(small)= 20 n(big)= 20 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

#### b. Collocated vs. Jaycee Park

t-test

Friday, January 22, 2010, 11:13:48 AM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, January 22, 2010, 11:13:48 AM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Jaycee	20	0	0.00715	0.00381	0.0111

Mann-Whitney U Statistic= 110.500

T = 499.500 n(small)= 20 n(big)= 20 (P = 0.016)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.016)

#### c. Collocated vs. Water Treatment Plant

**t-test**

Friday, January 22, 2010, 11:14:02 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:14:02 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Water Tmt Plant	20	0	0.0104	0.00494	0.0157

Mann-Whitney U Statistic= 146.000

T = 464.000 n(small)= 20 n(big)= 20 (P = 0.148)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.148)

#### d. Collocated vs. Triangle Park

**t-test**

Friday, January 22, 2010, 11:14:17 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:14:17 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Triangle Park	5	0	0.00486	0.00412	0.00897

Mann-Whitney U Statistic= 22.000

T = 37.000 n(small)= 5 n(big)= 20 (P = 0.062)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.062)

#### e. Collocated vs. Mountain Peak

**t-test**

Friday, January 22, 2010, 11:14:31 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:14:31 AM

**Data source:** Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Mountain Peak	5	0	0.00707	0.00597	0.0111

Mann-Whitney U Statistic= 32.000

T = 47.000 n(small)= 5 n(big)= 20 (P = 0.234)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.234)

#### f. Collocated vs. Vitovsky

t-test

Friday, January 22, 2010, 11:14:42 AM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, January 22, 2010, 11:14:42 AM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Vitovsky	5	0	0.00873	0.00534	0.0117

Mann-Whitney U Statistic= 33.000

T = 48.000 n(small)= 5 n(big)= 20 (P = 0.262)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.262)

#### g. Collocated vs. Midlothian HS

t-test

Friday, January 22, 2010, 11:14:58 AM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Friday, January 22, 2010, 11:14:58 AM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Mid HS	5	0	0.00487	0.00355	0.00630

Mann-Whitney U Statistic= 11.000

T = 26.000 n(small)= 5 n(big)= 20 (P = 0.009)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.009)

#### D. Lead

##### a. Collocated vs. Wyatt Rd

t-test

Monday, March 29, 2010, 5:06:59 PM

Data source: Pb Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, March 29, 2010, 5:06:59 PM

Data source: Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Wyatt Rd	20	0	0.01000	0.00373	0.0193

Mann-Whitney U Statistic= 84.000

T = 294.000 n(small)= 20 n(big)= 20 (P = 0.002)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

##### b. Collocated vs. Jaycee Park

t-test

Friday, January 22, 2010, 11:16:51 AM

Data source: Pb Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:16:51 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Jaycee	20	0	0.00215	0.00150	0.00288

Mann-Whitney U Statistic= 130.500

T = 479.500 n(small)= 20 n(big)= 20 (P = 0.062)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.062)

**c. Collocated vs. Water Treatment Plant****t-test**

Friday, January 22, 2010, 11:17:05 AM

**Data source:** Pb Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:17:05 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Water Tmt Plant	20	0	0.00273	0.00190	0.00406

Mann-Whitney U Statistic= 183.500

T = 426.500 n(small)= 20 n(big)= 20 (P = 0.665)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.665)

**d. Collocated vs. Triangle Park****t-test**

Friday, January 22, 2010, 11:17:20 AM

**Data source:** Pb Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:17:20 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Triangle Park	5	0	0.00205	0.00153	0.00334

Mann-Whitney U Statistic= 31.000

T = 46.000 n(small)= 5 n(big)= 20 (P = 0.209)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.209)

**e. Collocated vs. Mountain Peak****t-test**

Friday, January 22, 2010, 11:17:40 AM

**Data source:** Pb Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:17:40 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Mountain Peak	5	0	0.00197	0.00143	0.00232

Mann-Whitney U Statistic= 19.000

T = 34.000 n(small)= 5 n(big)= 20 (P = 0.038)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.038)

#### f. Collocated vs. Vitovsky

**t-test**

Friday, January 22, 2010, 11:17:56 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:17:56 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Vitovsky	5	0	0.00171	0.00159	0.00210

Mann-Whitney U Statistic= 19.000

T = 34.000 n(small)= 5 n(big)= 20 (P = 0.038)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.038)

#### g. Collocated vs. Midlothian HS

**t-test**

Friday, January 22, 2010, 11:18:08 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:18:08 AM

**Data source:** Pb Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Mid HS	5	0	0.00299	0.00228	0.00313

Mann-Whitney U Statistic= 43.000

T = 58.000 n(small)= 5 n(big)= 20 (P = 0.659)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.659)

#### E. Nickel

##### a. Collocated vs. Wyatt Rd

**t-test**

Tuesday, April 13, 2010, 3:32:30 PM

**Data source:** Ni Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.673)

**Equal Variance Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Tuesday, April 13, 2010, 3:32:30 PM

**Data source:** Ni Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00105	0.000639	0.00140
Wyatt Rd	20	0	0.00213	0.000965	0.00328

Mann-Whitney U Statistic= 95.000

T = 305.000 n(small)= 20 n(big)= 20 (P = 0.005)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.005)

##### b. Collocated vs. Jaycee Park

**t-test**

Friday, January 22, 2010, 11:19:46 AM

**Data source:** Ni Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:19:46 AM

**Data source:** Ni Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00105	0.000639	0.00140
Jaycee	20	0	0.000879	0.000651	0.00134

Mann-Whitney U Statistic= 181.500

T = 428.500 n(small)= 20 n(big)= 20 (P = 0.626)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.626)

**c. Collocated vs. Water Treatment Plant****t-test**

Friday, January 22, 2010, 11:19:58 AM

**Data source:** Ni Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:19:58 AM

**Data source:** Ni Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00105	0.000639	0.00140
Water Tmt Plant	20	0	0.000963	0.000679	0.00127

Mann-Whitney U Statistic= 197.500

T = 412.500 n(small)= 20 n(big)= 20 (P = 0.957)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.957)

**d. Collocated vs. Triangle Park****t-test**

Friday, January 22, 2010, 11:20:08 AM

**Data source:** Ni Site in Metals Site Comparison.JNB**Normality Test:** Passed (P = 0.312)**Equal Variance Test:** Passed (P = 0.134)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00103	0.000406	0.0000907
Triangle Park	5	0	0.000764	0.000189	0.0000845

Difference 0.000268

t = 1.420 with 23 degrees of freedom. (P = 0.169)

95 percent confidence interval for difference of means: -0.000122 to 0.000658

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.169).

Power of performed test with alpha = 0.050: 0.152

The power of the performed test (0.152) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

**e. Collocated vs. Mountain Peak****t-test**

Friday, January 22, 2010, 11:20:18 AM

**Data source:** Ni Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.246)

**Equal Variance Test:** Passed (P = 0.248)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00103	0.000406	0.0000907
Mountain Peak	5	0	0.000837	0.000240	0.000107

Difference 0.000194

t = 1.017 with 23 degrees of freedom. (P = 0.320)

95 percent confidence interval for difference of means: -0.000201 to 0.000590

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.320).

Power of performed test with alpha = 0.050: 0.051

The power of the performed test (0.051) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Collocated vs. Vitovsky

t-test

Friday, January 22, 2010, 11:20:28 AM

**Data source:** Ni Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.152)

**Equal Variance Test:** Passed (P = 0.665)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00103	0.000406	0.0000907
Vitovsky	5	0	0.00115	0.000306	0.000137

Difference -0.000114

t = -0.582 with 23 degrees of freedom. (P = 0.566)

95 percent confidence interval for difference of means: -0.000517 to 0.000290

The difference in the mean values of the two groups is not great enough to reject the possibility that the difference is due to random sampling variability. There is not a statistically significant difference between the input groups (P = 0.566).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### g. Collocated vs. Midlothian HS

t-test

Friday, January 22, 2010, 11:20:39 AM

**Data source:** Ni Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.335)

**Equal Variance Test:** Passed (P = 0.087)

Group Name	N	Missing	Mean	Std Dev	SEM
Collocated	20	0	0.00103	0.000406	0.0000907
Mid HS	5	0	0.000615	0.000160	0.0000715

Difference 0.000417

t = 2.224 with 23 degrees of freedom. (P = 0.036)

95 percent confidence interval for difference of means: 0.0000291 to 0.000804

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.036).

Power of performed test with alpha = 0.050: 0.467

#### F. Mercury

##### a. Collocated vs. Wyatt Rd

**t-test**

Tuesday, April 13, 2010, 3:51:51 PM

**Data source:** Hg Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Tuesday, April 13, 2010, 3:51:51 PM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Wyatt Rd	20	0	0.0000375	0.0000205	0.0000970

Mann-Whitney U Statistic= 168.000

T = 378.000 n(small)= 20 n(big)= 20 (P = 0.394)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.394)

**b. Collocated vs. Jaycee Park****t-test**

Friday, January 22, 2010, 11:22:36 AM

**Data source:** Hg Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:22:36 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Jaycee	20	0	0.0000200	0.00000800	0.0000400

Mann-Whitney U Statistic= 163.500

T = 446.500 n(small)= 20 n(big)= 20 (P = 0.330)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.330)

**c. Collocated vs. Water Treatment Plant****t-test**

Friday, January 22, 2010, 11:22:51 AM

**Data source:** Hg Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:22:51 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Water Tmt Plant	20	0	0.0000135	0.00000950	0.0000230

Mann-Whitney U Statistic= 126.500

T = 483.500 n(small)= 20 n(big)= 20 (P = 0.048)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.048)

**d. Collocated vs. Triangle Park****t-test**

Friday, January 22, 2010, 11:23:07 AM

**Data source:** Hg Site in Metals Site Comparison.JNB**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:23:07 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
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Collocated	20	0	0.0000280	0.0000145	0.000103
Triangle Park	5	0	0.0000280	0.0000227	0.0000833

Mann-Whitney U Statistic= 43.500

T = 71.500 n(small)= 5 n(big)= 20 (P = 0.683)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.683)

#### e. Collocated vs. Mountain Peak

**t-test**

Friday, January 22, 2010, 11:23:19 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:23:19 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Mountain Peak	5	0	0.000266	0.000230	0.000293

Mann-Whitney U Statistic= 14.000

T = 101.000 n(small)= 5 n(big)= 20 (P = 0.016)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.016)

#### f. Collocated vs. Vitovsky

**t-test**

Friday, January 22, 2010, 11:23:31 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:23:31 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Vitovsky	5	0	0.00001000	0.00000775	0.0000150

Mann-Whitney U Statistic= 17.500

T = 32.500 n(small)= 5 n(big)= 20 (P = 0.030)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.030)

#### g. Collocated vs. Midlothian HS

**t-test**

Friday, January 22, 2010, 11:23:42 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

**Mann-Whitney Rank Sum Test**

Friday, January 22, 2010, 11:23:42 AM

**Data source:** Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Mid HS	5	0	0.00000600	0.00000600	0.00000825

Mann-Whitney U Statistic= 11.500

T = 26.500 n(small)= 5 n(big)= 20 (P = 0.010)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.010)

*Appendix H – PM<sub>10</sub> Metals Site Comparisons: All Four Quarters of Data*

## A. Aluminum

### I. Comparison of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, March 29, 2010, 3:49:38 PM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, March 29, 2010, 3:49:38 PM

Data source: Al Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.133	0.0851	0.162
Wyatt Rd	20	0	0.239	0.157	0.332
Jaycee	20	0	0.0745	0.0625	0.102
Water Tmt Plant	20	0	0.116	0.0751	0.152

H = 25.249 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee	722.500	6.952	Yes
Wyatt Rd vs Water Tmt Plant	492.000	4.734	Yes
Wyatt Rd vs Collocated	423.500	4.075	Yes
Collocated vs Jaycee	299.000	2.877	No
Collocated vs Water Tmt Plant	68.500	0.659	Do Not Test
Water Tmt Plant vs Jaycee	230.500	2.218	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### II. Comparison of Mobile Sites

#### One WayOne-Way Analysis of Variance

Friday, March 19, 2010, 11:06:02 AM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksFriday, March 19, 2010, 11:06:02 AM

Data source: Al Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0503	0.0421	0.0678
Mountain Peak	5	0	0.0708	0.0601	0.0967
Vitovsky	5	0	0.0878	0.0705	0.113
Mid HS	5	0	0.0425	0.0358	0.141

H = 3.754 with 3 degrees of freedom. (P = 0.289)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.289)

### III. Comparison of All Sites

#### One WayOne-Way Analysis of Variance

Monday, March 29, 2010, 3:50:24 PM

Data source: Al Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Monday, March 29, 2010, 3:50:24 PM

**Data source:** Al Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.133	0.0851	0.162
Wyatt Rd	20	0	0.239	0.157	0.332
Jaycee	20	0	0.0745	0.0625	0.102
Water Tmt Plant	20	0	0.116	0.0751	0.152
Triangle Park	5	0	0.0503	0.0421	0.0678
Mountain Peak	5	0	0.0708	0.0601	0.0967
Vitovsky	5	0	0.0878	0.0705	0.113
Mid HS	5	0	0.0425	0.0358	0.141

H = 35.482 with 7 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Wyatt Rd vs Triangle Park	60.825	4.193	Yes
Wyatt Rd vs Mid HS	48.925	3.373	Yes
Wyatt Rd vs Mountain Peak	44.025	3.035	No
Wyatt Rd vs Jaycee	43.000	4.687	Do Not Test
Wyatt Rd vs Vitovsky	37.825	2.608	Do Not Test
Wyatt Rd vs Water Tmt Plant	28.000	3.052	Do Not Test
Wyatt Rd vs Collocated	23.725	2.586	Do Not Test
Collocated vs Triangle Park	37.100	2.558	No
Collocated vs Mid HS	25.200	1.737	Do Not Test
Collocated vs Mountain Peak	20.300	1.399	Do Not Test
Collocated vs Jaycee	19.275	2.101	Do Not Test
Collocated vs Vitovsky	14.100	0.972	Do Not Test
Collocated vs Water Tmt Plant	4.275	0.466	Do Not Test
Water Tmt Pla vs Triangle Park	32.825	2.263	Do Not Test
Water Tmt Plant vs Mid HS	20.925	1.443	Do Not Test
Water Tmt Pla vs Mountain Peak	16.025	1.105	Do Not Test
Water Tmt Plant vs Jaycee	15.000	1.635	Do Not Test
Water Tmt Plant vs Vitovsky	9.825	0.677	Do Not Test
Vitovsky vs Triangle Park	23.000	1.254	Do Not Test
Vitovsky vs Mid HS	11.100	0.605	Do Not Test
Vitovsky vs Mountain Peak	6.200	0.338	Do Not Test
Vitovsky vs Jaycee	5.175	0.357	Do Not Test
Jaycee vs Triangle Park	17.825	1.229	Do Not Test
Jaycee vs Mid HS	5.925	0.408	Do Not Test
Jaycee vs Mountain Peak	1.025	0.0707	Do Not Test
Mountain Peak vs Triangle Park	16.800	0.916	Do Not Test
Mountain Peak vs Mid HS	4.900	0.267	Do Not Test
Mid HS vs Triangle Park	11.900	0.649	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## B. Chromium

### I. Comparison of Stationary Sites

**One Way One-Way Analysis of Variance**

Monday, March 29, 2010, 4:14:28 PM

**Data source:** Cr Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Monday, March 29, 2010, 4:14:28 PM

**Data source:** Cr Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00243	0.00218	0.00344
Wyatt Rd	20	0	0.00433	0.00279	0.00685
Jaycee	20	0	0.00207	0.00187	0.00222
Water Tmt Plant	20	0	0.00207	0.00179	0.00222

H = 36.691 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Water Tmt Plant	750.000	7.217	Yes
Wyatt Rd vs Jaycee	750.000	7.217	Yes
Wyatt Rd vs Collocated	332.000	3.195	No
Collocated vs Water Tmt Plant	418.000	4.022	Yes
Collocated vs Jaycee	418.000	4.022	Yes
Jaycee vs Water Tmt Plant	0.000	0.000	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## II. Comparison of Mobile Sites

**One Way One-Way Analysis of Variance**

Friday, January 22, 2010, 11:09:36 AM

**Data source:** Cr Site in Metals Site Comparison.JNB

**Normality Test:** Passed (P = 0.446)

**Equal Variance Test:** Passed (P = 0.079)

Group Name	N	Missing	Mean	Std Dev	SEM
Triangle Park	5	0	0.00157	0.000263	0.000118
Mountain Peak	5	0	0.00184	0.000232	0.000104
Vitovsky	5	0	0.00264	0.000353	0.000158
Mid HS	5	0	0.00200	0.0000886	0.0000396

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000312	0.00000104	16.251	<0.001
Residual	16	0.00000102	0.0000000639		
Total	19	0.00000414			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Vitovsky vs. Triangle Park	0.00107	4	9.501	<0.001	Yes
Vitovsky vs. Mountain Peak	0.000800	3	7.077	<0.001	Yes
Vitovsky vs. Mid HS	0.000640	2	5.662	0.001	Yes
Mid HS vs. Triangle Park	0.000434	3	3.839	0.039	Yes
Mid HS vs. Mountain Peak	0.000160	2	1.415	0.332	No
Mountain Pea vs. Triangle Par	0.000274	2	2.424	0.106	No

### III. Comparison of All Sites

#### One WayOne-Way Analysis of Variance

Monday, March 29, 2010, 4:15:17 PM

Data source: Cr Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, March 29, 2010, 4:15:17 PM

Data source: Cr Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00243	0.00218	0.00344
Wyatt Rd	20	0	0.00433	0.00279	0.00685
Jaycee	20	0	0.00207	0.00187	0.00222
Water Tmt Plant	20	0	0.00207	0.00179	0.00222
Triangle Park	5	0	0.00161	0.00133	0.00172
Mountain Peak	5	0	0.00189	0.00162	0.00204
Vitovsky	5	0	0.00264	0.00232	0.00287
Mid HS	5	0	0.00204	0.00191	0.00207

H = 54.860 with 7 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Wyatt Rd vs Triangle Park	72.075	4.969	Yes
Wyatt Rd vs Mountain Peak	59.975	4.135	Yes
Wyatt Rd vs Mid HS	50.275	3.466	Yes
Wyatt Rd vs Jaycee	45.100	4.916	Yes
Wyatt Rd vs Water Tmt Plant	44.800	4.883	Yes
Wyatt Rd vs Collocated	18.725	2.041	No
Wyatt Rd vs Vitovsky	12.675	0.874	Do Not Test
Vitovsky vs Triangle Park	59.400	3.237	Yes
Vitovsky vs Mountain Peak	47.300	2.578	No
Vitovsky vs Mid HS	37.600	2.049	Do Not Test
Vitovsky vs Jaycee	32.425	2.235	Do Not Test
Vitovsky vs Water Tmt Plant	32.125	2.215	Do Not Test
Vitovsky vs Collocated	6.050	0.417	Do Not Test
Collocated vs Triangle Park	53.350	3.678	Yes
Collocated vs Mountain Peak	41.250	2.844	Do Not Test
Collocated vs Mid HS	31.550	2.175	Do Not Test
Collocated vs Jaycee	26.375	2.875	Do Not Test
Collocated vs Water Tmt Plant	26.075	2.842	Do Not Test
Water Tmt Pla vs Triangle Park	27.275	1.880	No
Water Tmt Pla vs Mountain Peak	15.175	1.046	Do Not Test
Water Tmt Plant vs Mid HS	5.475	0.377	Do Not Test
Water Tmt Plant vs Jaycee	0.300	0.0327	Do Not Test
Jaycee vs Triangle Park	26.975	1.860	Do Not Test
Jaycee vs Mountain Peak	14.875	1.025	Do Not Test
Jaycee vs Mid HS	5.175	0.357	Do Not Test
Mid HS vs Triangle Park	21.800	1.188	Do Not Test
Mid HS vs Mountain Peak	9.700	0.529	Do Not Test
Mountain Peak vs Triangle Park	12.100	0.659	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## C. Manganese

### I. Comparison of Stationary Sites

#### One WayOne-Way Analysis of Variance

Monday, March 29, 2010, 4:51:39 PM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, March 29, 2010, 4:51:39 PM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Wyatt Rd	20	0	0.0493	0.0222	0.0903
Jaycee	20	0	0.00715	0.00381	0.0111
Water Tmt Plant	20	0	0.0104	0.00494	0.0157

H = 28.709 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee	737.000	7.092	Yes
Wyatt Rd vs Water Tmt Plant	607.500	5.846	Yes
Wyatt Rd vs Collocated	425.500	4.094	Yes
Collocated vs Jaycee	311.500	2.997	No
Collocated vs Water Tmt Plant	182.000	1.751	Do Not Test
Water Tmt Plant vs Jaycee	129.500	1.246	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### II. Comparison of Mobile Sites

#### One WayOne-Way Analysis of Variance

Friday, January 22, 2010, 11:12:53 AM

Data source: Mn Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksFriday, January 22, 2010, 11:12:53 AM

Data source: Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.00486	0.00412	0.00897
Mountain Peak	5	0	0.00707	0.00597	0.0111
Vitovsky	5	0	0.00873	0.00534	0.0117
Mid HS	5	0	0.00487	0.00355	0.00630

H = 5.241 with 3 degrees of freedom. (P = 0.155)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.155)

### III. Comparison of All Sites

#### One WayOne-Way Analysis of Variance

Monday, March 29, 2010, 4:52:09 PM

Data source: Mn Site in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Monday, March 29, 2010, 4:52:09 PM

**Data source:** Mn Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0137	0.00766	0.0306
Wyatt Rd	20	0	0.0493	0.0222	0.0903
Jaycee	20	0	0.00715	0.00381	0.0111
Water Tmt Plant	20	0	0.0104	0.00494	0.0157
Triangle Park	5	0	0.00486	0.00412	0.00897
Mountain Peak	5	0	0.00707	0.00597	0.0111
Vitovsky	5	0	0.00873	0.00534	0.0117
Mid HS	5	0	0.00487	0.00355	0.00630

H = 37.617 with 7 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Wyatt Rd vs Mid HS	61.175	4.217	Yes
Wyatt Rd vs Triangle Park	52.075	3.590	Yes
Wyatt Rd vs Jaycee	44.550	4.856	Yes
Wyatt Rd vs Mountain Peak	39.375	2.714	No
Wyatt Rd vs Vitovsky	39.275	2.708	Do Not Test
Wyatt Rd vs Water Tmt Plant	36.125	3.938	Do Not Test
Wyatt Rd vs Collocated	24.725	2.695	Do Not Test
Collocated vs Mid HS	36.450	2.513	No
Collocated vs Triangle Park	27.350	1.885	Do Not Test
Collocated vs Jaycee	19.825	2.161	Do Not Test
Collocated vs Mountain Peak	14.650	1.010	Do Not Test
Collocated vs Vitovsky	14.550	1.003	Do Not Test
Collocated vs Water Tmt Plant	11.400	1.243	Do Not Test
Water Tmt Plant vs Mid HS	25.050	1.727	Do Not Test
Water Tmt Pla vs Triangle Park	15.950	1.100	Do Not Test
Water Tmt Plant vs Jaycee	8.425	0.918	Do Not Test
Water Tmt Pla vs Mountain Peak	3.250	0.224	Do Not Test
Water Tmt Plant vs Vitovsky	3.150	0.217	Do Not Test
Vitovsky vs Mid HS	21.900	1.194	Do Not Test
Vitovsky vs Triangle Park	12.800	0.698	Do Not Test
Vitovsky vs Jaycee	5.275	0.364	Do Not Test
Vitovsky vs Mountain Peak	0.100	0.00545	Do Not Test
Mountain Peak vs Mid HS	21.800	1.188	Do Not Test
Mountain Peak vs Triangle Park	12.700	0.692	Do Not Test
Mountain Peak vs Jaycee	5.175	0.357	Do Not Test
Jaycee vs Mid HS	16.625	1.146	Do Not Test
Jaycee vs Triangle Park	7.525	0.519	Do Not Test
Triangle Park vs Mid HS	9.100	0.496	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

#### D. Lead

##### I. Comparisons of Stationary Sites

##### One Way One-Way Analysis of Variance

Monday, March 29, 2010, 5:06:16 PM

**Data source:** Pb Site in Metals Site Comparison..JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, March 29, 2010, 5:06:16 PM

**Data source:** Pb Site in Metals Site Comparison..JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Wyatt Rd	20	0	0.01000	0.00373	0.0193
Jaycee	20	0	0.00215	0.00150	0.00288
Water Tmt Plant	20	0	0.00273	0.00190	0.00406

H = 22.093 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee	666.000	6.409	Yes
Wyatt Rd vs Water Tmt Plant	486.000	4.677	Yes
Wyatt Rd vs Collocated	424.000	4.080	Yes
Collocated vs Jaycee	242.000	2.329	No
Collocated vs Water Tmt Plant	62.000	0.597	Do Not Test
Water Tmt Plant vs Jaycee	180.000	1.732	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

## II. Comparisons of Mobile Sites

**One WayOne-Way Analysis of Variance**

Friday, January 22, 2010, 11:15:52 AM

**Data source:** Pb Site in Metals Site Comparison..JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Friday, January 22, 2010, 11:15:52 AM

**Data source:** Pb Site in Metals Site Comparison..JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.00205	0.00153	0.00334
Mountain Peak	5	0	0.00197	0.00143	0.00232
Vitovsky	5	0	0.00171	0.00159	0.00210
Mid HS	5	0	0.00299	0.00228	0.00313

H = 5.971 with 3 degrees of freedom. (P = 0.113)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.113)

## III. Comparisons of All Sites

**One WayOne-Way Analysis of Variance**

Monday, March 29, 2010, 5:06:42 PM

**Data source:** Pb Site in Metals Site Comparison..JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, March 29, 2010, 5:06:42 PM

**Data source:** Pb Site in Metals Site Comparison..JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00302	0.00221	0.00469
Wyatt Rd	20	0	0.01000	0.00373	0.0193
Jaycee	20	0	0.00215	0.00150	0.00288
Water Tmt Plant	20	0	0.00273	0.00190	0.00406
Triangle Park	5	0	0.00205	0.00153	0.00334
Mountain Peak	5	0	0.00197	0.00143	0.00232
Vitovsky	5	0	0.00171	0.00159	0.00210
Mid HS	5	0	0.00299	0.00228	0.00313

H = 31.485 with 7 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Wyatt Rd vs Vitovsky	53.875	3.714	Yes
Wyatt Rd vs Mountain Peak	52.075	3.590	Yes
Wyatt Rd vs Triangle Park	42.675	2.942	No
Wyatt Rd vs Jaycee	40.800	4.447	Do Not Test
Wyatt Rd vs Water Tmt Plant	29.175	3.180	Do Not Test
Wyatt Rd vs Mid HS	27.475	1.894	Do Not Test
Wyatt Rd vs Collocated	24.875	2.711	Do Not Test
Collocated vs Vitovsky	29.000	1.999	No
Collocated vs Mountain Peak	27.200	1.875	Do Not Test
Collocated vs Triangle Park	17.800	1.227	Do Not Test
Collocated vs Jaycee	15.925	1.736	Do Not Test
Collocated vs Water Tmt Plant	4.300	0.469	Do Not Test
Collocated vs Mid HS	2.600	0.179	Do Not Test
Mid HS vs Vitovsky	26.400	1.439	Do Not Test
Mid HS vs Mountain Peak	24.600	1.341	Do Not Test
Mid HS vs Triangle Park	15.200	0.828	Do Not Test
Mid HS vs Jaycee	13.325	0.919	Do Not Test
Mid HS vs Water Tmt Plant	1.700	0.117	Do Not Test
Water Tmt Plant vs Vitovsky	24.700	1.703	Do Not Test
Water Tmt Pla vs Mountain Peak	22.900	1.579	Do Not Test
Water Tmt Pla vs Triangle Park	13.500	0.931	Do Not Test
Water Tmt Plant vs Jaycee	11.625	1.267	Do Not Test
Jaycee vs Vitovsky	13.075	0.901	Do Not Test
Jaycee vs Mountain Peak	11.275	0.777	Do Not Test
Jaycee vs Triangle Park	1.875	0.129	Do Not Test
Triangle Park vs Vitovsky	11.200	0.610	Do Not Test
Triangle Park vs Mountain Peak	9.400	0.512	Do Not Test
Mountain Peak vs Vitovsky	1.800	0.0981	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## E. Nickel

### I. Comparisons of Stationary Sites

#### One Way One-Way Analysis of Variance

Tuesday, April 13, 2010, 3:31:23 PM

**Data source:** Ni Site in Metals Site Comparison..JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Tuesday, April 13, 2010, 3:31:23 PM

Data source: Ni Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00105	0.000639	0.00140
Wyatt Rd	20	0	0.00213	0.000965	0.00328
Jaycee	20	0	0.000879	0.000651	0.00134
Water Tmt Plant	20	0	0.000963	0.000679	0.00127

H = 11.590 with 3 degrees of freedom. (P = 0.009)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.009)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee	455.500	4.383	Yes
Wyatt Rd vs Collocated	384.500	3.700	Yes
Wyatt Rd vs Water Tmt Plant	362.000	3.483	No
Water Tmt Plant vs Jaycee	93.500	0.900	No
Water Tmt Plant vs Collocated	22.500	0.217	Do Not Test
Collocated vs Jaycee	71.000	0.683	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

**II. Comparisons of Mobile Sites**

**One Way One-Way Analysis of Variance**

Friday, January 22, 2010, 11:18:59 AM

Data source: Ni Site in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.680)

Equal Variance Test: Passed (P = 0.505)

Group Name	N	Missing	Mean	Std Dev	SEM
Triangle Park	5	0	0.000764	0.000189	0.0000845
Mountain Peak	5	0	0.000837	0.000240	0.000107
Vitovsky	5	0	0.00115	0.000306	0.000137
Mid HS	5	0	0.000615	0.000160	0.0000715

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000000748	0.000000249	4.694	0.016
Residual	16	0.000000850	0.0000000531		
Total	19	0.00000160			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.016).

