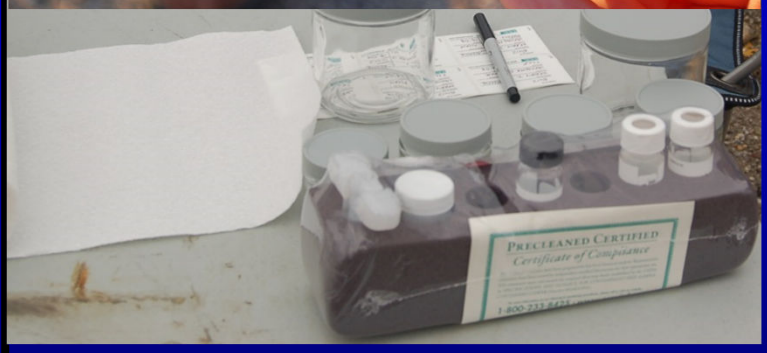
# Risk Mitigation Work Plan for the Proposed Fairfield Jail/Public Safety Facility 334 West Wheeling Street Lancaster, Ohio

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## RELIABILITY OF REPORT - DISCLAIMER

Conclusions reached in this report are based upon the objective data available to the CONSULTANTS at the time of forming their opinions and as presented in the report. The accuracy of the report depends upon the accuracy of these data. Every effort is made to evaluate the information by the methods that generally are recognized to constitute the state of the art at the time of rendering the report and conclusions, and the conclusions reached herein represent our opinions. Subsurface conditions are known to vary both in space and time, and there is inherent risk in the extrapolation of data.

THE CONSULTANTS are not responsible for actual conditions proved to be materially at variance with the data that were available to them and upon which they relied, as presented in the report.

The opinions, conclusions and recommendations shown in the report are put forth for a specific and proposed purpose and for the specific site discussed. The CONSULTANTS are not responsible for any other application, whether of purpose or location, of our opinions, conclusions and recommendations other than as specifically indicated in the report.

## EXECUTIVE SUMMARY

On December 15, 2014, the City of Lancaster instituted an Interim Policy for Development within the Wellhead Protection Zones. At that time, Fairfield County had been developing plans for siting a new Public Safety Facility/Sheriff's Office at 334 West Wheeling Street, Lancaster, Ohio and the plans were mostly completed. The proposed location is situated within the one-year time-of-travel to the Miller Park Wellfield.

In March, 2014, Fairfield County had engaged Bennett & Williams Environmental Consultants, Inc. to perform a limited Phase II Environmental Assessment for the area under the proposed new building footprint (prior to the institution of the Lancaster Interim Policy). A portion of this report included preparation of a site specific risk assessment that evaluated pathways of exposure to workers and residents at the proposed jail facility. This document can be accessed at http://www.co.fairfield.oh.us/COMMISH/jail_lpiiesa_report.pdf.

The City of Lancaster reviewed this document and requested that, due to the proximity of the Miller Park Wellfield to the site, the soil leaching to groundwater pathway for offsite receptors also be evaluated as a precaution. Anticipating that this analysis might show that this pathway was complete and that the property specific risk assessment might show a risk to the wellfield, the City requested that a Risk Mitigation Work Plan be prepared for the site in accordance with the new Interim Policy requiring a work plan for all risks identified as a result of a property specific risk assessment.

The results of the property specific risk assessment using the leaching model showed that under both current conditions and proposed post-construction conditions, that none of the eight constituents leached to groundwater in 100 years, the standard time period used in leaching assessments. These results were obtained despite the fact that the most conservative input parameters were used to reach these results. Therefore, based on the results of the leaching model, no risk to the Miller Park wellfield was found.

However, the results of the property specific risk assessment showed that risks were posed by fill materials at the site to construction/excavation workers due to dermal exposure to arsenic and inhalation exposure to mercury. Fairfield County will require, as part of the bid documents, that contractors develop a health and safety plan to address these risks. The risk from arsenic can be managed by limiting construction/excavation workers to no more than 90 fulltime days onsite or by requiring workers (as part of a health and safety plan) to wear gloves and long sleeves. Similarly, the risk from mercury can be managed (as part of a health and safety plan) by limiting either the number of hours and/or the number of days of exposure for the worker to no more than 200 fulltime days.

Due to the proximity of the Miller Park Wellfield and the importance of protection of the aquifer, Fairfield County also proposes additional voluntary measures designed to minimize any impact to the aquifer both during and after construction of the proposed construction of the Fairfield County Jail/Public Safety Facility. These measures include: "casing off" the fill materials as part of the construction of the auger cast piles to minimize the downward transport of fill materials into the aquifer; having an environmental professional onsite during excavation activities to confirm that the fill does not contain materials subject to additional regulation; managing all fill materials onsite in areas where fill is already present; and disposing of excess fill materials offsite, if needed, at a solid waste disposal facility. These measures are in addition to many other items specifically requested by the City of Lancaster and already incorporated in the plans and specifications.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES



## LIST OF APPENDICES

# SECTION 1
# INTRODUCTION

## 1.1 Introduction

On December 15, 2014, the City of Lancaster instituted an Interim Policy for Development within the Wellhead Protection Zones. At that time, Fairfield County had been developing plans for siting a new Public Safety Facility/Sheriff's Office at 334 West Wheeling Street, Lancaster, Ohio and the plans were mostly completed. Pursuant to a meeting held on January 6, 2015 between officials from Fairfield County, the City of Lancaster, and Bennett & Williams employees, available documentation was prepared addressing all items within the Interim Policy. Due to the critical construction timeline, this information was compiled into four volumes and submitted to the City of Lancaster in both paper and electronic format on January 20, 2015. On January 23, 2015, a follow-up meeting was held to provide opportunity for the City of Lancaster to ask questions about the submittal. At this meeting, representatives of Fairfield County and the City of Lancaster as well as employees of Bennett & Williams and Burgess & Niple (hired to review the environmental information) were in attendance.

On March 3, 2015, the City of Lancaster forwarded a review of the information submitted on January 20, 2015 to Fairfield County. Among the items requested, the City stated *"Please prepare and submit a Risk Mitigation Work Plan detailing analysis and handling of excavated soils, and other proposed mitigation such as double-casing the proposed auger cast borings"*. Fairfield County agreed to assess the need for a Risk Mitigation Work Plan in accordance with the Lancaster Interim Policy on Development within the Wellhead Protection Zones.

## 1.2 Lancaster Interim Policy Criteria Triggering the Need for a Property Specific Risk Assessment (PSRA)

The Lancaster Interim Policy on Development within the Wellhead Protection Zones requires that *"soil and groundwater analysis shall include, at a minimum, the parameters listed on the attached Table 1"* (also reproduced here as Table 1).

Once soil has been analyzed, the Lancaster Interim Policy specifies that *"Soil analytical results shall be compared to the residential land use category generic numerical direct-contact soil standards found in Appendix A to the Ohio Administrative Code (OAC) 3745-300-08, Table 1."* Similarly, once the groundwater is analyzed, the Lancaster Interim Policy specifies that *"Groundwater analytical results shall be compared to the generic unrestricted potable use standards found in Appendix A to OAC 3745-300-08, Table VI"*.

According to the Lancaster Interim Policy*, "for sites where soil and groundwater meet the Ohio VAP generic numerical standards found in Appendix A of OAC 3745-300-08 and as described above, no further action is required"*. However, the Lancaster Interim Policy states that *"For sites where soil or groundwater samples exceed the Ohio VAP generic numerical standards found in Appendix A of OAC 3745-300-08, a property specific risk assessment (PSRA)*

*must be conducted in accordance with the requirements of OAC 3745-300-09. For the purposes of the PSRA, the land use shall be residential and the groundwater shall be critical resource. The PSRA shall be conducted under the direction of an Ohio EPA VAP Certified Professional".*

Table 1. Required analytical parameters (Lancaster Interim Policy for Development within the Wellhead Protection Zones, December 15, 2014).

| **Inorganics** | **Volatile Organic Compounds** | **Synthetic Organic Compounds** |
|---|---|---|
| Aluminum | Benzene | Alachlor (LASSO)-2051 |
| Antimony | Carbon Tetrachloride | Atrazine-2650 |
| Arsenic | Monochlorobenzene | Simazine-2037 |
| Barium | 1,2-Dichlorobenzene | |
| Beryllium | 1,4-Dichlorobenzene | |
| Cadmium | 1,2-Dichloroethane | |
| Chromium | 1,1-Dichloroethene | |
| Cobalt | cis-1,2-Dichloroethene | |
| Copper | trans-1,2-Dichloroethane | |
| Cyanide | Dichloromethane | |
| Lead | 1,2-Dichloropropane | |
| Magnesium | Ethylbenzene | |
| Mercury | Styrene | |
| Nickel | Tetrachloroethene | |
| Selenium | Toluene | |
| Silver | 1,2,4-Trichlorobenzene | |
| Sodium | 1,1,1-Trichloroethane | |
| Thallium | 1,1,2-Trichloroethane | |
| Vanadium | Trichloroethene | |
| Zinc | Vinyl Chloride | |
| | Xylenes, total | |

### 1.3 Lancaster Interim Policy Criteria Triggering a Risk Mitigation Work Plan

The Lancaster Interim Policy specifies that <u>if</u> risks are identified by the property specific risk assessment, then a Risk Mitigation Work Plan needs to be prepared. According to the Interim Policy, *"The VAP Certified Professional in conjunction with the Structural Engineer and the Site Engineer shall prepare a Risk Mitigation Work Plan that recommends construction techniques and practices required to mitigate the risks identified in the PSRA. The Risk Mitigation Work Plan shall be submitted to the City for review. Upon approval by the City, techniques and practices proposed in the Risk Mitigation Work Plan shall be incorporated into the plans".*

## SECTION 2
## ANALYTICAL RESULTS

### 2.1 Soil Results

Onsite soils were sampled during two separate field events. First, fill materials were sampled during the 2014 Limited Phase II Environmental Assessment and analytical results presented in Bennett & Williams (2014a). Second, fill and native soil was sampled during the installation of two new onsite monitoring wells (MW-9S and MW-9D) in April 2015 (Bennett & Williams, 2015a). A summary of the analytical results and comparison to the residential land use category generic numerical direct-contact soil standards found in Appendix A to the Ohio Administrative Code (OAC) 3745-300-08, Table 1 are included in the following sections. The locations where samples were collected are shown in Figure 1.

#### 2.1.1 *Soils Analyzed During the 2014 Limited Phase II Environmental Assessment*

Fill materials encountered during the Limited Phase II Environmental Assessment were analyzed for:

1) toxicity characteristic leaching procedure (TCLP) for metals, volatile organic compounds (VOCs) and semi-volatile organic compounds using EPA sample extraction Method 1311 and analytical Methods 6010B/7470A/8260B/8260C;

2) total concentration of "target analyte list" metals using EPA analytical Methods 6010B/7471A;

3) total concentration of "target compound list" VOCs using EPA Methods 5035 and 5035A for sample collection, preservation, and handling in addition to EPA analytical Method 8260B;

4) total concentration of "target compound list" semi-volatile organics using EPA analytical Method 8270C; and

5) both "gasoline range organics" (GROs) and "diesel range organics" (DROs) using EPA analytical method 8015C.

Due to the fact that the initial environmental sampling was conducted in March 2014, prior to the adoption of the Lancaster Interim Policy, analyses of soil and water included many additional parameters not required in Table 1, but did not include all of the required analytes. Fairfield County flagged these parameters in the January 20, 2015 submittal to the City of Lancaster and indicated that soil samples were not analyzed for cyanide, Alachlor and Simazine. Similarly, groundwater samples were not sampled for cyanide, Alachlor, Atrazine and Simazine. Fairfield County explained that the reason that Alachlor, Atrazine, and Simazine had not been tested was because these compounds are all pesticides used for agricultural purposes. The reason no pesticides were analyzed is because the historical site information indicated that the property


Figure 1.
Soil sampling locations.

had been filled prior to World War II and no farming activities had taken place on the site in the ensuing years. Prior to World War II, pesticides were not manufactured. Similarly, the monitoring wells installed by the City of Lancaster on the site (MW4-S and MW4-D) as part of the source water protection program were sampled for cyanide, but all values were shown to be non-detect from 1995 through 2009 when sampling ended.

The City of Lancaster considered the information provided on January 20, 2015 and concluded in the March 3, 2015 comments on the submission that *"Soil samples were not analyzed for cyanide, Alachlor, and Simazine, and therefore were not analyzed in accordance with the required parameters indicated on Table 1 of the policy. However, the analytical list used during the Limited Phase II ESA was comprehensive and reasonable based on the information available during the field investigation. Cyanide was not identified as a chemical of concern (COC) and Alachlor and Simazine are pesticides generally associated with agriculture and rural runoff. No further action is required".*

Analytical results are presented and discussed in the following sections.

*2.1.1.1 TCLP Metals, VOCs and SVOCs*

The purpose of analyzing soils using the Toxic Characteristic Leaching Potential (TCLP) is to determine if the soil is a characteristic hazardous waste as determined by analyzing toxicity by leaching potential. This requires testing using the TCLP, Method 1311, to determine an extract concentration and comparison of that concentration to values in Table 1 of OAC 3745-51-24 to confirm the absence or presence of constituents above the listed values. This is described further in Bennett & Williams (2014a) (previously submitted to the City of Lancaster on January 20, 2015) and available on the Fairfield County Commissioner's website at http://www.co.fairfield.oh.us/COMMISH/jail_lpiiesa_report.pdf.

The summary in the Bennett & Williams (2014a) report states *"Based on the analytical results for TCLP analyses of all regulated metals, VOCs and SVOCs, only two metals, cadmium and lead were detected above the laboratory reporting limit. However, no regulated compounds were detected above the regulatory limits set for designation of materials as hazardous waste in Table 1 of OAC 3745-51-24. Therefore, the fill materials at the site are not considered to be hazardous wastes".* These results are presented here for completeness and informational purposes only. Soils analyzed by TCLP do not have residential land use category generic numerical direct-contact soil standards found in Appendix A to the Ohio Administrative Code (OAC) 3745-300-08, Table 1. Therefore, no additional analysis is required under the Lancaster Interim Policy.

*2.1.1.2 Target Analyte List Metals*

Seventeen samples were collected from ten borings for the 23 metals in the "target analyte list". Samples were collected in the fill from intervals ranging from 1.5 to 12 feet below the ground surface. Samples were analyzed by Methods 6010B and/or 7471A. Table 2 shows the analytical results, boring and depth from which the sample was collected, as well as the VAP generic numerical direct-contact soil standard for a single chemical for residential land use from

Table 2. Analytical results for metals in soils compared to VAP residential generic numerical direct contact soil values (OAC 3745-300-08 Appendix A, Table 1).

| BORING NUMBER<br>Depth<br>Sample Date | BW1<br>4-6 Ft<br>3/20/2014 | BW1<br>10-12 Ft<br>3/20/2014 | BW2<br>2-4 Ft<br>3/20/2014 | BW3<br>1.5-2 Ft<br>3/20/2014 | BW3<br>2-4 Ft<br>3/20/2014 | BW4<br>2-4 Ft<br>3/20/2014 | BW4<br>8-10 Ft<br>3/20/2014 | BW5<br>1-2 Ft<br>3/20/2014 | BW5<br>10-11 Ft<br>3/20/2014 | BW6<br>1-2 Ft<br>3/20/2014 | BW6<br>4-6 Ft<br>3/20/2014 | BW7<br>2-4 Ft<br>3/21/2014 | BW7<br>6-8 Ft<br>3/21/2014 | BW8<br>4-6 Ft<br>3/21/2014 | BW8<br>6-8 Ft<br>3/21/2014 | BW9<br>2-4 Ft<br>3/21/2014 | BW10<br>2-4 Ft<br>3/21/2014 | VAP generic numerical direct-contact Soil standard for a single chemical - residential land use category. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Aluminum | 7500 | 5800 | 5700 | 2600 | 6500 | 4,500 | 6,800 | 4,000 | 11,000 | 4,700 | 4,600 | 5,700 | 4,500 | 5,600 | 5,300 | 6,100 | 1,400 | None |
| Antimony | 43 | 11 | 14 | 1.3 | 0.74 J | 0.78 J | <6.0 | 0.69 J | 0.97 J | <1.0 | 0.51 J | 0.39 J | 0.41 J | 5.9 | 1.2 | 0.58 J | <0.82 | 63 |
| Arsenic | 18 | 94 | 22 | 7 | 12 | 8.8 | 36 | 11 | 34 | 3.6 | 6.8 | 7.1 | 9.2 | 460 | 23 | 12 | 1.9 | 12 |
| Barium | 450 | 3300 | 500 | 27 | 68 B | 61 | 920 | 32 | 220 | 22 | 27 | 57 B | 44 B | 170 B | 160 B | 120 B | 11 J B | None |
| Beryllium | 0.68 | 0.56 J | 0.34 J | 0.11 J | 0.46 J | 0.21 J | 2 | 0.27 J | 0.80 J | 0.17 J | 0.25 J | 0.26 J | 0.37 J | 0.43 J | 0.39 J | 0.62 | 0.058 J | 310 |
| Cadmium | 1.4 | 6.4 | 6.8 | 0.39 | 0.43 | 0.25 | 2.6 | 0.53 | 6.5 | 0.16 J | 1.9 | 0.41 | 0.33 | 4.1 | 3.3 | 1.3 | 0.062 J | 140 |
| Calcium | 58000 | 60000 | 57000 | 7800 | 15000 | 4700 | 21000 | 36000 | 19000 | 2600 | 28000 | 5800 | 9100 | 12000 | 7900 | 10000 | 1400 | None |
| Chromium | 37 | 330 | 81 | 35 | 16 | 34 | 60 | 19 | 120 | 8.9 | 19 | 26 | 22 | 23 | 20 | 15 | 8.6 | 24 |
| Cobalt | 6.2 | 6.7 J | 4.6 J | 2.5 J | 4.7 J | 4.1 J | 12 | 5.2 | 11 | 2.6 J | 3.3 J | 3.4 J | 4.1 J | 8.1 | 6.8 | 6.8 | 1.4 J | None |
| Copper | 62 | 300 | 2300 | 61 | 36 | 58 | 360 | 40 | 77 | 10 | 21 | 96 | 74 | 56 | 41 | 31 | 8.7 | 6,300 |
| Iron | 24000 | 95000 | 45000 | 19000 | 22000 | 30000 | 150000 | 22000 | 91000 | 9900 | 15000 | 22000 | 28000 | 31000 | 22000 | 20000 | 8100 | None |
| Lead | 1100 | 2000 | 1600 | 18 | 41 | 32 | 1400 | 25 | 260 | 9.2 | 14 | 44 | 55 | 260 | 230 | 150 | 5.9 | 400 |
| Magnesium | 7800 | 13000 | 9200 | 3100 | 4800 | 640 | 3100 | 11000 | 3700 | 970 | 6300 | 1600 | 3000 | 3500 | 2700 | 3200 | 510 | None |
| Manganese | 470 | 860 | 680 | 170 | 400 | 620 | 790 | 370 | 760 | 150 | 220 | 450 | 380 | 440 | 380 | 560 | 91 | None |
| Mercury | 0.29 | 57 | 8 | 0.044J | 0.080 J | <0.10 | 6.2 | 0.051 J | 1.1 | <0.12 | 0.017J | 0.069 J | 0.15 | 0.6 | 0.54 | 0.25 | 0.035 J | 3 |
| Nickel | 24 | 34 | 14 | 25 | 27 | 37 | 56 | 44 | 36 | 7.7 | 14 | 34 | 37 | 26 | 28 | 43 | 10 | 3,100 |
| Potassium | 920 | 850 J | 770 | 320 J | 720 B | 440 J | 470 J | 730 | 1700 | 650 | 660 | 530 B | 490 J B | 810 B | 740 B | 790 B | 150 J B | None |
| Selenium | 0.71 | 5.5 | 2.3 | 0.49 | <0.51 | 0.54 | 2.3 | <0.47 | 4.7 | 1.4 | 0.83 | 0.62 | 0.85 | 9.4 | 4.6 | 0.73 | <0.41 | 780 |
| Silver | 1 | 3.7 | 0.23 J | <0.45 | <0.51 | <0.47 | <0.60 | <0.47 | 0.96 J | <0.50 | <0.40 | <0.45 | <0.51 | 0.63 | 0.66 | 0.17 J | <0.41 | 780 |
| Sodium | 510 J | 960 J | 190 J | 130 J | 290 J | 94 J | 180 J | 77 J | 210 J | 350 J | 490 | 810 | 610 | 110 J | 81 J | 210 J | 100 J | None |
| Thallium | <1.2 | 1.5 J | <0.96 | <0.90 | <1.0 | <0.93 | 1.6 | <0.93 | 1.2 J | <1.0 | <0.80 | <0.91 | <1.0 | <1.2 | <0.87 | <0.95 | <0.82 | NA |
| Vanadium | 20 | 24 | 19 | 8.5 | 17 | 14 | 23J | 14 | 30 | 12 | 15 | 10 | 10 | 18 | 13 | 16 | 4.6 | None |
| Zinc | 390 | 4500 | 1300 | 26 | 92 | 46 | 1000 | 71 | 700 | 19 | 34 | 100 | 66 | 500 | 300 | 150 | 11 | 47,000 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

B=Compound was found in the blank and sample

= Exceeds Residential Standard in OAC 3745-300-08 Appendix A, Table 1

Appendix A of OAC 3745-300-08, Table 1. Note that the generic direct contact soil standard for chromium is for chromium VI (the most toxic form of chromium), even though the value for chromium represents total chromium. The laboratory results are included in Bennett & Williams (2014a). The results show that four constituents: arsenic, chromium, lead, and mercury exceed the residential VAP standards in at least one interval in at least one boring.