Power of performed test with alpha = 0.050: 0.694

All Pairwise All-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Vitovsky vs. Mid HS	0.000530	4	5.145	0.011	Yes
Vitovsky vs. Triangle Park	0.000381	3	3.700	0.047	Yes
Vitovsky vs. Mountain Peak	0.000308	2	2.988	0.051	No
Mountain Peak vs. Mid HS	0.000222	3	2.157	0.306	No
Mountain Pea vs. Triangle Par	0.0000734	2	0.712	0.622	Do Not Test

Triangle Park vs. Mid HS 0.000149 2 1.445 0.322 Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

### III. Comparisons of All Sites

#### One Way One-Way Analysis of Variance

Tuesday, April 13, 2010, 3:32:02 PM

Data source: Ni Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks Tuesday, April 13, 2010, 3:32:02 PM

Data source: Ni Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.00105	0.000639	0.00140
Wyatt Rd	20	0	0.00213	0.000965	0.00328
Jaycee	20	0	0.000879	0.000651	0.00134
Water Tmt Plant	20	0	0.000963	0.000679	0.00127
Triangle Park	5	0	0.000772	0.000625	0.000931
Mountain Peak	5	0	0.000773	0.000656	0.000996
Vitovsky	5	0	0.00128	0.000840	0.00138
Mid HS	5	0	0.000603	0.000490	0.000769

H = 20.504 with 7 degrees of freedom. (P = 0.005)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.005)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Wyatt Rd vs Mid HS	52.050	3.588	Yes
Wyatt Rd vs Triangle Park	38.950	2.685	No
Wyatt Rd vs Mountain Peak	33.050	2.278	Do Not Test
Wyatt Rd vs Jaycee	27.600	3.008	Do Not Test
Wyatt Rd vs Collocated	23.000	2.507	Do Not Test
Wyatt Rd vs Water Tmt Plant	21.900	2.387	Do Not Test
Wyatt Rd vs Vitovsky	12.950	0.893	Do Not Test
Vitovsky vs Mid HS	39.100	2.131	No
Vitovsky vs Triangle Park	26.000	1.417	Do Not Test
Vitovsky vs Mountain Peak	20.100	1.095	Do Not Test
Vitovsky vs Jaycee	14.650	1.010	Do Not Test
Vitovsky vs Collocated	10.050	0.693	Do Not Test
Vitovsky vs Water Tmt Plant	8.950	0.617	Do Not Test
Water Tmt Plant vs Mid HS	30.150	2.078	Do Not Test
Water Tmt Pla vs Triangle Park	17.050	1.175	Do Not Test
Water Tmt Pla vs Mountain Peak	11.150	0.769	Do Not Test
Water Tmt Plant vs Jaycee	5.700	0.621	Do Not Test
Water Tmt Plant vs Collocated	1.100	0.120	Do Not Test
Collocated vs Mid HS	29.050	2.003	Do Not Test
Collocated vs Triangle Park	15.950	1.100	Do Not Test
Collocated vs Mountain Peak	10.050	0.693	Do Not Test
Collocated vs Jaycee	4.600	0.501	Do Not Test

Jaycee vs Mid HS	24.450	1.686	Do Not Test
Jaycee vs Triangle Park	11.350	0.782	Do Not Test
Jaycee vs Mountain Peak	5.450	0.376	Do Not Test
Mountain Peak vs Mid HS	19.000	1.036	Do Not Test
Mountain Peak vs Triangle Park	5.900	0.322	Do Not Test
Triangle Park vs Mid HS	13.100	0.714	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

## F. Mercury

### I. Comparisons of Stationary Sites

#### One WayOne-Way Analysis of Variance

Tuesday, April 13, 2010, 3:50:57 PM

Data source: Hg Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksTuesday, April 13, 2010, 3:50:57 PM

Data source: Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Wyatt Rd	20	0	0.0000375	0.0000205	0.0000970
Jaycee	20	0	0.0000200	0.00000800	0.0000400
Water Tmt Plant	20	0	0.0000135	0.00000950	0.0000230

H = 9.932 with 3 degrees of freedom. (P = 0.019)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.019)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Water Tmt Plant	432.000	4.157	Yes
Wyatt Rd vs Jaycee	309.000	2.973	No
Wyatt Rd vs Collocated	143.000	1.376	Do Not Test
Collocated vs Water Tmt Plant	289.000	2.781	No
Collocated vs Jaycee	166.000	1.597	Do Not Test
Jaycee vs Water Tmt Plant	123.000	1.184	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### II. Comparisons of Mobile Sites

#### One WayOne-Way Analysis of Variance

Friday, January 22, 2010, 11:21:42 AM

Data source: Hg Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksFriday, January 22, 2010, 11:21:42 AM

Data source: Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0000280	0.0000227	0.0000833
Mountain Peak	5	0	0.000266	0.000230	0.000293
Vitovsky	5	0	0.00001000	0.00000775	0.0000150

Mid HS 5 0 0.00000600 0.00000600 0.00000825

H = 16.800 with 3 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Mountain Peak vs Mid HS	70.000	5.292	Yes
Mountain Peak vs Vitovsky	53.000	4.006	Yes
Mountain Peak vs Triangle Park	23.000	1.739	No
Triangle Park vs Mid HS	47.000	3.553	No
Triangle Park vs Vitovsky	30.000	2.268	Do Not Test
Vitovsky vs Mid HS	17.000	1.285	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### III. Comparisons of All Sites

#### One Way One-Way Analysis of Variance

Tuesday, April 13, 2010, 3:51:25 PM

Data source: Hg Site in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks Tuesday, April 13, 2010, 3:51:25 PM

Data source: Hg Site in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000280	0.0000145	0.000103
Wyatt Rd	20	0	0.0000375	0.0000205	0.0000970
Jaycee	20	0	0.0000200	0.00000800	0.0000400
Water Tmt Plant	20	0	0.0000135	0.00000950	0.0000230
Triangle Park	5	0	0.0000280	0.0000227	0.0000833
Mountain Peak	5	0	0.000266	0.000230	0.000293
Vitovsky	5	0	0.00001000	0.00000775	0.0000150
Mid HS	5	0	0.00000600	0.00000600	0.00000825

H = 32.411 with 7 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
Mountain Peak vs Mid HS	77.900	4.246	Yes
Mountain Peak vs Vitovsky	67.800	3.695	Yes
Mountain Peak vs Water Tmt Pla	53.800	3.709	Yes
Mountain Peak vs Jaycee	47.050	3.244	Yes
Mountain Peak vs Collocated	36.475	2.515	No
Mountain Peak vs Wyatt Rd	28.250	1.948	Do Not Test
Mountain Peak vs Triangle Park	28.000	1.526	Do Not Test
Triangle Park vs Mid HS	49.900	2.720	No
Triangle Park vs Vitovsky	39.800	2.169	Do Not Test

Triangle Park vs Water Tmt Pla	25.800	1.779	Do Not Test
Triangle Park vs Jaycee	19.050	1.313	Do Not Test
Triangle Park vs Collocated	8.475	0.584	Do Not Test
Triangle Park vs Wyatt Rd	0.250	0.0172	Do Not Test
Wyatt Rd vs Mid HS	49.650	3.423	Do Not Test
Wyatt Rd vs Vitovsky	39.550	2.727	Do Not Test
Wyatt Rd vs Water Tmt Plant	25.550	2.785	Do Not Test
Wyatt Rd vs Jaycee	18.800	2.049	Do Not Test
Wyatt Rd vs Collocated	8.225	0.897	Do Not Test
Collocated vs Mid HS	41.425	2.856	Do Not Test
Collocated vs Vitovsky	31.325	2.159	Do Not Test
Collocated vs Water Tmt Plant	17.325	1.888	Do Not Test
Collocated vs Jaycee	10.575	1.153	Do Not Test
Jaycee vs Mid HS	30.850	2.127	Do Not Test
Jaycee vs Vitovsky	20.750	1.430	Do Not Test
Jaycee vs Water Tmt Plant	6.750	0.736	Do Not Test
Water Tmt Plant vs Mid HS	24.100	1.661	Do Not Test
Water Tmt Plant vs Vitovsky	14.000	0.965	Do Not Test
Vitovsky vs Mid HS	10.100	0.550	Do Not Test

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Note: The multiple comparisons on ranks do not include an adjustment for ties.

*Appendix I – PM<sub>10</sub> Metals Site Comparisons: Individual Quarters of Data*

## A. 1<sup>st</sup> Quarter Metals PM<sub>10</sub> Data

### I. Aluminum

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:05:40 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:05:40 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Al Collocated	5	0	0.166	0.110	0.183
Wyatt Rd	5	0	0.303	0.133	0.456
Jaycee Park	5	0	0.0665	0.0529	0.0746
Water Treatment Plant	5	0	0.0846	0.0693	0.101
Triangle Park	5	0	0.0503	0.0421	0.0678

H = 8.043 with 4 degrees of freedom. (P = 0.090)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.090)

### II. Chromium

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:06:21 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:06:21 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Cr Collocated	5	0	0.00339	0.00212	0.00361
Wyatt Rd	5	0	0.00665	0.00316	0.00840
Jaycee Park	5	0	0.00187	0.00146	0.00234
Water Treatment Plant	5	0	0.00182	0.00163	0.00193
Triangle Park	5	0	0.00161	0.00133	0.00172

H = 11.564 with 4 degrees of freedom. (P = 0.021)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.021)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Triangle Park	69.500	4.223	Yes
Wyatt Rd vs Water Treatme	48.500	2.947	No
Wyatt Rd vs Jaycee Park	48.500	2.947	Do Not Test
Wyatt Rd vs Cr Collocated	16.000	0.972	Do Not Test
Cr Collocated vs Triangle Park	53.500	3.251	No
Cr Collocated vs Water Treatme	32.500	1.975	Do Not Test
Cr Collocated vs Jaycee Park	32.500	1.975	Do Not Test
Jaycee Park vs Triangle Park	21.000	1.276	Do Not Test
Jaycee Park vs Water Treatme	0.000	0.000	Do Not Test
Water Treatme vs Triangle Park	21.000	1.276	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant

difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### III. Manganese

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:07:02 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:07:02 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Mn Collocated	5	0	0.0329	0.0122	0.0348
Wyatt Rd	5	0	0.0924	0.0206	0.130
Jaycee Park	5	0	0.00668	0.00559	0.0133
Water Treatment Plant	5	0	0.0110	0.00835	0.0152
Triangle Park	5	0	0.00486	0.00412	0.00897

H = 7.894 with 4 degrees of freedom. (P = 0.096)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.096)

### IV. Lead

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:07:31 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:07:31 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Pb Collocated	5	0	0.00490	0.00369	0.00690
Wyatt Rd	5	0	0.0103	0.00760	0.0172
Jaycee Park	5	0	0.00312	0.00188	0.00602
Water Treatment Plant	5	0	0.00355	0.00211	0.00503
Triangle Park	5	0	0.00205	0.00153	0.00334

H = 5.808 with 4 degrees of freedom. (P = 0.214)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.214)

### V. Nickel

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:26:59 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:26:59 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Ni Collocated	5	0	0.00111	0.000973	0.00168
Wyatt Rd	5	0	0.00329	0.00233	0.00349

Jaycee Park	5	0	0.000680	0.000655	0.00209
Water Treatment Plant	5	0	0.000912	0.000636	0.000973
Triangle Park	5	0	0.000772	0.000625	0.000931

H = 6.683 with 4 degrees of freedom. (P = 0.154)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.154)

## VI. Mercury

### a. Comparison between sites

#### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 3:27:31 PM

Data source: Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 3:27:31 PM

Data source: Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Hg Collocated	5	0	0.0000320	0.0000103	0.0000612
Wyatt Rd	5	0	0.0000210	0.0000150	0.0000960
Jaycee Park	5	0	0.0000190	0.0000115	0.0000532
Water Treatment Plant	5	0	0.00000800	0.00000600	0.0000147
Triangle Park	5	0	0.0000280	0.0000227	0.0000833

H = 7.418 with 4 degrees of freedom. (P = 0.115)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.115)

## B. 2<sup>nd</sup> Quarter Metals Data

### I. Aluminum

#### a. Comparison between sites

#### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:13:09 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.509)

Equal Variance Test: Passed (P = 0.075)

Group Name	N	Missing	Mean	Std Dev	SEM
Al Collocated	5	0	0.107	0.0338	0.0151
Wyatt Rd	5	0	0.265	0.108	0.0484
Jaycee Park	5	0	0.107	0.0535	0.0239
Water Treatment Plant	5	0	0.118	0.0436	0.0195
Mountain Peak	5	0	0.0837	0.0408	0.0183

Source of Variation	DF	SS	MS	F	P
Between Groups	4	0.107	0.0267	6.922	0.001
Residual	20	0.0772	0.00386		
Total	24	0.184			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.001).

Power of performed test with alpha = 0.050: 0.956

All PairwiseAll-Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
Wyatt Rd vs. Mountain Peak	0.181	5	6.525	0.002	Yes
Wyatt Rd vs. Jaycee Park	0.158	4	5.686	0.004	Yes
Wyatt Rd vs. Al Collocated	0.158	3	5.679	0.002	Yes
Wyatt Rd vs. Water Treatm	0.147	2	5.298	0.001	Yes

Water Treatm vs. Mountain Peak	0.0341	4	1.228	0.821	No
Water Treatm vs. Jaycee Park	0.0108	3	0.389	0.959	Do Not Test
Water Treatm vs. Al Collocate	0.0106	2	0.381	0.791	Do Not Test
Al Collocate vs. Triangle Par	0.0235	3	0.847	0.822	Do Not Test
Al Collocated vs. Jaycee Park	0.000220	2	0.00792	0.996	Do Not Test
Jaycee Park vs. Mountain Peak	0.0233	2	0.839	0.560	Do Not Test

A result of "Do Not Test" occurs for a comparison when no significant difference is found between two means that enclose that comparison. For example, if you had four means sorted in order, and found no difference between means 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed means is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the means, even though one may appear to exist.

## II. Chromium

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Thursday, January 21, 2010, 4:13:43 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks Thursday, January 21, 2010, 4:13:43 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Cr Collocated	5	0	0.00220	0.00198	0.00275
Wyatt Rd	5	0	0.00426	0.00343	0.00583
Jaycee Park	5	0	0.00195	0.00169	0.00216
Water Treatment Plant	5	0	0.00177	0.00173	0.00197
Mountain Peak	5	0	0.00189	0.00162	0.00204

H = 15.006 with 4 degrees of freedom. (P = 0.005)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.005)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Mountain Peak	74.500	4.527	Yes
Wyatt Rd vs Water Treatme	73.000	4.436	Yes
Wyatt Rd vs Jaycee Park	63.500	3.859	Yes
Wyatt Rd vs Cr Collocated	34.000	2.066	No
Cr Collocated vs Mountain Peak	40.500	2.461	No
Cr Collocated vs Water Treatme	39.000	2.370	Do Not Test
Cr Collocated vs Jaycee Park	29.500	1.793	Do Not Test
Jaycee Park vs Mountain Peak	11.000	0.668	Do Not Test
Jaycee Park vs Water Treatme	9.500	0.577	Do Not Test
Water Treatme vs Mountain Peak	1.500	0.0911	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### III. Manganese

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:14:13 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:14:13 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Mn Collocated	5	0	0.0127	0.0104	0.0214
Wyatt Rd	5	0	0.0608	0.0450	0.0910
Jaycee Park	5	0	0.0102	0.00824	0.0184
Water Treatment Plant	5	0	0.0156	0.0104	0.0212
Mountain Peak	5	0	0.00707	0.00597	0.0111

H = 12.827 with 4 degrees of freedom. (P = 0.012)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.012)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Mountain Peak	81.000	4.922	Yes
Wyatt Rd vs Jaycee Park	57.000	3.464	No
Wyatt Rd vs Water Treatme	50.000	3.038	Do Not Test
Wyatt Rd vs Mn Collocated	47.000	2.856	Do Not Test
Mn Collocated vs Mountain Peak	34.000	2.066	No
Mn Collocated vs Jaycee Park	10.000	0.608	Do Not Test
Mn Collocated vs Water Treatme	3.000	0.182	Do Not Test
Water Treatme vs Mountain Peak	31.000	1.884	Do Not Test
Water Treatme vs Jaycee Park	7.000	0.425	Do Not Test
Jaycee Park vs Mountain Peak	24.000	1.458	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### IV. Lead

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:14:47 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:14:47 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Pb Collocated	5	0	0.00255	0.00215	0.00416
Wyatt Rd	5	0	0.00443	0.00389	0.0331
Jaycee Park	5	0	0.00221	0.00174	0.00244
Water Treatment Plant	5	0	0.00192	0.00165	0.00278
Mountain Peak	5	0	0.00197	0.00143	0.00232

H = 12.383 with 4 degrees of freedom. (P = 0.015)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.015)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Mountain Peak	72.000	4.375	Yes
Wyatt Rd vs Jaycee Park	63.500	3.859	Yes
Wyatt Rd vs Water Treatme	60.500	3.676	No
Wyatt Rd vs Pb Collocated	39.000	2.370	Do Not Test
Pb Collocated vs Mountain Peak	33.000	2.005	No
Pb Collocated vs Jaycee Park	24.500	1.489	Do Not Test
Pb Collocated vs Water Treatme	21.500	1.306	Do Not Test
Water Treatme vs Mountain Peak	11.500	0.699	Do Not Test
Water Treatme vs Jaycee Park	3.000	0.182	Do Not Test
Jaycee Park vs Mountain Peak	8.500	0.516	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

## V. Nickel

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Thursday, January 21, 2010, 4:15:21 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:15:21 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Ni Collocated	5	0	0.00101	0.000629	0.00137
Wyatt Rd	5	0	0.00205	0.00131	0.00261
Jaycee Park	5	0	0.00134	0.000885	0.00136
Water Treatment Plant	5	0	0.00124	0.000679	0.00144
Mountain Peak	5	0	0.000773	0.000656	0.000996

H = 7.380 with 4 degrees of freedom. (P = 0.117)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.117)

## VI. Mercury

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Thursday, January 21, 2010, 4:15:46 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:15:46 PM

Data source: Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Hg Collocated	5	0	0.000320	0.000137	0.000373

Wyatt Rd	5	0	0.0000700	0.0000582	0.000293
Jaycee Park	5	0	0.0000580	0.0000375	0.000203
Water Treatment Plant	5	0	0.0000620	0.0000497	0.0000827
Mountain Peak	5	0	0.000266	0.000230	0.000293

H = 7.945 with 4 degrees of freedom. (P = 0.094)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.094)

### C. 3<sup>rd</sup> Quarter Metals Data

#### I. Aluminum

##### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:16:35 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks Thursday, January 21, 2010, 4:16:35 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Al Collocated	5	0	0.118	0.0964	0.162
Wyatt Rd	5	0	0.212	0.184	0.383
Jaycee Park	5	0	0.0938	0.0658	0.144
Water Treatment Plant	5	0	0.112	0.0712	0.126
Vitovsky	5	0	0.0878	0.0705	0.113

H = 10.626 with 4 degrees of freedom. (P = 0.031)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.031)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Vitovsky	67.000	4.071	Yes
Wyatt Rd vs Jaycee Park	60.000	3.646	No
Wyatt Rd vs Water Treatme	55.000	3.342	Do Not Test
Wyatt Rd vs Al Collocated	38.000	2.309	Do Not Test
Al Collocated vs Vitovsky	29.000	1.762	No
Al Collocated vs Jaycee Park	22.000	1.337	Do Not Test
Al Collocated vs Water Treatme	17.000	1.033	Do Not Test
Water Treatme vs Vitovsky	12.000	0.729	Do Not Test
Water Treatme vs Jaycee Park	5.000	0.304	Do Not Test
Jaycee Park vs Vitovsky	7.000	0.425	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

#### II. Chromium

##### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:17:06 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Thursday, January 21, 2010, 4:17:06 PM

**Data source:** Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Cr Collocated	5	0	0.00259	0.00227	0.00364
Wyatt Rd	5	0	0.00474	0.00359	0.00826
Jaycee Park	5	0	0.00214	0.00214	0.00234
Water Treatment Plant	5	0	0.00222	0.00213	0.00246
Vitovsky	5	0	0.00264	0.00232	0.00287

H = 14.265 with 4 degrees of freedom. (P = 0.006)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.006)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee Park	77.000	4.679	Yes
Wyatt Rd vs Water Treatme	70.000	4.254	Yes
Wyatt Rd vs Cr Collocated	35.500	2.157	No
Wyatt Rd vs Triangle Park	35.000	2.127	Do Not Test
Vitovsky vs Jaycee Park	42.000	2.552	No
Vitovsky vs Water Treatme	35.000	2.127	Do Not Test
Vitovsky vs Cr Collocated	0.500	0.0304	Do Not Test
Cr Collocated vs Jaycee Park	41.500	2.522	Do Not Test
Cr Collocated vs Water Treatme	34.500	2.096	Do Not Test
Water Treatme vs Jaycee Park	7.000	0.425	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### III. Manganese

#### a. Comparison between sites

**One Way One-Way Analysis of Variance**

Thursday, January 21, 2010, 4:17:32 PM

**Data source:** Copy of Copy of Data 7 in Metals Site Comparison.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks** Thursday, January 21, 2010, 4:17:32 PM

**Data source:** Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Mn Collocated	5	0	0.00866	0.00537	0.0208
Wyatt Rd	5	0	0.0372	0.0320	0.107
Jaycee Park	5	0	0.00360	0.00322	0.00783
Water Treatment Plant	5	0	0.00530	0.00409	0.00610
Vitovsky	5	0	0.00873	0.00534	0.0117

H = 14.149 with 4 degrees of freedom. (P = 0.007)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.007)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee Park	76.000	4.618	Yes
Wyatt Rd vs Water Treatme	74.000	4.497	Yes
Wyatt Rd vs Vitovsky	45.000	2.734	No
Wyatt Rd vs Mn Collocated	40.000	2.431	Do Not Test
Mn Collocated vs Jaycee Park	36.000	2.188	No
Mn Collocated vs Water Treatme	34.000	2.066	Do Not Test
Mn Collocated vs Vitovsky	5.000	0.304	Do Not Test
Vitovsky vs Jaycee Park	31.000	1.884	Do Not Test
Vitovsky vs Water Treatme	29.000	1.762	Do Not Test
Water Treatme vs Jaycee Park	2.000	0.122	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

#### IV. Lead

##### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Thursday, January 21, 2010, 4:18:01 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:18:01 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Pb Collocated	5	0	0.00214	0.00163	0.00380
Wyatt Rd	5	0	0.0151	0.00561	0.0277
Jaycee Park	5	0	0.00137	0.00134	0.00192
Water Treatment Plant	5	0	0.00223	0.00161	0.00846
Vitovsky	5	0	0.00171	0.00159	0.00210

H = 10.987 with 4 degrees of freedom. (P = 0.027)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.027)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Jaycee Park	72.500	4.405	Yes
Wyatt Rd vs Vitovsky	58.500	3.555	No
Wyatt Rd vs Pb Collocated	42.500	2.582	Do Not Test
Wyatt Rd vs Water Treatme	39.000	2.370	Do Not Test
Water Treatme vs Jaycee Park	33.500	2.036	No
Water Treatme vs Vitovsky	19.500	1.185	Do Not Test
Water Treatme vs Pb Collocated	3.500	0.213	Do Not Test
Pb Collocated vs Jaycee Park	30.000	1.823	Do Not Test
Pb Collocated vs Vitovsky	16.000	0.972	Do Not Test
Vitovsky vs Jaycee Park	14.000	0.851	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant

difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

## V. Nickel

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Thursday, January 21, 2010, 4:18:28 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:18:28 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Ni Collocated	5	0	0.00109	0.000773	0.00130
Wyatt Rd	5	0	0.00153	0.00124	0.00299
Jaycee Park	5	0	0.000959	0.000889	0.00118
Water Treatment Plant	5	0	0.00120	0.000968	0.00490
Vitovsky	5	0	0.00128	0.000840	0.00138

H = 4.918 with 4 degrees of freedom. (P = 0.296)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.296)

## VI. Mercury

### a. Comparison between sites

#### One Way One-Way Analysis of Variance

Thursday, January 21, 2010, 4:18:52 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Thursday, January 21, 2010, 4:18:52 PM

Data source: Copy of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Hg Collocated	5	0	0.0000230	0.0000135	0.0000280
Wyatt Rd	5	0	0.0000680	0.0000355	0.000136
Jaycee Park	5	0	0.00000600	0.00000400	0.0000243
Water Treatment Plant	5	0	0.0000120	0.0000113	0.0000188
Vitovsky	5	0	0.00001000	0.00000775	0.0000150

H = 12.395 with 4 degrees of freedom. (P = 0.015)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.015)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Vitovsky	70.000	4.254	Yes
Wyatt Rd vs Jaycee Park	69.500	4.223	Yes
Wyatt Rd vs Water Treatme	55.000	3.342	No
Wyatt Rd vs Hg Collocated	40.500	2.461	Do Not Test
Hg Collocated vs Vitovsky	29.500	1.793	No
Hg Collocated vs Jaycee Park	29.000	1.762	Do Not Test
Hg Collocated vs Water Treatme	14.500	0.881	Do Not Test
Water Treatme vs Vitovsky	15.000	0.911	Do Not Test
Water Treatme vs Jaycee Park	14.500	0.881	Do Not Test

Jaycee Park vs Vitovsky 0.500 0.0304 Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

## D. 4<sup>th</sup> Quarter Metals Data

### I. Aluminum

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Tuesday, April 20, 2010, 11:36:36 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Passed (P = 0.785)

Equal Variance Test: Passed (P = 0.359)

Group Name	N	Missing	Mean	Std Dev	SEM
Al Collocated	5	0	0.122	0.0594	0.0266
Wyatt Rd	5	0	0.194	0.111	0.0495
Jaycee Park	5	0	0.0682	0.0368	0.0165
Water Treatment Plant	5	0	0.159	0.0663	0.0297
Midlothian HS	5	0	0.0798	0.0573	0.0256

Source of Variation	DF	SS	MS	F	P
Between Groups	4	0.0558	0.0140	2.808	0.053
Residual	20	0.0994	0.00497		
Total	24	0.155			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.053).

Power of performed test with alpha = 0.050: 0.446

The power of the performed test (0.446) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### II. Chromium

#### a. Comparison between sites

##### One WayOne-Way Analysis of Variance

Tuesday, April 20, 2010, 11:33:48 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks Tuesday, April 20, 2010, 11:33:48 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Cr Collocated	5	0	0.00241	0.00230	0.00332
Wyatt Rd	5	0	0.00294	0.00237	0.00525
Jaycee Park	5	0	0.00200	0.00195	0.00226
Water Treatment Plant	5	0	0.00221	0.00219	0.00230
Midlothian HS	5	0	0.00204	0.00191	0.00207

H = 13.994 with 4 degrees of freedom. (P = 0.007)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.007)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Midlothian HS	73.000	4.436	Yes
Wyatt Rd vs Jaycee Park	57.500	3.494	No
Wyatt Rd vs Water Treatme	28.500	1.732	Do Not Test
Wyatt Rd vs Cr Collocated	11.000	0.668	Do Not Test
Cr Collocated vs Midlothian HS	62.000	3.767	No
Cr Collocated vs Jaycee Park	46.500	2.826	Do Not Test
Cr Collocated vs Water Treatme	17.500	1.063	Do Not Test
Water Treatme vs Midlothian HS	44.500	2.704	Do Not Test
Water Treatme vs Jaycee Park	29.000	1.762	Do Not Test
Jaycee Park vs Midlothian HS	15.500	0.942	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### III. Manganese

#### a. Comparison between sites

##### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 11:34:23 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Tuesday, April 20, 2010, 11:34:23 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Mn Collocated	5	0	0.00875	0.00617	0.0193
Wyatt Rd	5	0	0.0233	0.0105	0.0506
Jaycee Park	5	0	0.00601	0.00316	0.00987
Water Treatment Plant	5	0	0.0134	0.00654	0.0190
Midlothian HS	5	0	0.00487	0.00355	0.00630

H = 9.866 with 4 degrees of freedom. (P = 0.043)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.043)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise All-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Midlothian HS	64.000	3.889	Yes
Wyatt Rd vs Jaycee Park	54.000	3.281	No
Wyatt Rd vs Water Treatme	24.000	1.458	Do Not Test
Wyatt Rd vs Mn Collocated	23.000	1.398	Do Not Test
Mn Collocated vs Midlothian HS	41.000	2.491	No
Mn Collocated vs Jaycee Park	31.000	1.884	Do Not Test
Mn Collocated vs Water Treatme	1.000	0.0608	Do Not Test
Water Treatme vs Midlothian HS	40.000	2.431	Do Not Test
Water Treatme vs Jaycee Park	30.000	1.823	Do Not Test
Jaycee Park vs Midlothian HS	10.000	0.608	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

#### IV. Lead

##### a. Comparison between sites

###### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 11:34:49 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Tuesday, April 20, 2010, 11:34:49 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Pb Collocated	5	0	0.00333	0.00230	0.00415
Wyatt Rd	5	0	0.00478	0.00295	0.0140
Jaycee Park	5	0	0.00270	0.00185	0.00323
Water Treatment Plant	5	0	0.00338	0.00273	0.00415
Midlothian HS	5	0	0.00299	0.00228	0.00313

H = 4.746 with 4 degrees of freedom. (P = 0.314)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.314)

#### V. Nickel

##### a. Comparison between sites

###### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 11:35:22 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Tuesday, April 20, 2010, 11:35:22 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
Ni Collocated	5	0	0.000619	0.000509	0.00104
Wyatt Rd	5	0	0.00104	0.000630	0.00304
Jaycee Park	5	0	0.000543	0.000469	0.000680
Water Treatment Plant	5	0	0.000677	0.000522	0.00141
Midlothian HS	5	0	0.000603	0.000490	0.000769

H = 4.652 with 4 degrees of freedom. (P = 0.325)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.325)

#### VI. Mercury

##### a. Comparison between sites

###### One Way One-Way Analysis of Variance

Tuesday, April 20, 2010, 11:35:46 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

###### Kruskal-Wallis One Way One-Way Analysis of Variance on Ranks

Tuesday, April 20, 2010, 11:35:46 AM

Data source: Copy (2) of Copy of Data 7 in Metals Site Comparison.JNB

Group	N	Missing	Median	25%	75%
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Hg Collocated	5	0	0.0000150	0.0000130	0.0000250
Wyatt Rd	5	0	0.0000200	0.0000133	0.0000343
Jaycee Park	5	0	0.0000150	0.00000575	0.0000232
Water Treatment Plant	5	0	0.00001000	0.00000950	0.0000145
Midlothian HS	5	0	0.00000600	0.00000600	0.00000825

---

H = 8.057 with 4 degrees of freedom. (P = 0.090)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.090)

## *Appendix J – Metals Seasonal Variation Comparisons*

## I. Collocated

### a. Aluminum

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:48:06 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.992)

Equal Variance Test: Passed (P = 0.836)

Group Name	N	Missing	Mean	Std Dev	SEM
Al-1st Quarter	5	0	0.142	0.0582	0.0260
2nd Quarter	5	0	0.107	0.0338	0.0151
3rd Quarter	5	0	0.135	0.0608	0.0272
4th Quarter	5	0	0.122	0.0594	0.0266

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00358	0.00119	0.407	0.750
Residual	16	0.0470	0.00294		
Total	19	0.0506			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.750).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### b. Chromium

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:48:33 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.144)

Equal Variance Test: Passed (P = 0.881)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr-1st Q	5	0	0.00297	0.000915	0.000409
2nd Q	5	0	0.00245	0.000695	0.000311
3rd Q	5	0	0.00303	0.00111	0.000498
4th Q	5	0	0.00281	0.000780	0.000349

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000103	0.000000342	0.432	0.733
Residual	16	0.0000127	0.000000792		
Total	19	0.0000137			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.733).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### c. Manganese

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:48:56 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.312)

Equal Variance Test: Passed (P = 0.902)

Group Name	N	Missing	Mean	Std Dev	SEM
Mn-1st Q	5	0	0.0246	0.0140	0.00627
2nd Q	5	0	0.0165	0.00949	0.00424
3rd Q	5	0	0.0143	0.0140	0.00627

4th Q 5 0 0.0129 0.00995 0.00445

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000406	0.000135	0.930	0.449
Residual	16	0.00233	0.000145		
Total	19	0.00273			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.449).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### d. Lead

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:49:36 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 11:49:36 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Pb-1st Q	5	0	0.00490	0.00369	0.00690
2nd Q	5	0	0.00255	0.00215	0.00416
3rd Q	5	0	0.00214	0.00163	0.00380
4th Q	5	0	0.00333	0.00230	0.00415

H = 2.939 with 3 degrees of freedom. (P = 0.401)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.401)

#### e. Nickel

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:50:01 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.296)

Equal Variance Test: Passed (P = 0.923)

Group Name	N	Missing	Mean	Std Dev	SEM
Ni-1st Q	5	0	0.00124	0.000457	0.000205
2nd Q	5	0	0.00100	0.000399	0.000178
3rd Q	5	0	0.00108	0.000346	0.000155
4th Q	5	0	0.000803	0.000411	0.000184

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000000501	0.000000167	1.017	0.411
Residual	16	0.00000263	0.000000164		
Total	19	0.00000313			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.411).

Power of performed test with alpha = 0.050: 0.052

The power of the performed test (0.052) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Mercury

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:50:50 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way Analysis of Variance on Ranks**

Tuesday, June 01, 2010, 11:50:50 AM

**Data source:** Collocated-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Hg-1st Q	5	0	0.0000320	0.0000103	0.0000612
2nd Q	5	0	0.000320	0.000137	0.000373
3rd Q	5	0	0.0000230	0.0000135	0.0000280
4th Q	5	0	0.0000150	0.0000130	0.0000250

H = 10.459 with 3 degrees of freedom. (P = 0.015)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.015)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
2nd Q vs 4th Q	53.000	4.006	Yes
2nd Q vs 3rd Q	50.000	3.780	Yes
2nd Q vs Hg-1st Q	43.000	3.250	No
Hg-1st Q vs 4th Q	10.000	0.756	No
Hg-1st Q vs 3rd Q	7.000	0.529	Do Not Test
3rd Q vs 4th Q	3.000	0.227	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

**g. Hexavalent Chromium**

**One Way Analysis of Variance**

Tuesday, June 01, 2010, 11:51:12 AM

**Data source:** Collocated-Metals in Monitor Comparisons.JNB

**Normality Test:** Passed (P = 0.193)

**Equal Variance Test:** Passed (P = 0.090)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr6+-1st Q	5	0	0.0000965	0.000109	0.0000486
2nd Q	5	0	0.0000413	0.0000429	0.0000192
3rd Q	5	0	0.0000380	0.0000400	0.0000179
4th Q	5	0	0.0000447	0.0000473	0.0000212

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000000115	0.00000000384	0.879	0.473
Residual	16	0.0000000699	0.00000000437		
Total	19	0.0000000814			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.473).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

**II. Wyatt Rd**

**a. Aluminum**

### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:16:11 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.090)

Equal Variance Test: Passed (P = 0.642)

Group Name	N	Missing	Mean	Std Dev	SEM
Al-1st Quarter	5	0	0.309	0.235	0.105
2nd Quarter	5	0	0.265	0.108	0.0484
3rd Quarter	5	0	0.310	0.224	0.1000
4th Quarter	5	0	0.194	0.111	0.0495

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0450	0.0150	0.465	0.711
Residual	16	0.516	0.0323		
Total	19	0.561			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.711).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### b. Chromium

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:17:43 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.232)

Equal Variance Test: Passed (P = 0.734)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr-1st Q	5	0	0.00595	0.00322	0.00144
2nd Q	5	0	0.00501	0.00294	0.00131
3rd Q	5	0	0.00605	0.00364	0.00163
4th Q	5	0	0.00379	0.00188	0.000841

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000166	0.00000552	0.616	0.614
Residual	16	0.000143	0.00000896		
Total	19	0.000160			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.614).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### c. Manganese

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:18:18 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.378)

Equal Variance Test: Passed (P = 0.492)

Group Name	N	Missing	Mean	Std Dev	SEM
Mn-1st Q	5	0	0.0807	0.0652	0.0292
2nd Q	5	0	0.0715	0.0487	0.0218
3rd Q	5	0	0.0683	0.0586	0.0262
4th Q	5	0	0.0306	0.0247	0.0110

Source of Variation	DF	SS	MS	F	P
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Between Groups	3	0.00732	0.00244	0.916	0.455
Residual	16	0.0426	0.00267		
Total	19	0.0500			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.455).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### d. Lead

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:19:49 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:19:49 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Pb-1st Q	5	0	0.0103	0.00760	0.0172
2nd Q	5	0	0.00443	0.00389	0.0331
3rd Q	5	0	0.0151	0.00561	0.0277
4th Q	5	0	0.00478	0.00295	0.0140

H = 1.160 with 3 degrees of freedom. (P = 0.763)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.763)

#### e. Nickel

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:20:09 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.747)

Equal Variance Test: Passed (P = 0.965)

Group Name	N	Missing	Mean	Std Dev	SEM
Ni-1st Q	5	0	0.00283	0.00132	0.000589
2nd Q	5	0	0.00206	0.00114	0.000509
3rd Q	5	0	0.00212	0.00133	0.000594
4th Q	5	0	0.00169	0.00132	0.000591

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000337	0.00000112	0.688	0.573
Residual	16	0.0000262	0.00000163		
Total	19	0.0000295			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.573).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Mercury

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:20:34 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way Analysis of Variance on Ranks**  
**Data source:** Wyatt Rd-Metals in Monitor Comparisons.JNB

Tuesday, June 01, 2010, 1:20:34 PM

Group	N	Missing	Median	25%	75%
Hg-1st Q	5	0	0.0000210	0.0000150	0.0000960
2nd Q	5	0	0.0000700	0.0000582	0.000293
3rd Q	5	0	0.0000680	0.0000355	0.000136
4th Q	5	0	0.0000200	0.0000133	0.0000343

H = 7.188 with 3 degrees of freedom. (P = 0.066)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.066)

**g. Hexavalent Chromium**

**One Way Analysis of Variance**

Tuesday, June 01, 2010, 1:20:55 PM

**Data source:** Wyatt Rd-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way Analysis of Variance on Ranks**

Tuesday, June 01, 2010, 1:20:55 PM

**Data source:** Wyatt Rd-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Cr6+-1st Q	5	0	0.0000192	0.00000251	0.000215
2nd Q	5	0	0.0000609	0.00000215	0.0000897
3rd Q	5	0	0.0000340	0.0000269	0.0000427
4th Q	5	0	0.0000361	0.00000215	0.0000612

H = 0.190 with 3 degrees of freedom. (P = 0.979)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.979)

**III. Jaycee Park**

**a. Aluminum**

**One Way Analysis of Variance**

Tuesday, June 01, 2010, 12:48:24 PM

**Data source:** Jaycee Park-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way Analysis of Variance on Ranks**

Tuesday, June 01, 2010, 12:48:24 PM

**Data source:** Jaycee Park-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Al-1st Quarter	5	0	0.0665	0.0529	0.0746
2nd Quarter	5	0	0.0786	0.0764	0.132
3rd Quarter	5	0	0.0938	0.0658	0.144
4th Quarter	5	0	0.0686	0.0338	0.0992

H = 4.623 with 3 degrees of freedom. (P = 0.202)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.202)

**b. Chromium**

**One Way Analysis of Variance**

Tuesday, June 01, 2010, 1:09:12 PM

**Data source:** Jaycee Park-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One Way Analysis of Variance on Ranks**

Tuesday, June 01, 2010, 1:09:12 PM

**Data source:** Jaycee Park-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Cr-1st Q	5	0	0.00187	0.00146	0.00234
2nd Q	5	0	0.00195	0.00169	0.00216
3rd Q	5	0	0.00214	0.00214	0.00234
4th Q	5	0	0.00200	0.00195	0.00226

H = 5.559 with 3 degrees of freedom. (P = 0.135)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.135)

### c. Manganese

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:09:40 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:09:40 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Mn-1st Q	5	0	0.00668	0.00559	0.0133
2nd Q	5	0	0.0102	0.00824	0.0184
3rd Q	5	0	0.00360	0.00322	0.00783
4th Q	5	0	0.00601	0.00316	0.00987

H = 5.720 with 3 degrees of freedom. (P = 0.126)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.126)

### d. Lead

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:10:12 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.185)

Equal Variance Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:10:12 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Pb-1st Q	5	0	0.00312	0.00188	0.00602
2nd Q	5	0	0.00221	0.00174	0.00244
3rd Q	5	0	0.00137	0.00134	0.00192
4th Q	5	0	0.00270	0.00185	0.00323

H = 4.989 with 3 degrees of freedom. (P = 0.173)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.173)

### e. Nickel

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:10:36 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.279)

Equal Variance Test: Passed (P = 0.321)

Group Name	N	Missing	Mean	Std Dev	SEM
Ni-1st Q	5	0	0.00125	0.000809	0.000362
2nd Q	5	0	0.00114	0.000322	0.000144
3rd Q	5	0	0.00106	0.000251	0.000112
4th Q	5	0	0.000575	0.000171	0.0000767

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000133	0.000000443	2.084	0.143
Residual	16	0.00000340	0.000000213		
Total	19	0.00000473			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.143).

Power of performed test with alpha = 0.050: 0.233

The power of the performed test (0.233) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### f. Mercury

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:11:07 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:11:07 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Hg-1st Q	5	0	0.0000190	0.0000115	0.0000532
2nd Q	5	0	0.0000580	0.0000375	0.000203
3rd Q	5	0	0.00000600	0.00000400	0.0000243
4th Q	5	0	0.0000150	0.00000575	0.0000232

H = 8.885 with 3 degrees of freedom. (P = 0.031)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.031)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
2nd Q vs 3rd Q	51.500	3.893	Yes
2nd Q vs 4th Q	43.500	3.288	No
2nd Q vs Hg-1st Q	27.000	2.041	Do Not Test
Hg-1st Q vs 3rd Q	24.500	1.852	No
Hg-1st Q vs 4th Q	16.500	1.247	Do Not Test
4th Q vs 3rd Q	8.000	0.605	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

#### g. Hexavalent Chromium

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:11:30 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.078)

Equal Variance Test: Passed (P = 0.498)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr6+-1st Q	5	0	0.0000218	0.0000252	0.0000113
2nd Q	5	0	0.0000107	0.0000118	0.00000526
3rd Q	5	0	0.0000119	0.00000896	0.00000401

4th Q 5 0 0.0000191 0.0000197 0.00000881

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000000000441	0.000000000147	0.474	0.705
Residual	16	0.00000000496	0.000000000310		
Total	19	0.00000000540			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.705).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### IV. Water Treatment Plant

##### a. Aluminum

###### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:12:11 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.907)

Equal Variance Test: Passed (P = 0.262)

Group Name	N	Missing	Mean	Std Dev	SEM
Al-1st Quarter	5	0	0.0885	0.0366	0.0164
2nd Quarter	5	0	0.118	0.0436	0.0195
3rd Quarter	5	0	0.102	0.0319	0.0143
4th Quarter	5	0	0.159	0.0663	0.0297

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0138	0.00460	2.127	0.137
Residual	16	0.0346	0.00216		
Total	19	0.0484			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.137).

Power of performed test with alpha = 0.050: 0.241

The power of the performed test (0.241) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

##### b. Chromium

###### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:12:44 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.451)

Equal Variance Test: Passed (P = 0.334)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr-1st Q	5	0	0.00179	0.000175	0.0000781
2nd Q	5	0	0.00184	0.000172	0.0000768
3rd Q	5	0	0.00228	0.000204	0.0000910
4th Q	5	0	0.00225	0.0000819	0.0000366

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.00000101	0.000000337	12.474	<0.001
Residual	16	0.000000432	0.0000000270		
Total	19	0.00000144			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.997

All Pairwise Multiple Comparison Procedures (Student-Newman-Keuls Method) :

Comparisons for factor:

Comparison	Diff of Means	p	q	P	P<0.050
3rd Q vs. Cr-1st Q	0.000486	4	6.611	0.001	Yes
3rd Q vs. 2nd Q	0.000438	3	5.958	0.002	Yes
3rd Q vs. 4th Q	0.0000280	2	0.381	0.791	No
4th Q vs. Cr-1st Q	0.000458	3	6.230	0.001	Yes
4th Q vs. 2nd Q	0.000410	2	5.577	0.001	Yes
2nd Q vs. Cr-1st Q	0.0000480	2	0.653	0.651	No

### c. Manganese

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:13:26 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.561)

Equal Variance Test: Passed (P = 0.107)

Group Name	N	Missing	Mean	Std Dev	SEM
Mn-1st Q	5	0	0.0115	0.00555	0.00248
2nd Q	5	0	0.0153	0.00737	0.00330
3rd Q	5	0	0.00533	0.00194	0.000869
4th Q	5	0	0.0136	0.00965	0.00432

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000286	0.0000955	2.097	0.141
Residual	16	0.000729	0.0000455		
Total	19	0.00102			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.141).

Power of performed test with alpha = 0.050: 0.236

The power of the performed test (0.236) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### d. Lead

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:14:00 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:14:00 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Pb-1st Q	5	0	0.00355	0.00211	0.00503
2nd Q	5	0	0.00192	0.00165	0.00278
3rd Q	5	0	0.00223	0.00161	0.00846
4th Q	5	0	0.00338	0.00273	0.00415

H = 2.971 with 3 degrees of freedom. (P = 0.396)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.396)

### e. Nickel

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:14:31 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:14:31 PM

**Data source:** Water Treatment Plant-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Ni-1st Q	5	0	0.000912	0.000636	0.000973
2nd Q	5	0	0.00124	0.000679	0.00144
3rd Q	5	0	0.00120	0.000968	0.00490
4th Q	5	0	0.000677	0.000522	0.00141

H = 5.583 with 3 degrees of freedom. (P = 0.134)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.134)

#### f. Mercury

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:15:01 PM

**Data source:** Water Treatment Plant-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:15:01 PM

**Data source:** Water Treatment Plant-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Hg-1st Q	5	0	0.00000800	0.00000600	0.0000147
2nd Q	5	0	0.0000620	0.0000497	0.0000827
3rd Q	5	0	0.0000120	0.0000113	0.0000188
4th Q	5	0	0.00001000	0.00000950	0.0000145

H = 11.383 with 3 degrees of freedom. (P = 0.010)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.010)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
2nd Q vs Hg-1st Q	58.500	4.422	Yes
2nd Q vs 4th Q	49.500	3.742	Yes
2nd Q vs 3rd Q	38.000	2.873	No
3rd Q vs Hg-1st Q	20.500	1.550	No
3rd Q vs 4th Q	11.500	0.869	Do Not Test
4th Q vs Hg-1st Q	9.000	0.680	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

#### g. Hexavalent Chromium

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:15:28 PM

**Data source:** Water Treatment Plant-Metals in Monitor Comparisons.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:15:28 PM

**Data source:** Water Treatment Plant-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Cr6+-1st Q	5	0	0.0000210	0.00000366	0.0000329
2nd Q	5	0	0.00000215	0.00000215	0.00000215

3rd Q	5	0	0.00000215	0.00000215	0.0000198
4th Q	5	0	0.0000204	0.0000126	0.0000522

H = 11.824 with 3 degrees of freedom. (P = 0.008)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.008)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
4th Q vs 2nd Q	53.500	4.044	Yes
4th Q vs 3rd Q	35.500	2.684	No
4th Q vs Cr6+-1st Q	5.000	0.378	Do Not Test
Cr6+-1st Q vs 2nd Q	48.500	3.666	Yes
Cr6+-1st Q vs 3rd Q	30.500	2.306	Do Not Test
3rd Q vs 2nd Q	18.000	1.361	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

*Appendix K – Raw Data Graphs*

## VOCs

### I. Comparisons with All 4 Quarters of Data

Comparison of Benzene for All 4 Quarters  
at All of the Monitoring Locations

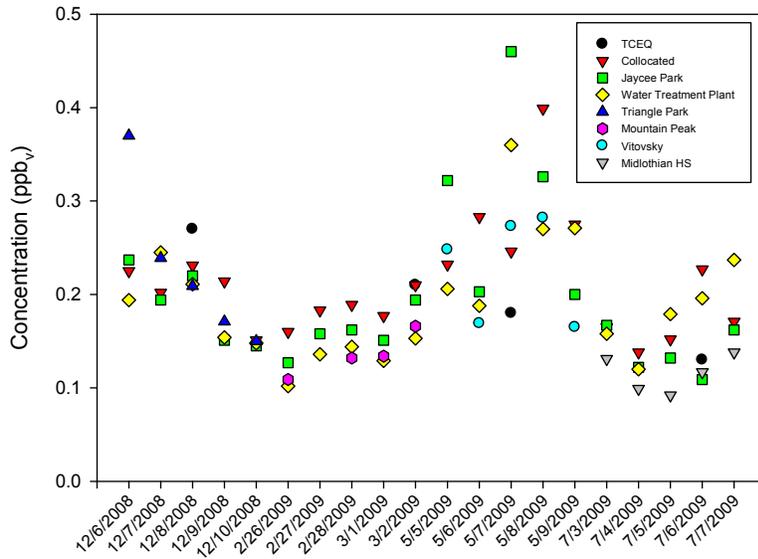


Figure K- 1. Monitoring Site Comparisons for Benzene for All Four Quarters of Data.

Comparison of 1,3-Butadiene for All 4 Quarters  
at All Sampling Locations

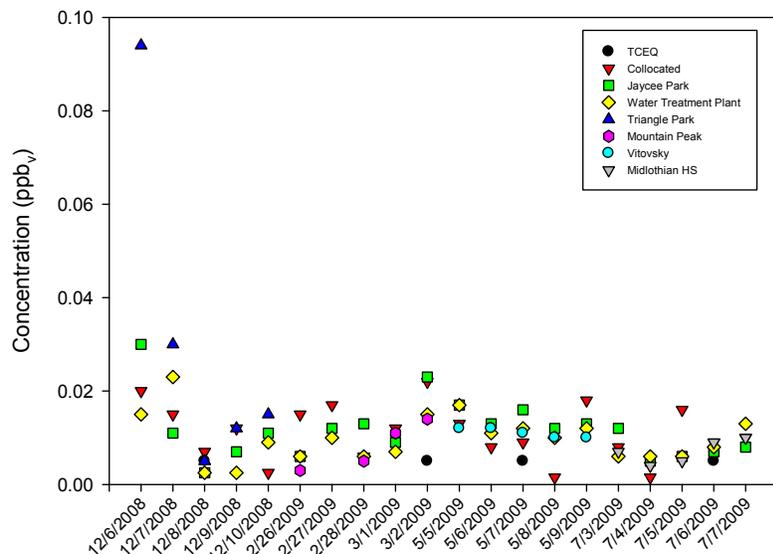


Figure K- 2. Monitoring Site Comparisons for 1,3-Butadiene for All Four Quarters of Data.

Comparison of Toluene for All 4 Quarters  
at All Sampling Locations

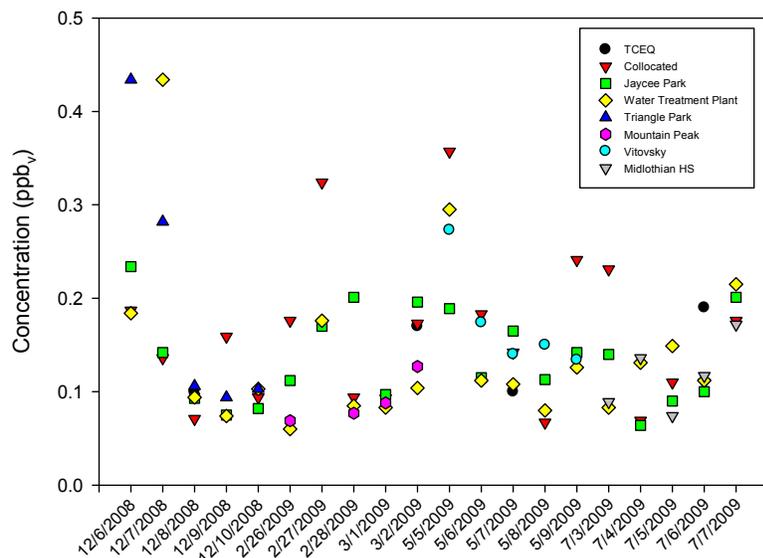


Figure K- 3. Monitoring Site Comparisons for Toluene for All Four Quarters of Data.

Comparison of Ethylbenzene for All 4 Quarters  
at All Sampling Locations

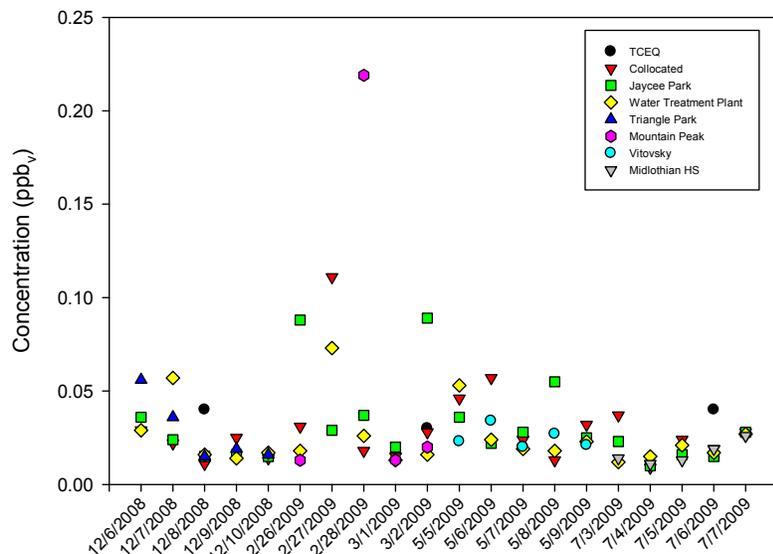


Figure K- 4. Monitoring Site Comparisons for Ethylbenzene for All Four Quarters of Data.

Comparison of *p+m*-Xylene for All 4 Quarters  
at All Sampling Locations

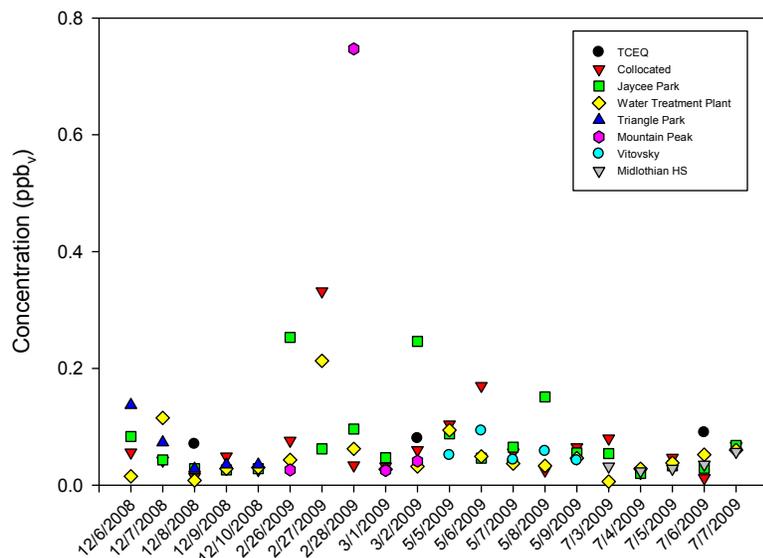


Figure K- 5. Monitoring Site Comparisons for *p+m*-Xylene for All Four Quarters of Data.

Comparison of *o*-Xylene for All 4 Quarters  
at All Sampling Locations

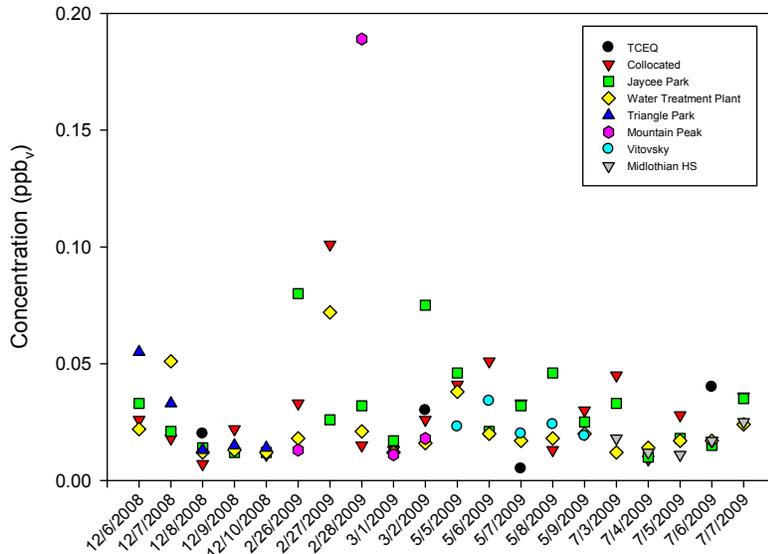


Figure K- 6. Monitoring Site Comparisons for *o*-Xylene for All Four Quarters of Data.

*II. Comparisons of Individual Quarterly Data*

1st Quarter Comparison of Sampling Sites: Benzene

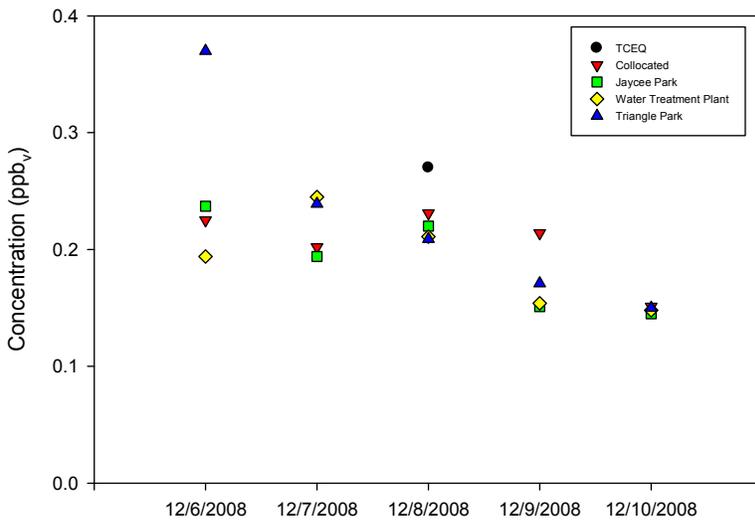


Figure K- 7. First Quarter Comparison of Sampling Sites: Benzene.

1st Quarter Comparison of Sampling Sites: 1,3-Butadiene

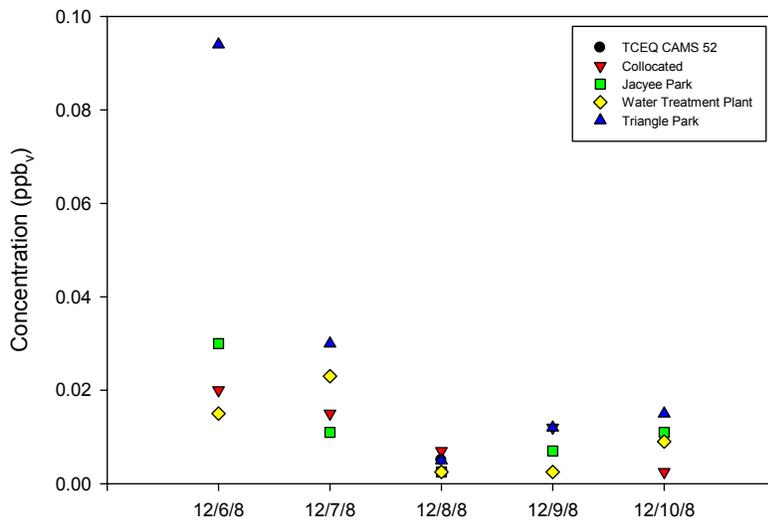


Figure K- 8. First Quarter Comparison of Sampling Sites: 1,3-Butadiene.

1st Quarter Comparison of Sampling Sites: Toluene

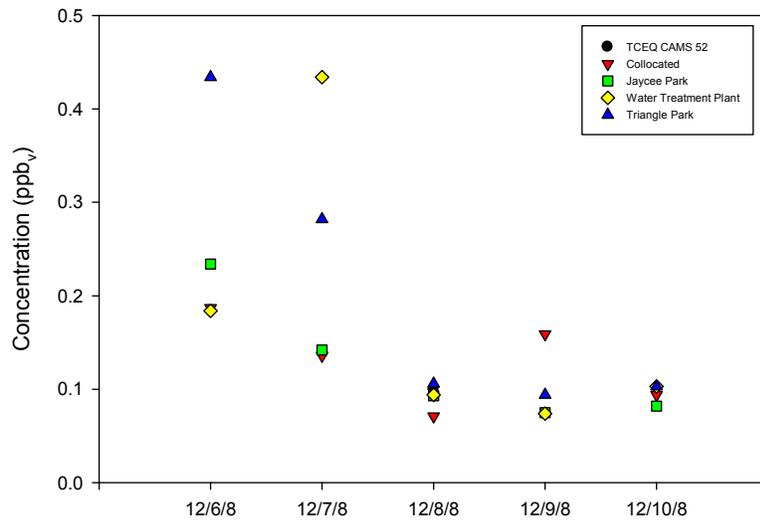


Figure K- 9. First Quarter Comparison of Sampling Sites: Toluene.

1st Quarter Comparison of Sampling Sites: Ethylbenzene

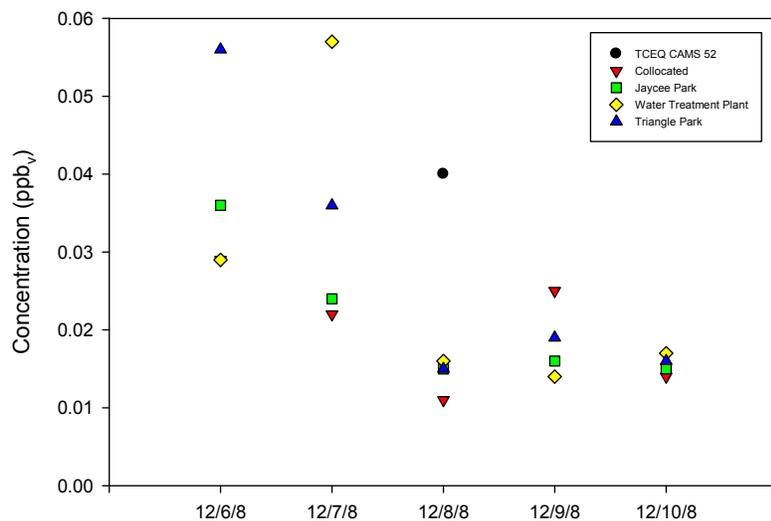


Figure K- 10. First Quarter Comparison of Sampling Sites: Ethylbenzene.

1st Quarter Comparison of Sampling Sites: *p+m*-Xylene

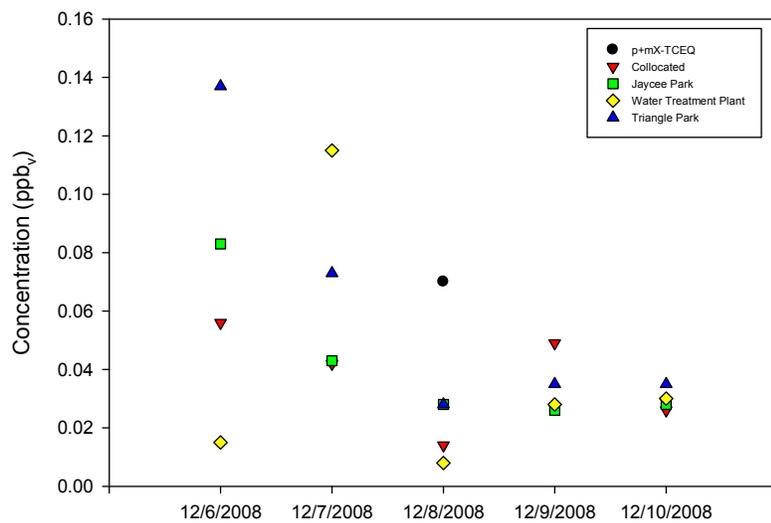


Figure K- 11. First Quarter Comparison of Sampling Sites: *p+m*-Xylene.

1st Quarter Comparison of Sampling Sites: *o*-Xylene

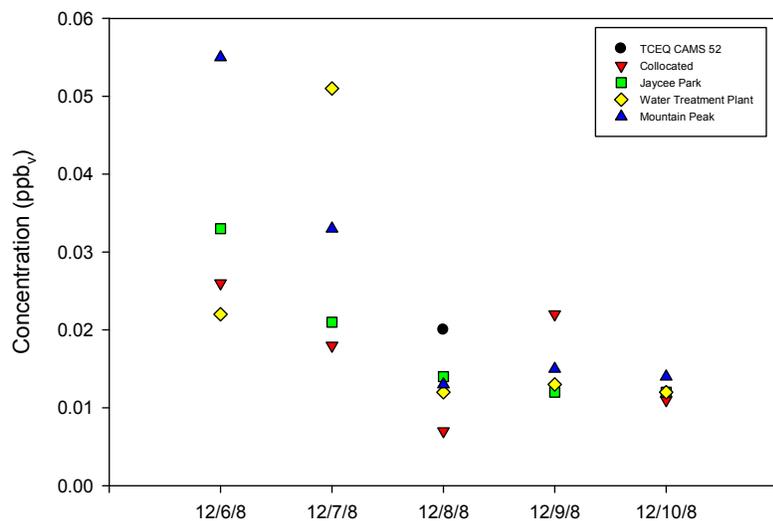


Figure K- 12. First Quarter Comparison of Sampling Sites: *o*-Xylene.