*2.1.1.3 Target Compound List Volatile Organic Compounds*

One sample was collected from each of the ten borings for the 48 VOCs in the "target compound list". Samples were collected from intervals ranging from the ground surface to 12 feet below the ground surface. Samples were analyzed by Method 8260B. Due to an oversight by Federal Express, the samples collected on March 21, 2014 from borings BW-7, BW-8, BW-9 and BW-10 were delivered to the laboratory late and were past the method holding time. These samples were analyzed, but additional samples were re-taken at the same intervals in companion borings BW-7A, BW-8A, BW-9A and BW-10A on March 31, 2014. Therefore, a total of 14 samples were analyzed.

Table 3 shows the 48 VOCs in the "target compound list" that were analyzed. Table 4 shows the analytical results only for those VOCs that were detected. Boring number and depth from which the sample was collected, as well as the generic numerical direct contact soil values for a single chemical for residential use from Appendix A of OAC 3745-300-08, Table 1 are also shown on Table 10. The laboratory results are included in Bennett & Williams (2014a). The results show that no VOCs were detected above the laboratory reporting limit, thus no generic numerical direct soil contact values were exceeded.

*2.1.1.4 Target Compound List Semi-Volatile Organic Compounds*

Seventeen samples were collected in the ten borings for the 65 SVOCs in the "target compound list". Samples were collected in the fill from intervals ranging from 1.5 to 12 feet below the ground surface. Samples were analyzed by Method 8270C. Table 5 shows the 65 SVOCs in the "target compound list" that were analyzed. Table 6 shows the analytical results, boring and depth from which the sample was collected, as well as the VAP generic numerical direct contact soil standard for a single chemical for residential land use from Appendix A of OAC 3745-300-08, Table 1. The laboratory results are included in Bennett & Williams (2014a). The results show that six constituents: benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz(a,h)anthracene, and indeno[1,2,3-cd]pyrene exceed the generic numerical direct contact soil standards in at least one interval in at least one boring.

Table 3. "Target compound list" of VOCs analyzed in soil.

| | | |
|---|---|---|
| 1,1,1-Trichloroethane | Acetone | Ethylbenzene |
| 1,1,2,2-Tetrachloroethane | Benzene | Ethylene Dibromide |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | Bromoform | Isopropylbenzene |
| 1,1,2-Trichloroethane | Bromomethane | Methyl acetate |
| 1,1-Dichloroethane | Carbon disulfide | Methyl tert-butyl ether |
| 1,1-Dichloroethene | Carbon tetrachloride | Methylcyclohexane |
| 1,2,4-Trichlorobenzene | Chlorobenzene | Methylene Chloride |
| 1,2-Dibromo-3-Chloropropane | Chlorodibromomethane | Styrene |
| 1,2-Dichlorobenzene | Chloroethane | Tetrachloroethene |
| 1,2-Dichloroethane | Chloroform | Toluene |
| 1,2-Dichloropropane | Chloromethane | trans-1,2-Dichloroethene |
| 1,3-Dichlorobenzene | cis-1,2-Dichloroethene | trans-1,3-Dichloropropene |
| 1,4-Dichlorobenzene | cis-1,3-Dichloropropene | Trichloroethene |
| 2-Butanone (MEK) | Cyclohexane | Trichlorofluoromethane |
| 2-Hexanone | Dichlorobromomethane | Vinyl chloride |
| 4-Methyl-2-pentanone (MIBK) | Dichlorodifluoromethane | Xylenes, Total |

Table 4. Analytical results for VOCs detected in soil compared to VAP residential generic numerical direct contact soil standards (OAC 3745-300-08 Appendix A, Table 1).

| BORING NUMBER | BW1 | BW2 | BW3 | BW4 | BW5 | BW6 | BW7 | BW7A | BW8 | BW8A | BW9 | BW9A | BW10 | BW10A | VAP residential generic numerical direct contact soil standard for a single chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 10-12 Ft | 2-4 Ft | 2-4 Ft | 2-4 Ft | 4-6 Ft | 1-2 Ft | 2-4 Ft | 2-4 Ft | 4-6 Ft | 4-6 Ft | 0-2 Ft | 0-2 Ft | 2-4 Ft | 2-4 Ft | |
| Sample Date | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | |
| PARAMETER | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1,2,4-Trichlorobenzene | <0.0035 | <0.0029 | <0.0037 | 0.00017 J B | 0.00027 J B | <0.0035 | <0.0029 | <0.0025 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 150 |
| 2-Butanone (MEK) | 0.0014 J | <0.011 | <0.015 | <0.013 | <0.0097 | <0.014 | 0.00085 J B | <0.010 | <0.014 | <0.0093 | <0.011 | <0.012 | <0.013 | <0.010 | 28,000 |
| Acetone | 0.0057 J | <0.011 | <0.015 | <0.013 | 0.0095 J | <0.014 | <0.011 | <0.010 | <0.014 | <0.0093 | <0.011 | 0.0070 J | <0.013 | <0.010 | 110,000 |
| Isopropylbenzene | <0.0035 | <0.0029 | <0.0037 | 0.00060 J | <0.0024 | <0.0035 | <0.0029 | <0.0025 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | None |
| Methyl acetate | 0.0014 J | <0.0057 | <0.0073 | <0.0064 | <0.0048 | <0.0069 | <0.0057 | <0.0051 | <0.0069 | <0.0046 | <0.0055 | <0.0060 | <0.0066 | <0.0051 | None |
| Methylene Chloride | <0.0035 | 0.00053 J | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0025 | <0.0035 | <0.0023 | <0.0028 | 0.00041 J | <0.0033 | <0.0025 | 750 |
| Styrene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | 0.000093 J | <0.0035 | <0.0029 | <0.0025 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 870 |
| Toluene | <0.0035 | <0.0029 | <0.0037 | 0.00021 J | <0.0024 | <0.0035 | <0.0029 | <0.0025 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 820 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

B = Compound was found in the blank and sample

Table 5. “Target compound list” of SVOCs analyzed in soil.

| | | |
|---|---|---|
| 1,1'-Biphenyl | 4-Nitroaniline | Dibenzofuran |
| 2,4,5-Trichlorophenol | 4-Nitrophenol | Diethyl phthalate |
| 2,4,6-Trichlorophenol | Acenaphthene | Dimethyl phthalate |
| 2,4-Dichlorophenol | Acenaphthylene | Di-n-butyl phthalate |
| 2,4-Dimethylphenol | Acetophenone | Di-n-octyl phthalate |
| 2,4-Dinitrophenol | Anthracene | Fluoranthene |
| 2,4-Dinitrotoluene | Atrazine | Fluorene |
| 2,6-Dinitrotoluene | Benzaldehyde | Hexachlorobenzene |
| 2-Chloronaphthalene | Benzo[a]anthracene | Hexachlorobutadiene |
| 2-Chlorophenol | Benzo[a]pyrene | Hexachlorocyclopentadiene |
| 2-Methylnaphthalene | Benzo[b]fluoranthene | Hexachloroethane |
| 2-Methylphenol | Benzo[g,h,i]perylene | Indeno[1,2,3-cd]pyrene |
| 2-Nitroaniline | Benzo[k]fluoranthene | Isophorone |
| 2-Nitrophenol | bis (2-chloroisopropyl) ether | Naphthalene |
| 3 & 4 Methylphenol | Bis(2-chloroethoxy)methane | Nitrobenzene |
| 3,3'-Dichlorobenzidine | Bis(2-chloroethyl)ether | N-Nitrosodi-n-propylamine |
| 3-Nitroaniline | Bis(2-ethylhexyl) phthalate | N-Nitrosodiphenylamine |
| 4,6-Dinitro-2-methylphenol | Butyl benzyl phthalate | Pentachlorophenol |
| 4-Bromophenyl phenyl ether | Caprolactam | Phenanthrene |
| 4-Chloro-3-methylphenol | Carbazole | Phenol |
| 4-Chloroaniline | Chrysene | Pyrene |
| 4-Chlorophenyl phenyl ether | Dibenz(a,h)anthracene | Dibenzofuran |

Table 6. Analytical results for SVOCs detected in soil compared to VAP residential generic numerical direct contact soil values (Appendix A OAC 3745-300-08 Table 1).

| BORING NUMBER | BW1 | BW1 | BW2 | BW3 | BW3 | BW4 | BW4 | BW5 | BW5 | BW6 | BW6 | BW7 | BW7 | BW8 | BW8 | BW9 | BW10 | VAP Residential Generic Numerical Direct-Contact Soil Standard for a Single Chemical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 4-6 Ft | 10-12 Ft | 2-4 Ft | 1.5-2 Ft | 2-4 Ft | 2-4 Ft | 8-10 Ft | 1-2 Ft | 10-11 Ft | 1-2 Ft | 4-6 Ft | 2-4 Ft | 6-8 Ft | 4-6 Ft | 6-8 Ft | 2-4 Ft | 2-4 Ft | |
| Sample Date | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | |
| PARAMETER | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1,1'-Biphenyl | <0.250 | <53 | 0.016 J | 0.0093 J | 0.0066 J | 0.040 J | <0.330 | 0.033 J | <0.57 | <0.056 | 0.0067 J | 0.036 J | 0.049 J | 0.016 J | 0.023 J | 0.013 J | 0.025 J | 1,600 |
| 2-Methylnaphthalene | 0.033 | 3.7 J | 0.047 | 0.045 | 0.038 | 0.19 | 0.1 | 0.091 | 0.096 | 0.028 | 0.033 | 0.12 | 0.55 | 0.09 | 0.13 | 0.057 | 0.12 | 460 |
| Acenaphthene | <0.033 | 19 | 0.12 | 0.024 | 0.021 | 0.043 | 0.1 | 0.039 | 0.055 J | <0.0074 | 0.012 | 0.4 | 0.19 | 0.073 | 0.089 | 0.093 | 0.029 | 6,900 |
| Acenaphthylene | <0.033 | 75 | 0.057 | <0.0072 | 0.0044 J | <0.018 | 0.032 J | 0.015 | <0.076 | <0.0074 | <0.0073 | 0.016 | 0.024 | 0.036 | 0.039 | 0.013 | <0.030 | None |
| Acetophenone | <0.49 | <110 | <0.29 | <0.11 | <0.12 | 0.028 J | <0.66 | <0.22 | <1.1 | <0.11 | <0.11 | 0.027 J | 0.088 J | <0.24 | <0.3 | 0.012 J | <0.450 | 2,500 |
| Anthracene | 0.027 J | 170 | 0.3 | 0.017 | 0.014 | 0.063 | 0.21 | 0.084 | 0.3 | <0.0074 | 0.021 | 0.09 | 0.11 | 0.12 | 0.18 | 0.047 | 0.09 | 34,000 |
| Benzaldehyde | 0.0240 J | <110 | 0.063 J | <0.11 | <0.12 | <0.27 | 0.19 J | <0.22 | <1.1 | <0.11 | <0.11 | 0.036 J | 0.076 J | 0.038 J | <0.3 | 0.024 J | <0.45 | None |
| Benz[a]anthracene | 0.15 | 420 | 1 | 0.2 | 0.15 | 0.87 | 1.8 | 0.62 | 6.1 | 0.034 | 0.13 | 0.81 | 0.69 | 0.98 | 1.1 | 0.43 | 0.91 | 12 |
| Benzo[a]pyrene | 0.46 | 370 | 1 | 0.32 | 0.25 | 1.6 | 3.2 | 0.97 | 5.4 | 0.33 | 0.2 | 1.6 | 1.3 | 1.2 | 1.5 | 0.81 | 2.2 | 1.2 |
| Benzo[b]fluoranthene | 0.41 | 420 | 1.4 | 0.58 | 0.37 | 2.5 | 3.9 | 1.6 | 5 | 0.57 | 0.33 | 1.9 | 2.1 | 1.7 | 2.7 | 1.3 | 3.4 | 12 |
| Benzo[g,h,i]perylene | 0.5 | 200 | 0.65 | 0.39 | 0.3 | 2.4 | 3 | 1.4 | 4.2 | 1.1 | 0.23 | 1.7 | 0.51 | 1.2 | 0.6 | 0.41 | 1.1 | None |
| Benzo[k]fluoranthene | 0.087 | 180 | 0.49 | 0.17 | 0.14 | 0.76 | 1.6 | 0.48 | 0.92 | 0.15 | 0.082 | 0.74 | 0.54 | 0.66 | 0.61 | 0.32 | 0.93 | 120 |
| Bis(2-ethylhexyl) phthalate | <0.340 | <75 | <0.2 | 0.035 J B | <0.083 | <0.19 | <0.47 | <0.15 | <0.8 | 0.027 J B | 0.1 B | 0.043 J | 0.063 J B | <0.17 | 0.064 J B | 0.04 J B | <0.31 | 690 |
| Carbazole | <0.25 | <53 | 0.098 J | <0.054 | <0.059 | <0.13 | <0.33 | <0.11 | <0.57 | <0.056 | <0.055 | <0.11 | <0.11 | 0.11 J | 0.12 J | <0.057 | <0.22 | None |
| Chrysene | 0.19 | 380 | 1.1 | 0.27 | 0.21 | 1.2 | 1.9 | 0.76 | 9.5 | 0.65 | 0.18 | 0.99 | 0.79 | 1.1 | 1.3 | 0.48 | 1.1 | 1,200 |
| Dibenz(a,h)anthracene | 0.33 | 59 | 0.18 | 0.095 | 0.064 | 0.54 | 0.72 | 0.3 | 3.6 | 0.24 | 0.06 | 0.38 | 0.14 | 0.27 | 0.17 | 0.1 | 0.24 | 1.2 |
| Dibenzofuran | <0.25 | 27 J | 0.071 J | 0.017 J | 0.013 J | 0.066 J | 0.061 J | 0.037 J | 0.050 J | 0.016 J | 0.012 J | 0.084 J | 0.14 | 0.039 J | 0.065 J | 0.026 J | 0.044 J | None |
| Di-n-butyl phthalate | <0.34 | <75 | <0.2 | <0.075 | <0.083 | <0.19 | <0.47 | <0.15 | <0.8 | <0.078 | 20.01 J | <0.16 | <0.16 | <0.17 | <0.21 | 0.035 J B | <0.31 | None |
| Fluoranthene | 0.2 | 980 | 2 | 0.22 | 0.18 | 0.79 | 1.7 | 0.8 | 1.7 | 0.016 | 0.22 | 0.82 | 0.75 | 1.6 | 1.8 | 0.48 | 0.94 | 4,600 |
| Fluorene | <0.033 | 67 | 0.1 | 0.0064 J | 0.0061 J | 0.021 | 0.056 | 0.021 | 0.1 | <0.0074 | <0.0073 | 0.08 | 0.056 | 0.039 | 0.057 | 0.017 | 0.043 | 4,600 |
| Indeno[1,2,3-cd]pyrene | 0.26 | 180 | 0.53 | 0.29 | 0.22 | 1.7 | 2.4 | 1 | 2.2 | 0.78 | 0.16 | 1.2 | 0.44 | 0.91 | 0.51 | 0.33 | 0.85 | 12 |
| Naphthalene | <0.033 | 13 | 0.08 | 0.033 | 0.024 | 0.13 | 0.1 | 0.086 | 0.19 | 0.017 | 0.022 | 0.13 | 0.37 | 0.083 | 0.15 | 0.048 | 0.094 | 90 |
| Pentachlorophenol | <0.74 | <160 | <0.44 | <0.16 | <0.18 | <0.4 | 0.3 J | <0.33 | <1.7 | <0.17 | <0.17 | <0.34 | <0.33 | <0.36 | <0.45 | <0.17 | <0.67 | 18 |
| Phenanthrene | 0.1 | 570 | 1.3 | 0.11 | 0.086 | 0.4 | 0.8 | 0.4 | 1.2 | 0.03 | 0.12 | 0.51 | 0.63 | 0.7 | 0.93 | 0.24 | 0.43 | None |
| Pyrene | 0.16 | 800 | 1.8 | 0.19 | 0.18 | 0.73 | 1.6 | 0.69 | 2.3 | 0.014 | 0.19 | 0.87 | 0.81 | 1.5 | 1.8 | 0.47 | 1 | 3,400 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

B=Compound was found in the blank and sample

= Exceeds Residential Standard in OAC 3745-300-08 Appendix A, Table 1

*2.1.1.5 GRO and DRO*

Two samples were collected for GRO (C-6 to C-10) and DRO (C-10 to C-28) from two separate borings. Samples were collected from the fill from depths of 6 to 8 and 8 to 9 feet below the ground surface. Samples were analyzed by Method 8015C. Table 7 shows the analytical results, boring and depth from which the sample was collected, as well as the Ohio EPA DERR petroleum action level for Category 1 (the most vulnerable category). Soil TPH (GRO) petroleum action levels range from 105 ppm (Category 1) to 600 ppm (Category 4) (Ohio EPA, 2005a). Soil TPH (DRO) petroleum action levels range from 380 ppm (Category 1) to 1156 ppm (Category 4) (Ohio EPA, 2005). The laboratory results are included in Bennett & Williams (2014a). The results show that no DERR petroleum action levels were exceeded.