2nd Quarter Comparison of Sampling Sites: Benzene

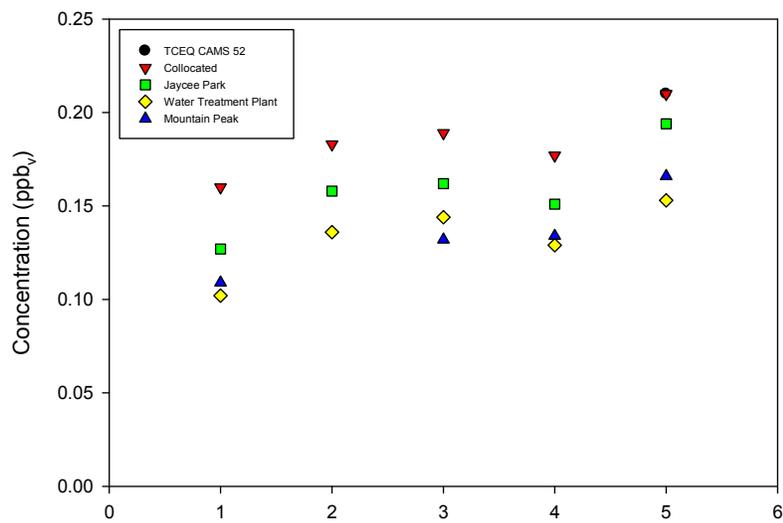


Figure K- 13. Second Quarter Comparison of Sampling Sites: Benzene.

2nd Quarter Comparison of Sampling Sites: 1,3-Butadiene

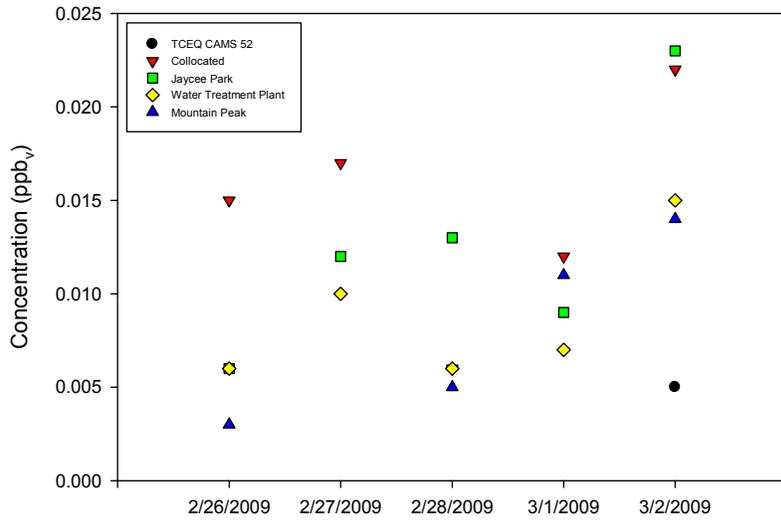


Figure K- 14. Second Quarter Comparison of Sampling Sites: 1,3-Butadiene.

2nd Quarter Comparison of Sampling Sites: Toluene

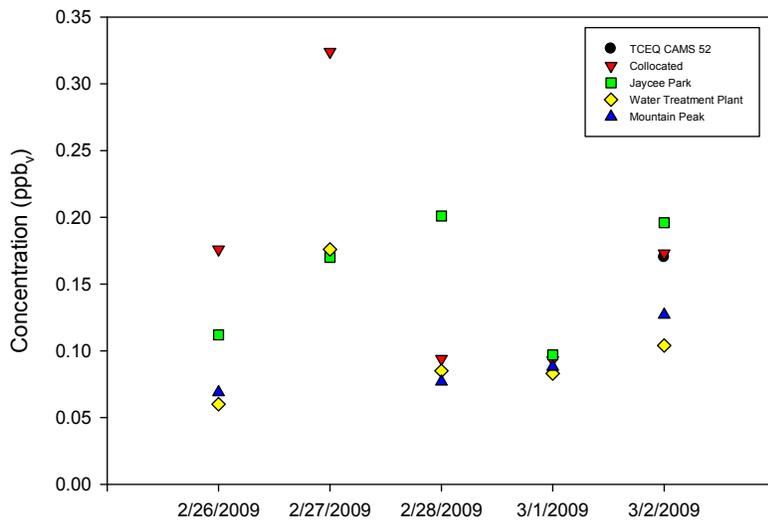


Figure K- 15. Second Quarter Comparison of Sampling Sites: Toluene.

2nd Quarter Comparison of Sampling Sites: Ethylbenzene

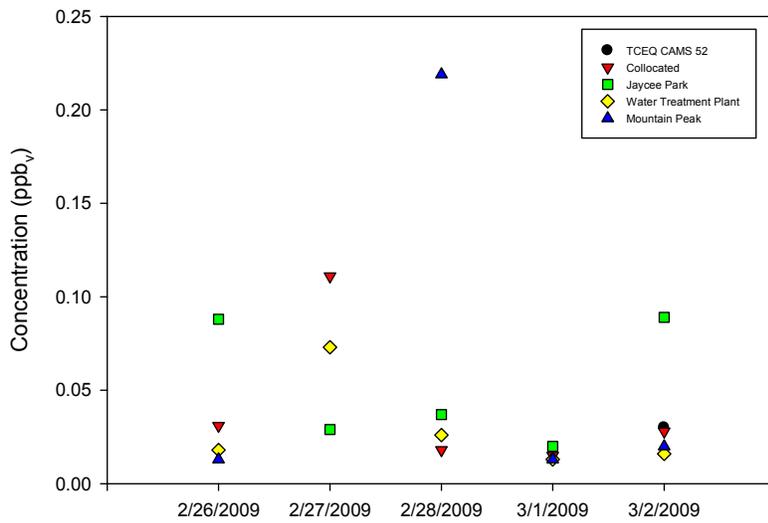


Figure K- 16. Second Quarter Comparison of Sampling Sites: Ethylbenzene.

2nd Quarter Comparison of Sampling Sites: *p+m*-Xylene

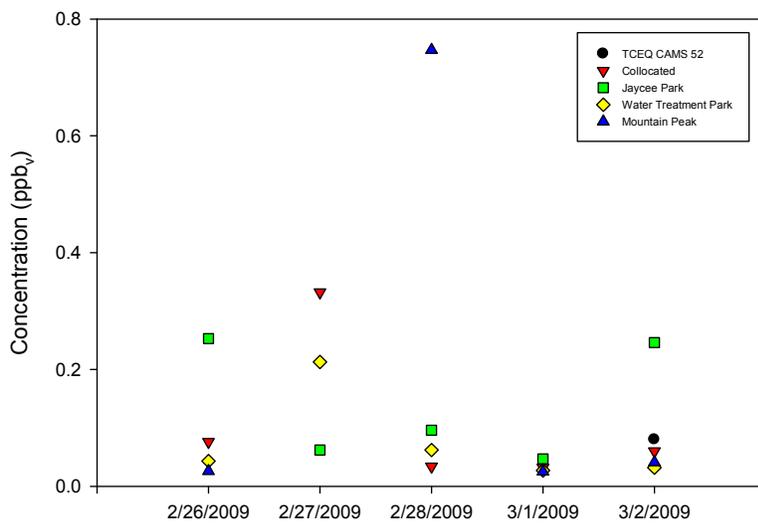


Figure K- 17. Second Quarter Comparison of Sampling Sites: *p+m*-Xylene.

2nd Quarter Comparison of Sampling Sites: o-Xylene

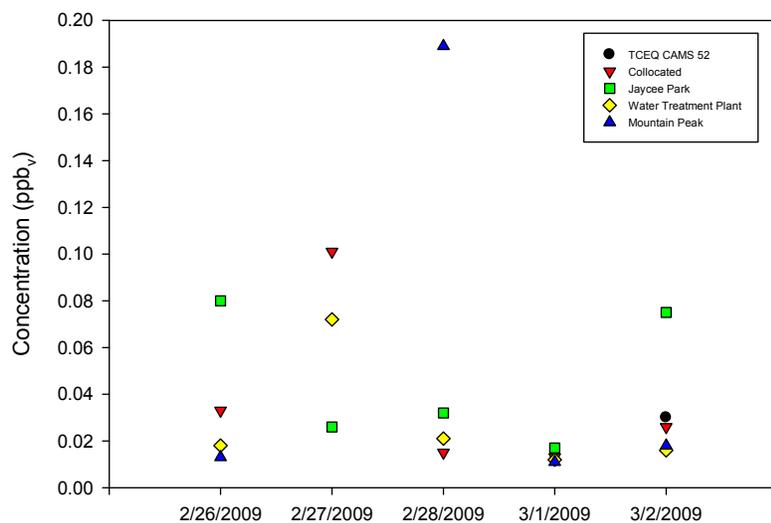


Figure K- 18. Second Quarter Comparison of Sampling Sites: o-Xylene.

3rd Quarter Comparison of Sampling Sites: Benzene

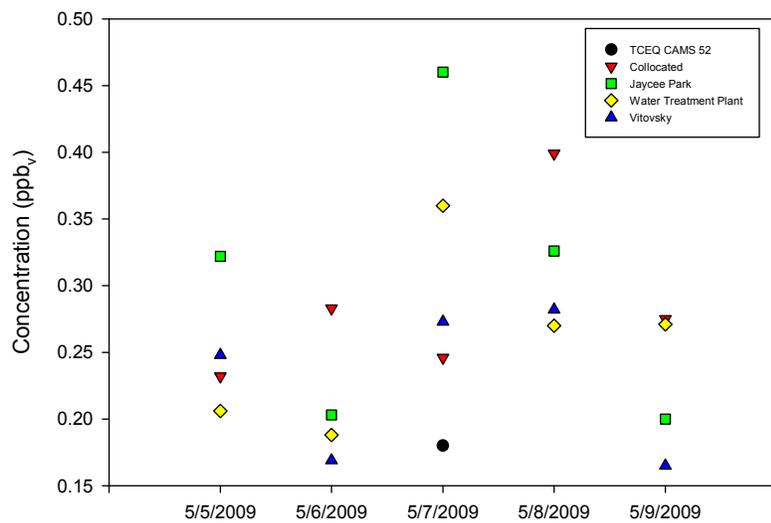


Figure K- 19. Third Quarter Comparison of Sampling Sites: Benzene.

3rd Quarter Comparison of Sampling Sites: 1,3-Butadiene

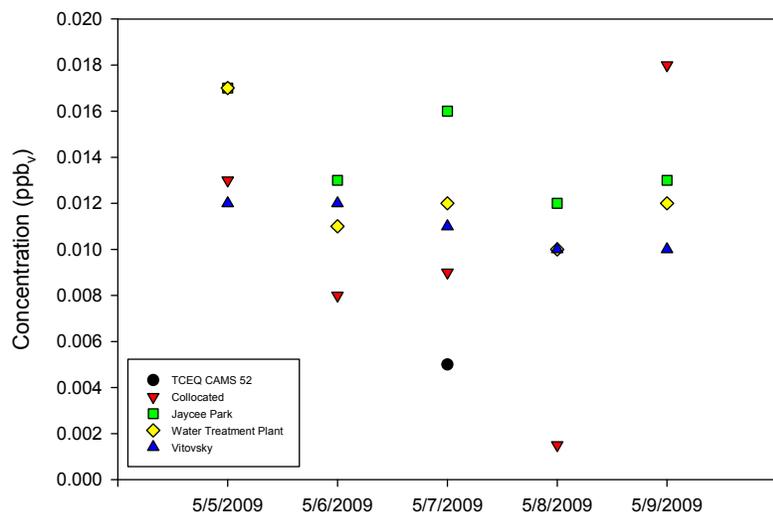


Figure K- 20. Third Quarter Comparison of Sampling Sites: 1,3-Butadiene.

3rd Quarter Comparison of Sampling Sites: Toluene

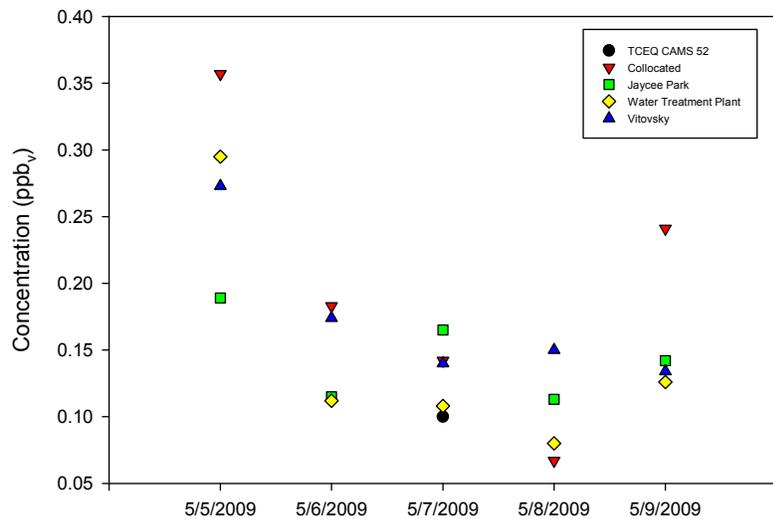


Figure K- 21. Third Quarter Comparison of Sampling Sites: Toluene.

### 3rd Quarter Comparison of Sampling Sites: Ethylbenzene

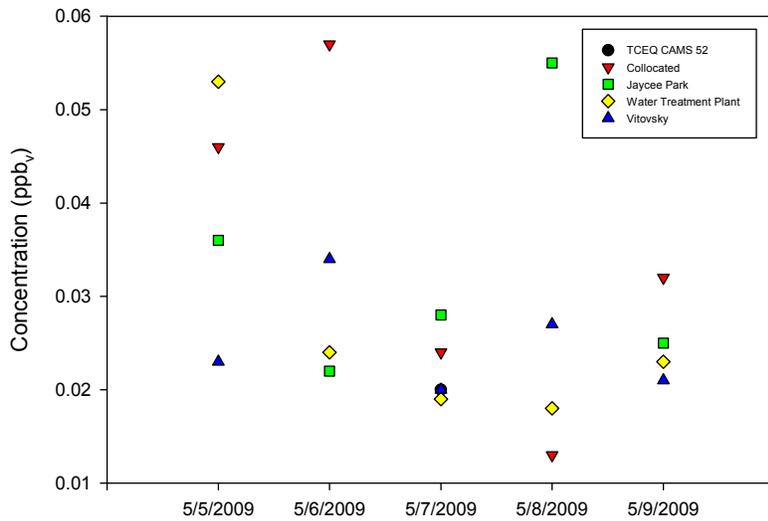


Figure K- 22. Third Quarter Comparison of Sampling Sites: Ethylbenzene.

### 3rd Quarter Comparison of Sampling Sites: *p+m*-Xylene

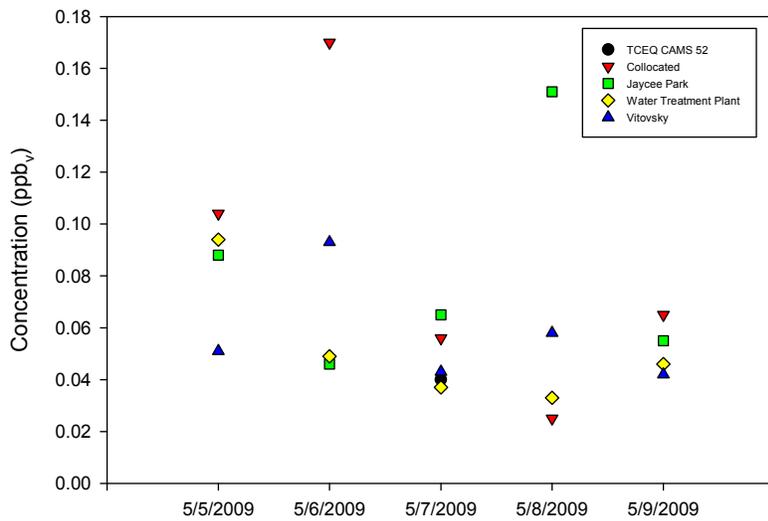


Figure K- 23. Third Quarter Comparison of Sampling Sites: *p+m*-Xylene.

3rd Quarter Comparison of Sampling Sites: *o*-Xylene

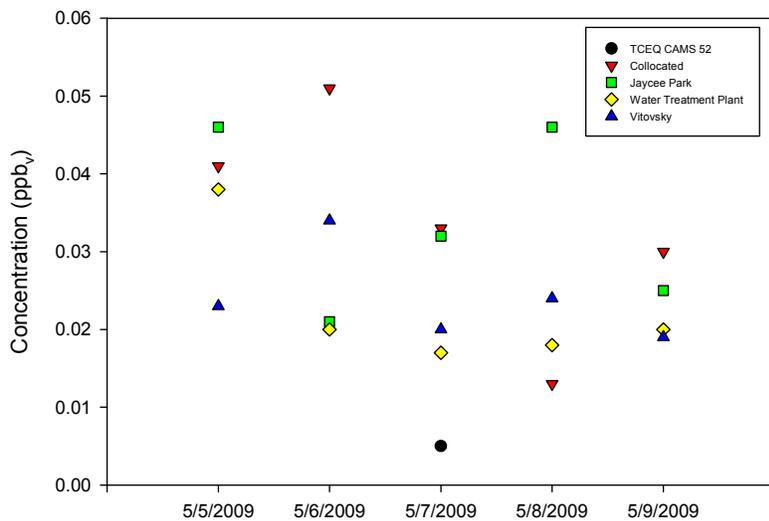
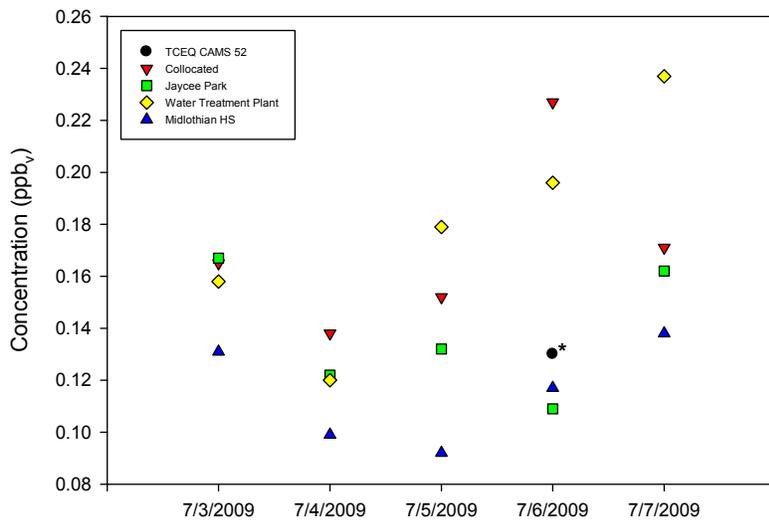


Figure K- 24. Third Quarter Comparison of Sampling Sites: *o*-Xylene.

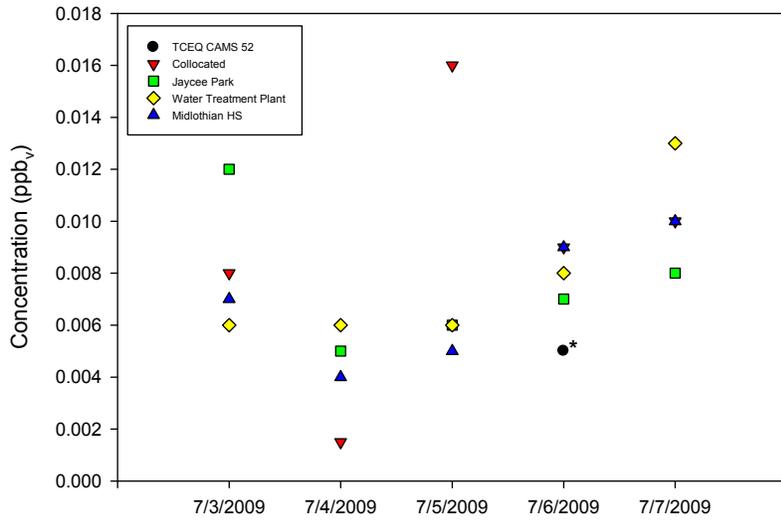
4th Quarter Comparison of Sampling Sites: Benzene



\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

Figure K- 25. Fourth Quarter Comparison of Sampling Sites: Benzene.

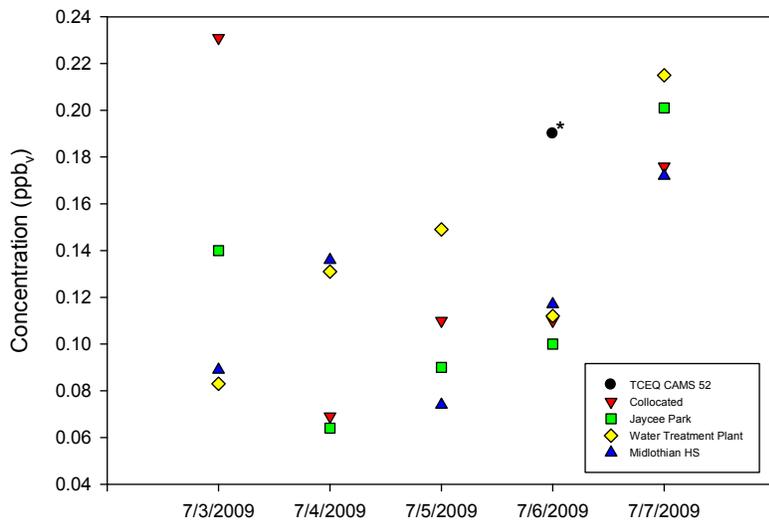
#### 4th Quarter Comparison of Sampling Sites: 1,3-Butadiene



\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

**Figure K- 26. Fourth Quarter Comparison of Sampling Sites: 1,3-Butadiene.**

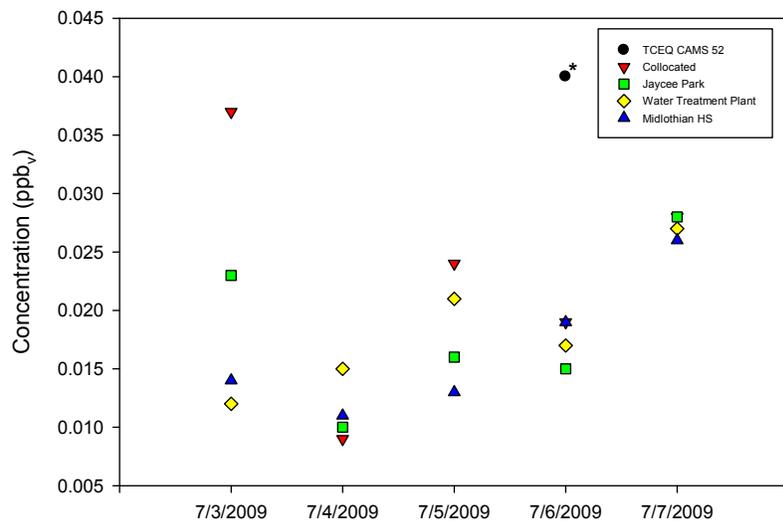
#### 4th Quarter Comparison of Sampling Sites: Toluene



\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

**Figure K- 27. Fourth Quarter Comparison of Sampling Sites: Toluene.**

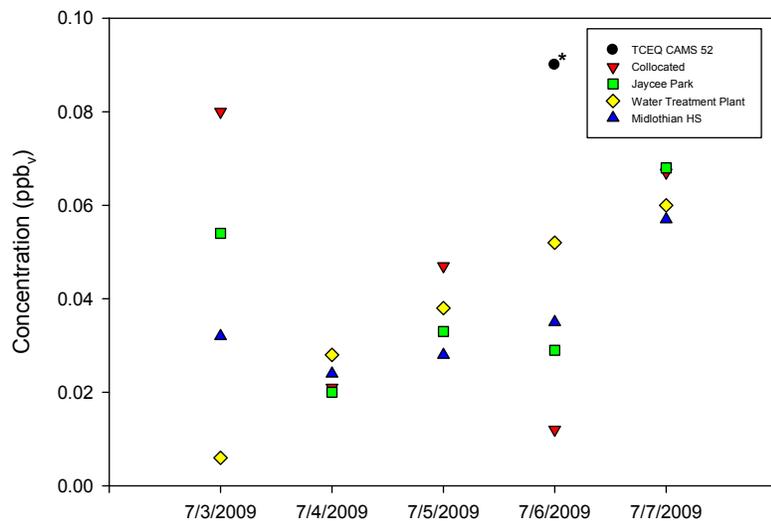
### 4th Quarter Comparison of Sampling Sites: Ethylbenzene



\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

**Figure K- 28. Fourth Quarter Comparison of Sampling Sites: Ethylbenzene.**

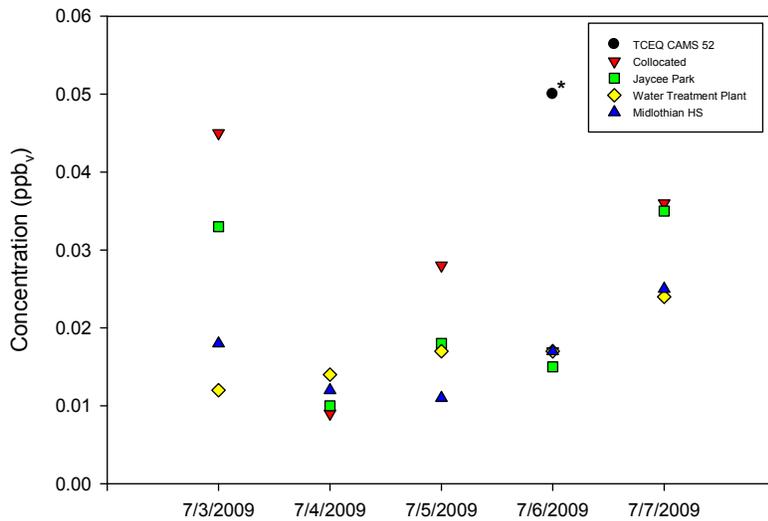
### 4th Quarter Comparison of Sampling Sites: *p+m*-Xylene



\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

**Figure K- 29. Fourth Quarter Comparison of Sampling Sites: *p+m*-Xylene.**

### 4th Quarter Comparison of Sampling Sites: *o*-Xylene



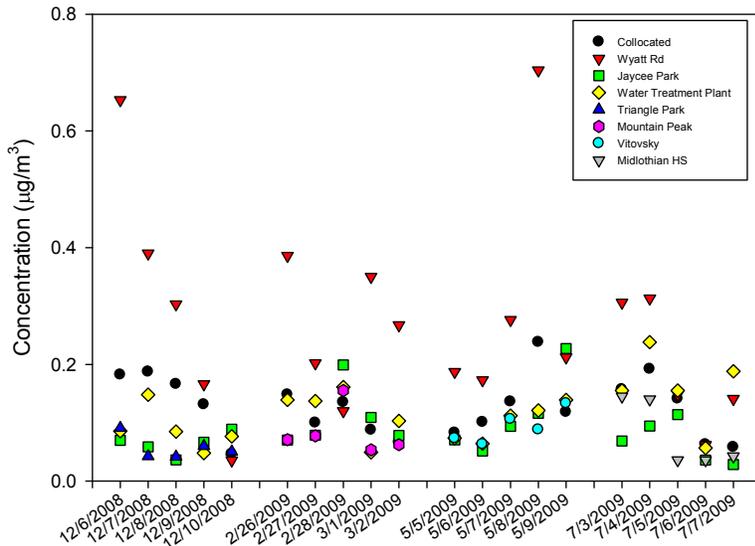
\*Due to a backlog in the TCEQ lab, this TCEQ CAMS 52 data point is UNVALIDATED data.

**Figure K- 30. Fourth Quarter Comparison of Sampling Sites: *o*-Xylene.**

## Metals

### I. Comparisons with All 4 Quarters of Data

Comparison of Aluminum for All 4 Quarters  
at All of the Monitoring Locations



**Figure K- 31. Monitoring Site Comparisons for PM<sub>10</sub> Aluminum for All Four Quarters of Data.**

Comparison of Chromium for All 4 Quarters  
at All of the Monitoring Locations

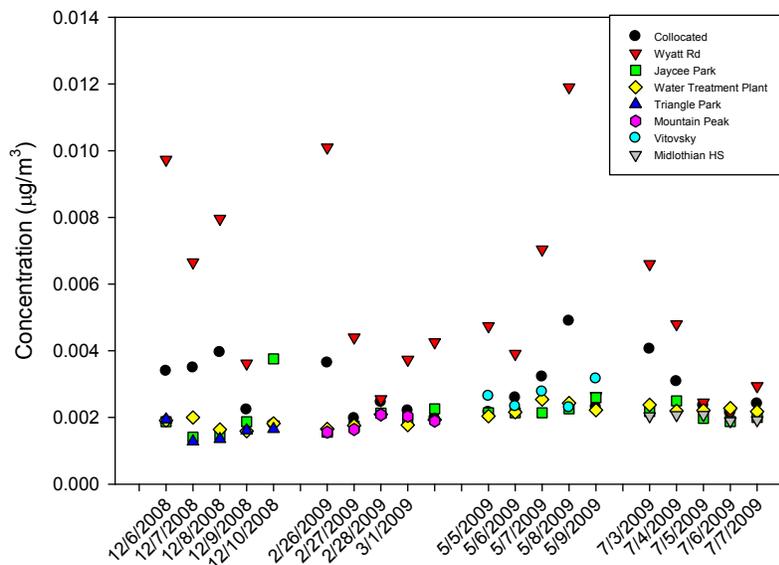


Figure K- 32. Monitoring Site Comparisons for PM<sub>10</sub> Chromium for All Four Quarters of Data.

Comparison of Manganese for All 4 Quarters  
at All of the Monitoring Locations

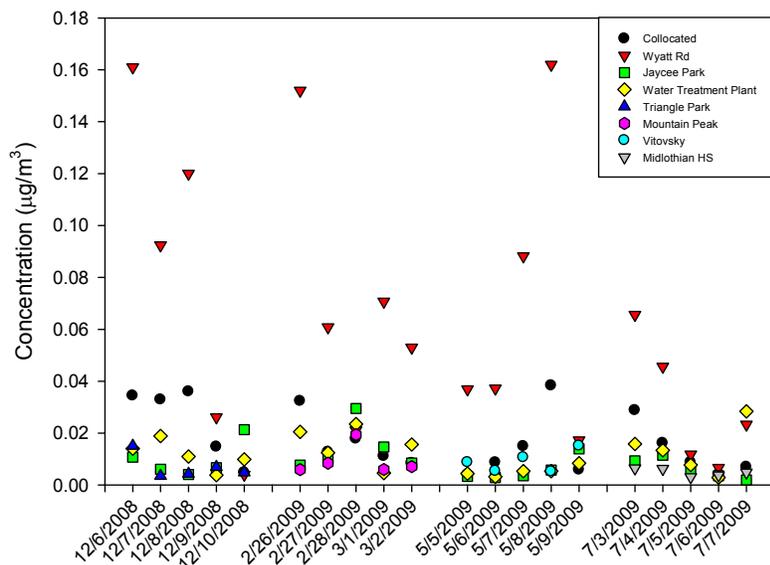


Figure K- 33. Monitoring Site Comparisons for PM<sub>10</sub> Manganese for All Four Quarters of Data.

Comparison of Lead for All 4 Quarters  
at All of the Monitoring Locations

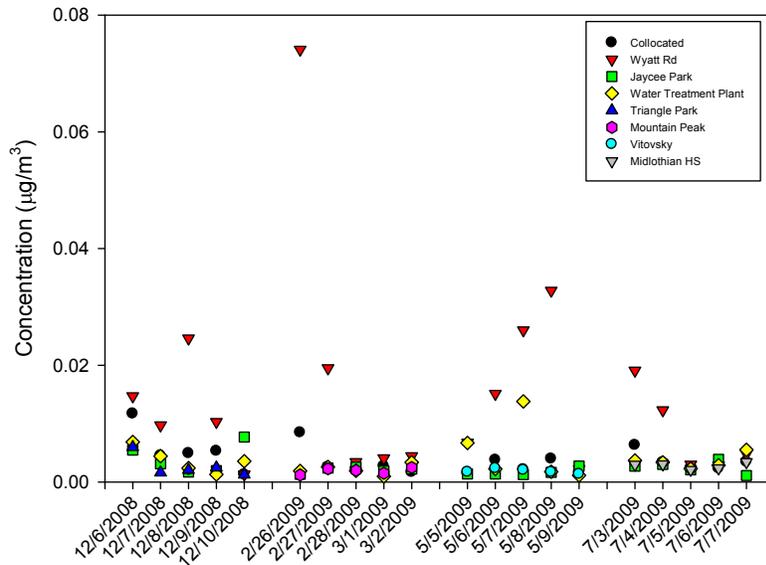


Figure K- 34. Monitoring Site Comparisons for PM<sub>10</sub> Lead for All Four Quarters of Data.

Comparison of Nickel for All 4 Quarters  
at All of the Monitoring Locations

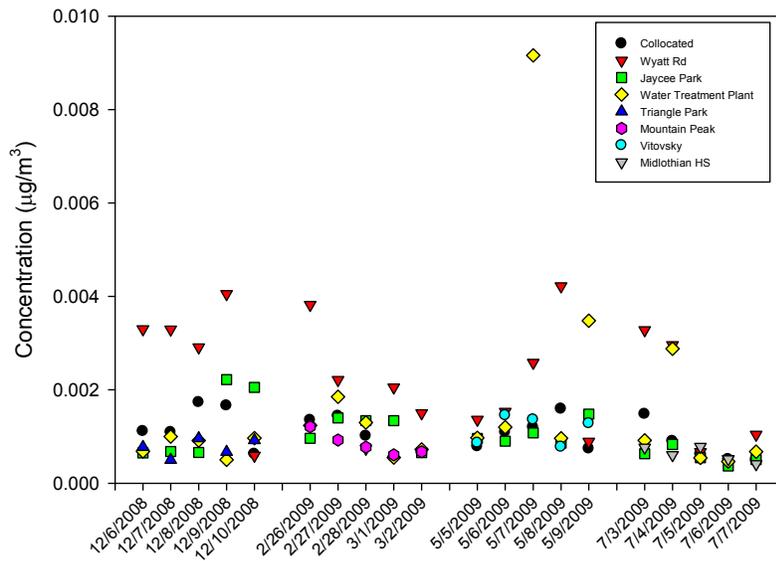


Figure K- 35. Monitoring Site Comparisons for PM<sub>10</sub> Nickel for All Four Quarters of Data.

Comparison of Mercury for All 4 Quarters  
at All of the Monitoring Locations

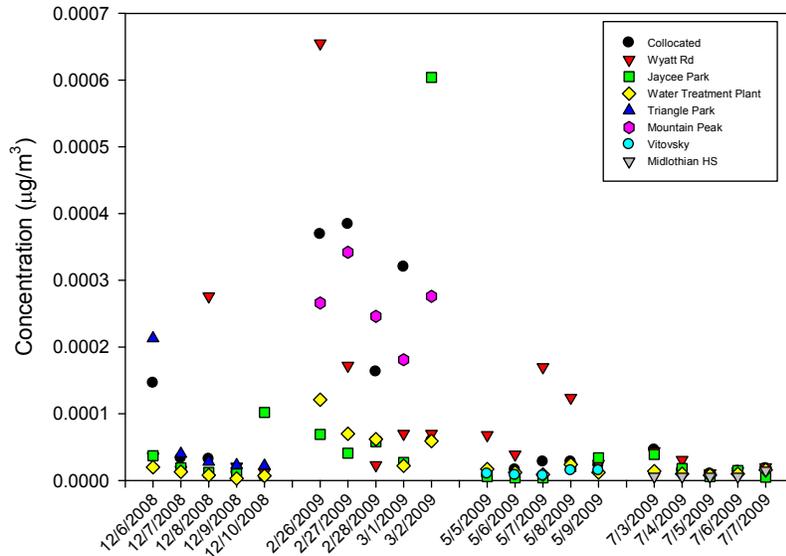


Figure K- 36. Monitoring Site Comparisons for PM<sub>10</sub> Mercury for All Four Quarters of Data.

II. Comparisons of Individual Quarterly Data

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum

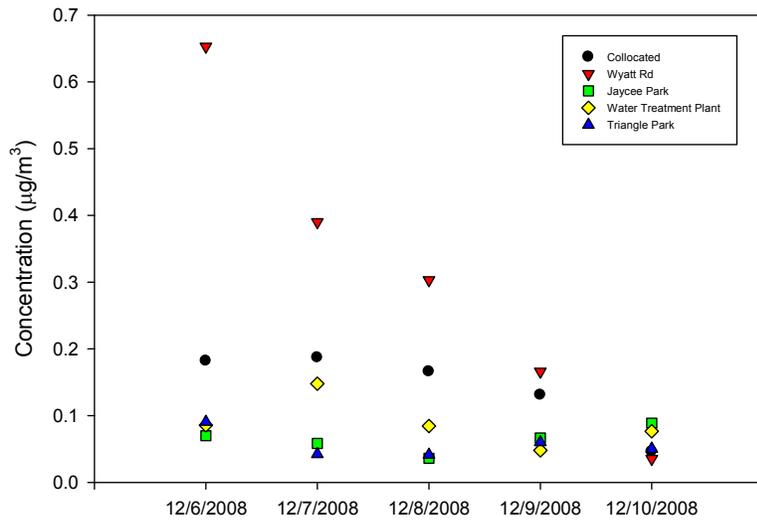


Figure K- 37. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum.

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Total Chromium

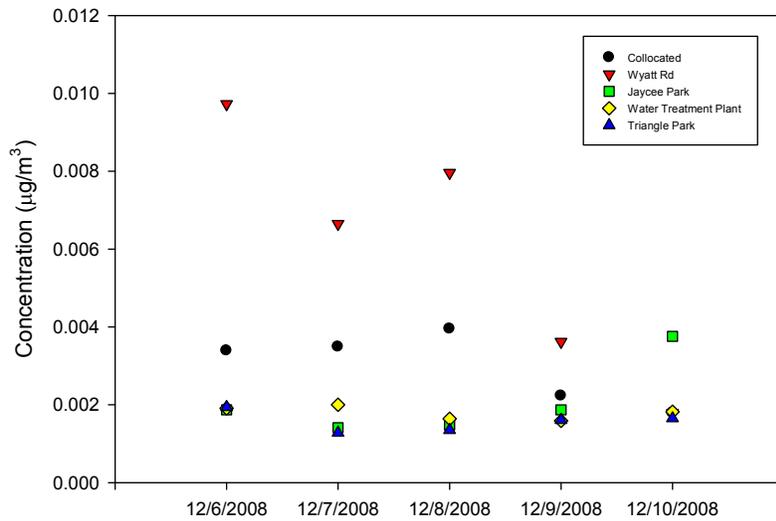


Figure K- 38. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium.

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese

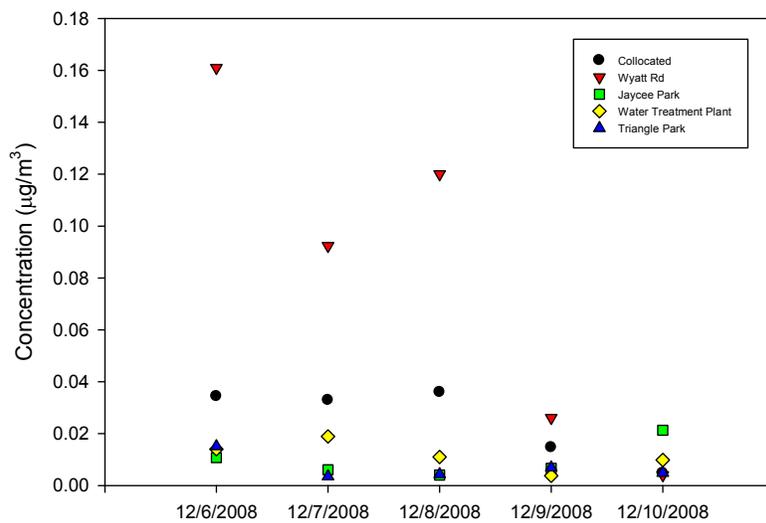


Figure K- 39. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese.

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead

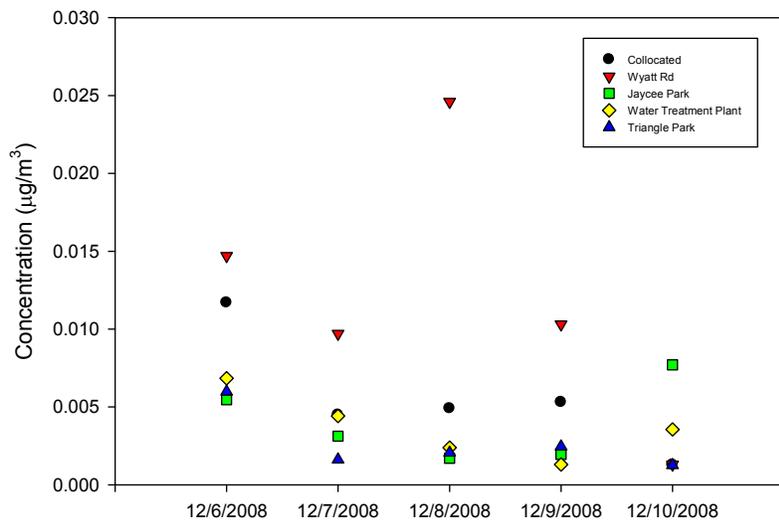


Figure K- 40. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead.

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel

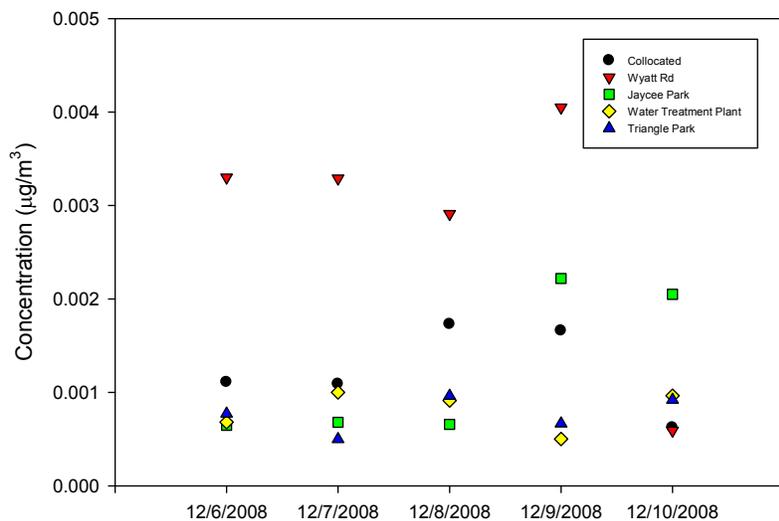


Figure K- 41. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel.

1st Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury

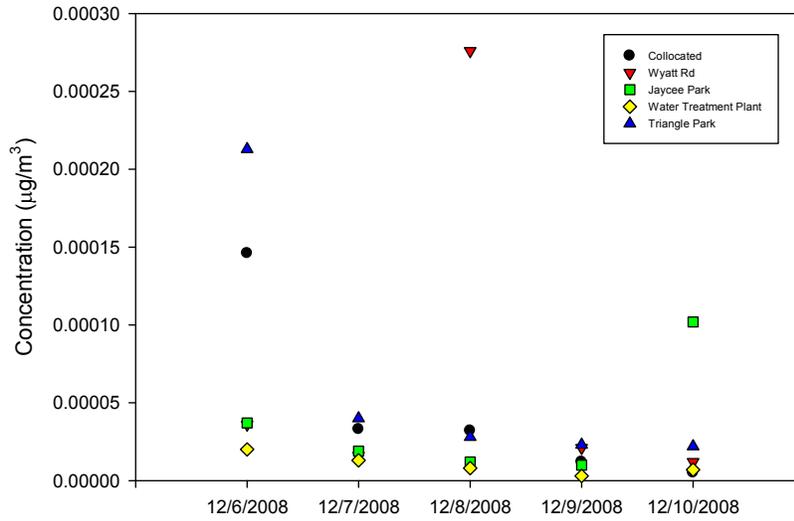


Figure K- 42. First Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum

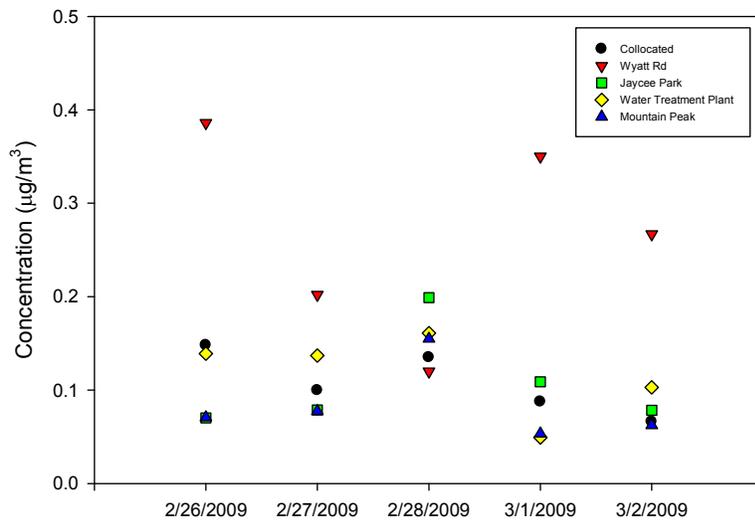


Figure K- 43. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium

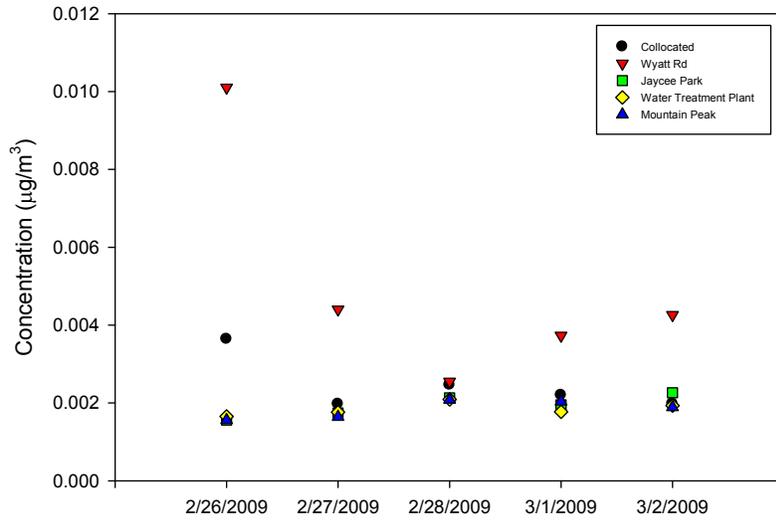


Figure K- 44. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese

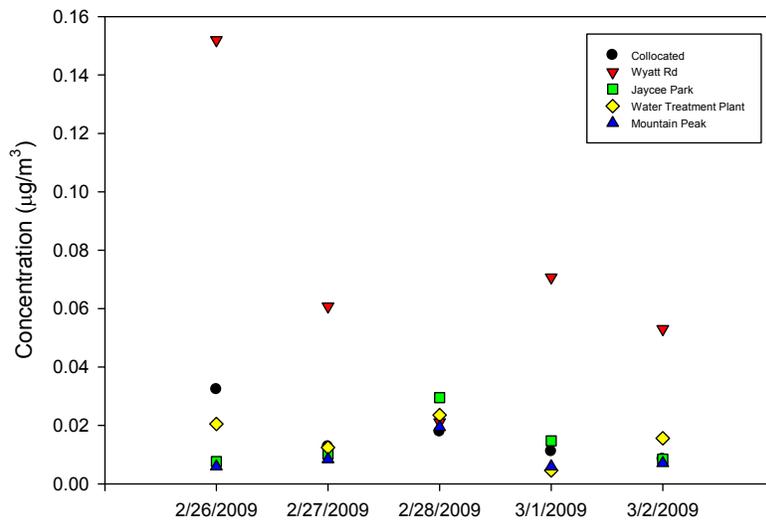


Figure K- 45. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead

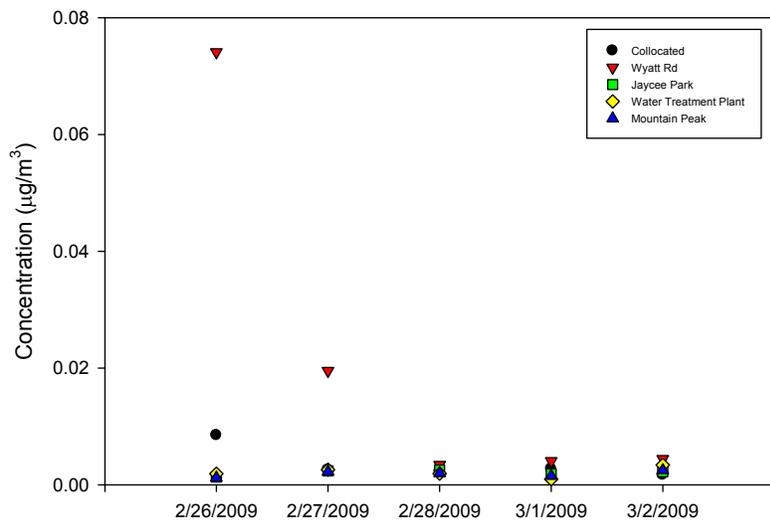


Figure K- 46. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel

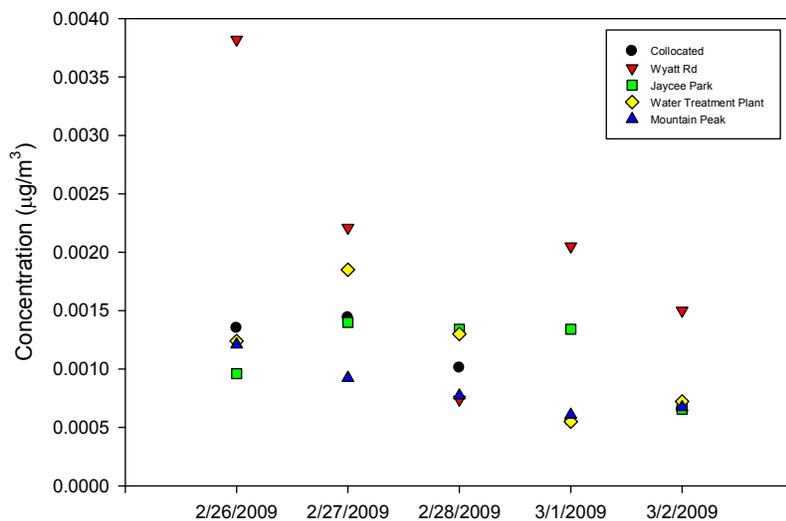


Figure K- 47. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel.

2nd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury

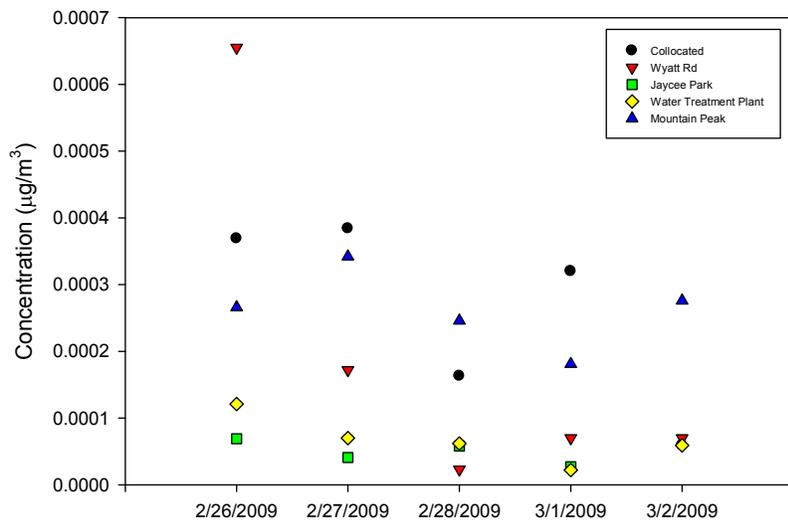


Figure K- 48. Second Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury.

3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum

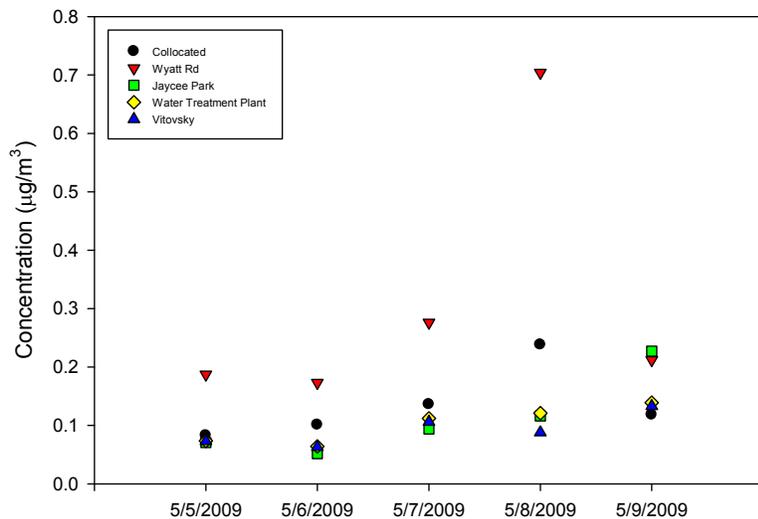


Figure K- 49. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum.

### 3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium

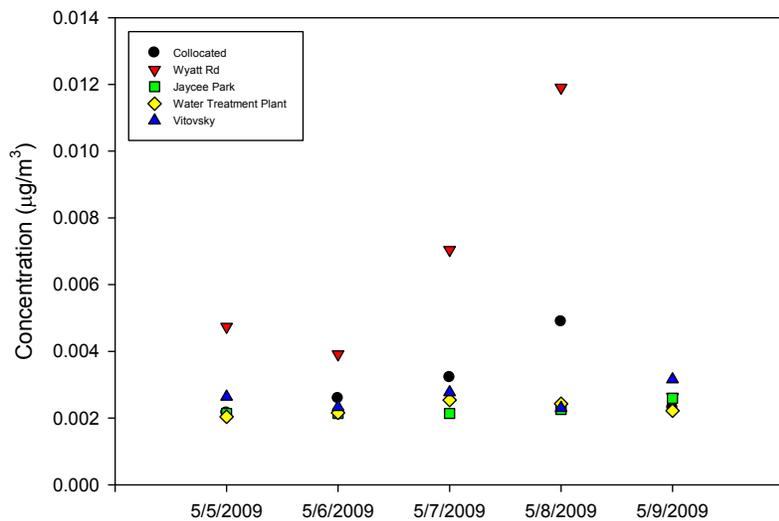


Figure K- 50. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium.

### 3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese

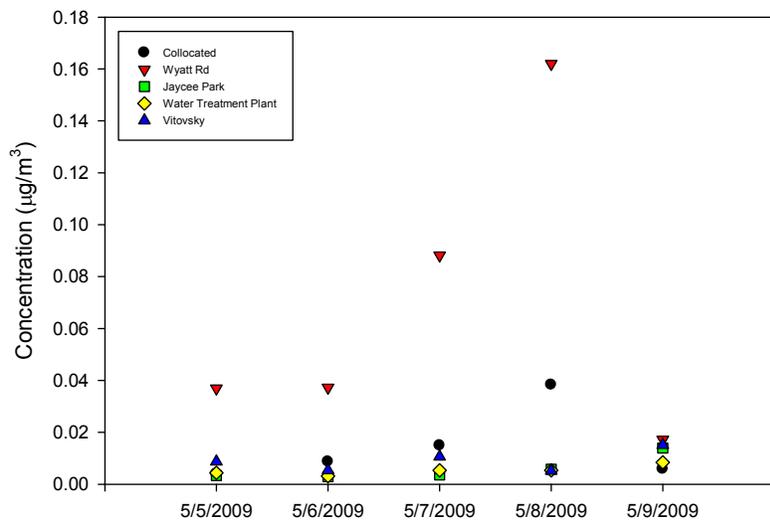


Figure K- 51. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese.

3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead

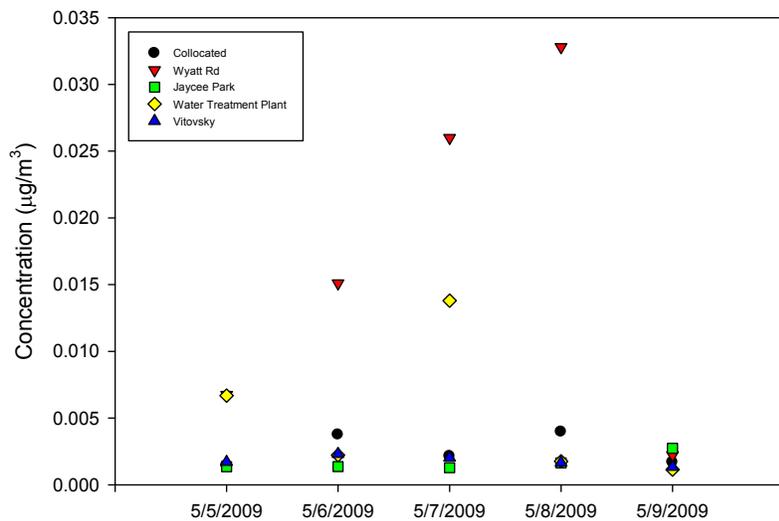


Figure K- 52. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead.

3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel

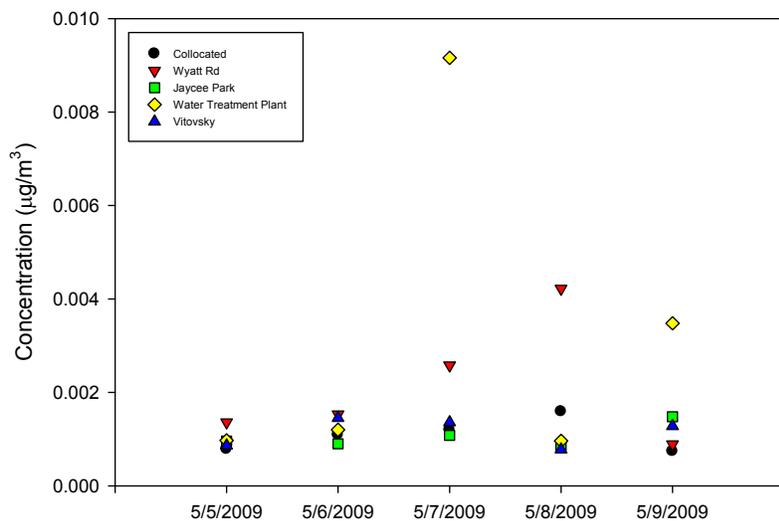


Figure K- 53. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel.

3rd Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury

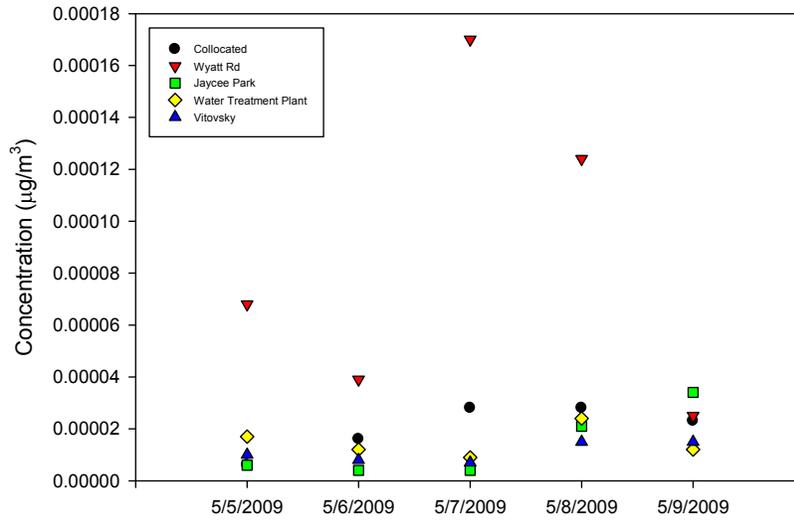


Figure K- 54. Third Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum

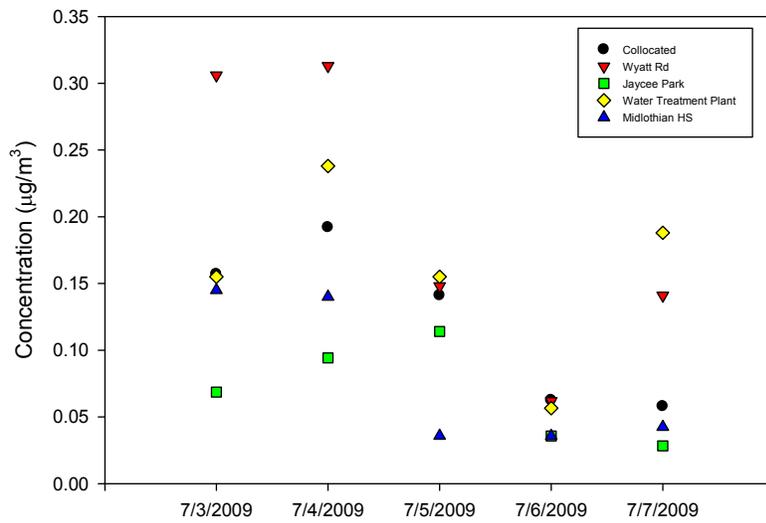


Figure K- 55. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Aluminum.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium

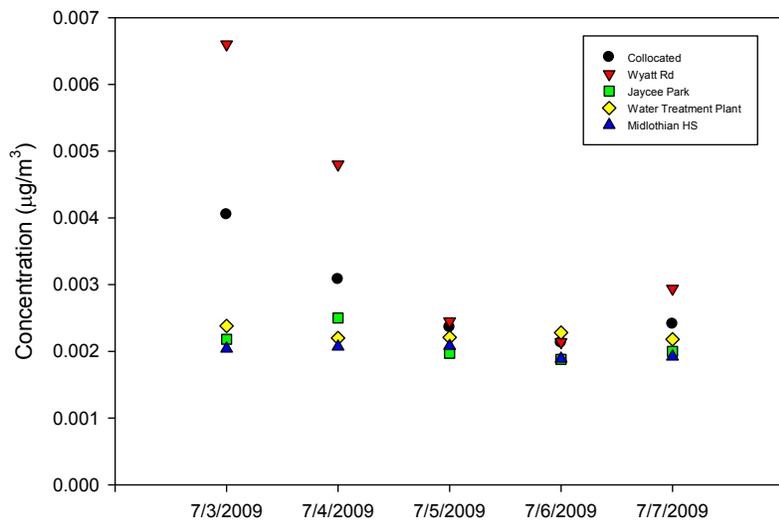


Figure K- 56. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Chromium.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese

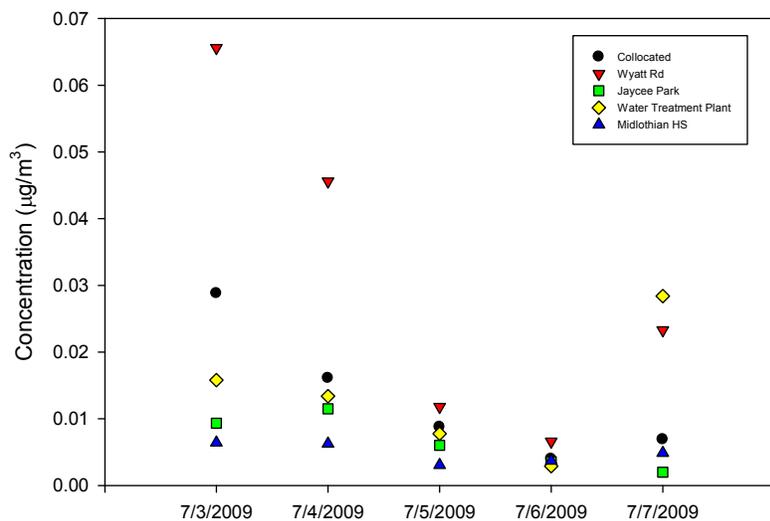


Figure K- 57. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Manganese.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead

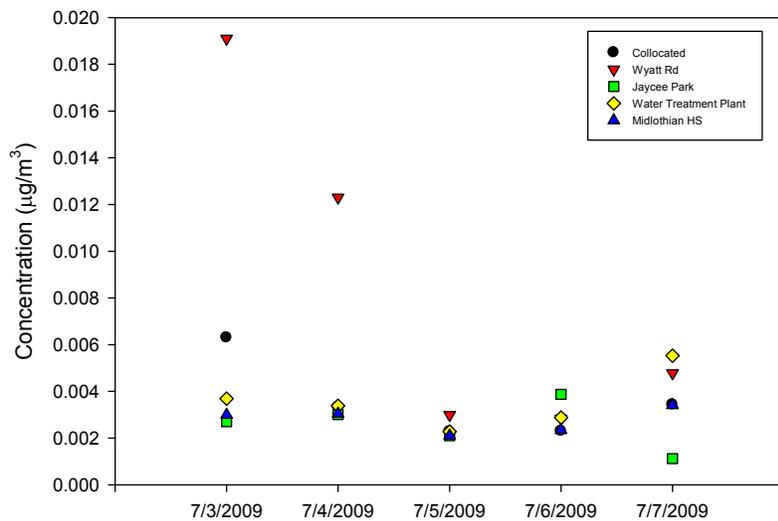


Figure K- 58. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Lead.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel

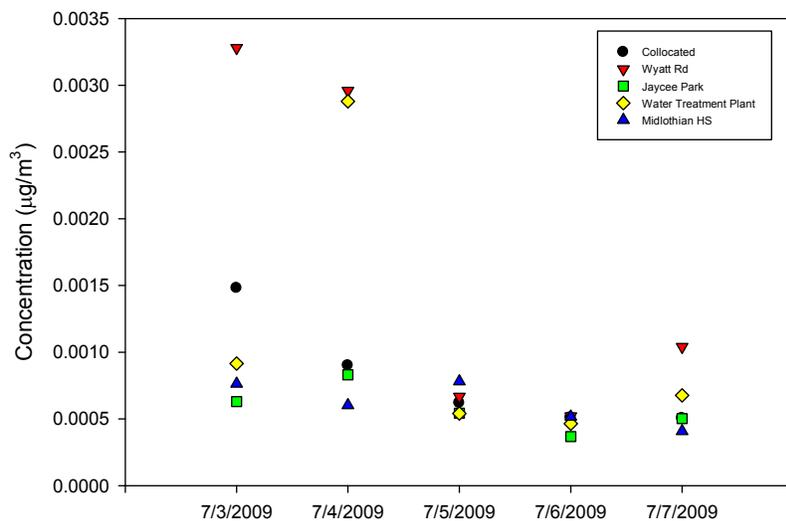


Figure K- 59. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Nickel.