Table 7. Analytical results for gasoline range organics (GRO) and diesel range organics (GRO) in soil.

| BORING NUMBER<br>Depth<br>Sample Date<br><br>PARAMETER | BW2<br>8-9 Ft<br>3/20/2014<br><br>mg/kg | BW10<br>6-8 Ft<br>3/21/2014<br><br>mg/kg | DERR<br>Petroleum<br>Action Levels<br><br>mg/kg |
|---|---|---|---|
| Gasoline Range Organics [C6 – C10] | <0.12 | <0.11 | 105* |
| Diesel Range Organics [C10 – C28] | 41 | 68 | 380* |
| * Action levels are for Category 1 (the most conservative) | | | |

Soils analyzed for DRO and GRO do not have residential land use category generic numerical direct-contact soil standards found in Appendix A to the Ohio Administrative Code (OAC) 3745-300-08, Table 1. Therefore, no additional analysis is required under the Lancaster Interim Policy.

### *2.1.2 Soils Analyzed During the 2015 Installation of Monitoring Wells MW-9S and MW-9D*

As part of the drilling of the monitoring wells, fill was encountered in both monitoring well MW-9S and MW-9D as anticipated based on previous site investigations from 1999 through 2015 (Bennett & Williams, 2015a). One sample from the fill in each of the borings was collected and submitted for laboratory analysis of the analytes in Table 1 of the Lancaster Interim Policy on Development within the Wellhead Protection Zones. In addition, a till layer was encountered in MW-9D from 30 to 32 feet that may have been classified as either a silty clay or a clayey silt. Because the pilings for the building are anticipated to be as deep as 60 feet, and in order to be conservative, a sample was collected from this depth as well. Analytical results are presented in the following sections.

*2.1.2.1 Inorganic Compounds*

Three samples were collected from the two monitoring well borings for the twenty inorganic compounds in Table 1 of the Lancaster Interim Policy. Samples were collected in the fill from the 10-foot to 12-foot interval in MW-9S and the 4-foot to 6-foot interval in MW-9D. In addition, a suspected clay layer from 30 feet to 32 feet was sampled in MW-9D. Samples were analyzed by Methods 6010B, 7471A (mercury) and 9012B (cyanide). Table 8 shows the analytical results, boring and depth from which the sample was collected, as well as the residential land use category generic numerical direct-contact soil standards found in Appendix A to OAC 3745-300-08, Table 1. The laboratory results are included in Bennett & Williams (2015a). The results show that one constituent, arsenic (at 19 and 20 mg/kg), was detected above the Voluntary Action Program residential generic numerical direct-contact soil standard of 12 mg/kg.

*2.1.2.2 Volatile Organic Compounds*

Three samples were collected from the two borings for the twenty one volatile organic compounds in Table 1 of the Lancaster Interim Policy. Samples were collected in the fill from the 10-foot to 12-foot interval in MW-9S and the 2-foot to 4-foot interval in MW-9D. In addition, a suspected clay layer from 30 feet to 32 feet was sampled in MW-9D. Samples were analyzed by Method 8260B. Table 9 shows the analytical results, boring and depth from which the sample was collected, as well as the residential land use category generic numerical direct-contact soil standards found in Appendix A to OAC 3745-300-08, Table 1. The laboratory results are included in Bennett & Williams (2015a). The results show that no volatile organic compounds were detected and no residential generic numerical direct contact soil standards were exceeded.

*2.1.2.3 Synthetic Organic Compounds*

Three samples were collected from the two borings for the three synthetic organic compounds in Table 1 of the Lancaster Interim Policy. Samples were collected in the fill from the 10-foot to 12-foot interval in MW-9S and the 6-foot to 7-foot interval in MW-9D. In addition, a suspected clay layer from 30 feet to 32 feet was sampled in MW-9D. Samples were analyzed by Method 8141B. Table 10 shows the analytical results, boring and depth from which the sample was collected, as well as the fact that there are no residential land use category generic numerical direct-contact soil standards found in Appendix A to OAC 3745-300-08, Table 1. The laboratory results are included in Bennett & Williams (2015a). The results show that no synthetic organic compounds were detected.

Table 8. Analytical results for metals in soils compared to generic numerical direct contact soil standards (residential land use category) in Appendix A to OAC 3745-300-8, Table 1.

| SAMPLE NUMBER<br><br>Depth<br>Parameter | MW-9S FILL<br><br>10-12 feet<br>(mg/kg) | MW-9D FILL<br><br>4-6 feet<br>(mg/kg) | MW-9D NATURAL<br><br>30-32 feet<br>(mg/kg) | Residential Numerical Generic Direct Contact Soil Standard for a Single Chemical<br>(mg/kg) |
|---|---|---|---|---|
| Aluminum | 4000 | 8400 | 3900 | None |
| Antimony | <1.0 | <1.0 | <0.96 | 63 |
| Arsenic | 19 | 20 | 9.4 | 12 |
| Barium | 23 | 99 | 58 | None |
| Beryllium | 0.27J | 0.92 | 0.24J | 310 |
| Cadmium | 0.58 | 0.66 | 0.41B | 140 |
| Chromium | 7.3 | 40 | 5.9B | NA |
| Cobalt | 7.2 | 8 | 6.4 | None |
| Copper | 22 | 270 | 16 | 6300 |
| Cyanide | <0.60 | <0.61 | 0.55 | 1,000,000 |
| Lead | 29 | 73 | 7.5 | 400 |
| Magnesium | 22000 | 4500 | 31000 | None |
| Mercury | 0.22 | 0.59 | 0.031JB | 3.1 |
| Nickel | 22B | 20B | 21B | None |
| Selenium | 0.87 | 1.6 | 0.44J | 780 |
| Silver | 0.47J | 0.14 | <0.48 | 780 |
| Sodium | 230J | 450J | 150J | None |
| Thallium | 0.68J | 0.79J | 0.72J | NA |
| Vanadium | 14B | 23B | 11 | None |
| Zinc | 84 | 180 | 52B | 47,000 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

B=Compound was found in the blank and sample

= Exceeds Residential Standard in OAC 3745-300-08 Table 1

Table 9. Analytical results for organic compounds in soils compared to generic numerical direct contact soil standards (residentialland use category) in Appendix A to OAC 3745-300-08, Table 1.

| SAMPLE NUMBER<br><br>Depth<br>Parameter | MW-9S FILL<br><br>10-12 feet<br>(mg/kg) | MW-9D FILL<br><br>2-4 feet<br>(mg/kg) | MW-9D NATURAL<br><br>30-32 feet<br>(mg/kg) | Residential Generic Numerical Direct Contact Soil Standard for a Single Chemical<br>(mg/kg) |
|---|---|---|---|---|
| Benzene | <0.0032 | <0.0024 | <0.0024 | 26 |
| Carbon Tetrachloride | <0.0032 | <0.0024 | <0.0024 | 15 |
| Monochlorobenzene | <0.0032 | <0.0024 | <0.0024 | 700 |
| 1,2-Dichlorobenzene | <0.0032 | <0.0024 | <0.0024 | 380 |
| 1,4-Dichlorobenzene | <0.0032 | <0.0024 | <0.0024 | 61 |
| 1,2-Dichloroethane | <0.0032 | <0.0024 | <0.0024 | 11 |
| 1,1-Dichloroethene | <0.0032 | <0.0024 | <0.0024 | 83 |
| cis-1,2-Dichloroethene | <0.0032 | <0.0024 | <0.0024 | None |
| trans-1,2-Dichloroethane | <0.0032 | <0.0024 | <0.0024 | 370 |
| Dichloromethane | <0.0032 | <0.0024 | <0.0024 | 750 |
| 1,2-Dichloropropane | <0.0032 | <0.0024 | <0.0024 | 23 |
| Ethylbenzene | <0.0032 | <0.0024 | <0.0024 | 130 |
| Styrene | <0.0032 | <0.0024 | <0.0024 | 870 |
| Tetrachloroethene | <0.0032 | <0.0024 | <0.0024 | 170 |
| Toluene | <0.0032 | <0.0024 | <0.0024 | 820 |
| 1,2,4-Trichlorobenzene | <0.0032 | <0.0024 | <0.0024 | 150 |
| 1,1,1-Trichloroethane | <0.0032 | <0.0024 | <0.0024 | 640 |
| 1,1,2-Trichloroethane | <0.0032 | <0.0024 | <0.0024 | 26 |
| Trichloroethene | <0.0032 | <0.0024 | <0.0024 | 11 |
| Vinyl Chloride | <0.0032 | <0.0024 | <0.0024 | 1.3 |
| Xylenes, total | <0.0063 | <0.0049 | <0.0049 | 260 |

Table 10. Analytical results for synthetic organic compounds in soils compared to VAP generic direct contact soil values for residential exposure.

| SAMPLE NUMBER<br><br>Depth<br>Parameter | MW-9S<br>FILL<br>10-12 feet<br>(mg/kg) | MW-9D<br>FILL<br>6-7 feet<br>(mg/kg) | MW-9D<br>NATURAL<br>30-32 feet<br>(mg/kg) | Residential Generic Numerical Direct Contact Soil Standard for a Single Chemical<br>(mg/kg) |
|---|---|---|---|---|
| Alachlor (LASSO)-2051 | <79 | <76 | <72 F1 F2 | None |
| Atrazine-2650 | <79 | <76 | <72 F2 | None |
| Simazine-2037 | <79 | <76 | <72 F1 F2 | None |

F1=MS and/or MSD Recovery exceeds the control limts

F2=MS/MSD RPD exceeds control limits

### *2.1.3 Soils Results Summary*

Soil analytical results show that residential generic numerical direct-contact soil standards for a single chemical as listed in Appendix A of OAC 3745-300-08, Table 1 were exceeded for four metals (arsenic, chromium, lead, and mercury) and six constituents SVOCs (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz(a,h)anthracene, and indeno[1,2,3-cd]pyrene) in at least one interval in at least one boring during the 2014 investigation. Similarly, arsenic concentrations in the fill materials in the two 2015 monitoring well borings exceeded the residential generic numerical direct-contact soil standards for a single chemical as listed in Appendix A of OAC 3745-300-08, Table 1. Therefore, the Lancaster Interim Policy requires that a property specific risk assessment be performed. In fact, Bennett & Williams (2014a) included a property specific risk assessment. The results of this risk assessment are presented in Section 3.

## 2.2 Water Results

Groundwater was sampled from two temporary monitoring wells installed at the bottom of the fill during the 2014 Limited Phase II Environmental Assessment and analytical results were presented in Bennett & Williams (2014a). Although two permanent monitoring wells (MW-9S and MW-9D) were installed deeper in the aquifer materials underlying the fill by Fairfield County to be used as part of the monitoring network for the City of Lancaster in their Source Water Protection program (Bennett & Williams, 2015a), the monitoring wells were sampled by the City on April 15, 2015 and results are not available at the time of preparation of this report. The locations where samples were collected are shown in Figure 2.

### *2.2.1 Water Analyzed During the 2014 Limited Phase II Environmental Assessment*

Groundwater samples were collected in two temporary monitoring wells installed in the only zones within the fill where sufficient saturation for the installation of a groundwater monitoring well was encountered. Each monitoring well was sampled for: the "target analyte list" of metals using EPA analytical Methods 6010B/7470B and the "target compound list" of VOCs using EPA Method 8260B.

Due to the fact that the initial environmental sampling was conducted in March 2014, prior to the adoption of the Lancaster Interim Policy, analyses of soil and water included many additional parameters not required in Table 1, but did not include all of the required analytes. Fairfield County flagged these parameters in the January 20, 2015 submittal to the City of Lancaster and indicated that groundwater samples were not sampled for cyanide, Alachlor, Atrazine and Simazine. Fairfield County explained that the reason that Alachlor, Atrazine, and Simazine had not been tested was because these compounds are all pesticides used for agricultural purposes. The reason no pesticides were analyzed is because the historical site information indicated that the property had been filled prior to World War II and no farming activities had taken place on the site in the ensuing years. Prior to World War II, pesticides were not manufactured. Similarly, the monitoring wells installed by the City of Lancaster on the site


Figure 2.
Water sampling locations.

(4-S and 4-D) as part of the source water protection program were sampled for cyanide, but all values were shown to be non-detect from 1995 through 2009 when sampling ended.

The City of Lancaster considered the information provided on January 20, 2015 and concluded in the March 3, 2015 comments on the submission that *"The groundwater samples were not analyzed for cyanide, Alachlor, Atrazine, and Simazine, and therefore were not analyzed in accordance with the required parameters indicated on Table 1 of the policy. However, the analytical list used during the Limited Phase II ESA was comprehensive and reasonable based on the information available during the field investigation. Cyanide was not identified as a chemical of concern (COC) and Alachlor, Atrazine, and Simazine are pesticides generally associated with agriculture and rural runoff. No further action is required"*.

Analytical results are presented and discussed in the following sections.

*2.2.1.1 Target Analyte List Metals*

Samples were collected from two monitoring wells for the 23 metals in the "target analyte list. The samples were analyzed by Methods 6010B and/or 7471A. Table 11 shows the analytical results as well as the VAP generic unrestricted potable use standards based on maximum contaminant levels from Appendix A of OAC 3745-300-08, Table VI. The laboratory results are included in Bennett & Williams (2014a). The results show that one of the analytes, arsenic, was detected above the VAP generic unrestricted potable use standards based on maximum contaminant levels from Appendix A of OAC 3745-300-08, Table VI.

Although the concentration of arsenic (0.043 mg/L) in one of the temporary monitoring wells does exceed the VAP generic unrestricted potable use standards, and hence the primary drinking water standard (0.010 mg/L), concentrations of arsenic in pumping well 28 in the Miller Park Wellfield that is part of the Ohio EPA ambient state-wide monitoring network also shows exceedances of the generic unrestricted potable use standards (and the MCL). (For reference, well 28 is located upgradient from the site, almost to Sixth Avenue and is one of the pumping wells that is the furthest away from the proposed new Public Safety Facility/Sheriff's Office.) Ohio EPA (2013a) (Appendix A) shows that, from the 21 samples collected between March 5, 1992 and November 3, 2011, the minimum concentration of arsenic was 0.0088 mg/L and the maximum was 0.018 mg/L. Statistically, the mean concentration was 0.0114 mg/L and the median was 0.012 mg/L. Both the mean and the median are above the generic unrestricted potable use standards and the MCL. Figure 3 presents the time series plot for arsenic and shows the concentrations through time for pumping well 28 in the Miller Park Wellfield (Ohio EPA, 2013b) (Appendix B).

Table 11. Analytical results for dissolved metals in groundwater in the fill compared to VAP generic unrestricted potable use standards based on maximum contaminant levels (OAC 3745-300-08 Appendix A, Table VI).

| WELL NUMBER<br>Sample Date<br><br>Parameter | BW1<br>03/31/2014<br><br>Water<br>mg/L | BW4<br>03/31/2014<br><br>Water<br>mg/L | Laboratory<br>Reporting<br><br>Limit<br>mg/L | Method<br>Detection<br><br>Limit<br>mg/L | Primary<br>Drinking Water<br><br>Standard<br>mg/L | Secondary<br>Drinking Water<br><br>Standard<br>mg/L | VAP generic unrestricted potable use standards based on maximum contaminant levels<br>mg/L |
|---|---|---|---|---|---|---|---|
| Aluminum | <0.2 | <0.2 | 0.2 | 0.097 | | 0.05-0.2 | None |
| Antimony | <0.010 | <0.010 | 0.010 | 0.0021 | 0.006 | | 0.006 |
| Arsenic | 0.0078 J | 0.043 | 0.010 | 0.0032 | 0.010 | | 0.010 |
| Barium | 0.4 B | 0.21 B | 0.2 | 0.00067 | 2.0 | | None |
| Beryllium | <0.005 | <0.005 | 0.005 | 0.00046 | 0.004 | | 0.004 |
| Cadmium | <0.002 | <0.002 | 0.002 | 0.00066 | 0.005 | | 0.005 |
| Calcium | 290 B | 160 B | 5 | 0.13 | | | None |
| Chromium | 0.0033 J | <0.005 | 0.005 | 0.0022 | 0.1 | | 0.1 |
| Cobalt | <0.007 | 0.0037 J | 0.007 | 0.0017 | | | None |
| Copper | <0.025 | <0.025 | 0.025 | 0.0045 | 1.3 | 1 | 1.3 |
| Iron | 15 | 5.1 | 0.1 | 0.081 | | 0.3 | None |
| Lead | 0.0027 J | <0.003 | 0.015 | 0.0019 | 0.015 | | 0.015 |
| Magnesium | 45 | 23 | 5 | 0.034 | | | None |
| Manganese | 1 | 1.1 | 0.015 | 0.00096 | | 0.05 | None |
| Mercury | <0.002 | <0.002 | 0.0004 | 0.0012 | 0.002 | | 0.002 |
| Nickel | 0.0049 J | 0.0094 J | 0.04 | 0.0032 | | | None |
| Potassium | 17 | 8.7 | 5 | 0.072 | | | None |
| Selenium | <5.0 | 4.9J | 0.005 | 0.0041 | 0.05 | | 0.050 |
| Silver | <0.005 | <0.005 | 0.005 | 0.0022 | | 0.1 | None |
| Sodium | 360 | 62 | 5 | 0.59 | | | None |
| Thallium | < 0.01 | < 0.01 | 0.01 | 0.0047 | 0.002 | | 0.002 |
| Vanadium | <0.007 | <0.007 | 0.007 | 0.0024 | | | None |
| Zinc | 0.047 JB | 0.13 B | 0.25 | 0.024 | | 5 | None |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate

B=Compound was found in the blank and sample

Exceeds generic unrestricted potable use standars based on maximum contaminant levels (OAC 3745-300-08 in Appendix A, Table VI.

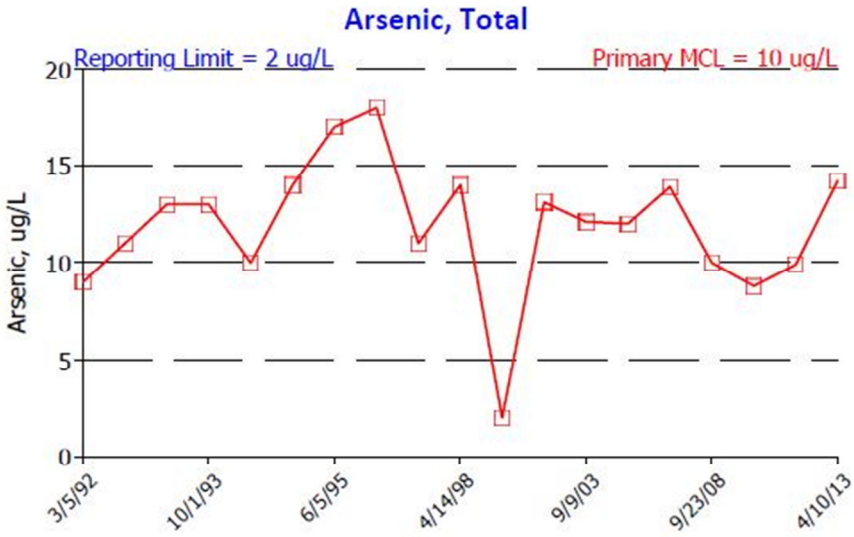


Figure 3. Time series of concentrations of arsenic in production well 28 in the Miller Park Wellfield, March 5, 1992 through April 10, 20013 (Ohio EPA, 2013b).