4th Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury

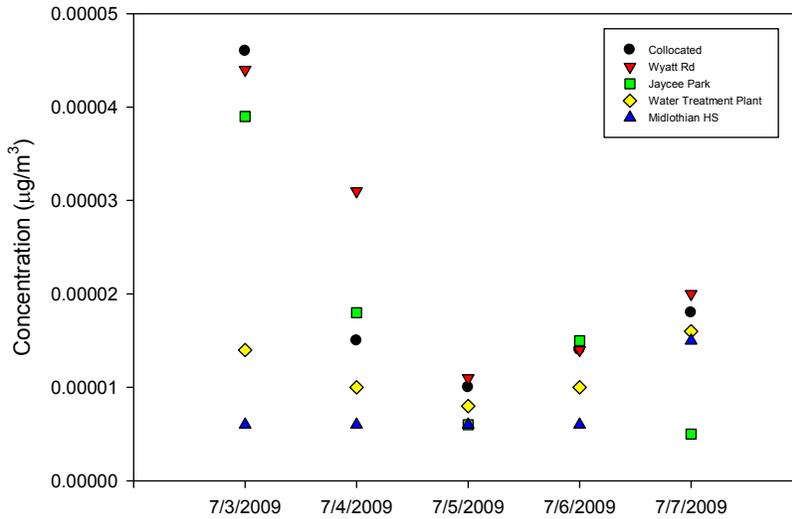


Figure K- 60. Fourth Quarter Comparison of Sampling Sites: PM<sub>10</sub> Mercury.

III. Hexavalent Chromium Comparisons of Quarterly Data

A. Comparisons with All 4 Quarters of Data

Comparison of Cr<sup>6+</sup> PM<sub>10</sub> for All 4 Quarters  
at All of the Monitoring Locations

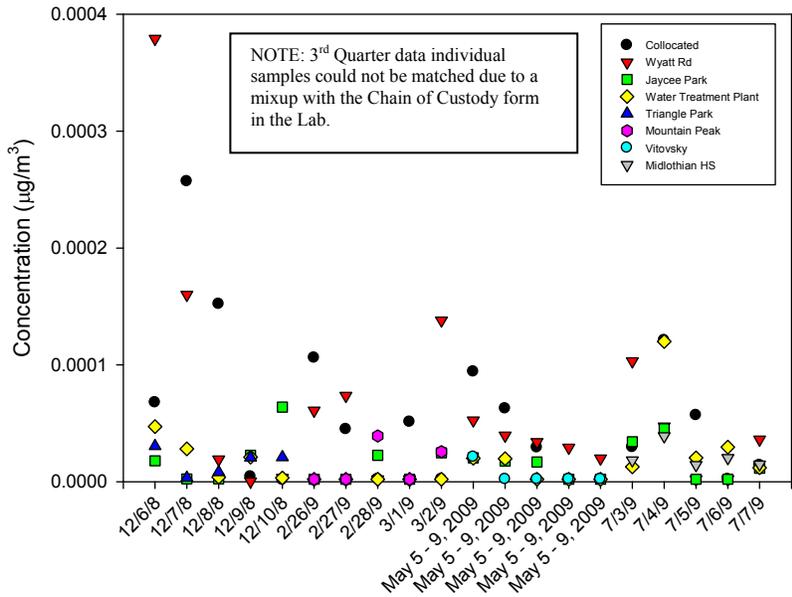


Figure K- 61. Monitoring Site Comparisons for PM<sub>10</sub> Cr<sup>6+</sup> for All Four Quarters of Data.

## B. Comparisons with Individual Quarterly Data

1st Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$

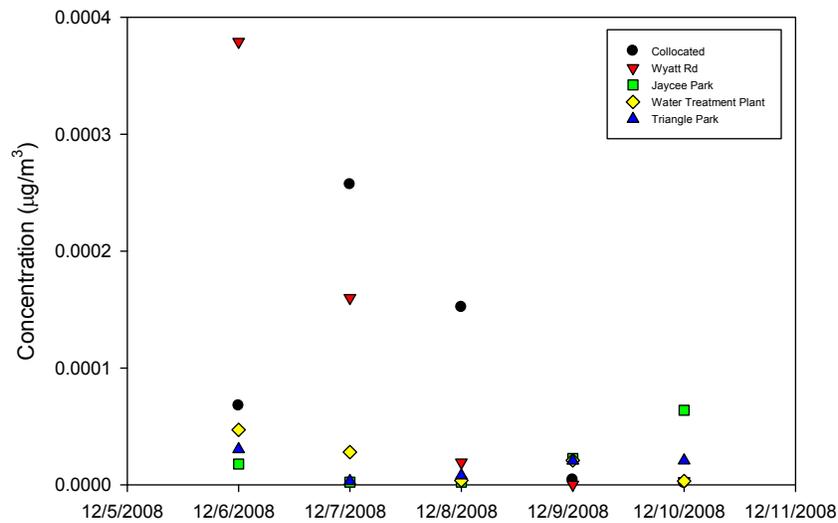


Figure K- 62. First Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$ .

2nd Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$

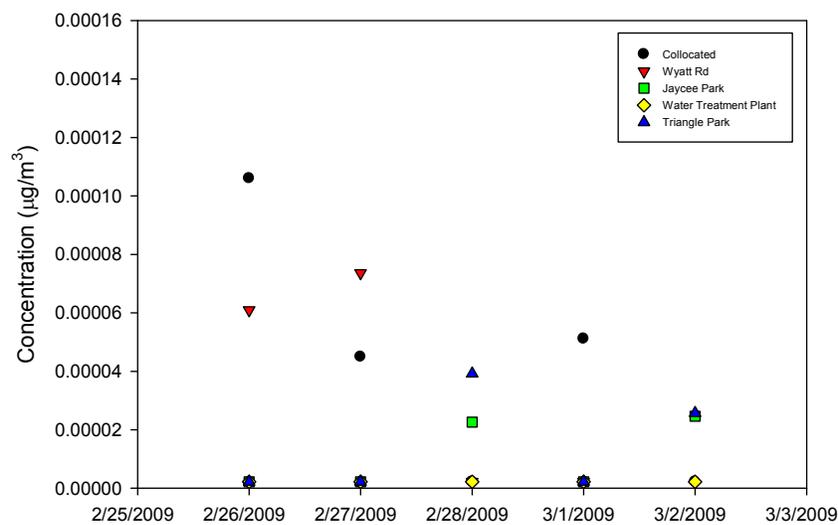


Figure K- 63. Second Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$ .

3rd Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$

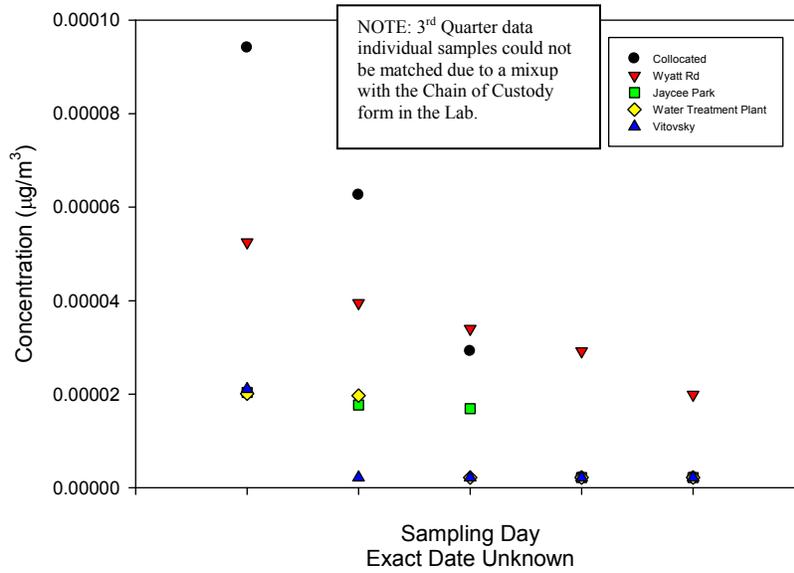


Figure K- 64. Third Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$ .

4th Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$

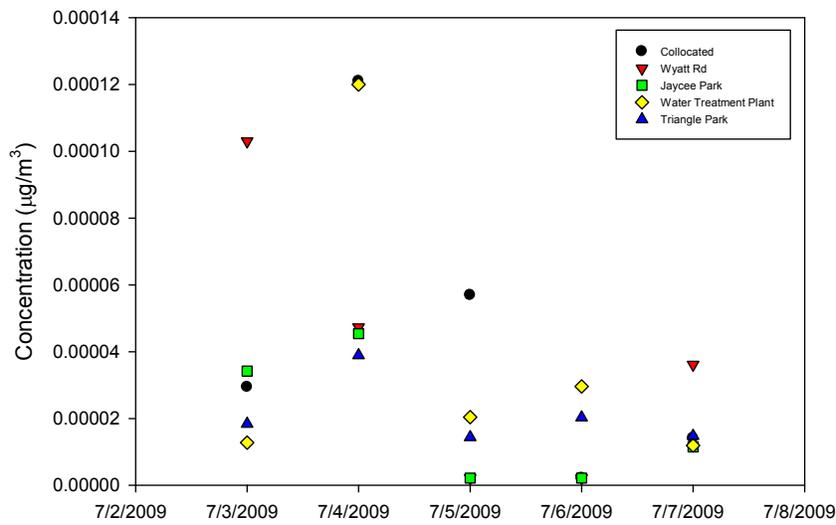


Figure K- 65. Fourth Quarter Comparison of Sampling Sites:  $PM_{10} Cr^{6+}$ .

*Appendix L – PM<sub>10</sub> Hexavalent Chromium Comparisons*

### A. PM<sub>10</sub> Cr<sup>6+</sup> Comparison to Total Cr

t-test

Tuesday, February 02, 2010, 11:55:57 AM

Data source: total Chromium in Chromium.JNB

Group Name	N	Missing	Mean	Std Dev	SEM
Row 1-CrT	100	0	0.00275	0.00178	0.000178
Row 2-Cr6+	100	0	0.0000327	0.0000543	0.00000543
Difference		0.00272			

t = 15.245 with 198 degrees of freedom. (P = <0.001)

95 percent confidence interval for difference of means: 0.00237 to 0.00307

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

### B. PM<sub>10</sub> Cr<sup>6+</sup> Site Comparisons to Collocated Monitor

#### I. Collocated vs. Wyatt Rd

t-test

Monday, February 01, 2010, 3:58:21 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:58:21 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Wyatt Rd	20	0	0.0000350	0.00000270	0.0000673

Mann-Whitney U Statistic= 198.500

T = 411.500 n(small)= 20 n(big)= 20 (P = 0.978)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.978)

#### II. Collocated vs. Jaycee Park

t-test

Monday, February 01, 2010, 3:58:35 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:58:35 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Jaycee Park	20	0	0.0000142	0.00000215	0.0000226

Mann-Whitney U Statistic= 134.500

T = 475.500 n(small)= 20 n(big)= 20 (P = 0.075)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.075)

#### III. Collocated vs. Water Treatment Plant

t-test

Monday, February 01, 2010, 3:58:52 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:58:52 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Water Treatment Plant	20	0	0.00000785	0.00000215	0.0000207

Mann-Whitney U Statistic= 132.000

T = 478.000 n(small)= 20 n(big)= 20 (P = 0.063)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.063)

#### IV. Collocated vs. Triangle Park

t-test

Monday, February 01, 2010, 3:59:08 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:59:08 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Triangle Park	5	0	0.0000206	0.00000689	0.0000233

Mann-Whitney U Statistic= 39.000

T = 54.000 n(small)= 5 n(big)= 20 (P = 0.474)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.474)

#### V. Collocated vs. Mountain Peak Elementary School

t-test

Monday, February 01, 2010, 3:59:21 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:59:21 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Mountain Peak	5	0	0.00000215	0.00000215	0.0000291

Mann-Whitney U Statistic= 28.500

T = 43.500 n(small)= 5 n(big)= 20 (P = 0.147)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.147)

#### VI. Collocated vs. J.A. Vitovsky Elementary School

t-test

Monday, February 01, 2010, 3:59:34 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:59:34 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Vitovsky	5	0	0.00000215	0.00000215	0.00000689

Mann-Whitney U Statistic= 22.000

T = 37.000 n(small)= 5 n(big)= 20 (P = 0.056)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.056)

## VII. Collocated vs. Midlothian High School

t-test

Monday, February 01, 2010, 3:59:50 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test

Monday, February 01, 2010, 3:59:50 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Midlothian HS	5	0	0.0000184	0.0000147	0.0000249

Mann-Whitney U Statistic= 42.000

T = 57.000 n(small)= 5 n(big)= 20 (P = 0.609)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.609)

## C. PM<sub>10</sub> Cr<sup>6+</sup> Site Comparisons: All Four Quarters of Data

### I. Comparison of Stationary Sites

One WayOne-Way Analysis of Variance

Monday, February 01, 2010, 3:57:28 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, February 01, 2010, 3:57:28 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Wyatt Rd	20	0	0.0000350	0.00000270	0.0000673
Jaycee Park	20	0	0.0000142	0.00000215	0.0000226
Water Treatment Plant	20	0	0.00000785	0.00000215	0.0000207

H = 7.754 with 3 degrees of freedom. (P = 0.051)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.051)

### II. Comparison of Mobile Sites

One WayOne-Way Analysis of Variance

Monday, February 01, 2010, 3:57:41 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, February 01, 2010, 3:57:41 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Triangle Park	5	0	0.0000206	0.00000689	0.0000233
Mountain Peak	5	0	0.00000215	0.00000215	0.0000291
Vitovsky	5	0	0.00000215	0.00000215	0.00000689
Midlothian HS	5	0	0.0000184	0.0000147	0.0000249

H = 4.301 with 3 degrees of freedom. (P = 0.231)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.231)

### III. Comparison of All Sites

#### One WayOne-Way Analysis of Variance

Monday, February 01, 2010, 3:57:58 PM

Data source: Data 4 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, February 01, 2010, 3:57:58 PM

Data source: Data 4 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	20	0	0.0000372	0.00000215	0.0000809
Wyatt Rd	20	0	0.0000350	0.00000270	0.0000673
Jaycee Park	20	0	0.0000142	0.00000215	0.0000226
Water Treatment Plant	20	0	0.00000785	0.00000215	0.0000207
Triangle Park	5	0	0.0000206	0.00000689	0.0000233
Mountain Peak	5	0	0.00000215	0.00000215	0.0000291
Vitovsky	5	0	0.00000215	0.00000215	0.00000689
Midlothian HS	5	0	0.0000184	0.0000147	0.0000249

H = 12.873 with 7 degrees of freedom. (P = 0.075)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.075)

### D. PM<sub>10</sub> Cr<sup>6+</sup> Site Comparisons: Individual Quarters of Data

#### I. 1<sup>st</sup> Quarter PM<sub>10</sub> Cr<sup>6+</sup> Data

#### One WayOne-Way Analysis of Variance

Monday, February 01, 2010, 4:53:23 PM

Data source: Data 3 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, February 01, 2010, 4:53:23 PM

Data source: Data 3 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0000677	0.00000360	0.000178
Wyatt Rd	5	0	0.0000192	0.00000251	0.000215
Jaycee Park	5	0	0.0000179	0.00000240	0.0000329
Water Treatment Plant	5	0	0.0000210	0.00000366	0.0000329
Triangle Park	5	0	0.0000206	0.00000689	0.0000233

H = 1.147 with 4 degrees of freedom. (P = 0.887)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.887)

#### II. 2<sup>nd</sup> Quarter PM<sub>10</sub> Cr<sup>6+</sup> Data

#### One WayOne-Way Analysis of Variance

Monday, February 01, 2010, 5:07:13 PM

Data source: Data 5 in Chromium.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One WayOne-Way Analysis of Variance on RanksMonday, February 01, 2010, 5:07:13 PM

Data source: Data 5 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0000449	0.00000215	0.0000648
Wyatt Rd	5	0	0.0000609	0.00000215	0.0000897
Jaycee Park	5	0	0.00000215	0.00000215	0.0000231
Water Treatment Plant	5	0	0.00000215	0.00000215	0.00000215
Mountain Peak	5	0	0.00000215	0.00000215	0.0000291

H = 6.598 with 4 degrees of freedom. (P = 0.159)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.159)

### III. 3<sup>rd</sup> Quarter PM<sub>10</sub> Cr<sup>6+</sup> Data

**One WayOne-Way Analysis of Variance**

Monday, February 01, 2010, 5:08:00 PM

**Data source:** Data 6 in Chromium.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, February 01, 2010, 5:08:00 PM

**Data source:** Data 6 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0000292	0.00000215	0.0000705
Wyatt Rd	5	0	0.0000340	0.0000269	0.0000427
Jaycee Park	5	0	0.0000169	0.00000215	0.0000184
Water Treatment Plant	5	0	0.00000215	0.00000215	0.0000198
Vitovsky	5	0	0.00000215	0.00000215	0.00000689

H = 9.844 with 4 degrees of freedom. (P = 0.043)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.043)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All PairwiseAll-Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
Wyatt Rd vs Vitovsky	58.500	3.555	No
Wyatt Rd vs Water Treatme	52.500	3.190	Do Not Test
Wyatt Rd vs Jaycee Park	46.500	2.826	Do Not Test
Wyatt Rd vs Collocated	20.000	1.215	Do Not Test
Collocated vs Vitovsky	38.500	2.339	Do Not Test
Collocated vs Water Treatme	32.500	1.975	Do Not Test
Collocated vs Jaycee Park	26.500	1.610	Do Not Test
Jaycee Park vs Vitovsky	12.000	0.729	Do Not Test
Jaycee Park vs Water Treatme	6.000	0.365	Do Not Test
Water Treatme vs Vitovsky	6.000	0.365	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

### IV. 4<sup>th</sup> Quarter PM<sub>10</sub> Cr<sup>6+</sup> Data

**One WayOne-Way Analysis of Variance**

Monday, February 01, 2010, 5:08:25 PM

**Data source:** Data 7 in Chromium.JNB

**Normality Test:** Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

**Kruskal-Wallis One WayOne-Way Analysis of Variance on Ranks**Monday, February 01, 2010, 5:08:25 PM

**Data source:** Data 7 in Chromium.JNB

Group	N	Missing	Median	25%	75%
Collocated	5	0	0.0000294	0.0000111	0.0000729
Wyatt Rd	5	0	0.0000361	0.00000215	0.0000612

Jaycee Park	5	0	0.0000115	0.00000215	0.0000370
Water Treatment Plant	5	0	0.0000204	0.0000126	0.0000522
Midlothian HS	5	0	0.0000184	0.0000147	0.0000249

H = 1.347 with 4 degrees of freedom. (P = 0.853)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.853)

## E. Hexavalent Chromium Seasonal Variation Comparisons

### I. Collocated

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 11:51:12 AM

Data source: Collocated-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.193)

Equal Variance Test: Passed (P = 0.090)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr6+-1st Q	5	0	0.0000965	0.000109	0.0000486
2nd Q	5	0	0.0000413	0.0000429	0.0000192
3rd Q	5	0	0.0000380	0.0000400	0.0000179
4th Q	5	0	0.0000447	0.0000473	0.0000212

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.0000000115	0.00000000384	0.879	0.473
Residual	16	0.0000000699	0.00000000437		
Total	19	0.0000000814			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.473).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

### II. Wyatt Rd

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:20:55 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

#### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:20:55 PM

Data source: Wyatt Rd-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Cr6+-1st Q	5	0	0.0000192	0.00000251	0.000215
2nd Q	5	0	0.0000609	0.00000215	0.0000897
3rd Q	5	0	0.0000340	0.0000269	0.0000427
4th Q	5	0	0.0000361	0.00000215	0.0000612

H = 0.190 with 3 degrees of freedom. (P = 0.979)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.979)

### III. Jaycee Park

#### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:11:30 PM

Data source: Jaycee Park-Metals in Monitor Comparisons.JNB

Normality Test: Passed (P = 0.078)

Equal Variance Test: Passed (P = 0.498)

Group Name	N	Missing	Mean	Std Dev	SEM
Cr6+-1st Q	5	0	0.0000218	0.0000252	0.0000113

2nd Q	5	0	0.0000107	0.0000118	0.00000526
3rd Q	5	0	0.0000119	0.00000896	0.00000401
4th Q	5	0	0.0000191	0.0000197	0.00000881

Source of Variation	DF	SS	MS	F	P
Between Groups	3	0.000000000441	0.000000000147	0.474	0.705
Residual	16	0.00000000496	0.000000000310		
Total	19	0.00000000540			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.705).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.

Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

#### IV. Water Treatment Plant

##### One Way Analysis of Variance

Tuesday, June 01, 2010, 1:15:28 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Normality Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

##### Kruskal-Wallis One Way Analysis of Variance on Ranks

Tuesday, June 01, 2010, 1:15:28 PM

Data source: Water Treatment Plant-Metals in Monitor Comparisons.JNB

Group	N	Missing	Median	25%	75%
Cr6+-1st Q	5	0	0.0000210	0.00000366	0.0000329
2nd Q	5	0	0.00000215	0.00000215	0.00000215
3rd Q	5	0	0.00000215	0.00000215	0.0000198
4th Q	5	0	0.0000204	0.0000126	0.0000522

H = 11.824 with 3 degrees of freedom. (P = 0.008)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.008)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P<0.05
4th Q vs 2nd Q	53.500	4.044	Yes
4th Q vs 3rd Q	35.500	2.684	No
4th Q vs Cr6+-1st Q	5.000	0.378	Do Not Test
Cr6+-1st Q vs 2nd Q	48.500	3.666	Yes
Cr6+-1st Q vs 3rd Q	30.500	2.306	Do Not Test
3rd Q vs 2nd Q	18.000	1.361	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

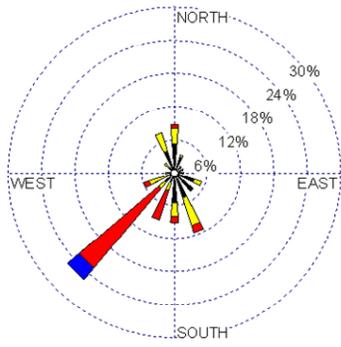
A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

## *Appendix M – Wind Roses*

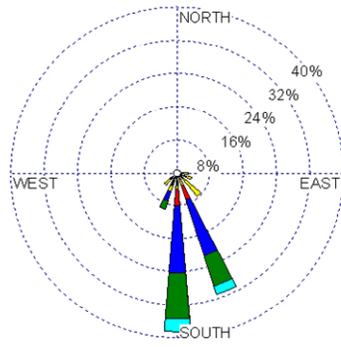
# Daily Wind Direction Averages

## A. Collocated Monitor

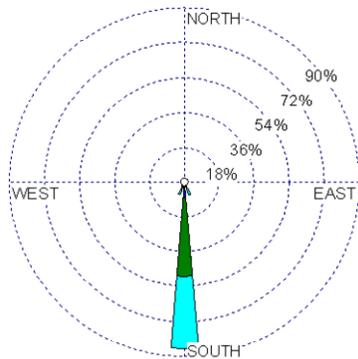
### I. 1<sup>st</sup> Quarter



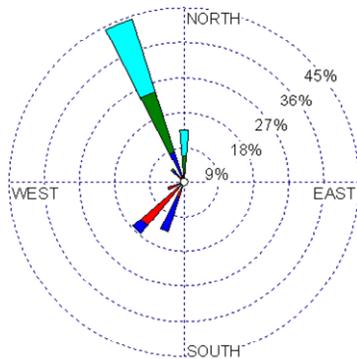
06-Dec-08



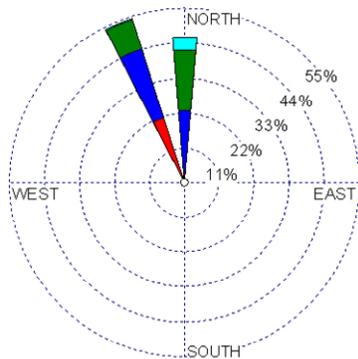
07-Dec-08



08-Dec-08

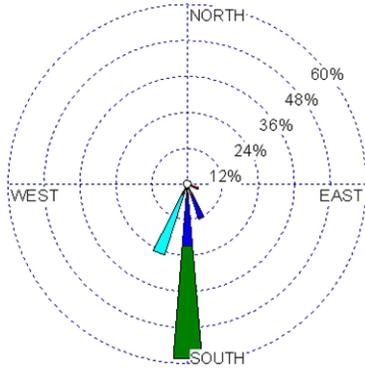


09-Dec-08

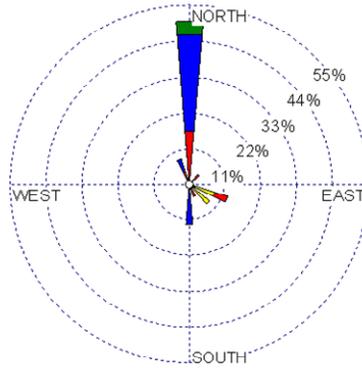


10-Dec-08

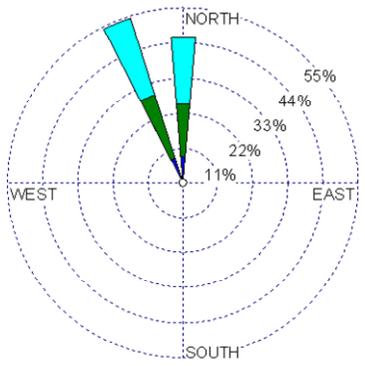
## II. 2<sup>nd</sup> Quarter



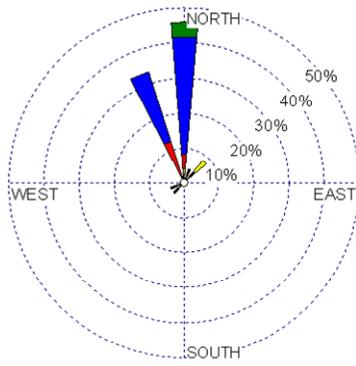
26 Feb 09



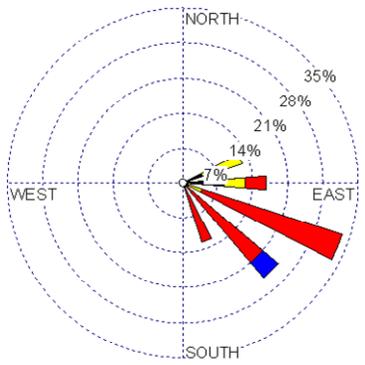
27 Feb 09



28 Feb 09

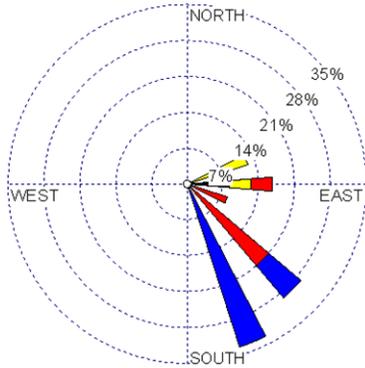


01 Mar 09

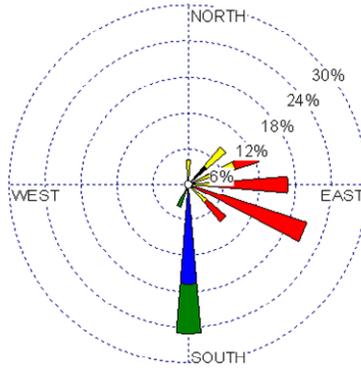


02 Mar 09

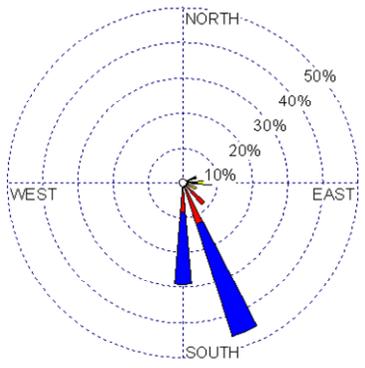
### III. 3<sup>rd</sup> Quarter



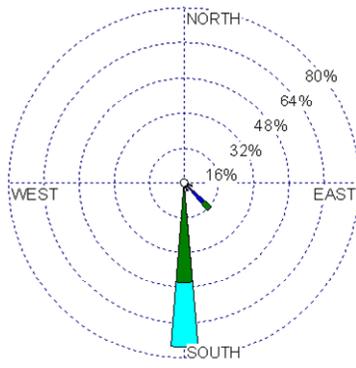
5 May 09



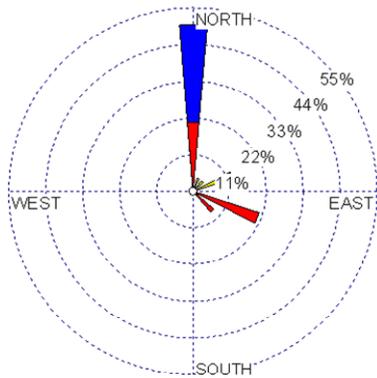
6 May 09



7 May 09



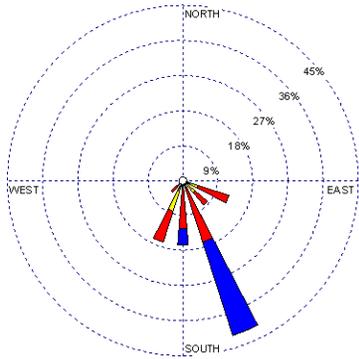
8 May 09



9 May 09



## IV. 4<sup>th</sup> Quarter

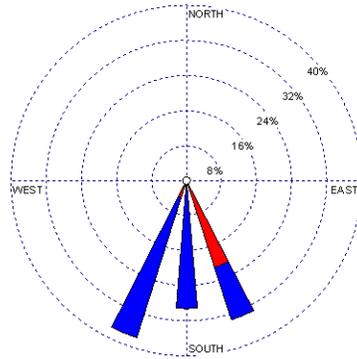


3 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

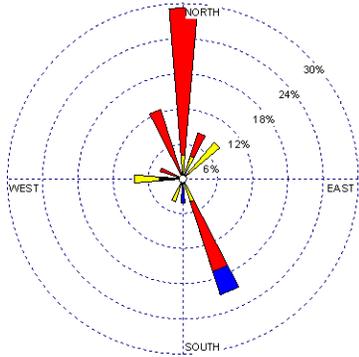


4 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

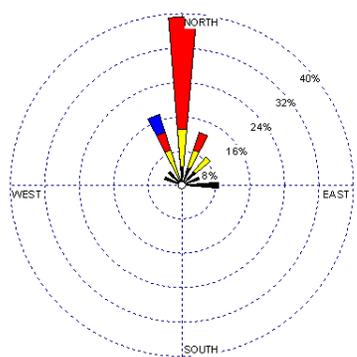


5 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

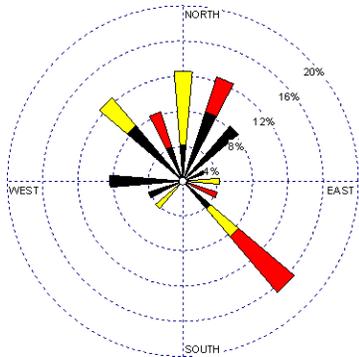


6 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%



7 July 09

WIND SPEED  
(Knots)

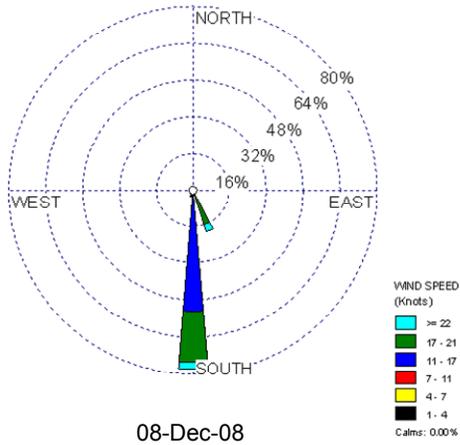
- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

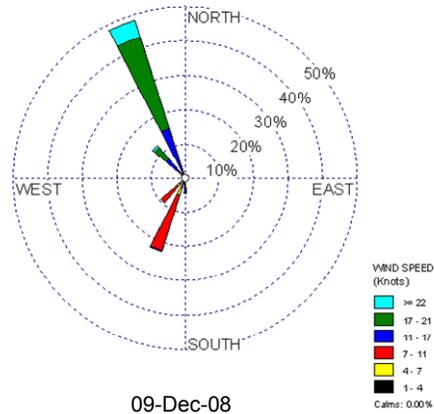
**B. Wyatt Rd**  
**I. 1<sup>st</sup> Quarter**

No meteorological data available for 06-Dec-08

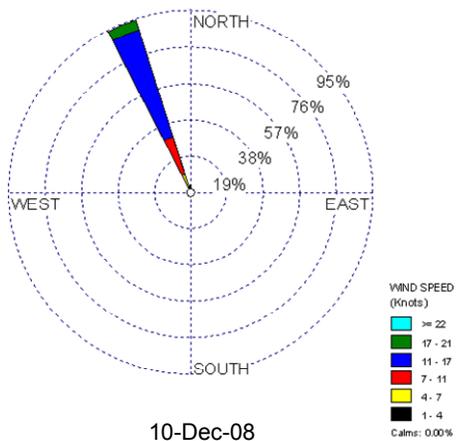
Insufficient data capture for 07-Dec-08



08-Dec-08

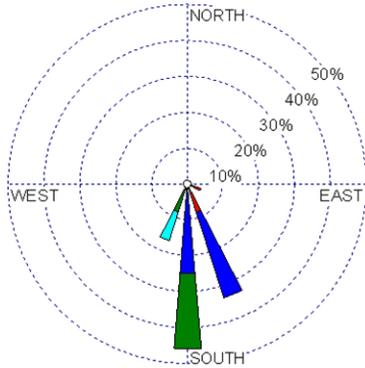


09-Dec-08

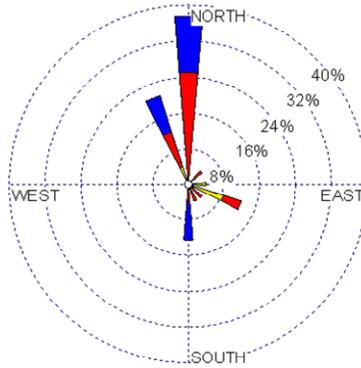


10-Dec-08

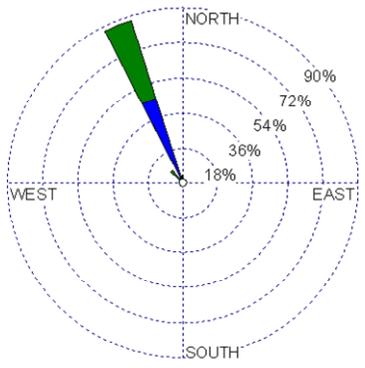
## II. 2<sup>nd</sup> Quarter



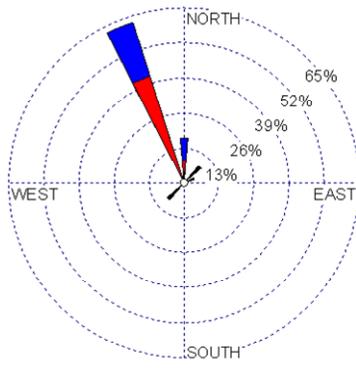
26 Feb 09



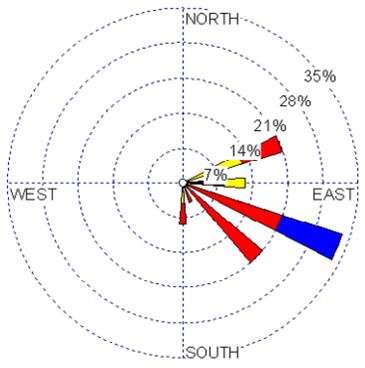
27 Feb 09



28 Feb 09

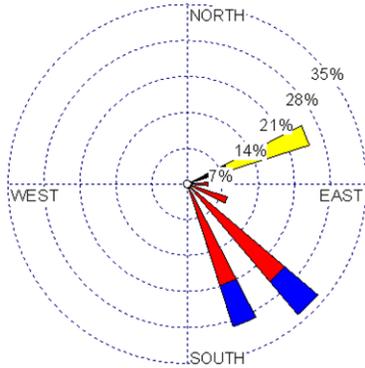


01 Mar 09

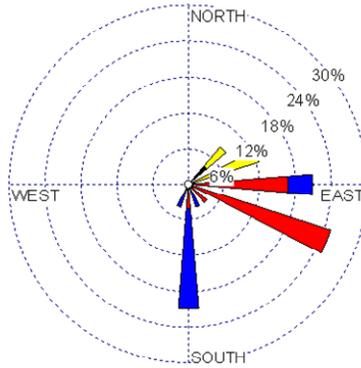


02 Mar 09

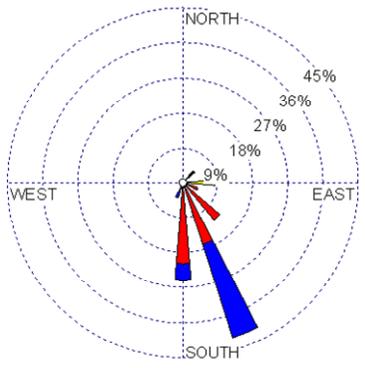
### III. 3<sup>rd</sup> Quarter



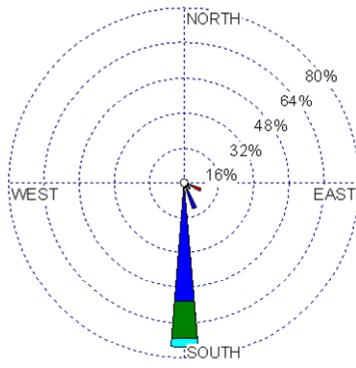
5 May 09



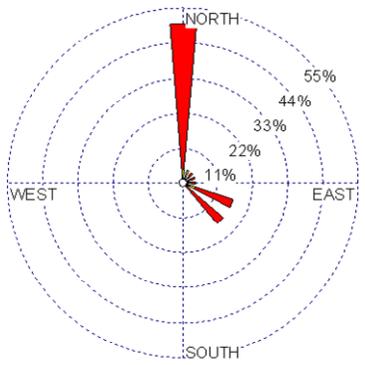
6 May 09



7 May 09

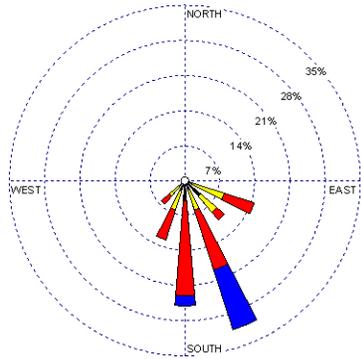


8 May 09



9 May 09

## IV. 4<sup>th</sup> Quarter

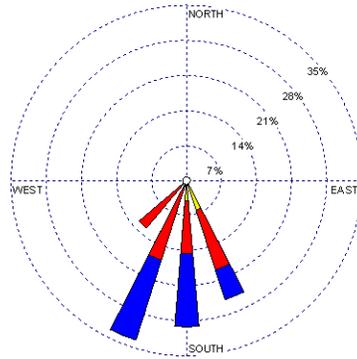


3 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

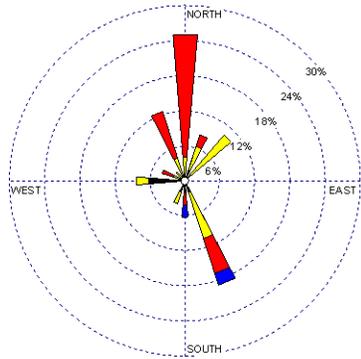


4 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

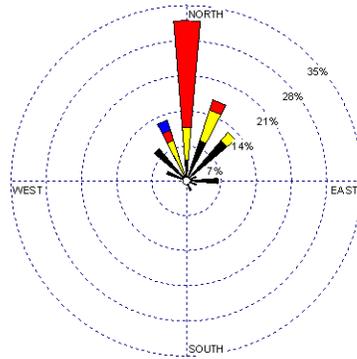


5 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

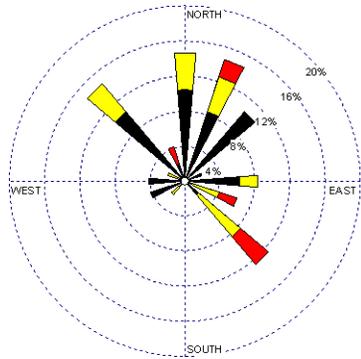


6 July 09

WIND SPEED  
(Knots)

- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%



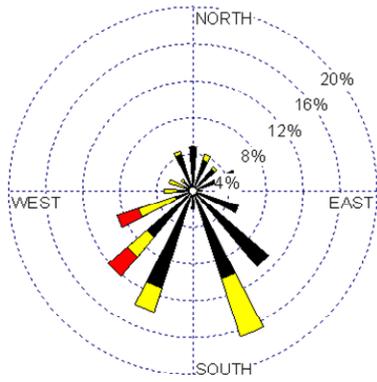
7 July 09

WIND SPEED  
(Knots)

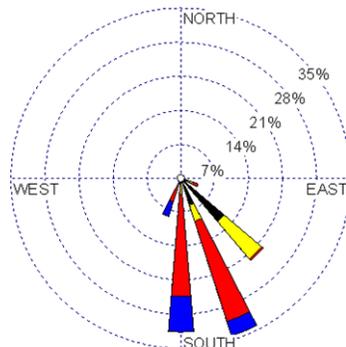
- ≥ 22
- 17 - 21
- 11 - 17
- 7 - 11
- 4 - 7
- 1 - 4

Calms: 0.00%

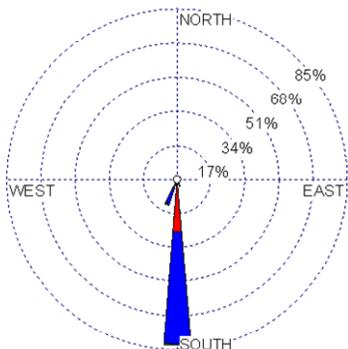
**C. Jaycee Park**  
**I. 1<sup>st</sup> Quarter**



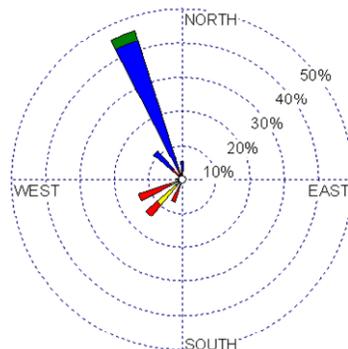
06-Dec-08



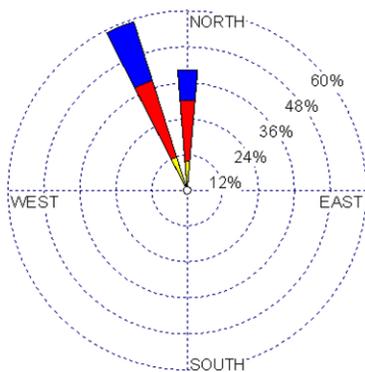
07-Dec-08



08-Dec-08



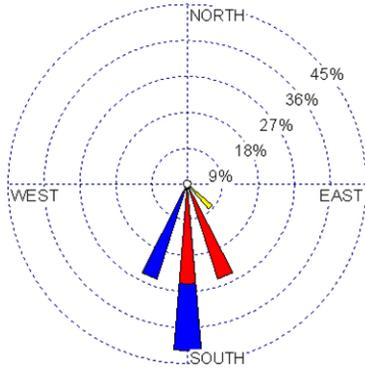
09-Dec-08



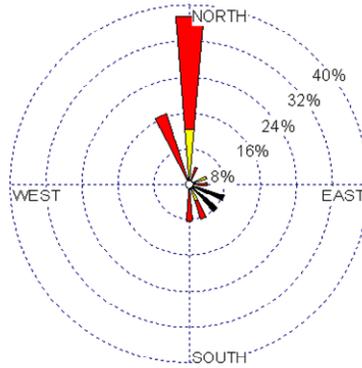
10-Dec-08



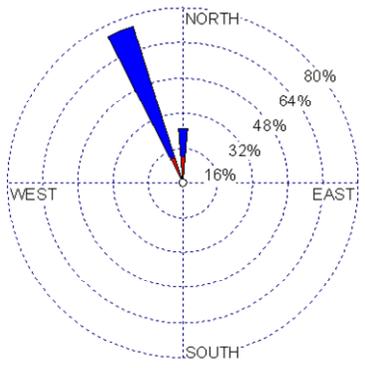
## II. 2<sup>nd</sup> Quarter



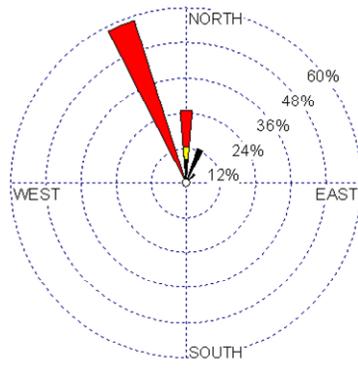
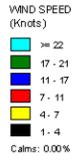
26 Feb 09



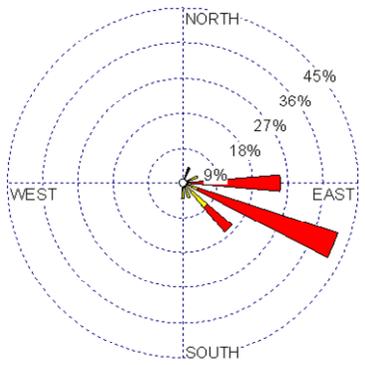
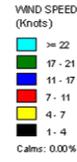
27 Feb 09



28 Feb 09



01 Mar 09

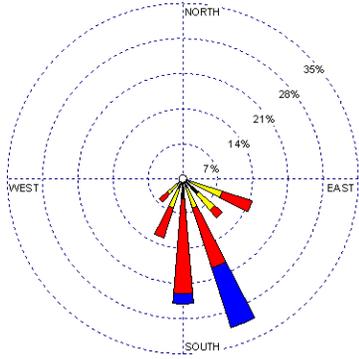


02 Mar 09



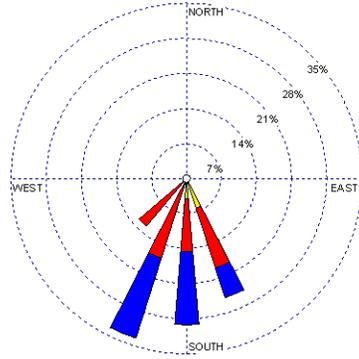


## IV. 4<sup>th</sup> Quarter



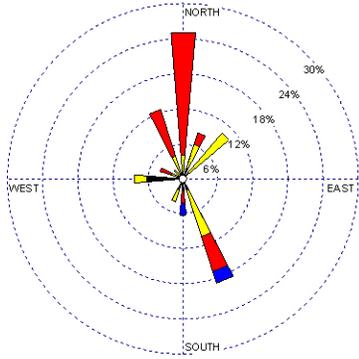
3 July 09

WIND SPEED  
(Knots)  
 >= 22  
 17 - 21  
 11 - 17  
 7 - 11  
 4 - 7  
 1 - 4  
 Calms: 0.00%



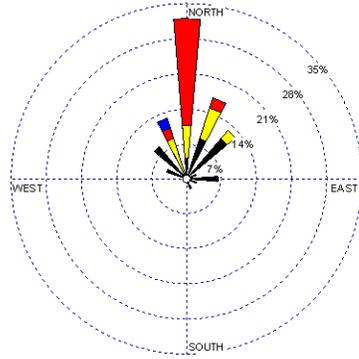
4 July 09

WIND SPEED  
(Knots)  
 >= 22  
 17 - 21  
 11 - 17  
 7 - 11  
 4 - 7  
 1 - 4  
 Calms: 0.00%



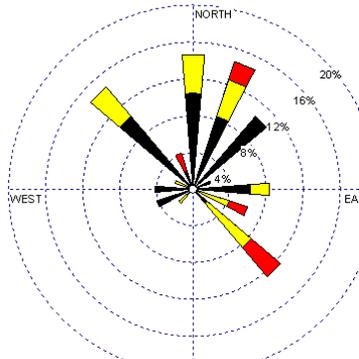
5 July 09

WIND SPEED  
(Knots)  
 >= 22  
 17 - 21  
 11 - 17  
 7 - 11  
 4 - 7  
 1 - 4  
 Calms: 0.00%



6 July 09

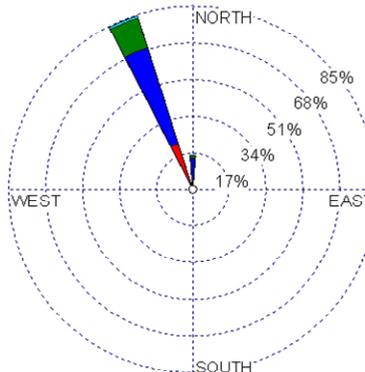
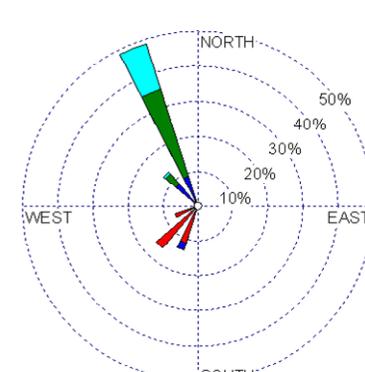
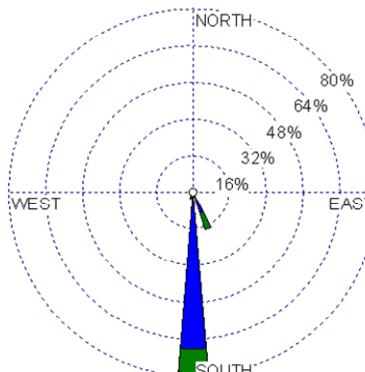
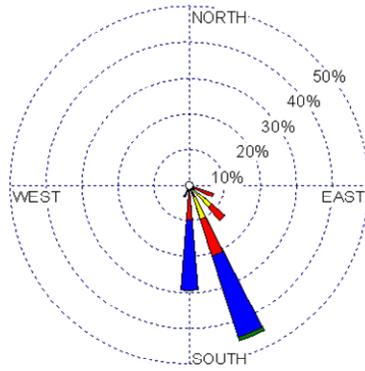
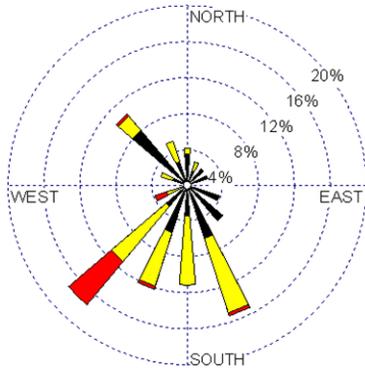
WIND SPEED  
(Knots)  
 >= 22  
 17 - 21  
 11 - 17  
 7 - 11  
 4 - 7  
 1 - 4  
 Calms: 0.00%



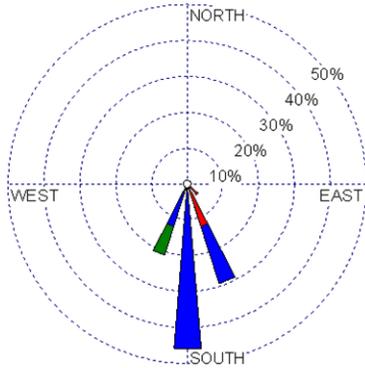
7 July 09

WIND SPEED  
(Knots)  
 >= 22  
 17 - 21  
 11 - 17  
 7 - 11  
 4 - 7  
 1 - 4  
 Calms: 0.00%

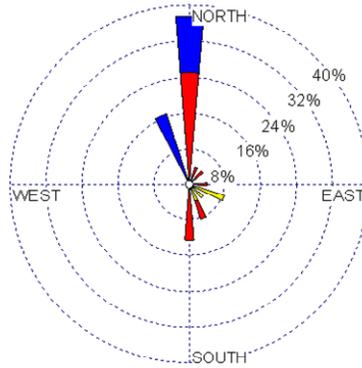
**D. Water Treatment Plant  
I. 1<sup>st</sup> Quarter**



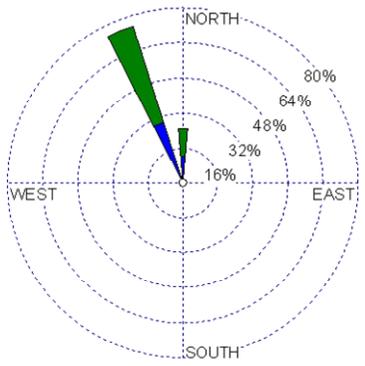
## II. 2<sup>nd</sup> Quarter



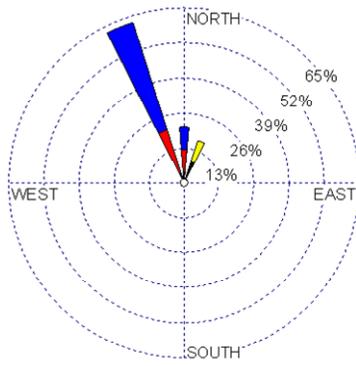
26 Feb 09



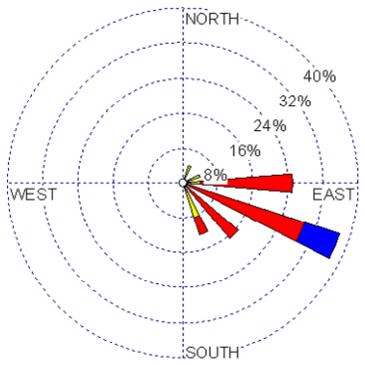
27 Feb 09



28 Feb 09



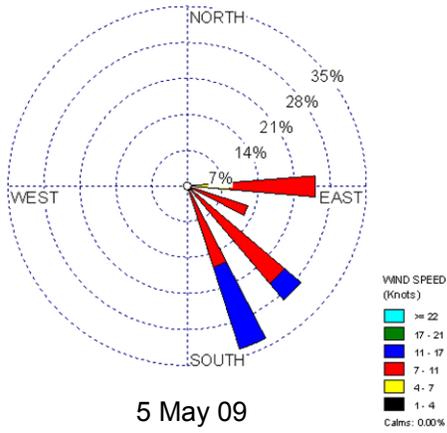
01 Mar 09



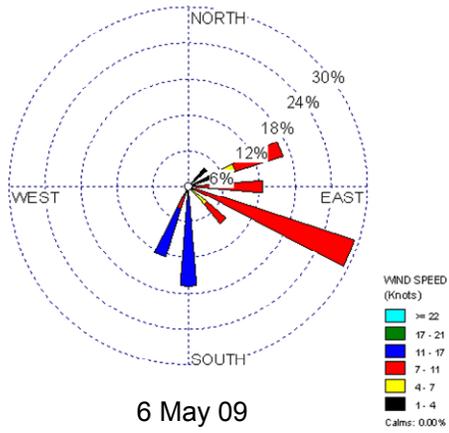
02 Mar 09



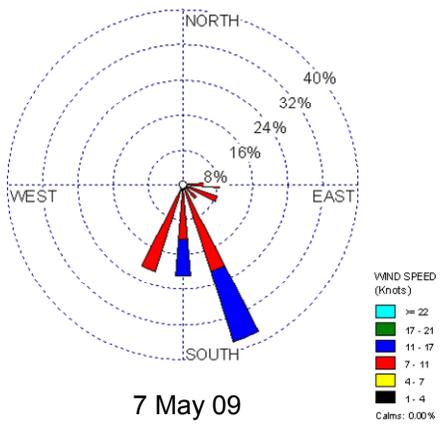
### III. 3<sup>rd</sup> Quarter



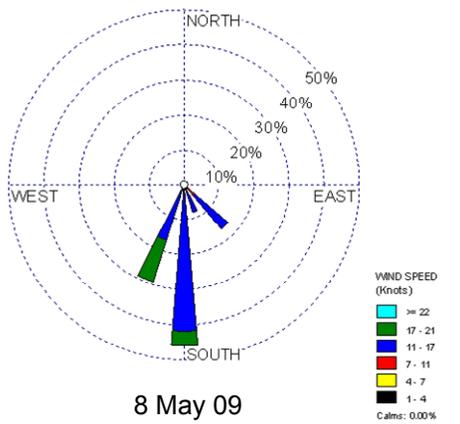
5 May 09



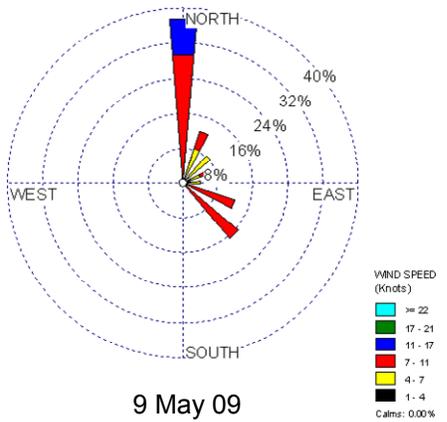
6 May 09



7 May 09

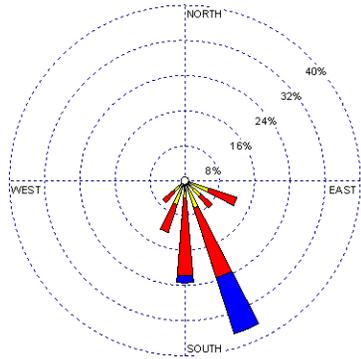


8 May 09

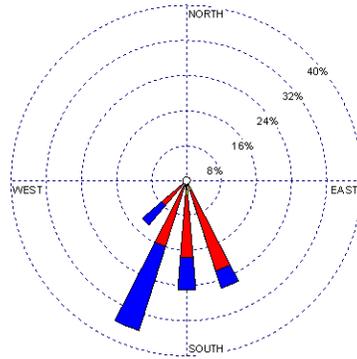


9 May 09

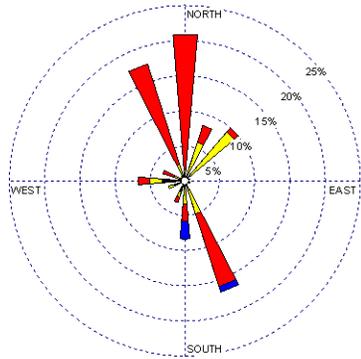
## IV. 4<sup>th</sup> Quarter



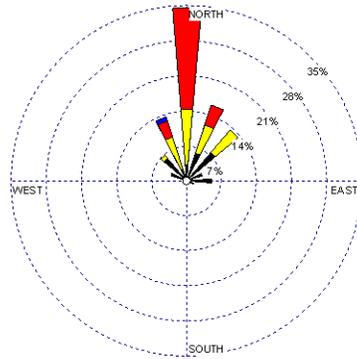
3 July 09



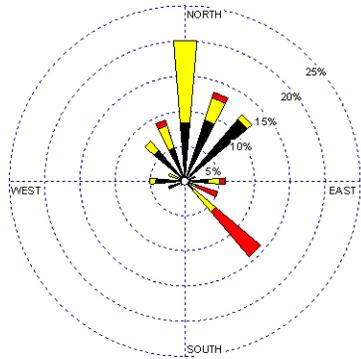
4 July 09



5 July 09



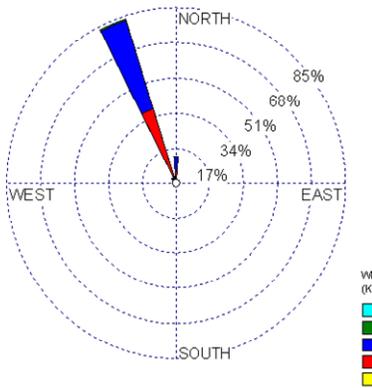
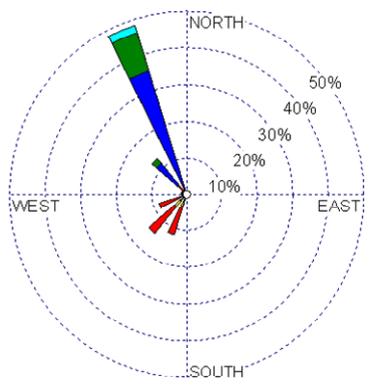
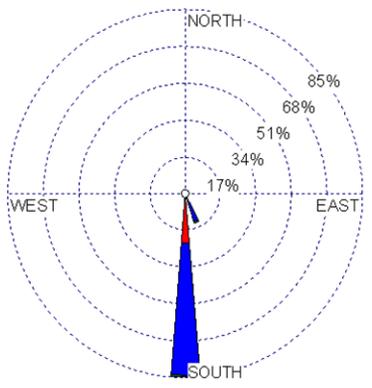
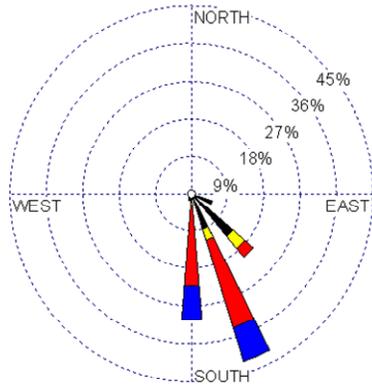
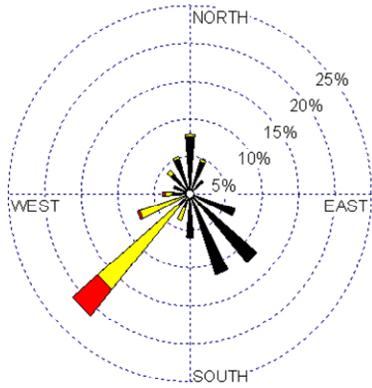
6 July 09