Data for pumping well 28 in the Miller Park Wellfield show that arsenic concentrations are mostly above the primary drinking water standard. Because concentrations of arsenic are also present in the wellfield above the generic unrestricted potable use standards, no site specific risk assessment was performed for arsenic.

In addition to arsenic, Table 11 shows that both the reporting limit (0.01 mg/L) and the maximum detection limit (0.0047 mg/L) for thallium are higher than the maximum contaminant level (MCL) and the VAP standard (0.002mg/L).

With regard to thallium, according to US EPA (2014a), *"Thallium is a metal found in natural deposits such as ores containing other elements. The greatest use of thallium is in specialized electronic research equipment. The major sources of thallium in drinking water are leaching from ore-processing sites; and discharge from electronics, glass, and drug factories"*. ATSDR (2013) summarizes information about thallium by stating *"Exposure to thallium occurs mainly from eating food. Exposure to higher levels of thallium may occur in the workplace. Breathing high levels of thallium may result in effects on the nervous system, while ingesting high levels of it results in vomiting, diarrhea, temporary hair loss, and other effects."*

A review of the available water quality information for the two monitoring wells that the City of Lancaster installed on the Fairfield County property in October 1995 (MW-4S and MW-4D) shows that thallium was not detected in 31 samples collected from October 17, 1995 through July 8, 2009. According to the City of Lancaster, no additional samples were collected from July 8, 1999 through March 2015. The well logs show that these wells were drilled through five feet of *"subase* (sic) *and foundry sand"*, which are the fill materials that were found to be present on the rest of the 44 borings on the site. Appendix C contains a location map, logs for monitoring wells MW-4S and MW-4D as well as the analytical results provided by the City of Lancaster. Based on this information, thallium is not a chemical of concern at the site.

*2.2.1.2 Target Compound List Volatile Organic Compounds*

Samples were collected from the two temporary monitoring wells within the fill and analyzed for the 48 VOCs in the "target compound list". Samples were analyzed by Method 8260B. Table 12 shows the analytical results, the temporary monitoring wells from which the samples were collected, and the date the sample was collected. The laboratory results are in Bennett & Williams (2014a). The results for VOCs in the samples (Table 12) show that no VOCs were detected above the reporting limit in the water samples from the site.

However, with regard to1,2-Dibromo-3-Chloropropane (DBCP), although DBCP was not detected, both the reporting limit (1.0 ug/L) and the maximum detection limit (0.67 ug/L) were above the VAP generic unrestricted potable use standard (0.2 ug/L). According to US EPA (2014b), DBCP *"is used primarily as an unclassified nematocide for soil fumigation of cucumbers, summer squash, cabbage, cauliflower, carrots, snap beans, okra, aster, shasta daisy, lawn grasses and ornamental shrubs."* Further, *"The major source of 1,2-dibromo-3-chloropropane in drinking water is runoff/leaching from soil fumigant used on soybeans, cotton, pineapples and orchards"* (US EPA, 2014b). Based on the listed sources and the known historical uses of the property, no sources of DCBP are anticipated at the site. Further, although the tables provided to us by the City of Lancaster indicate that VOCs were analyzed by Method 8260B, the only VOC ever reported was carbon disulfide in 1996. During this time period, a frequent source of carbon disulfide in samples was shown to be the powder used in gloves worn to collect samples. Finally, Table 1 of the Lancaster Interim Policy on Development within the Wellhead Protection Zones does not require testing for this parameter.

Therefore, no VAP generic unrestricted potable use standards were exceeded.

### *2.2.2 Water Results Summary*

Water analytical results show that generic unrestricted potable use standards as listed in Appendix A of OAC 3745-300-08, Table VI were exceeded only for one metal (arsenic) in one sample from water within the fill in 2014. Further examination of analytical results for arsenic from pumping well 28 (just south of Sixth Avenue and likely significantly upgradient of the Fairfield County property) in the Miller Park Wellfield showed that concentrations of arsenic in the pumping well also exceed the generic unrestricted potable use standards as listed in Appendix A of OAC 3745-300-08, Table VI. In fact, the time series plots prepared by Ohio EPA (2013b) show that the concentrations in pumping well 28 are consistently greater than the MCL. Therefore, although the Lancaster Interim Policy technically requires that a property specific risk assessment be performed, none is warranted in this situation.

Table 12. Analytical results for VOCs detected in groundwater in the fill compared to VAP generic unrestricted potable use standards based on maximum contaminant levels (OAC 3745-300-08 Appendix A, Table VI).

| WELL NUMBER | BW1 | BW4 | TRIP BLANK | Laboratory Reporting | Method Detection | VAP generic unrestricted potable use standards based on maximum contaminant levels |
|---|---|---|---|---|---|---|
| Sample Date | 3/31/2014 | 3/31/2014 | 3/31/2014 | | | |
| | Water | Water | Water | Limit | Limit | |
| PARAMETER | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| 1,1,1-Trichloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.22 | 200 |
| 1,1,2,2-Tetrachloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.18 | None |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.28 | None |
| 1,1,2-Trichloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.27 | 5 |
| 1,1-Dichloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.15 | None |
| 1,1-Dichloroethene | <1.0 | <1.0 | <1.0 | 1.0 | 0.19 | 7 |
| 1,2,4-Trichlorobenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.15 | 70 |
| 1,2-Dibromo-3-Chloropropane | <2.0 | <2.0 | <2.0 | 1.0 | 0.67 | 0.2 |
| 1,2-Dichlorobenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | 600 |
| 1,2-Dichloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.22 | 5 |
| 1,2-Dichloropropane | <1.0 | <1.0 | <1.0 | 1.0 | 0.18 | 5 |
| 1,3-Dichlorobenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.14 | None |
| 1,4-Dichlorobenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | 75 |
| 2-Butanone (MEK) | <10 | 0.61 J | <10 | 10.0 | 0.57 | None |
| 2-Hexanone | <10 | <10 | <10 | 10.0 | 0.41 | None |
| 4-Methyl-2-pentanone (MIBK) | <10 | <10 | <10 | 10.0 | 0.32 | None |
| Acetone | 3.0 J B | 4.0 J B | <10 | 10.0 | 1.10 | None |
| Benzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | 5 |
| Bromoform | <1.0 | <1.0 | <1.0 | 1.0 | 0.64 | 80 |
| Bromomethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.41 | None |
| Carbon disulfide | 0.69 J | <1.0 | <1.0 | 1.0 | 0.13 | None |
| Carbon tetrachloride | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | 5 |
| Chlorobenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.15 | 100 |
| Chlorodibromomethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.18 | None |
| Chloroethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.29 | None |
| Chloroform | <1.0 | <1.0 | <1.0 | 1.0 | 0.16 | 80 |
| Chloromethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.30 | None |
| cis-1,2-Dichloroethene | <1.0 | <1.0 | <1.0 | 1.0 | 0.17 | None |
| cis-1,3-Dichloropropene | <1.0 | <1.0 | <1.0 | 1.0 | 0.14 | None |
| Cyclohexane | <1.0 | <1.0 | <1.0 | 1.0 | 0.12 | None |
| Dichlorobromomethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.15 | 80 |
| Dichlorodifluoromethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.31 | None |
| Ethylbenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.17 | 700 |
| Ethylene Dibromide | <1.0 | <1.0 | <1.0 | 1.0 | 0.24 | None |
| Isopropylbenzene | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | None |
| Methyl acetate | <10 | <10 | <10 | 10.0 | 0.38 | None |
| Methyl tert-butyl ether | <1.0 | <1.0 | <1.0 | 1.0 | 0.17 | None |
| Methylcyclohexane | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | None |
| Methylene Chloride (Dichloromethane) | <1.0 | <1.0 | 0.41 J B | 1.0 | 0.33 | 5 |
| Styrene | <1.0 | <1.0 | <1.0 | 1.0 | 0.11 | 100 |
| Tetrachloroethene | <1.0 | <1.0 | <1.0 | 1.0 | 0.29 | 5 |
| Toluene | <1.0 | <1.0 | <1.0 | 1.0 | 0.13 | 1000 |
| trans-1,2-Dichloroethene | <1.0 | <1.0 | <1.0 | 1.0 | 0.19 | None |
| trans-1,3-Dichloropropene | <1.0 | <1.0 | <1.0 | 1.0 | 0.19 | None |
| Trichloroethene | <1.0 | <1.0 | <1.0 | 1.0 | 0.17 | 5 |
| Trichlorofluoromethane | <1.0 | <1.0 | <1.0 | 1.0 | 0.21 | None |
| Vinyl chloride | <1.0 | <1.0 | <1.0 | 1.0 | 0.22 | 2 |
| Xylenes, Total | <2.0 | <2.0 | <2.0 | 2.0 | 0.14 | 10000 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate
B=Compound was found in the blank and sample

## 2.3 Summary of Need for Property Specific Risk Assessment

Based on the soil analytical results collected in the fill in 2014, generic numerical direct-contact soil standards for a single chemical as listed in Appendix A of OAC 3745-300-08, Table 1 were exceeded for four metals (arsenic, chromium, lead, and mercury) and six constituents SVOCs (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz(a,h)anthracene, and indeno[1,2,3-cd]pyrene) in at least one interval in at least one boring. Similarly, arsenic concentrations in the fill materials in the two 2015 monitoring well borings exceeded the generic numerical direct-contact soil standards for a single chemical as listed in Appendix A of OAC 3745-300-08, Table 1. Therefore, the Lancaster Interim Policy requires that a property specific risk assessment be performed based on the soil concentrations. Results from the risk assessment performed prior to the adoption of the Lancaster Interim Policy are presented in Section 3.

Water analytical results show that generic unrestricted potable use standards as listed in Appendix A of OAC 3745-300-08, Table VI were exceeded only for one metal (arsenic) in one sample from water within the fill in 2014. However, pumping well 28 in the Miller Park wellfield consistently showed concentrations of arsenic above the VAP generic unrestricted potable use standards and the MCL. Most significantly, pumping well 28 is just south of Sixth Avenue (the furthest pumping well from the Fairfield County site) and likely upgradient in most pumping scenarios. Therefore, although the Lancaster Interim Policy technically requires that a property specific risk assessment be performed, none is warranted in this situation. Also, the City of Lancaster did not request such an evaluation. Alternately, the City of Lancaster in their March 3, 2015 comments on the Fairfield County submittal requested that *"the potential risks associated with* [the] *soil leaching to groundwater pathway"* be evaluated. The results of this analysis are summarized in Section 4 and included in Bennett & Williams (2015b).

# SECTION 3
# RISK ASSESSMENT FOR DERMAL AND INHALATION PATHWAYS

## 3.1 Introduction

As discussed in Section 2, analytical results collected from the fill materials showed that numerical direct-contact soil standards for a single chemical as listed in Appendix A of OAC 3745-300-08, Table 1 were exceeded for four metals (arsenic, chromium, lead, and mercury) and six constituents SVOCs (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz(a,h)anthracene, and indeno[1,2,3-cd]pyrene) in at least one interval in at least one boring during the 2014 investigation (Bennett & Williams, 2014a) and for arsenic in the 2015 installation of monitoring wells MW-9S and MW-9D (Bennett & Williams, 2015a). Therefore, the Lancaster Interim Policy requires that a property specific risk assessment be performed based on the soil concentrations.

As discussed in earlier sections, a property specific risk assessment was performed and results presented in the July 7, 2014 Bennett & Williams report as part of a Limited Phase II Environmental Property Assessment for areas under the proposed footprint of the new Public Safety Facility/Sheriff's Office. Subsequent evaluation of risk posed by soil gas and/or vapor intrusion was performed and presented in Bennett & Williams (2014b and 2015c). The Lancaster Interim Policy for Development within the Wellhead Protection Zones was not adopted until December 15, 2014. A summary of the results of these previous risk assessments is presented herein.

## 3.2 Site Orientation

The site of the proposed Fairfield County Jail/Public Safety Facility is located in an urban area, in downtown Lancaster, Ohio. Currently, the Fairfield County Sheriff's Office and MSMJ is adjacent to the proposed footprint of the new facility. Previously, the site had been filled using primarily foundry sand. The proposed future land use is for the Fairfield County Jail/Public Safety Facility. The site is supplied by both sanitary sewers and municipal water.

## 3.3 Exposure Routes

Given the current and future land use envisioned at the site, the populations with the potential to be impacted are current and future adult residents of the prison, current and future adults working at the jail and onsite workers involved in future excavation and construction. The current and proposed prison facilities do not have capacity for juvenile offenders and any child visitors can be expected to be onsite only for short periods of time while visiting adult offenders.

Possible exposure routes for onsite excavation and construction workers include: ingestion, inhalation and dermal contact. Ingestion of chemicals of concern is not a significant concern because water at the site is not used as a drinking water source and the site is supplied

by municipal water. However, during excavation and construction, on-site workers may be exposed to chemicals of concern through dermal contact and inhalation of outdoor air (Table 13).

Table 13. Exposure pathways for risk assessment.

| Land Use | Potentially Exposed Population | Exposure Route, Media and Exposure Point |
|---|---|---|
| Future | | |
| Construction and Excavation | On-site Workers | Dermal contact with chemicals of concern in soil during excavation and construction |
| Construction and Excavation | On-site Workers | Inhalation of chemicals of concern during excavation and construction |
| Future and Current | | |
| Industrial | On-site Workers | Inhalation of chemicals of concern in indoor air |
| Residential | On-site Adult Residents | Inhalation of chemicals of concern in indoor air |

### 3.4 Chemicals of Concern

The following metals were detected above the reporting limit: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc. Calcium, magnesium, iron, potassium and sodium were omitted as chemicals of concern due to a lack of information on possible negative health effects caused by these metals. Cobalt, copper, nickel and silver were omitted due to the extremely limited toxicological data available for these metals. Thallium was not included as a chemical of concern because it was only detected above the reporting limit in one sample from boring BW-4. Lead was evaluated separately from the other chemicals of concern (COC), as recommended by USEPA (2014c). Therefore, the metals evaluated during the quantitative risk assessment were: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, manganese, mercury, selenium, vanadium and zinc. Arsenic, chromium, lead and mercury were reported at concentrations higher than the VAP residential generic numerical direct contact soil values (Table 2). Therefore, a property specific risk assessment was performed on all constituents that exceeded the generic numerical direct contact soil standards for residential land use as listed in OAC 3745-300-08 in Appendix A, Table I. In addition, eight other inorganic parameters were also evaluated.

No VOCs were detected in any sample above the laboratory reporting limits. Therefore, no VOCs were examined during this risk assessment (Table 4). Several SVOCs were reported above the laboratory detection limits: 2-methyl naphthalene, acenaphthene, acenaphthylene,

anthracene, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, dibenzofuran, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene and pyrene. Dibenzofuran was omitted from the risk assessment because it was only detected above the reporting limit in one sample from boring BW-7 (and did not exceed the generic numerical direct contact soil standards for residential land use as listed in OAC 3745-300-08 in Appendix A, Table I). The remaining detected SVOCs were designated as COCs in the risk assessment. Benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthacene and indeno[1,2,3-cd]pyrene were reported at concentrations higher than the VAP residential generic numerical direct contact soil values (Table 6).

## 3.5 Results of the Initial Risk Assessment based on Soil Data

### *3.5.1 Initial Evaluation of Potential Risks to Construction/Excavation Workers*

#### *3.5.1.1 Arsenic and Mercury*

A risk assessment was performed on twelve metals and described in Bennett & Williams (2014a). However, only two metals (arsenic and mercury) pose potential exposure issues to construction/excavation workers.

As discussed in Bennett & Williams (2014a), based on the concentrations of COCs in the soil, construction/excavation workers are expected to have an increased dermal risk due to arsenic if they are onsite fulltime more than 90 days. This risk can be managed by requiring workers (as part of a health and safety plan) to wear gloves and long sleeves. Workers should also be reminded that showering after work will further reduce their exposure risk. Recommendations were made to Fairfield County to include this information in bid specifications to protect workers if they were to be onsite longer than 90 days fulltime.

In addition, construction/excavation workers are expected to have an unacceptable increased inhalation risk due to mercury if they are onsite fulltime more than 200 days. This risk can be managed (as part of a health and safety plan) by limiting either the number of hours and/or the number of days of exposure for the worker. Recommendations were made to Fairfield County to include this information in bid specifications to protect workers if they were to be onsite longer than 200 days fulltime.

#### *3.5.1.2 Lead*

As mentioned in Section 3.4, lead was evaluated separately from the other chemicals of concern (COCs), as recommended by USEPA (2014c). The USEPA's recommended model for evaluating blood lead concentrations in non-residential adult exposure scenarios is the Adult Lead Methodology (ALM). The ALM model is a tool to estimate the concentration of lead in the blood of non-residential adults exposed to lead in the environment. The methodology relates lead uptake at a site to the concentration of lead in the top layers of soil (i.e., exposure to dusts) and predicts the concentration of lead in the blood of pregnant women and a developing fetus. However, this methodology is also considered to be protective of adult male workers at the site.

The ALM calculated a geometric mean blood lead concentration of 11.6 µg/dl. This result is higher than the target blood lead concentration level of 10 µg/dl. When this situation occurs, construction worker exposure is subject to 29CFR 1926.62 (Section 5.10.3).

These OSHA regulations require that employers with workers who will be occupationally exposed to lead must determine whether an employee is exposed to levels of lead above the action level of 30 $\mu g/m^3$. The initial determination must be made using onsite air monitoring as if the employee is not wearing a respirator. If initial monitoring shows that the action is not exceeded, then no further air monitoring is necessary. Fairfield County performed initial air monitoring for lead. The results are discussed in Section 3.8.

### *3.5.2 Initial Evaluation of Potential Risks to Current and Future Adult Residents at the Fairfield County Jail/Sheriff's Office*

Possible exposure routes for current and future adult residents at the proposed Fairfield County Jail/Public Safety Facility include: ingestion, inhalation and dermal contact. Ingestion of chemicals of concern is not a significant concern because water at the site is not used as a drinking water source and the site is supplied by municipal water. The dermal exposure route for residents will not be a complete pathway because the plans for the proposed jail call for covering the soil with asphalt and there is currently no exposed soil. However, residents may be exposed to chemicals of concern through inhalation of indoor air (Table 13).

Concentrations of COCs in indoor air in the proposed jail and proposed jail and possible expansion were estimated for future adult resident using the Johnson and Ettinger (1991) model (Environmental Quality Management, 2004). Results of the risk assessment were based on solely on concentrations of constituents in the soil (as opposed to soil gas). Results showed that a hazard quotient as high as 3.66 was calculated for mercury for adult residents in the future jail (Table 14). This hazard quotient exceeded 0.1 (the hazard quotient recommended by Ohio EPA when hazard quotients are calculated from bulk soil analyses). This lower hazard quotient threshold (0.1 as opposed to the usual threshold of one) is used to account for the increased uncertainty associated with a risk assessment based on the analysis of bulk soil. Ohio EPA (2010) recommends further data collection (including soil gas sampling and analysis) prior to a definitive determination of risk. Therefore, soil gas data was collected and risk analyzed using soil gas data. These results are discussed further in Sections 3.6 and 3.7.

### *3.5.3 Initial Evaluation of Potential Risks to Current and Future Adult Workers at the Fairfield County Jail/Sheriff's Office*

Possible exposure routes for current and future adult workers at the proposed Fairfield County Jail/Public Safety Facility include: ingestion, inhalation and dermal contact. Ingestion of chemicals of concern is not a significant concern because water at the site is not used as a drinking water source and the site is supplied by municipal water. The dermal exposure route for workers will not be a complete pathway because the plans for the proposed jail call for covering the soil with asphalt and there is currently no exposed soil. However, workers may be exposed to chemicals of concern through inhalation of indoor air (Table 13).

Table 14. Initial results from the Johnson and Ettinger model showing vapor intrusion to indoor air hazard quotients.

| Parameter | Scenario | Incremental risk from vapor intrusion to indoor air (carcinogen) | Hazard quotient from vapor intrusion to indoor air (non-carcinogenic) |
|---|---|---|---|
| Acenaphthene | Residential proposed jail | | 9.48E-05 |
| | Residential proposed jail and | | 7.97E-05 |
| | Worker proposed jail | | 6.49E-05 |
| | Worker proposed jail and expansion | | 5.46E-05 |
| | Worker proposed Sheriff's office | | 1.69E-04 |
| Benzo[b]fluoranthene | Residential proposed jail | 3.15E-11 | |
| | Residential proposed jail and | 2.65E-11 | |
| | Worker proposed jail | 5.40E-10 | |
| | Worker proposed jail and expansion | 4.54E-10 | |
| | Worker proposed Sheriff's office | 1.41E-09 | |
| Chrysene | Residential proposed jail | 1.25E-12 | |
| | Residential proposed jail and | 1.05E-12 | |
| | Worker proposed jail | 2.13E-11 | |
| | Worker proposed jail and expansion | 1.80E-11 | |
| | Worker proposed Sheriff's office | 5.57E-11 | |
| Fluorene | Residential proposed jail | | 1.05E-04 |
| | Residential proposed jail and | | 8.84E-05 |
| | Worker proposed jail | | 7.20E-05 |
| | Worker proposed jail and expansion | | 6.05E-05 |
| | Worker proposed Sheriff's office | | 1.88E-04 |
| Mercury | Residential proposed jail | | 3.66 |
| | Residential proposed jail and | | 3.08 |
| | Worker proposed jail | | 2.51 |
| | Worker proposed jail and expansion | | 2.11 |
| | Worker proposed Sheriff's office | | 6.53 |
| 2-Methylnaphthalene | Residential proposed jail | | 4.72E-05 |
| | Residential proposed jail and | | 3.97E-05 |
| | Worker proposed jail | | 3.23E-05 |
| | Worker proposed jail and expansion | | 2.72E-05 |
| | Worker proposed Sheriff's office | | 8.43E-05 |
| Naphthalene | Residential proposed jail | | 6.61E-02 |
| | Residential proposed jail and | | 5.56E-02 |
| | Worker proposed jail | | 4.53E-02 |
| | Worker proposed jail and expansion | | 3.81E-02 |
| | Worker proposed Sheriff's office | | 1.18E-01 |
| Pyrene | | | 1.39E-05 |
| | Residential proposed jail and | | 1.19E-05 |
| | Worker proposed jail | | 9.51E-06 |
| | Worker proposed jail and expansion | | 7.99E-06 |
| | Worker proposed Sheriff's office | | 2.48E-05 |

Concentrations of COCs in indoor air in the proposed jail, proposed jail and possible expansion, and proposed Sheriff's Office were estimated for adult workers using the Johnson and Ettinger (1991) model (Environmental Quality Management, 2004). Results of the risk assessment were based on solely on concentrations of constituents in the soil (as opposed to soil gas). Results showed that a hazard quotient as high as 6.53 was calculated for mercury for adult workers in the proposed Sheriff's office (Table 14). This hazard quotient exceeded 0.1 (the hazard quotient recommended by Ohio EPA when hazard quotients are calculated from bulk soil analyses). This lower hazard quotient threshold (0.1 as opposed to the usual threshold of one) is used to account for the increased uncertainty associated with a risk assessment based on the analysis of bulk soil.

Similarly, a hazard quotient for naphthalene was calculated to be 0.118 (Table 14). This hazard quotient exceeded 0.1 (the hazard quotient recommended by Ohio EPA when hazard quotients are calculated from bulk soil analyses). This lower hazard quotient threshold (0.1 as opposed to the usual threshold of one) is used to account for the increased uncertainty associated with a risk assessment based on the analysis of bulk soil. Ohio EPA (2010) recommends further data collection (including soil gas sampling and analysis) prior to a definitive determination of risk. Therefore, soil gas data was collected and risk analyzed using soil gas data. These results are discussed further in Sections 3.6 and 3.7.

### 3.6 Results of Risk Assessment for Jail Residents and Workers based on Soil Gas Data

As discussed in the October 2, 2014 report, *"Vapor Intrusion Assessment; Proposed Fairfield County Jail/Public Safety Facility and Existing Sheriff's Office and MSMJ"* (Bennett & Williams, 2014b), soil gas data for this analysis were collected on July 24 and 25, 2014 and September 4 and 5, 2014. Soil gas samples were collected from subsurface probes installed coincident with the locations where the mercury and naphthalene were found to be the highest in the soil samples under the proposed building footprint. In addition, a subsurface probe was installed coincident with BW-3 to provide spatial distribution under the proposed building footprint and to correspond to the initial risk assessment calculations. Shallow and deep probes were installed at BW-1 where the fill materials were deeper and concentrations of constituents in the soil were greater. Six soil gas samples were collected.

No mercury or naphthalene was recorded in any soil gas probes above the laboratory detection limits. When calculating hazard quotients from soil gas data, a hazard quotient greater than one (1) is considered to pose a potential risk to exposed populations. A risk assessment for future workers and residents at the proposed Fairfield County Jail/Public Safety Facility demonstrated no increased non-carcinogenic risks to either workers or residents at the proposed facility, indicated by hazard quotients between $9.8 \times 10^{-6}$ and $1.1 \times 10^{-4}$.

## 3.7 Results of Risk Assessment for Jail Residents and Workers based on Indoor Air Data

As discussed in the January 2, 2015 report, "*Supplement to Vapor Intrusion Assessment, Existing Sheriff's Office and MSMJ, 334 West Wheeling Street, Lancaster, Ohio*" (Bennett & Williams, 2015c), sub-slab gas samples and collocated ambient air samples were collected on August 4 and 5, 2014 and November 4 and 5, 2014. The purpose of collecting indoor air samples was to measure concentrations of mercury and naphthalene in indoor air in the event that the sub-slab vapor samples showed concentrations of naphthalene and/or mercury. No detections of mercury or naphthalene were reported in the sub-slab air samples and there is no increased risk due to either mercury or naphthalene for residents or workers due to vapor intrusion through the sub-slab into the existing building. However, in order to be thorough, a risk assessment was conducted using the data collected during the sampling of ambient air.

Concentrations of mercury and naphthalene in indoor air were measured at five locations inside the current Sheriff's Office and MSMJ. After the first ambient air sampling in August 2014, when all samples returned non-detect values, it was decided to increase the volume of sample collected to further reduce the reporting limit. There were no detections of mercury or naphthalene in the ambient air, even at the reduced reporting limits used in November 2014. Because all samples were reported to be non-detect values, half the November 2014 reporting limits were used as the default "concentration" in the ambient air for the purposes of the risk assessment as recommended by USEPA (1991).

No excess health risk is posed to workers in the existing Sheriff's Office and MSMJ by mercury or naphthalene in the ambient air (hazard quotients of 0.10 and 0.14, respectively). This confirms the analysis of sub-slab mercury and naphthalene concentrations that also demonstrated no health risk to workers in the Sheriff's Office and MSMJ. Similarly, mercury and naphthalene do not pose a substantial risk to residents in the MSMJ (hazard quotients of 0.45 and 0.60, respectively).

## 3.8 Air Sampling for Lead

As discussed in the November 10, 2014 report, "*Initial Air Sampling for Lead at the Proposed Fairfield County Jail/Public Safety Facility and Existing Sheriff's Office and MSMJ, 334 West Wheeling Street, Lancaster, Ohio*" (Bennett & Williams, 2014c), initial sampling for lead in the air was conducted in accordance with 29CFR 1926.62 (Section 5.10.3) on October 27, 2014. Two samples were collected by monitoring air with personal monitors while excavating and manipulating fill materials in the area under the footprint of the proposed Fairfield County Jail/Public Safety Facility where the highest concentrations of lead were indicated. OSHA Method ID 125G was used to analyze the samples.

No lead was recorded in the samples above the laboratory detection limits of 0.324 $\mu g/m^3$. Also, the OSHA air action level for lead of 30 $\mu g/m^3$ was not exceeded. Therefore, because the initial monitoring did not exceed the OSHA air action level for lead, no further air monitoring during excavation and construction activities needs to be performed and no air program must be established.

## 3.9 Summary of Risks Posed by Soil and Air Exposure

In 2014, Bennett & Williams performed three separate data collection efforts and subsequent risk assessments to evaluate complete risk pathways at the site (Bennett & Williams 2014a, 2014b, 2014c, 2015c). The risk assessments were based on concentrations of chemicals of concern in soil, soil gas, subslab vapor, indoor air and outdoor air.

Although initial risk assessments performed using concentrations of contaminants of concern in the soil indicated that there may be a risk to future jail residents and/or jail workers from vapor intrusion into the new building by mercury and/or naphthalene, data collection of soil gas, subslab vapor and indoor air (in the current building) showed that no risk exists. Similarly, although initial risk assessments performed using concentrations of contaminants of concern in the soil indicated that there may be a risk to construction/excavation workers posed by lead, subsequent investigation and data collection under requirements by OSHA indicated that no air monitoring is necessary.

The risk assessment showed that the only risks posed by fill materials at the site were to construction/excavation workers. These risks were posed by dermal exposure to arsenic and an inhalation risk for mercury. The risk from arsenic can be managed by limiting construction/excavation workers to no more than 90 fulltime days onsite or by requiring workers (as part of a health and safety plan) to wear gloves and long sleeves. Workers should also be reminded that showering after work will further reduce their exposure risk. The risk from mercury can be managed (as part of a health and safety plan) by limiting either the number of hours and/or the number of days of exposure for the worker to no more than 200 fulltime days.

Fairfield County will require, as part of the bid documents, that contractors develop a health and safety plan to address these potential risks from arsenic and mercury.

# SECTION 4
# RISK ASSSESSMENT FOR INGESTION PATHWAY

## 4.1 Introduction

The initial risk assessments conducted in 2014 did not evaluate an onsite water ingestion pathway because the water at the site is not used as a drinking water source and the site is supplied by municipal water. However, samples of water were collected from the fill materials when water was encountered. Potential constituents in groundwater in the fill were deemed important because the City of Lancaster operates a public wellfield in Miller Park, immediately north of the site, on the north side of Wheeling Street.

As discussed in Section 2.2, the water was tested for target analyte list metals and target compound list volatile organic compounds (VOCs). Results showed that, with the exception of arsenic in one sample, the water within the fill materials met all primary drinking water standards (and hence all generic unrestricted potable use standards in Appendix A of OAC 3645-300-08, Table 1). However, concentrations of arsenic in pumping well 28 in the Miller Park Wellfield that is part of the Ohio EPA ambient state-wide monitoring network also shows exceedances of the generic unrestricted potable use standards (and the MCL). Further, both the mean and the median concentrations of arsenic in the pumping well are above the generic unrestricted potable use standards and the MCL. (For reference, well 28 is located upgradient from the site, almost to Sixth Avenue and is one of the pumping wells that is the furthest away from the proposed new Public Safety Facility/Sheriff's Office.) Ohio EPA (2013a).

Despite these results, the City of Lancaster, in the March 3, 2014 comments relating to the January 20, 2015 submittal by Fairfield County in response to the December 15, 2014 Lancaster Interim Policy on Development within the Wellhead Protection Zones requested that another risk analysis be performed. Specifically, the City stated "*The Limited Phase II ESA indicates that soil concentrations of antimony, arsenic, chromium, lead, mercury, selenium, and thallium exceed Ohio EPA generic leach-based soil values. Please evaluate the potential risks associated with soil leaching to groundwater pathway. The provide* [sic] *Risk Analysis indicates that the on-site groundwater pathway is not complete because the site is served by City of Lancaster water. However, the off-site receptor pathway has not been considered which is important because the City's Miller Park wellfield is located on the adjacent property to the north, the site lies within the 1-year Wellhead Protection Zone, and groundwater flow under the site is presumably towards the Miller Park wellfield. Please evaluate the risks associated with the off-site groundwater receptor pathway, being toward the City of Lancaster Miller Park wellfield."*

## 4.2 Risk Assessment of Soil Leaching to Groundwater Pathway

The City of Lancaster specifically requested that seven constituents (antimony, arsenic, chromium, lead, mercury, selenium, and thallium) that exceeded Ohio EPA generic leach-based soil values during the 2014 environmental investigation be further evaluated. Table 15 shows the location, depth, and date of sample collection as well as the generic leach-based soil values for inorganic chemicals where the source is ≥ ½ acre (Ohio EPA, 2008).

To make sure that the leaching potential was fully evaluated, the detected volatile organic chemicals as well as the semi-volatile organic chemicals were compared to leach-based standards for Soil Type I (Ohio EPA, 2008). According to Ohio EPA (2008), soil Type I *"may also include fill material…"* Table 16 shows that no volatile organic compounds exceeded the leach-based standards. However, Table 17 shows that one semi-volatile compound, naphthalene, exceeded the leach-based values for Type I soils. Therefore, even though the City did not request the evaluation of naphthalene, this compound was evaluated for completeness.

As discussed in the April 28, 2015 report, "*Evaluation of the Soil Leaching to Groundwater Pathway for Selected Metals for the Offsite Receptor of the Miller Park Wellfield, Lancaster, Ohio*" (Bennett & Williams, 2015b), the results of the leaching model showed that under both current conditions and proposed post-construction conditions, that none of the seven inorganic constituents leached to groundwater in 100 years. Similarly, the results of the leaching model also showed that naphthalene did not leach to groundwater in 100 years. These results were obtained despite the fact that the most conservative input parameters were used to reach these results. Therefore, based on the results of the leaching model, no risk to the Miller Park wellfield was found.

## 4.3 Summary of Risk to Water

SESOIL, a leaching model accepted by the Ohio EPA voluntary action program for evaluating leaching potential, was used to calculated the distance moved by each of the eight constituents that exceeded the Ohio generic leach-based soil values. The model results showed that none of the constituents leached to groundwater within 100 years. Therefore, no risk mitigation is required.

Table 15. Analytical results for inorganic chemicals in soils for which Ohio EPA has generic leach-based soil values (OEPA, 2008).

| BORING NUMBER<br>Depth<br>Sample Date<br>PARAMETER | BW1<br>4-6 Ft<br>3/20/2014<br>mg/kg | BW1<br>10-12 Ft<br>3/20/2014<br>mg/kg | BW2<br>2-4 Ft<br>3/20/2014<br>mg/kg | BW3<br>1.5-2 Ft<br>3/20/2014<br>mg/kg | BW3<br>2-4 Ft<br>3/20/2014<br>mg/kg | BW4<br>2-4 Ft<br>3/20/2014<br>mg/kg | BW4<br>8-10 Ft<br>3/20/2014<br>mg/kg | BW5<br>1-2 Ft<br>3/20/2014<br>mg/kg | BW5<br>10-11 Ft<br>3/20/2014<br>mg/kg | BW6<br>1-2 Ft<br>3/20/2014<br>mg/kg | BW6<br>4-6 Ft<br>3/20/2014<br>mg/kg | BW7<br>2-4 Ft<br>3/21/2014<br>mg/kg | BW7<br>6-8 Ft<br>3/21/2014<br>mg/kg | BW8<br>4-6 Ft<br>3/21/2014<br>mg/kg | BW8<br>6-8 Ft<br>3/21/2014<br>mg/kg | BW9<br>2-4 Ft<br>3/21/2014<br>mg/kg | BW10<br>2-4 Ft<br>3/21/2014<br>mg/kg | based value for sources ≥ 1/2 acre mg/kg<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | 43 | 11 | 14 | 1.3 | 0.74 J | 0.78 J | <6.0 | 0.69 J | 0.97 J | <1.0 | 0.51 J | 0.39 J | 0.41 J | 5.9 | 1.2 | 0.58 J | <0.82 | 4 |
| Arsenic | 18 | 94 | 22 | 7 | 12 | 8.8 | 36 | 11 | 34 | 3.6 | 6.8 | 7.1 | 9.2 | 460 | 23 | 12 | 1.9 | 3 |
| Barium | 450 | 3300 | 500 | 27 | 68 B | 61 | 920 | 32 | 220 | 22 | 27 | 57 B | 44 B | 170 B | 160 B | 120 B | 11 J B | 56,000 |
| Beryllium | 0.68 | 0.56 J | 0.34 J | 0.11 J | 0.46 J | 0.21 J | 2 | 0.27 J | 0.80 J | 0.17 J | 0.25 J | 0.26 J | 0.37 J | 0.43 J | 0.39 J | 0.62 | 0.058 J | 57 |
| Cadmium | 1.4 | 6.4 | 6.8 | 0.39 | 0.43 | 0.25 | 2.6 | 0.53 | 6.5 | 0.16 J | 1.9 | 0.41 | 0.33 | 4.1 | 3.3 | 1.3 | 0.062 J | 21 |
| Chromium | 37 | 330 | 81 | 35 | 16 | 34 | 60 | 19 | 120 | 8.9 | 19 | 26 | 22 | 23 | 20 | 15 | 8.6 | 56 |
| Lead | 1100 | 2000 | 1600 | 18 | 41 | 32 | 1400 | 25 | 260 | 9.2 | 14 | 44 | 55 | 260 | 230 | 150 | 5.9 | 89 |
| Mercury | 0.29 | 57 | 8 | 0.044J | 0.080 J | <0.10 | 6.2 | 0.051 J | 1.1 | <0.12 | 0.017J | 0.069 J | 0.15 | 0.6 | 0.54 | 0.25 | 0.035 J | 12 |
| Nickel | 24 | 34 | 14 | 25 | 27 | 37 | 56 | 44 | 36 | 7.7 | 14 | 34 | 37 | 26 | 28 | 43 | 10 | 182 |
| Selenium | 0.71 | 5.5 | 2.3 | 0.49 | <0.51 | 0.54 | 2.3 | <0.47 | 4.7 | 1.4 | 0.83 | 0.62 | 0.85 | 9.4 | 4.6 | 0.73 | <0.41 | 2 |
| Silver | 1 | 3.7 | 0.23 J | <0.45 | <0.51 | <0.47 | <0.60 | <0.47 | 0.96 J | <0.50 | <0.40 | <0.45 | <0.51 | 0.63 | 0.66 | 0.17 J | <0.41 | 3,120 |
| Thallium | <1.2 | 1.5 J | <0.96 | <0.90 | <1.0 | <0.93 | 1.6 | <0.93 | 1.2 J | <1.0 | <0.80 | <0.91 | <1.0 | <1.2 | <0.87 | <0.95 | <0.82 | 1.5 |
| Vanadium | 20 | 24 | 19 | 8.5 | 17 | 14 | 23J | 14 | 30 | 12 | 15 | 10 | 10 | 18 | 13 | 16 | 4.6 | 130 |
| Zinc | 390 | 4500 | 1300 | 26 | 92 | 46 | 1000 | 71 | 700 | 19 | 34 | 100 | 66 | 500 | 300 | 150 | 11 | 44,000 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

■ = Exceeds Leach-based value for sources ≥ 1/2 acre (mg/kg)(OEPA, 2008)

Table 16. Analytical results for volatile organic chemicals detected in soil for which Ohio EPA has generic leach-based soil values (OEPA, 2008).