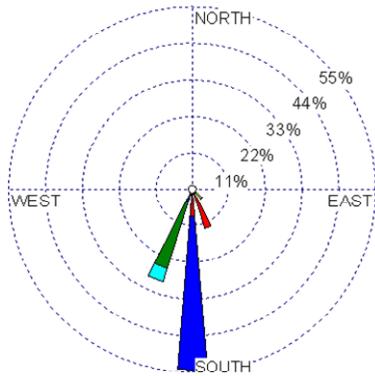
7 July 09



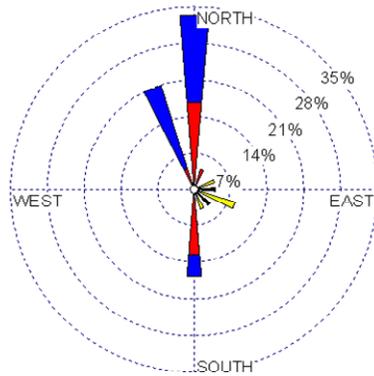
**E. Triangle Park  
I. 1<sup>st</sup> Quarter**



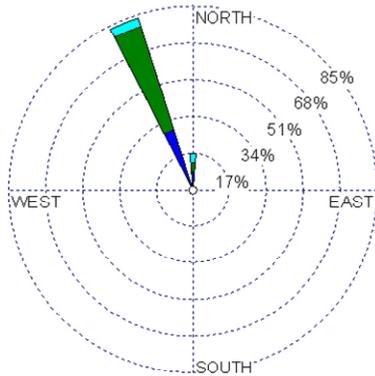
**F. Mountain Peak  
I. 2<sup>nd</sup> Quarter**



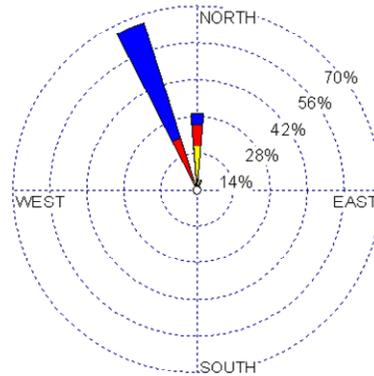
26 Feb 09



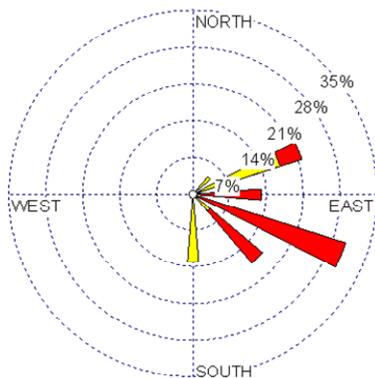
27 Feb 09



28 Feb 09

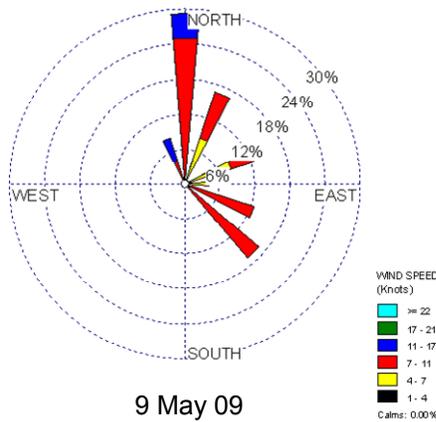
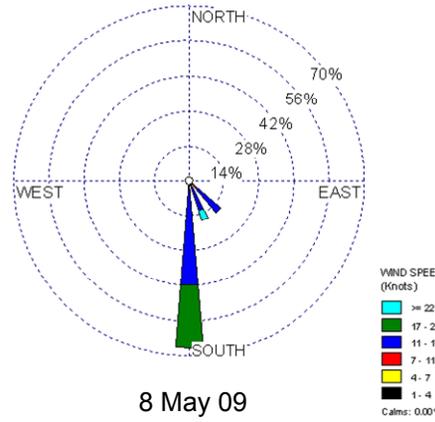
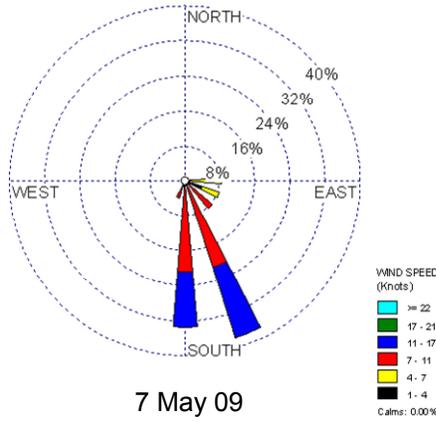
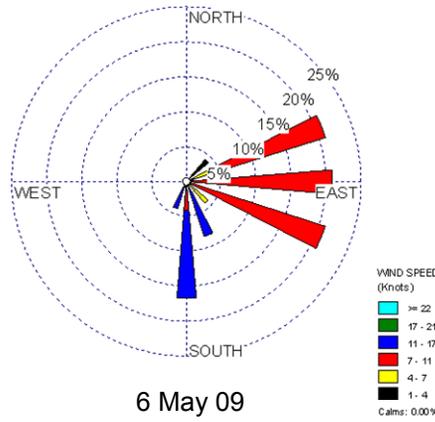
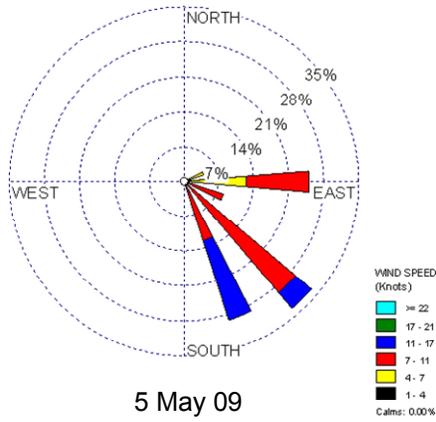


01 Mar 09

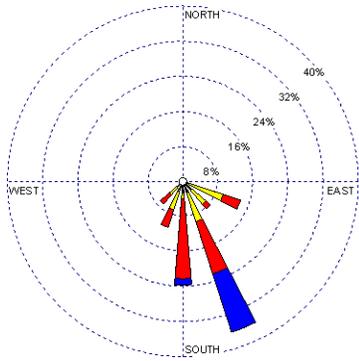


02 Mar 09

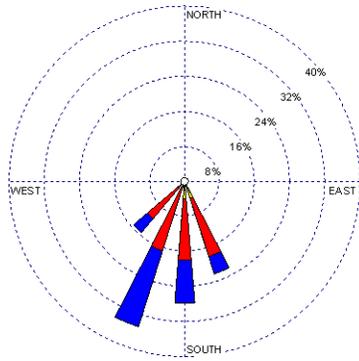
G. JA Vitovsky  
I. 3<sup>rd</sup> Quarter



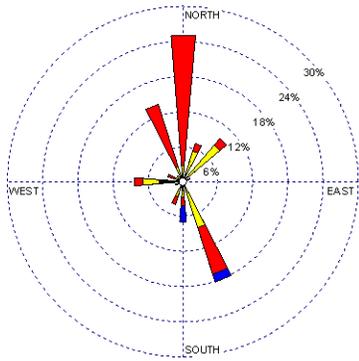
**H. Midlothian HS**  
**I. 4<sup>th</sup> Quarter**



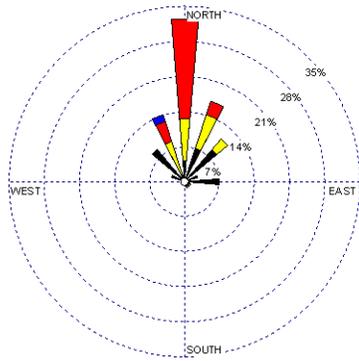
3 July 09



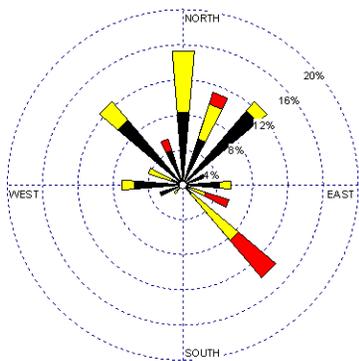
4 July 09



5 July 09



6 July 09

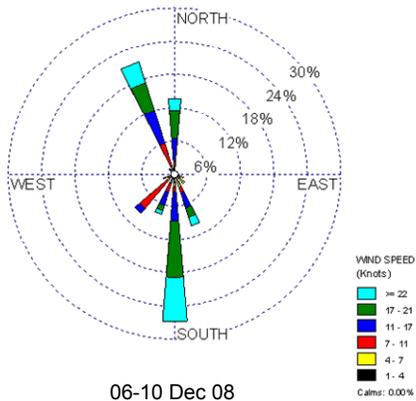


7 July 09

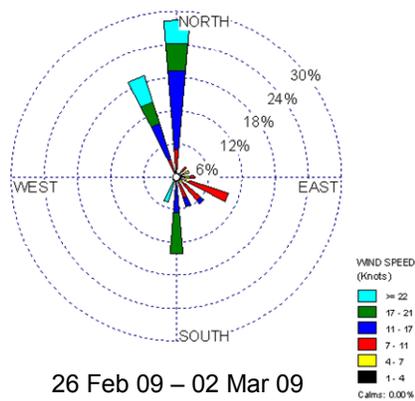
# Site Quarterly Wind Direction Averages

## A. Collocated Monitor

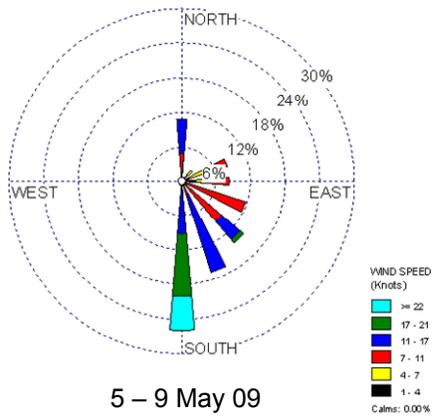
### I. 1<sup>st</sup> Quarter



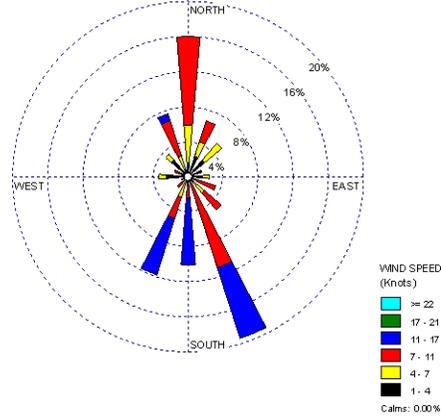
### II. 2<sup>nd</sup> Quarter



### III. 3<sup>rd</sup> Quarter



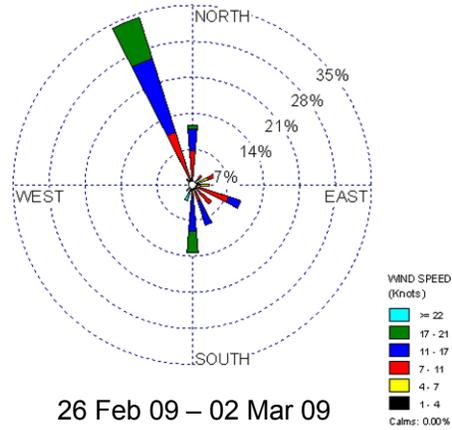
### IV. 4<sup>th</sup> Quarter



## B. Wyatt Rd

### I. 1<sup>st</sup> Quarter

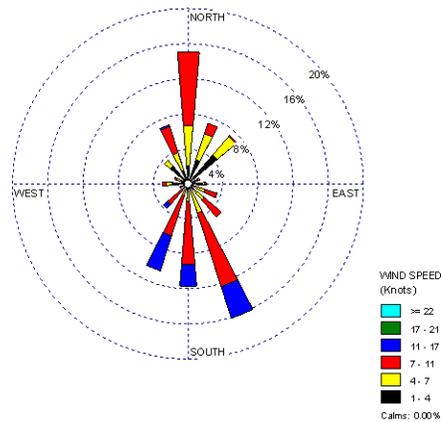
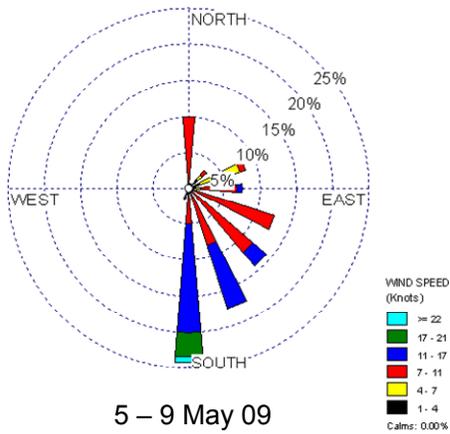
### II. 2<sup>nd</sup> Quarter



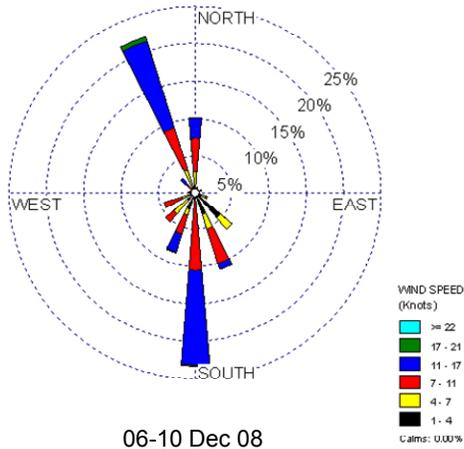
Insufficient data capture 06-10 Dec 08

### III. 3<sup>rd</sup> Quarter

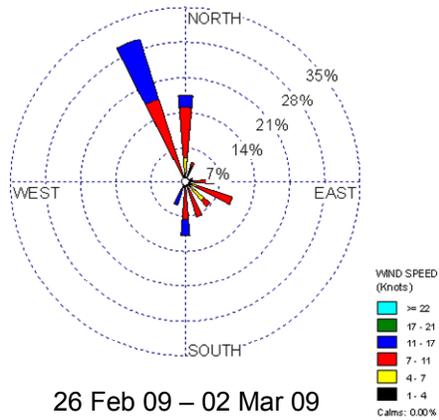
### IV. 4<sup>th</sup> Quarter



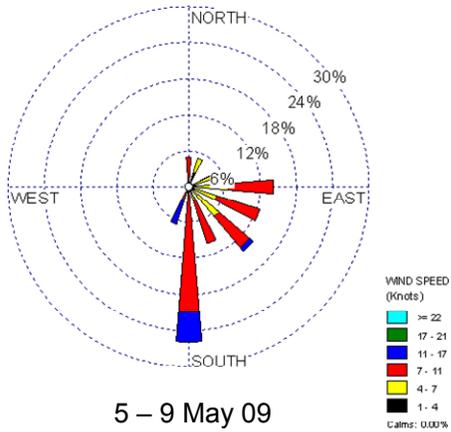
**C. Jaycee Park  
I. 1<sup>st</sup> Quarter**



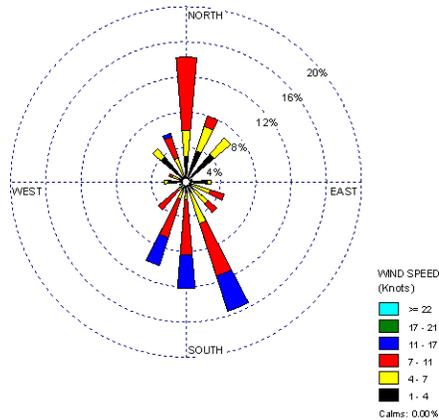
**II. 2<sup>nd</sup> Quarter**



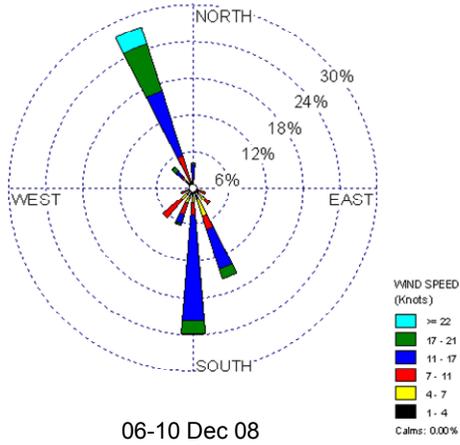
**III. 3<sup>rd</sup> Quarter**



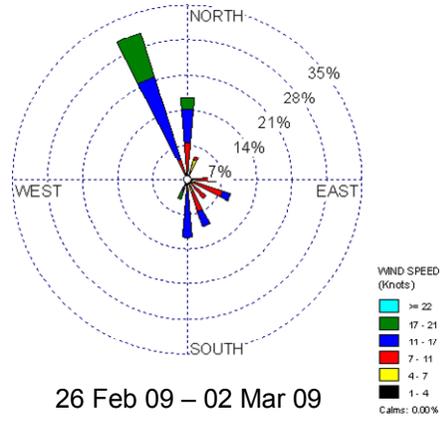
**IV. 4<sup>th</sup> Quarter**



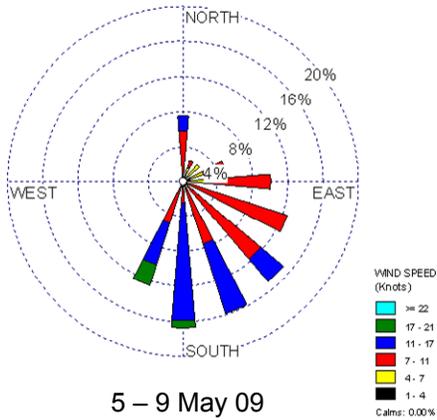
**D. Water Treatment Plant  
I. 1<sup>st</sup> Quarter**



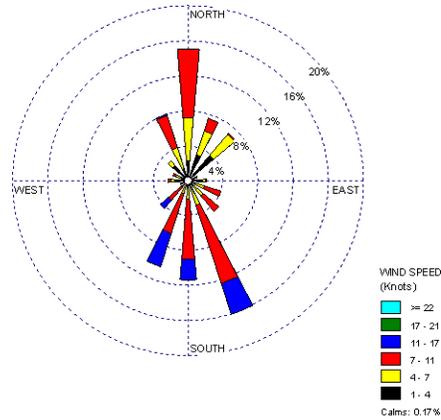
**II. 2<sup>nd</sup> Quarter**



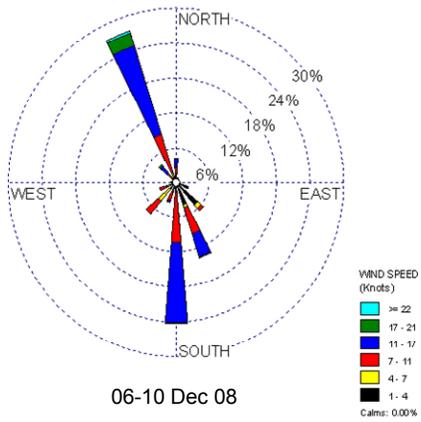
**III. 3<sup>rd</sup> Quarter**



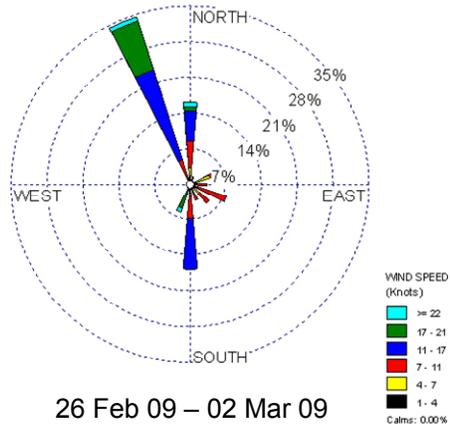
**IV. 4<sup>th</sup> Quarter**



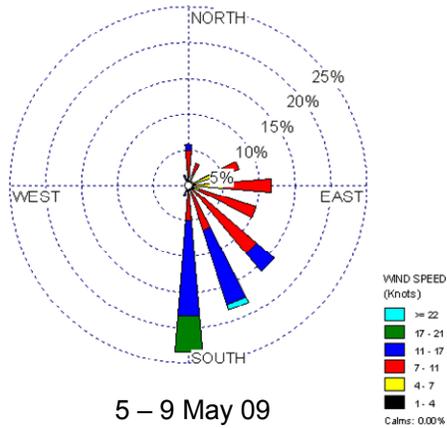
**E. Triangle Park  
I. 1<sup>st</sup> Quarter**



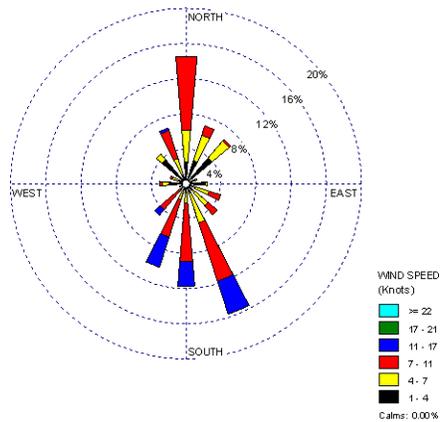
**F. Mountain Peak  
I. 2<sup>nd</sup> Quarter**



**G. JA Vitovsky  
I. 3<sup>rd</sup> Quarter**



**H. Midlothian HS  
I. 4<sup>th</sup> Quarter**



*Appendix N – URS Memorandum on 3<sup>rd</sup> Quarter Hexavalent Chromium Data*



## MEMORANDUM

TO: Tracie Phillips, TCEQ

FROM: Al Hendler, URS

DATE: June 9, 2009

SUBJECT: Midlothian Third Quarter Hexavalent Chromium ( $\text{Cr}^{6+}$ ) and Total Unspeciated Chromium ( $\text{Cr}_T$ ) Measurement Results

Third quarter sampling for the Midlothian, Texas Ambient Air Collection and Chemical Analysis Project took place on five consecutive days during May 5 – 9, 2009. As previously discussed, the laboratory results for  $\text{Cr}^{6+}$  samples cannot be positively aligned with the specific dates on which the samples were collected. This is because of a procedural mistake in which the Chain-of-Custody Form (COC) that documented the sampling date and site was removed from each solitary sample container by laboratory receiving personnel without the sampling date ever being copied from the COC.

Despite the oversight, the location at which each sample was collected is known because each shipping container was labeled with a site identification code. Therefore, the following conclusions can be drawn from the data:

- $\text{Cr}^{6+}$  levels did not exceed 0.1 nanograms per cubic meter ( $\text{ng}/\text{m}^3$ ) at any of the sampling sites on any of the five sampling days;
- Averaged over the entire five days,  $\text{Cr}^{6+}$  levels did not exceed  $0.038 \text{ ng}/\text{m}^3$  at any of the sampling sites;
- At Vitovsky Elementary School,  $\text{Cr}^{6+}$  levels were below the lower limit of detection on four of the five sampling days;
- At the four stationary sampling sites, 24-hour average  $\text{Cr}^{6+}$  levels were within the ranges measured during the first and second quarters; and
- At worst case,  $\text{Cr}^{6+}$  composed no greater than 4% of  $\text{Cr}_T$  at any of the sampling sites on any of the five sampling days.

Data from each site are summarized below

### CAMS 52

Twenty-four hour average  $\text{Cr}^{6+}$  levels ranged from below the lower limit of detection to 0.094  $\text{ng}/\text{m}^3$  with a mean of 0.038  $\text{ng}/\text{m}^3$  (assuming one-half the detection limit for the non-detects). All the 3<sup>rd</sup> quarter 24-hour levels were inside the range of 24-hour levels measured during the 1st and 2nd quarters while the 3<sup>rd</sup> quarter average was lower than the averages for Q1 and Q2. At worst case,  $\text{Cr}^{6+}$  composed no greater than 4% of  $\text{Cr}_T$  during any 24-hour period. This was estimated by dividing the 3<sup>rd</sup> quarter highest  $\text{Cr}^{6+}$  level by the lowest  $\text{Cr}_T$  level.

Quarterly Min., Max., and Means for  $\text{Cr}^{6+}$  in  $\text{ng}/\text{m}^3$

	Q1	Q2	Q3
Min	0.002	ND	ND
Max	0.257	0.106	0.094
Mean	0.097	0.041	0.038

3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  and  $\text{Cr}_T$  Results in  $\text{ng}/\text{m}^3$

Hexavalent Chromium		Total Chromium	
Rank	Conc.	Date	Conc.
1st	0.0941	5/5/2009	2.16
2nd	0.0626	5/6/2009	2.59
3rd	0.0292	5/7/2009	3.22
4th	ND	5/8/2009	4.89
5th	ND	5/9/2009	2.31
Min	ND	Min	2.16
Max	0.094	Max	4.89

### Wyatt Road

Twenty-four hour average  $\text{Cr}^{6+}$  levels ranged from 0.020  $\text{ng}/\text{m}^3$  to 0.053  $\text{ng}/\text{m}^3$  with a mean of 0.035  $\text{ng}/\text{m}^3$ . All the 3<sup>rd</sup> quarter 24-hour levels were inside the range of 24-hour levels measured during the 1st and 2nd quarters while the 3<sup>rd</sup> quarter average was lower than the averages for Q1 and Q2. At worst case,  $\text{Cr}^{6+}$  composed no greater than 2% of  $\text{Cr}_T$  during any 24-hour period. This was estimated by dividing the 3<sup>rd</sup> quarter highest  $\text{Cr}^{6+}$  level by the lowest  $\text{Cr}_T$  level.

Quarterly Min., Max., and Means for  $\text{Cr}^{6+}$  in  $\text{ng}/\text{m}^3$

	Q1	Q2	Q3
Min	ND	ND	0.020
Max	0.379	0.138	0.053
Mean	0.112	0.055	0.035

3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  and  $\text{Cr}_T$  Results in  $\text{ng}/\text{m}^3$

Hexavalent Chromium		Total Chromium	
Rank	Conc.	Date	Conc.
1st	0.0525	5/5/2009	4.74
2nd	0.0395	5/6/2009	3.91
3rd	0.034	5/7/2009	7.04
4th	0.0292	5/8/2009	11.9
5th	0.0199	5/9/2009	2.64
Min	0.020	Min	2.64
Max	0.053	Max	11.9

### Jaycee Park

Twenty-four hour average  $\text{Cr}^{6+}$  levels ranged from below the lower limit of detection to 0.020  $\text{ng}/\text{m}^3$  with a mean of 0.012  $\text{ng}/\text{m}^3$ . All the 3<sup>rd</sup> quarter 24-hour levels were inside the range of 24-hour levels measured during the 1st and 2nd quarters while the 3<sup>rd</sup> quarter average was between the averages for Q1 and Q2. At worst case,  $\text{Cr}^{6+}$  composed no greater than 1% of  $\text{Cr}_T$  during any 24-hour period. This was estimated by dividing the 3<sup>rd</sup> quarter highest  $\text{Cr}^{6+}$  level by the lowest  $\text{Cr}_T$  level.

Quarterly Min., Max., and Means for  $\text{Cr}^{6+}$  in  $\text{ng}/\text{m}^3$

	Q1	Q2	Q3
Min	0.002	ND	ND
Max	0.064	0.025	0.020
Mean	0.022	0.011	0.012

3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  and  $\text{Cr}_T$  Results in  $\text{ng}/\text{m}^3$

Hexavalent Chromium		Total Chromium	
Rank	Conc.	Date	Conc.
1 <sup>st</sup>	0.0204	5/5/2009	2.14
2 <sup>nd</sup>	0.0177	5/6/2009	2.14
3 <sup>rd</sup>	0.0169	5/7/2009	2.14
4 <sup>th</sup>	ND	5/8/2009	2.26
5 <sup>th</sup>	ND	5/9/2009	2.59
Min	ND	Min	2.14
Max	0.020	Max	2.59

### Water Treatment Plant

Twenty-four hour average  $\text{Cr}^{6+}$  levels ranged from below the lower limit of detection to 0.020  $\text{ng}/\text{m}^3$  with a mean of 0.009  $\text{ng}/\text{m}^3$ . All the 3<sup>rd</sup> quarter 24-hour levels were inside the range of 24-hour levels measured during the 1st and 2nd quarters while the 3<sup>rd</sup> quarter average was between the averages for Q1 and Q2. At worst case,  $\text{Cr}^{6+}$  composed no greater than 1% of  $\text{Cr}_T$  during any 24-hour period. This was estimated by dividing the 3<sup>rd</sup> quarter highest  $\text{Cr}^{6+}$  level by the lowest  $\text{Cr}_T$  level.

Quarterly Min., Max., and Means for  $\text{Cr}^{6+}$  in  $\text{ng}/\text{m}^3$

	Q1	Q2	Q3
Min	ND	ND	ND
Max	0.047	ND	0.020
Mean	0.021	0.002	0.009

3<sup>rd</sup> Quarter  $\text{Cr}^{6+}$  and  $\text{Cr}_T$  Results in  $\text{ng}/\text{m}^3$

Hexavalent Chromium		Total Chromium	
Rank	Conc.	Date	Conc.
1 <sup>st</sup>	0.0201	5/5/2009	2.04
2 <sup>nd</sup>	0.0197	5/6/2009	2.16
3 <sup>rd</sup>	ND	5/7/2009	2.54
4 <sup>th</sup>	ND	5/8/2009	2.43
5 <sup>th</sup>	ND	5/9/2009	2.22
Min	ND	Min	2.04
Max	0.020	Max	2.54

Vitovsky Elementary School

Twenty-four hour average Cr<sup>6+</sup> levels ranged from below the lower limit of detection to 0.021 ng/m<sup>3</sup> with a mean of 0.006 ng/m<sup>3</sup>. No sampling was conducted at Vitovsky Elementary School during the 1<sup>st</sup> and 2<sup>nd</sup> quarters. At worst case, Cr<sup>6+</sup> composed no greater than 1% of Cr<sub>T</sub> during any 24-hour period. This was estimated by dividing the 3<sup>rd</sup> quarter highest Cr<sup>6+</sup> level by the lowest Cr<sub>T</sub> level.

3<sup>rd</sup> Quarter Cr<sup>6+</sup> and Cr<sub>T</sub> Results in ng/m<sup>3</sup>

Hexavalent Chromium		Total Chromium	
Rank	Conc.	Date	Conc.
1st	0.0211	5/5/2009	2.64
2nd	ND	5/6/2009	2.33
3rd	ND	5/7/2009	2.77
4th	ND	5/8/2009	2.3
5th	ND	5/9/2009	3.16
Min	ND	Min	2.3
Max	0.021	Max	3.16

***Appendix O – ERG Letter to URS about 3<sup>rd</sup> Quarter Hexavalent Chromium Data***



June 9, 2009

Al Hendler  
URS Corporation  
9400 Amberglens Blvd  
Austin, TX 78720  
Project Name: JPTX

Dear Al Hendler,

As discussed with you via phone, there was an issue at the laboratory concerning the receipt of the samples collected in Midlothian, TX from 5/05/09 to 5/09/09. We were unable to identify the exact sample date for the samples that were collected in Midlothian, TX from May 5-9, 2009.

Our usual process for hexavalent chromium samples is to label the container with the sample identification code and date sampled to identify the samples. The Chain of Custody (COC) has the same information as the label on the container. The COCs are wrapped around the container for shipment to the field. After the sample is taken and sent back to the laboratory, the COCs are taken off the container and the samples are logged into our Laboratory Information Management System (LIMS). LIMS provides a unique identification code that is put on the COC and the COC is then matched back up with the container.

Because we were unsure what days the Midlothian samples would be taken, we did not place a date on the container label; however, they were labeled with the site codes. When the hexavalent chromium samples were received at the laboratory, the receiving personnel did not notice that the containers were not labeled with sample dates. When the COCs were removed, we were unable to determine which COC went with each of the samples after sample login. The codes were identified but the sample dates were not verifiable.

Because of this laboratory error, a new procedure was adopted to uniquely identify each of the sample containers. A container number will be recorded on the COCs before the samples are logged into LIMS. After the samples are given their unique identification code, the COC will be matched back to the container based on the identification code on the container.

Because we were unable to identify the exact sample date for these samples that were collected in Midlothian, TX from May 5-9, 2009, each of them are labeled with the range of sampling dates. The analytical data pass all of ERG laboratory's quality control requirements. The sample reports are attached to this letter.

If you have any questions, please contact me at 919-468-7924.

Sincerely,

Julie Swift  
Program Manager

601 Kuykendall Park Drive, Suite 200, Morrisville, NC 27560 • Phone (919) 468-7800 • Fax (919) 468-7803  
• Arlington, VA • Atlanta, GA • Austin, TX • Boston, MA • Chantilly, VA • Cincinnati, OH • Hershey, PA  
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