| BORING NUMBER | BW-1 | BW2 | BW3 | BW4 | BW-5 | BW6 | BW7 | BW7A | BW8 | BW8A | BW9 | BW9A | BW10 | BW10A | Generic leach-based soil values Soil Type I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 4-6 Ft | 2-4 Ft | 2-4 Ft | 2-4 Ft | 4-6 Ft | 1-2 Ft | 2-4 Ft | 2-4 Ft | 4-6 Ft | 4-6 Ft | 0-2 Ft | 0-2 Ft | 2-4 Ft | 2-4 Ft | |
| Sample Date | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | 3/21/2014 | 3/31/2014 | |
| PARAMETER | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Benzene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.017 |
| Toluene | <0.0035 | <0.0029 | <0.0037 | 0.00021 J | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 6.8 |
| Ethylbenzene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0056 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 12 |
| Total Xylenes | <0.007 | <0.0057 | <0.0073 | <0.0064 | <0.0048 | <0.0069 | <00.0057 | <0.0028 | <0.0069 | <0.0046 | <0.0055 | <0.0060 | <0.0066 | <0.0051 | 156 |
| Styrene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | 0.000093 J | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.46 |
| Methyl Ethyl Ketone | 0.0014 J | <0.011 | <0.015 | <0.013 | <0.0097 | <0.014 | 0.00085 J | <0.011 | <0.014 | <0.0093 | <0.011 | <0.012 | <0.013 | <0.010 | 1.80 |
| Carbon Tetrachloride | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.25 |
| 1,2-Dichloroethane | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.0030 |
| 1,1,1-Trichloroethane | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 1.20 |
| Vinyl Chloride | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.0090 |
| 1,1-Dichloroethene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.28 |
| cis-1,2-Dichloroethene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.12 |
| trans-1,2-Dichloroethene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.41 |
| Trichloroethene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.036 |
| Tetrachloroethene | <0.0035 | <0.0029 | <0.0037 | <0.0032 | <0.0024 | <0.0035 | <0.0029 | <0.0028 | <0.0035 | <0.0023 | <0.0028 | <0.0030 | <0.0033 | <0.0025 | 0.15 |

J = Result is less than the Reporting Limit, but greater than or equal to the Maximum Detection Limit and the concentration is an approximate value

Table 17. Analytical results for semi-volatile organic chemicals detected in soil for which Ohio EPA has generic leach-based soil values (OEPA, 2008).

| BORING NUMBER | BW1 | BW1 | BW2 | BW3 | BW3 | BW4 | BW4 | BW5 | BW5 | BW6 | BW6 | BW7 | BW7 | BW8 | BW8 | BW9 | BW10 | Leach-based soil value, Soil Type I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 4-6 Ft | 10-12 Ft | 2-4 Ft | 1.5-2 Ft | 2-4 Ft | 2-4 Ft | 8-10 Ft | 1-2 Ft | 10-11 Ft | 1-2 Ft | 4-6 Ft | 2-4 Ft | 6-8 Ft | 4-6 Ft | 6-8 Ft | 2-4 Ft | 2-4 Ft | |
| Sample Date | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/20/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | 3/21/2014 | |
| PARAMETER | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Naphthalene | <0.033 | 13 | 0.08 | 0.033 | 0.024 | 0.13 | 0.1 | 0.086 | 0.19 | 0.017 | 0.022 | 0.13 | 0.37 | 0.083 | 0.15 | 0.048 | 0.094 | 0.27 |

= Exceeds generic leach-based soil values for Soil Type I (Ohio EPA, 2008)

# SECTION 5
# RISK MITIGATION WORK PLAN

## 5.1 Risks Identified in the Property-Specific Risk Assessment

As explained in the previous sections of this report, the risks identified in the property specific risk assessment include the following:

1) dermal exposure to arsenic for construction/excavation workers; and

2) inhalation exposure to mercury for construction/excavation workers.

No other risks were determined in the property specific risk assessment.

## 5.2 Construction Techniques and Practices to Mitigate the Identified Risks

The Lancaster Interim Policy on Development within the Wellhead Protection Areas states that *"The VAP certified Professional in conjunction with the Structural Engineer and the Site Engineer shall prepare a Risk Mitigation Work Plan that recommends construction techniques and practices required to mitigate the risks identified in the PSRA"*. The following items constitute the formal Risk Mitigation Work Plan required by the Interim Policy:

1) Fairfield County will require, as part of the bid documents, that contractors develop a health and safety plan to address the potential dermal risk from arsenic. Bid specifications containing this information will be submitted to the City in a separate document. As stated previously, the risk from arsenic can be managed by limiting construction/excavation workers to no more than 90 fulltime days onsite or by requiring workers (as part of a health and safety plan) to wear gloves and long sleeves. Workers should also be reminded that showering after work will further reduce their exposure risk.

2) Fairfield County will require, as part of the bid documents, that contractors develop a health and safety plan to address the potential inhalation risk from mercury. Bid specifications containing this information will be submitted to the City in a separate document. As stated previously, the risk from mercury can be managed (as part of a health and safety plan) by limiting either the number of hours and/or the number of days of exposure for the worker to no more than 200 fulltime days.

Although the Lancaster Interim Policy on Development within the Wellhead Protection Areas requires that *"The Risk Mitigation Work Plan shall be submitted to the City for review"* and then *"Upon approval by the City, techniques and practices in the Risk Mitigation Work Plan shall be incorporated into the plans"*, Fairfield County has chosen to be proactive and include these items prior to the approval by the City.

### 5.3 Fairfield County Voluntary Measures Not Required by the Lancaster Interim Policy

As stated above, no additional measures are required by the Lancaster Interim Policy. However, Fairfield County has long been on record that it is committed to taking measures that it feels are necessary to protect the valuable water resources of the Miller Park Wellfield – for all residents. Fairfield County will perform the following practices independent of the requirements of the Lancaster Interim Policy for Development within the Wellhead Protection Zones. As such, these measures need no approval from the City.

1) In order to minimize the direct transport of fill materials downward into underlying aquifer material, the fill materials be "cased off" as part of the installation of the auger cast piling foundations for the building. Location of the pilings as wells as specifications for the installation of the auger cast pilings with surface casings will be provided for informational purposes in a separate document;

2) A qualified environmental professional will be present onsite during excavation activities to confirm that the fill does not contain quantities of industrial waste, residual waste, or municipal waste that may make the fill subject to additional regulation;

3) Onsite fill materials will be managed within the footprint of the current filled area (the whole site). If soil fill is disposed offsite, the soils will be disposed at a solid waste landfill; and

4) In order to minimize infiltration and future leaching of constituents from the fill, the entire site will be "capped" by placing all fill materials under a building, asphalt, or a synthetic liner underneath the grass areas.

Respectfully submitted,
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# Appendix A

# Water Quality Data
# Ohio EPA

OhioEPA Ambient Ground Water Quality Monitoring Program

# Inorganic Ground Water Well Summary Report

**System Name:** Lancaster Wellfield **Well Num:** 28 **Ambient Well ID:** 39FAI00195

**Status:** ActiveRotational **OEPA District:** CDO **County:** Fairfield **PWS Type:**

**Lith. Open Section:** USG **Major Aquifer:** Sand and Gravel **Aquifer Name:** HockingRiver **Well Log #:** 450884

**Sample Date Range** 3/5/1992 to 11/3/2011 **Depth (ft):** 104 **Casing Length (ft):** 60

| | Units | Report. Limit | Statistics: Mean | Min | Max | Median | Std. Dev. | Latest Sample | Sample Counts: Total | ND | % ND |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **FieldParameter** | | | | | | | | | | | |
| Oxidation Reduction Potential (ORP) | mV | N/A | -36.9 | -92 | -4 | -41 | 32.4 | -4 | 7 | N/A | N/A |
| Specific Conductance | umhos/cm | N/A | 908.4 | 450 | 1125 | 963 | 222.6 | 955 | 12 | N/A | N/A |
| Temperature, water | deg C | N/A | 13.9 | 11 | 17.4 | 13.9 | 1.6 | 13.9 | 18 | N/A | N/A |
| Total Dissolved Solids (TDS), Field | mg/L | N/A | 687.3 | 659 | 722 | 672 | 30.3 | 659 | 7 | N/A | N/A |
| Turbidity | NTU | N/A | 1.2 | 0.5 | 1.85 | 1.175 | 1 | 1.85 | 2 | N/A | N/A |
| Uncorrected Conductance | umhos/cm | N/A | 713.3 | 380 | 1000 | 775 | 233.9 | 860 | 6 | N/A | N/A |
| pH | S.U. | N/A | 7 | 6.66 | 7.5 | 7.05 | 0.2 | 7.15 | 17 | N/A | N/A |
| **Metals-ICP** | | | | | | | | | | | |
| Aluminum | ug/L | 200 | 200 | ND | ND | 200 | N/A | 200 | 17 | 17 | 100 |
| Barium | ug/L | 15 | 93.6 | 70 | 128 | 95 | 15.7 | 127 | 21 | 1 | 4.8 |
| Calcium | mg/L | 2 | 142.5 | 118 | 162 | 141.5 | 13.5 | 122 | 22 | 0 | 0 |
| Chromium | ug/L | 2 | 24.7 | ND | ND | 30 | N/A | 2 | 21 | 21 | 100 |
| Copper | ug/L | 2 | 9.4 | 3 | 15 | 10 | 4.9 | 7.5 | 21 | 14 | 66.7 |
| Hardness, Ca + Mg | mg/L | 10 | 503.6 | 295 | 598 | 509 | 68.6 | 453 | 17 | 0 | 0 |
| Iron | ug/L | 50 | 4725.4 | 104 | 6170 | 5175 | 1597.1 | 4450 | 22 | 0 | 0 |
| Lead | ug/L | 2 | 2 | ND | ND | 2 | N/A | 2 | 21 | 21 | 100 |
| Magnesium | mg/L | 1 | 41.3 | 34 | 48 | 41 | 4.2 | 36 | 22 | 0 | 0 |
| Manganese | ug/L | 10 | 185.4 | 123 | 241 | 182.5 | 32 | 162 | 22 | 0 | 0 |
| Nickel | ug/L | 2 | 32.9 | 2.4 | 3.3 | 40 | 0.5 | 3.3 | 21 | 18 | 85.7 |
| Potassium | mg/L | 2 | 2.2 | 2 | 3 | 2 | 0.3 | 2 | 22 | 1 | 4.5 |
| Sodium | mg/L | 5 | 29 | 23 | 36 | 27 | 4.1 | 36 | 22 | 0 | 0 |
| Strontium | ug/L | 30 | 3120.6 | 2670 | 3540 | 3115 | 249.7 | 2670 | 18 | 0 | 0 |
| Zinc | ug/L | 10 | 10.1 | 13 | 13 | 10 | 0 | 10 | 21 | 20 | 95.2 |
| **Metals-ICPMS** | | | | | | | | | | | |
| Arsenic | ug/L | 2 | 11.4 | 8.8 | 18 | 12 | 2.5 | 11 | 21 | 2 | 9.5 |
| Cadmium | ug/L | 0.2 | 0.2 | ND | ND | 0.2 | N/A | 0.2 | 21 | 21 | 100 |
| Selenium | ug/L | 2 | 2.1 | 3 | 3 | 2 | 0 | 2 | 21 | 18 | 85.7 |
| **NaOH-Preserved** | | | | | | | | | | | |
| Cyanide | ug/L | 10 | 10 | ND | ND | 10 | N/A | 10 | 10 | 10 | 100 |
| **Nutrients-Demand** | | | | | | | | | | | |
| Ammonia | mg/L | 0.05 | 0.5 | 0.39 | 0.941 | 0.4645 | 0.1 | 0.475 | 22 | 0 | 0 |
| Carbon, Total Organic (TOC) | mg/L | 2 | 2 | ND | ND | 2 | N/A | 2 | 21 | 21 | 100 |
| Chemical Oxygen Demand (COD) | mg/L | 20 | 12.3 | 12 | 24 | 10 | 6.2 | 20 | 22 | 19 | 86.4 |
| Nitrate+Nitrite as N | mg/L | 0.1 | 0.1 | 0.12 | 0.39 | 0.1 | 0.2 | 0.1 | 22 | 20 | 90.9 |
| Nitrogen, Nitrite (NO2) as NO2 | mg/L | 0.02 | 0 | ND | ND | 0.02 | N/A | 0.02 | 2 | 2 | 100 |
| Nitrogen, Total Kjeldahl (TKN) | mg/L | 0.2 | 0.8 | 0.55 | 0.97 | 0.76 | 0.2 | 0.68 | 11 | 0 | 0 |
| Phenols (mixture) | ug/L | 10 | 10 | ND | ND | 10 | N/A | 10 | 8 | 8 | 100 |
| Phosphorus | mg/L | 0.01 | 0 | 0.017 | 0.05 | 0.05 | 0 | 0.01 | 21 | 18 | 85.7 |
| **Unpreserved** | | | | | | | | | | | |
| Alkalinity, Total | mg/L | 5 | 366.3 | 319 | 404 | 364 | 23.1 | 404 | 20 | 0 | 0 |
| Bromide | ug/L | 20 | 72.3 | 66 | 79.1 | 71.95 | 6.9 | 66 | 4 | 0 | 0 |
| Chloride | mg/L | 5 | 48.6 | 27 | 71 | 45.85 | 12.1 | 71 | 22 | 1 | 4.5 |
| Fluoride | mg/L | 0.2 | 0.4 | 0.3 | 0.8 | 0.37 | 0.2 | 0.38 | 14 | 0 | 0 |
| Solids, Total | mg/L | 10 | 778 | 760 | 812 | 762 | 29.5 | 762 | 3 | 0 | 0 |
| Sulfate | mg/L | 10 | 130.3 | 62.3 | 196 | 134 | 42.4 | 62.6 | 21 | 0 | 0 |
| Total Dissolved Solids | mg/L | 10 | 653.8 | 578 | 730 | 661 | 46.3 | 578 | 20 | 0 | 0 |
| pH | S.U. | 1 | 7.2 | 7.17 | 7.19 | 7.18 | 0 | 7.17 | 2 | 0 | 0 |

**Explanation** Mean and median both use reporting limit for non-detects. ND denotes a result below the reporting limit. Report Date: 4/26/2013

# Appendix B

# Time Series Data
# Water Quality

# Ground Water Quality Report

Division of Drinking and Ground Waters
Report Date: 6/21/2013

Ambient Ground Water Quality Monitoring Program

# Inorganic Ground Water Quality Time Series

*This Ground Water Quality Report summarizes the raw (untreated) inorganic ground water history for a single well (see box below). Time series graphs are a concise method of visualizing the geochemical variability within a water well over time.*

| | | | |
|---|---|---|---|
| System Name: | Lancaster Wellfield | Well Number: | 28 |
| Ambient Well ID: | 39FAI00195 | County: | Fairfield |
| Casing Length (ft) | 60 | Well Depth (ft) | 104 |
| Major Lithology: | Sand and Gravel | Geologic Setting: | Buried_Valley |

In the graphics on the following pages, the sample dates are shown on the horizontal axes, and the parameter concentrations are indicated on the vertical axes. As an aid to the reader, Maximum Concentration Levels (MCLs in red text) and Secondary MCLs (SMCLs in blue text) have been noted on the graphs where applicable. Action Levels (ALEs, in red text) have also been indicated for lead and copper results. While MCLs, SMCLs and ALEs are convenient benchmarks for interpreting water quality data, please note that they apply strictly to compliance data from public water supply wells, and not to the raw, untreated ground water samples represented in this report.

The Ambient Ground Water Quality Monitoring Program (AGWQMP) was established by Ohio Environmental Protection Agency to characterize Ohio's ground water quality in order to enhance water resource planning and prioritize ground water protection activities. Managed by the Division of Drinking and Ground Waters, the AGWQMP database now contains some 215 active water supply wells across Ohio.

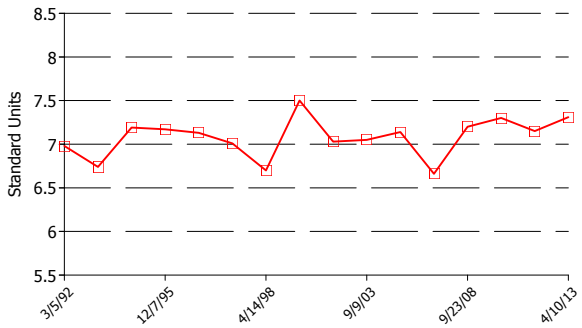
For additional information or answers to questions concerning the Ambient Ground Water Quality Monitoring Program, contact Christopher Kenah or Michael Slattery at (614)-644-2752 at Ohio EPA in Columbus, Oh., or email us at: gwq@epa.state.oh.us.

# Inorganic Time Series

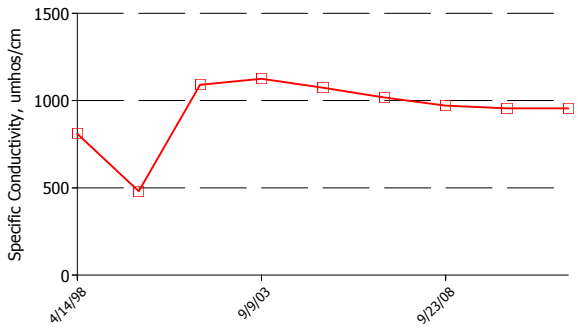
| | | | | | |
|---|---|---|---|---|---|
| Site Name | Lancaster Wellfield | Well Number | 28 | Ambient Well ID | 39FAI00195 |
| District | CDO | County | Fairfield | Aquifer Name | HockingRiver |
| Well Depth (ft) | 104 | Casing Length (ft) | 60 | Major Lithology | Sand and Gravel |

## FIELD DATA

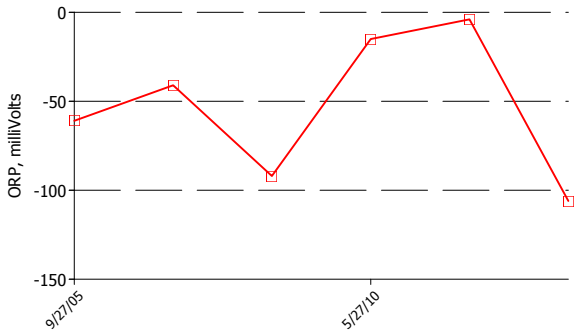
### pH, Field



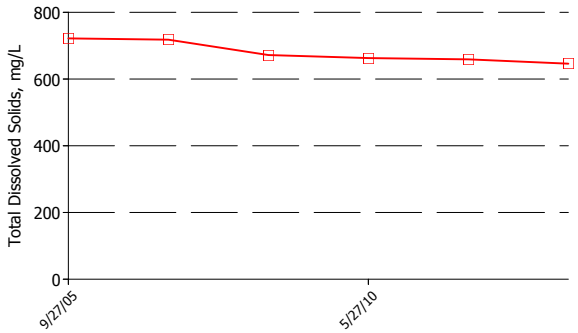

### Specific Conductivity, Field



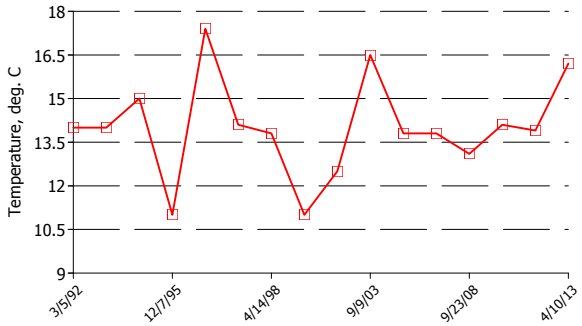

### Oxidation Reduction Potential, Field




### Total Dissolved Solids, Field



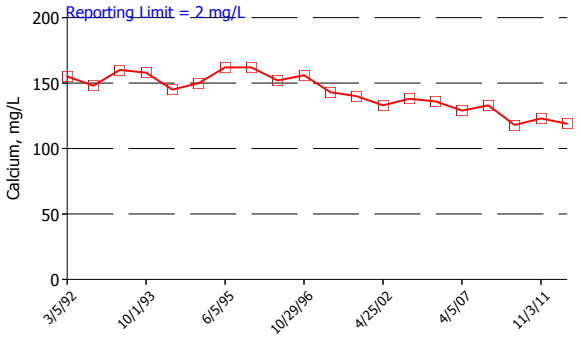

### Water Temperature, Field



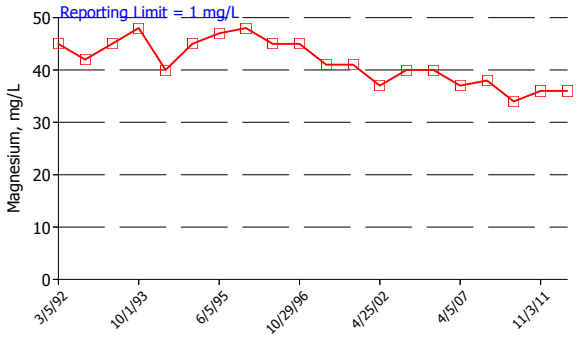
# MAJOR IONS, ALKALINITY, and TDS

| Station Name | Lancaster Wellfield | Well Number | 28 | Ambient Well ID | 39FAI00195 |
|---|---|---|---|---|---|

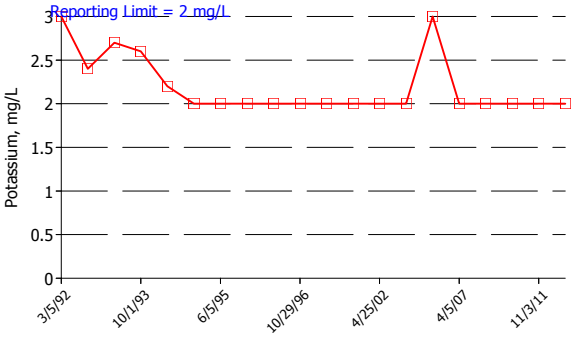
### Calcium, Total



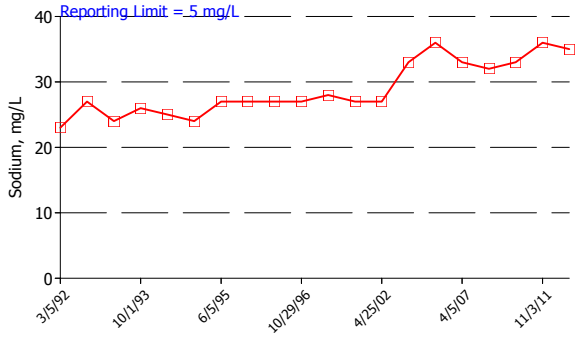

### Magnesium, Total



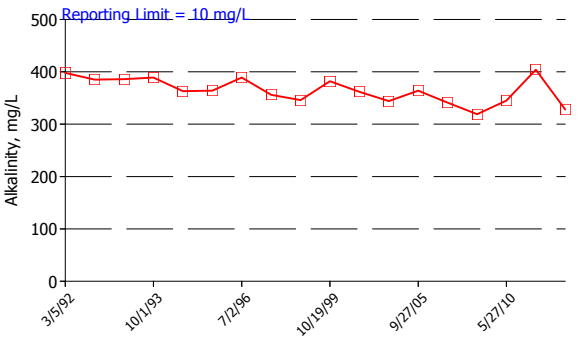

### Potassium, Total



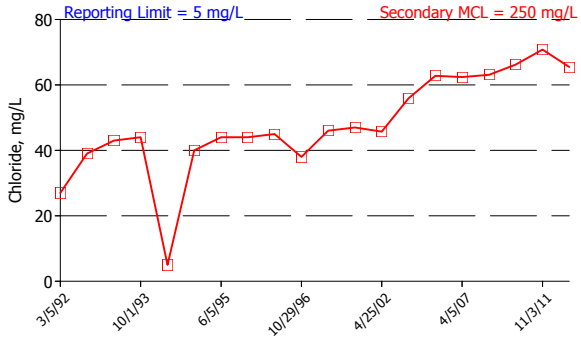

### Sodium, Total



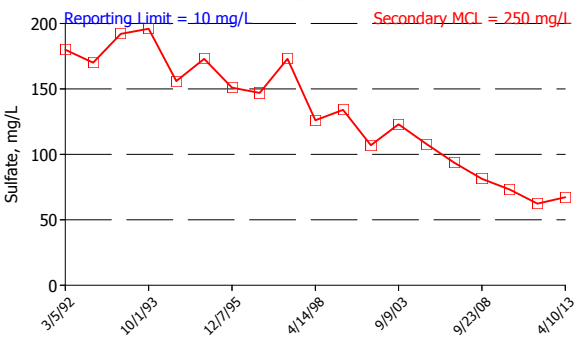

### Alkalinity, Total



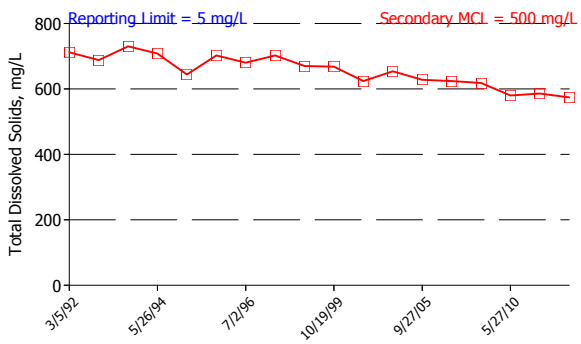

### Chloride, Total




### Sulfate, Total



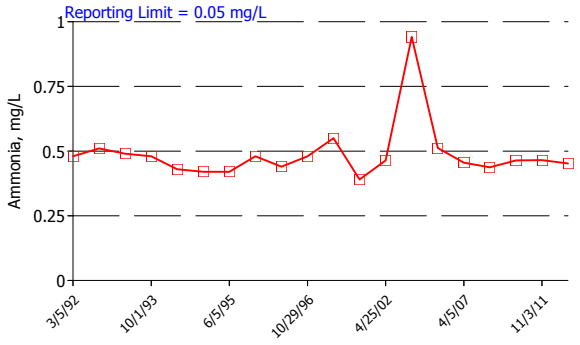

### Total Dissolved Solids



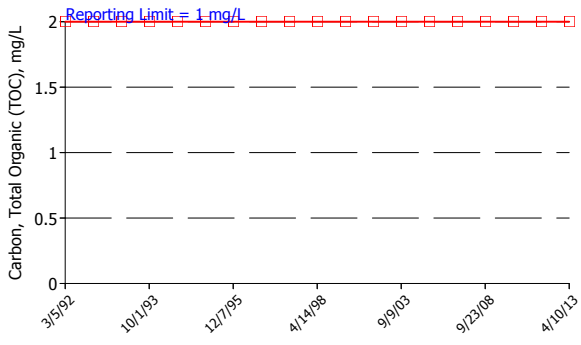
# NUTRIENTS

| Station Name | Lancaster Wellfield | Well Number | 28 | Ambient Well ID | 39FAI00195 |
|---|---|---|---|---|---|

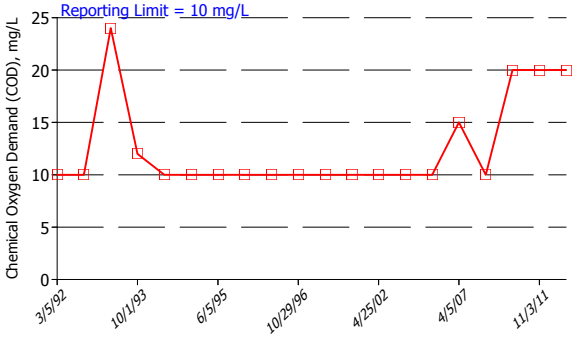
### Ammonia, Total



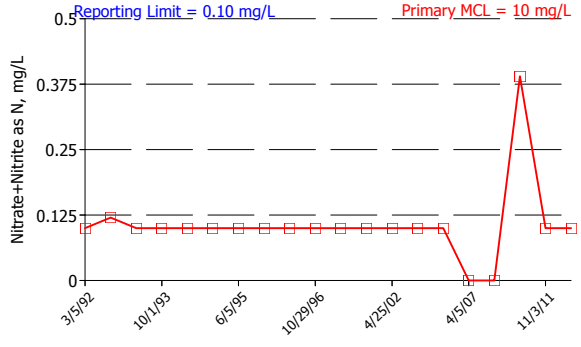

### Carbon, Total Organic (TOC)



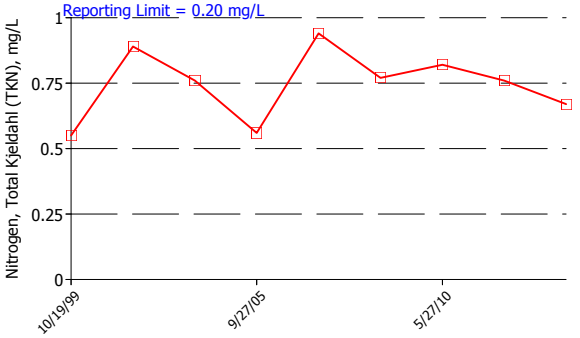

### Chemical Oxygen Demand (COD)



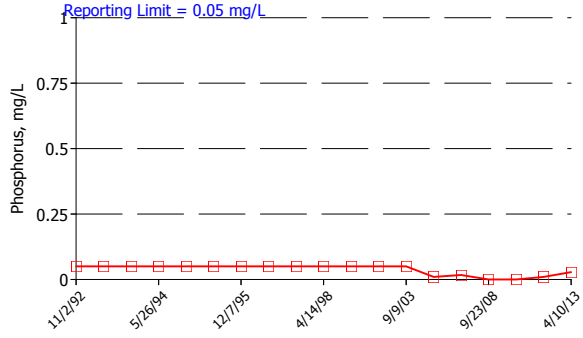

### Nitrate+Nitrite as N




### Nitrogen, Total Kjeldahl (TKN)




### Phosphorus, Total

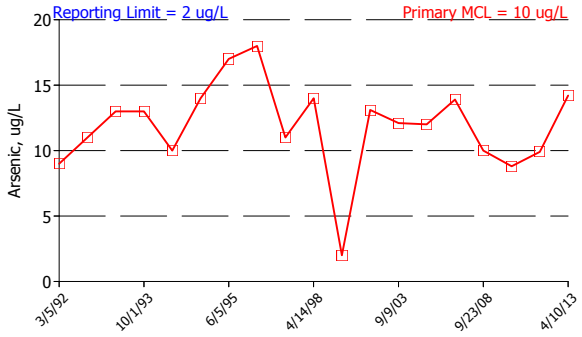



www.epa.ohio.gov/ddagw 50 W. Town St., Ste. 700 P.O. Box 1049 Columbus, OH 43216-1049 (614) 644-2752 (614) 644-2909 (fax)

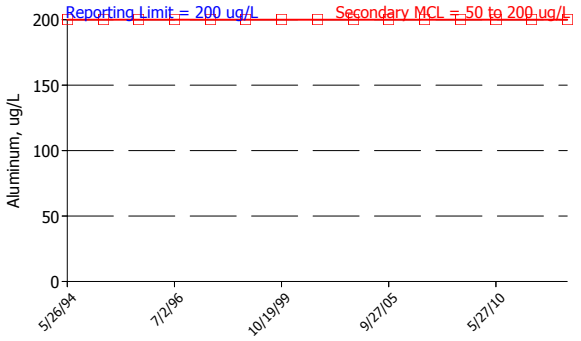
# TRACE IONS

| Station Name | Lancaster Wellfield | Well Number | 28 | Ambient Well ID | 39FAI00195 |
|---|---|---|---|---|---|

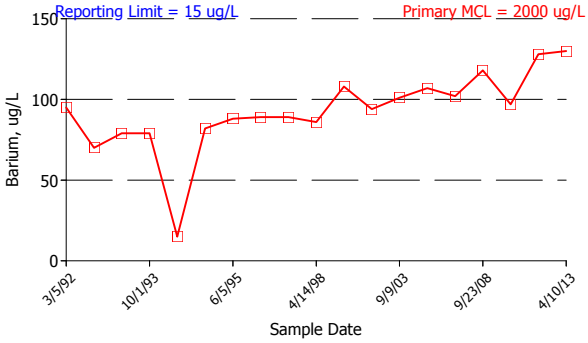
## Arsenic, Total



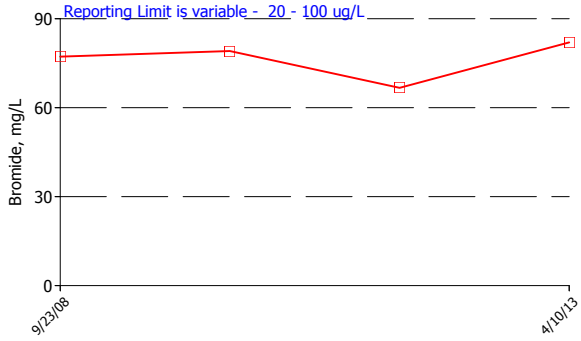

## Aluminum, Total



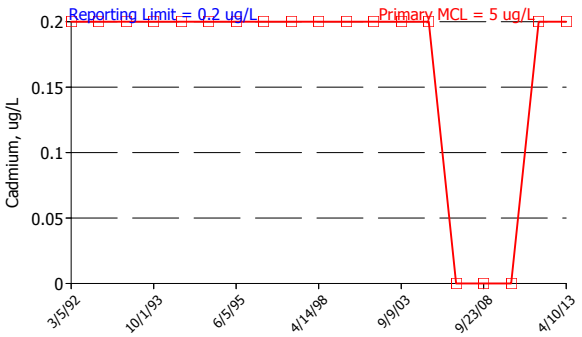

## Barium, Total



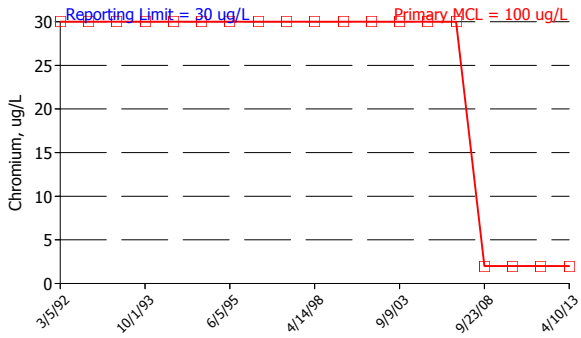

## Bromide, Total



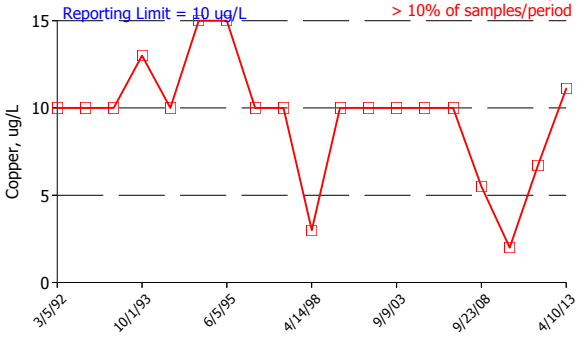

## Cadmium, Total



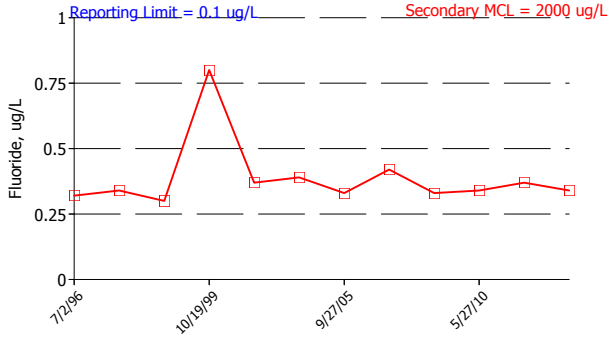

## Chromium, Total




## Copper, Total

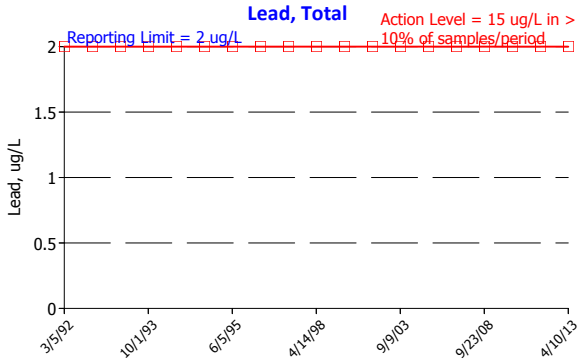


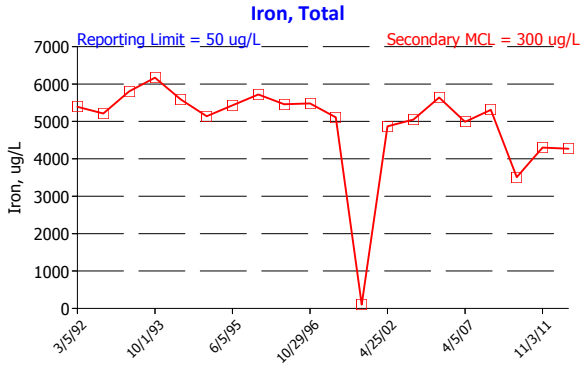

## Fluoride, Total

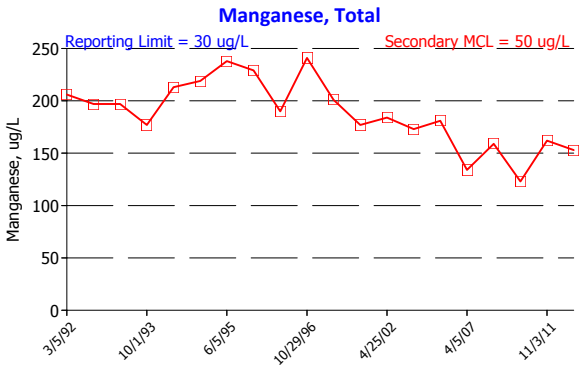


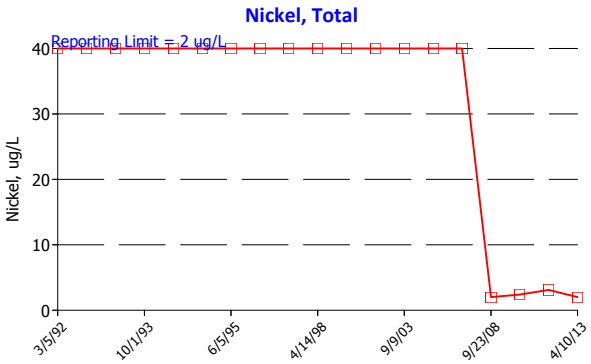
# TRACE IONS, cont'd

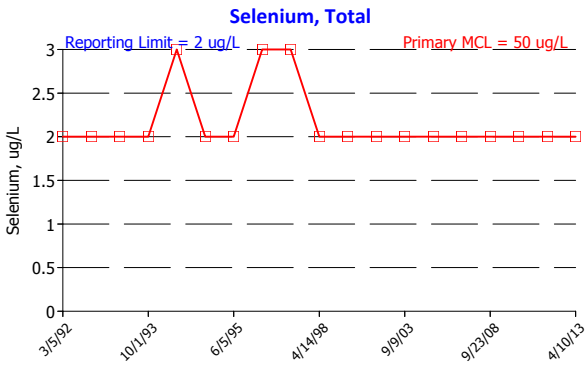
| Station Name | Lancaster Wellfield | Well Number | 28 | Ambient Well ID | 39FAI00195 |
|---|---|---|---|---|---|

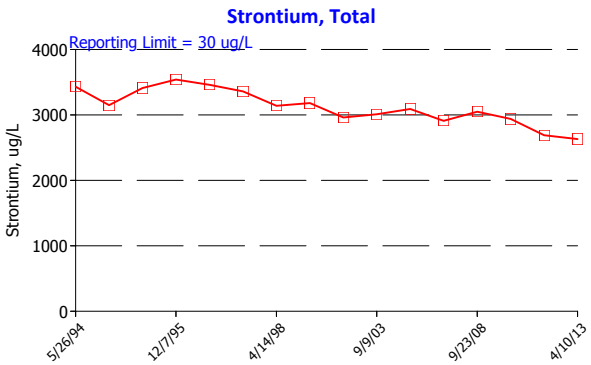


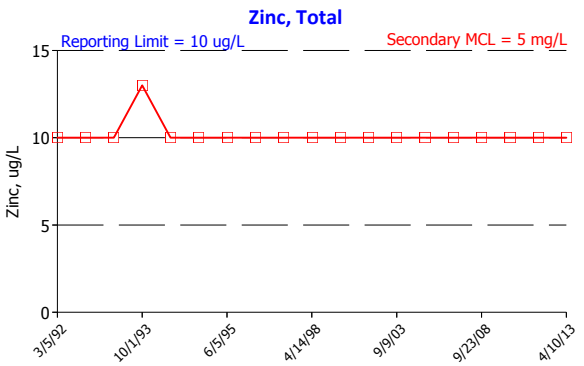



# Appendix C

# City of Lancaster Well Locations, Logs and Water Quality Data

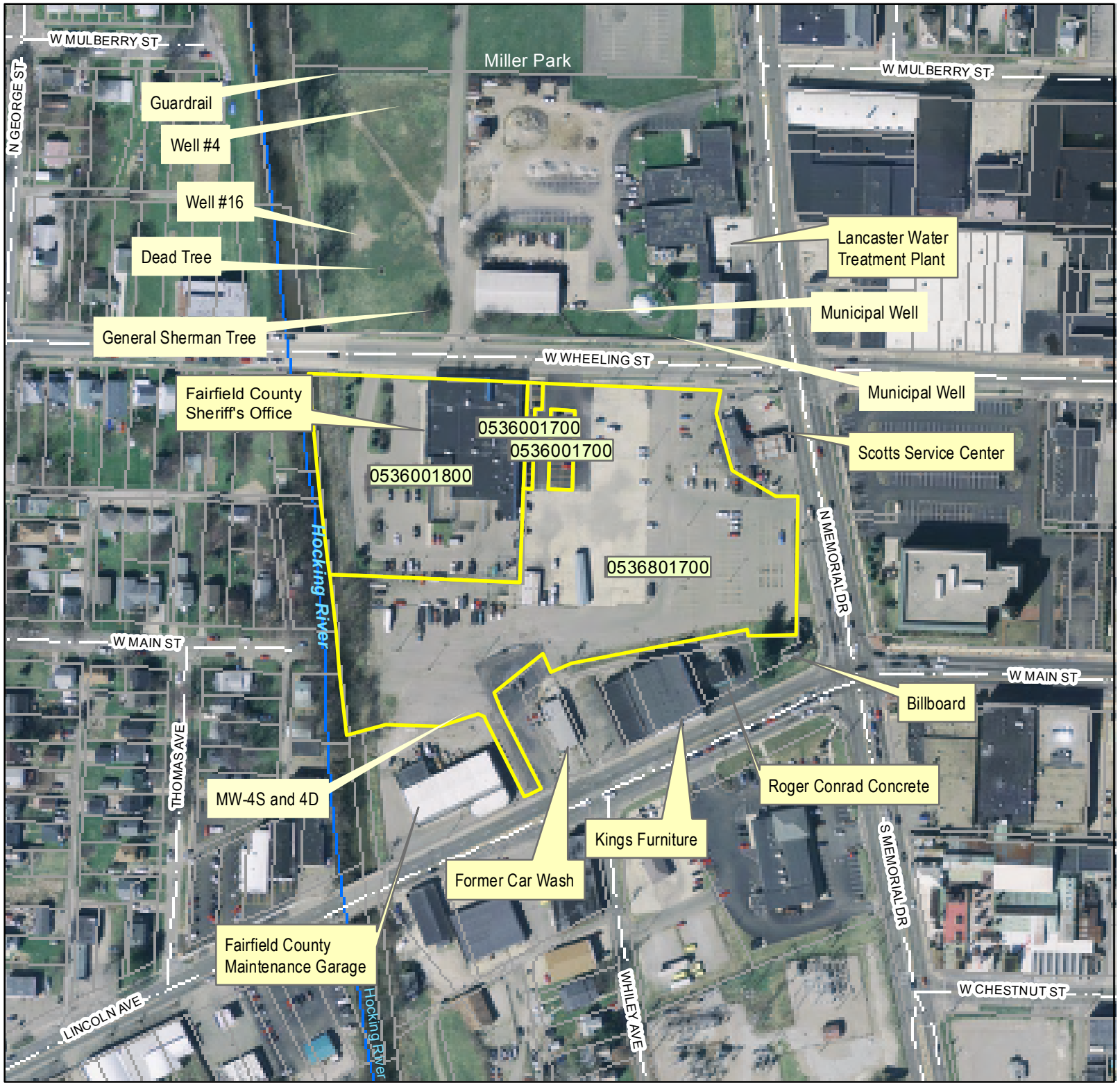



**Figure 1.**
**Site location map of proposed Fairfield County Jail/Public Safety Facility.**

N
W E
S

1 inch = 200 feet

0 50 100 200 300 Feet

# Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

**Well Log Number:** 816585

View Image of Original Well Log

**ORIGINAL OWNER AND LOCATION**

**Original Owner Name:** *CITY OF LANCASTER*
**County:** *FAIRFIELD* **Township:** *HOCKING* **Section Number:**
**Address:** *225 MEMORIAL DR N* **Lot Number:**
**City:** **State:** *OH* **Zip Code:** *43130*
**Location Number:** **Location Map Year:** **Location Area:**
**Latitude:** *39.7158* **Longitude:** *-82.60696*

**CONSTRUCTION DETAILS**

**Borehole Diameter:** 1: *asdfasdf* **Borehole Depth:** 1: *29 ft.* **Depth to Bedrock:**
2: 2:
**Casing Diameter:** 1: *2 in.* **Casing Length:** 1: *19 ft.* **Casing Thickness:** 1:
2: 2: 2:
**Casing Height Above Ground:** **Aquifer Type:** *SAND & GRAVEL*
**Date of Completion:** **Total Depth:** *29 ft.* **Well Use:**
**Driller's Name:** *BELASCO DRILLING, INC.*
**Screen Diameter:** **Slot Size:** **Screen Length:**
**Type:** **Material:**
**Set Between:**
**Gravel Pack Material/Size:** **Vol/Wt Used:**
**Method of Installation:** **Placed:**
**Grout Material/Size:** **Vol/Wt Used:**
**Method of Installation:** **Placed**

**WELL TEST DETAILS**

**Static Water Level:** **Test Rate:** Associated Reports
**Drawdown:** **Test Duration:**

**COMMENTS:**

**WELL LOG**

| Formations | From | To |
|---|---|---|
| SAND | 0 | 5 |
| GRAY SILTY CLAY | 5 | 22 |
| GRAY SAND & GRAVEL | 22 | 29 |

Printing Tips (opens in new window)

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Well log questions - Web site questions - Web policies

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

# WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

816585
Permit Number 94-599

COUNTY Fairfield TOWNSHIP Hocking SECTION/LOT No. (Circle One)

OWNER/BUILDER (Circle One or Both) City of Lancaster Division of Water (First / Last) PROPERTY ADDRESS (Address of well location) 225 N. Memorial Dr. (Number / Street) Lancaster (City)

LOCATION OF PROPERTY Lancaster - OH 43130 (Zip Code + 4)

## CONSTRUCTION DETAILS

CASING (Length below grade) Borehole Diameter 8 1/4 in.

[1] Diameter 2 in. Length 18.5 ft. Wall Thickness 2 1/2 in.

[2] Diameter ____ in. Length ____ ft. Wall Thickness ____ in.

Type: [1] Steel [1] Galv. [X] PVC [1] [2] Other ____

Joints: [X] Threaded [1] Welded [1] Solvent [1] [2] Other ____

Liner: NA Length ____ Type ____ Wall Thickness ____ in.

SCREEN

Type (wire wrapped, louvered, etc.) Slotted Material PVC

Length 10 ft. Diameter 2 inch in.

Set between 28.9 ft. and 18.9 ft. Slot .010

GROUT

Material Bentonite Volume used 50 lbs

Method of installation Tremie

Depth: placed from 14 ft. to 2 ft.

GRAVEL PACK (Filter Pack)

Material Sand Volume used 350 lbs

Method of installation Drop

Depth: placed from 28 ft. to 16.8' ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Monitoring well

☐ Rotary ☐ Cable [X] Augered ☐ Driven ☐ Dug ☐ Other ____

Date of Completion 7/27

## WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

| Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc. | From | To |
|---|---|---|
| Fill - Subase + Foundry Sand | 0 | 5' |
| Silty clay, grey, moist | 5' | 22' |
| Plastic | | |
| Sand and Gravel, grey | 22' | 29' |
| wet | | |
| Water @ 22' | | |

## WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ____

Test rate ____ gpm Duration of test ____ hrs.

Drawdown ____ ft.

Measured from: ☐ top of casing ☐ ground level ☐ Other ____

Static Level (depth to water) ____ ft. Date: ____

Quality (clear, cloudy, taste, odor) ____

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

## PUMP

Type of pump ____ Capacity ____ gpm

Pump set at ____ ft.

Pump installed by ____

## WELL LOCATION

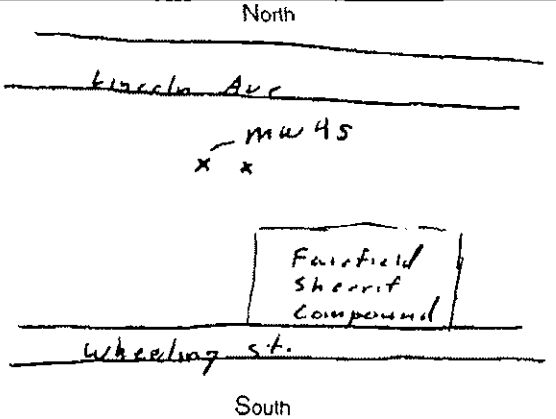
Location of well in State Plane coordinates, if available:

Zone ____ x ____ y ____

Elevation of well ____ ft./m. Datum plain: ☐ NAD27 ☐ NAD83

Source of coordinates: ☐ GPS ☐ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.




*(If additional space is needed to complete well log, use next consecutively numbered form.)

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm Belasco Drilling Services Signed ____

Address 1519 Alum Creek Dr. Date ____

94-599

# Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Soil and Water
Phone: 614-265-6740 Fax: 614-265-6767

**Well Log Number:** 816586

View Image of Original Well Log

**ORIGINAL OWNER AND LOCATION**

**Original Owner Name:** *CITY OF LANCASTER*
**County:** *FAIRFIELD* **Township:** *HOCKING* **Section Number:**
**Address:** *225 MEMORIAL DR N* **Lot Number:**
**City:** **State:** *OH* **Zip Code:** *43130*
**Location Number:** **Location Map Year:** **Location Area:**
**Latitude:** *39.7158* **Longitude:** *-82.60696*

**CONSTRUCTION DETAILS**

**Borehole Diameter: 1:** *asdfasdf* **Borehole Depth: 1:** *94 ft.* **Depth to Bedrock:**
**2:** **2:**
**Casing Diameter: 1:** *2 in.* **Casing Length: 1:** *85 ft.* **Casing Thickness: 1:**
**2:** **2:** **2:**
**Casing Height Above Ground:** **Aquifer Type:** *GLACIAL TILL*
**Date of Completion:** *10/2/1995* **Total Depth:** *94 ft.* **Well Use:**
**Driller's Name:** *BELASCO DRILLING, INC.*
**Screen Diameter:** **Slot Size:** **Screen Length:**
**Type:** **Material:**
**Set Between:**
**Gravel Pack Material/Size:** **Vol/Wt Used:**
**Method of Installation:** **Placed:**
**Grout Material/Size:** **Vol/Wt Used:**
**Method of Installation:** **Placed**

**WELL TEST DETAILS**

**Static Water Level:** **Test Rate:** **Associated Reports**
**Drawdown:** **Test Duration:**

**COMMENTS:**

**WELL LOG**

| Formations | From | To |
|---|---|---|
| SAND | 0 | 5 |
| GRAY SILTY CLAY | 5 | 22 |
| SAND & GRAVEL | 22 | 90 |
| GRAY TILL | 90 | 94 |

Printing Tips (opens in new window)

Print This Page | Close

Well log questions - Web site questions - Web policies

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

# WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

816586
Permit Number 94-599

COUNTY Fair field (City of Lancaster) TOWNSHIP Hocking SECTION/LOT No. (Circle One)

OWNER/BUILDER (Circle One or Both) Division of Water PROPERTY ADDRESS (Address of well location) 225 N. Memorial Dr Lancaster

LOCATION OF PROPERTY Lancaster, OH 43130 Zip Code + 4

## CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter ____ in.
[1] Diameter 2 in. Length* 85 ft. Wall Thickness 2 1/2 in.
[2] Diameter ____ in. Length* ____ ft. Wall Thickness ____ in.
Type: [1] Steel [1] Galv. [X] PVC [1] [2] Other
Joints: [X] Threaded [1] Welded [1] Solvent [1] [2] Other
Liner: NA Length ____ Type ____ Wall Thickness ____ in.

SCREEN
Type (wire wrapped, louvered, etc.) Slotted Material PVC
Length 10 ft. Diameter 2 in.
Set between 95.5 ft. and 85.5 ft. Slot .010

GROUT
Material Bentonite Volume used 200 lbs
Method of installation Tremie
Depth: placed from 75 ft. to 2 ft.

GRAVEL PACK (Filter Pack)
Material natural Volume used NA
Method of installation Collapse
Depth: placed from 96 ft. to 75 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Monitoring well
☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 10/2/95

## WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

| Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc. | From | To |
|---|---|---|
| Fill - Subsoil + Foundry sand | 0 | 5' |
| Silty clay, grey, moist, Plastic | 5 | 22' |
| Sand + gravel, wett (water @ 22') | 22' | 90' |
| Glacial till, green/grey | 90' | 94' |

*(If additional space is needed to complete well log, use next consecutively numbered form.)

## WELL TEST

☐ Bailing ☐ Pumping* ☐ Other
Test rate ____ gpm Duration of test ____ hrs.
Drawdown ____ ft.
Measured from: ☐ top of casing ☐ ground level ☐ Other
Static Level (depth to water) ____ ft. Date:
Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

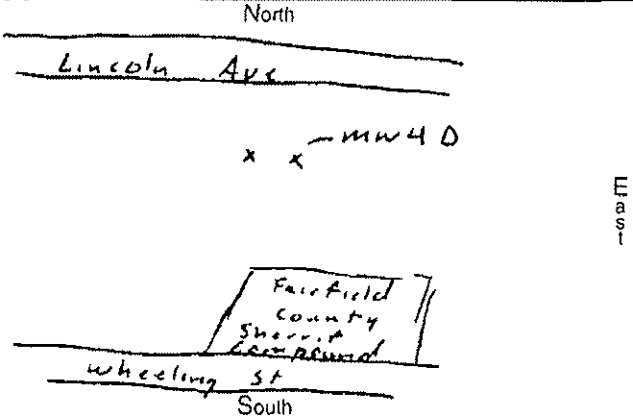
## PUMP

Type of pump ____ Capacity ____ gpm
Pump set at ____ ft.
Pump installed by

## WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone ____ x ____ y ____
Elevation of well ____ ft./m. Datum plain: ☐ NAD27 ☐ NAD83
Source of coordinates: ☐ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.




Drilling Firm Belasco Drilling Services
Address 1515 Alum creek Dr.

I hereby certify the information given is accurate and correct to the best of my knowledge.
Signed ____
Date ____

| PARAMETERS | Units | Detection Limit | MCL/SMCL/ ACTION LEVEL | MW-4D | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 10/17/1995 | 1/15/1996 | 4/22/1996 | 7/29/1996 | 2/11/1997 | 4/28/1997 | 7/7/1997 | 10/21/1997 | 6/24/1998 | 12/16/1998 | 7/20/1999 | 8/24/2000 | 11/27/2000 | 5/30/2001 | 10/17/2001 | 5/8/2002 | 11/1/2002 |
| **Inorganics** | | | | | | | | | | | | | | | | | | | | |
| CYANIDE | mg/L | 5 | 0.2 | < 0.005 | NA | NA | NA | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.01 | <0.01 | <0.01 | <0.005 | <0.005 |
| SULFIDE | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | < 1.0 | <1.0 | 2 | <0.05 | <0.05 |
| **Metals** | | | | | | | | | | | | | | | | | | | | |
| ALUMINUM | ug/L | | 0.05 to 0.2 mg/L (S) | 220 | <50.0 | <50.0 | <200.0 | <500.0 | <500.0 | <500.0 | <500.0 | <500.0 | <500.0 | <500.0 | <50.0 | <50.0 | NA | NA | NA | NA |
| ANTIMONY | ug/L | 4 | 6 | <5.0 | <5.0 | <5.0 | <60.0 | 4.7 | <4.0 | 6.2 | 7.5 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 |
| ARSENIC | ug/L | 5 | 50 | 5.0 | 9.0 | <3.0 | 10.9 | 12.0 | 13.0 | 1.0 | 1.0 | 8.8 | 8.9 | 7.7 | 6.1 | 6.0 | 9.0 | 8.0 | 6.7 | 6.7 |
| BARIUM | ug/L | 10 | 2000 | 290.0 | 340.0 | 200.0 | <200.0 | 350.0 | 340.0 | 358.0 | 337.0 | 354.0 | 355.0 | 338.0 | 404.0 | 377.0 | 440.0 | 393.0 | NA | NA |
| BERYLLIUM | ug/L | 0.5 | 4.0 | <5.0 | <5.0 | <5.0 | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.2 | <1.0 | <1.0 | <0.50 | <0.50 |
| CADMIUM | ug/L | 5 | 5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <1.0 | <1.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <1.0 | <5.0 | <5.0 | <5.0 | <1.0 | <1.0 |
| CALCIUM | mg/L | 0.05 | -- | 95 | 100 | 72 | 310 | 97 | 97 | 96 | 102 | 81 | 96 | 103 | 96 | 110 | 110 | 100 | 99 | 96 |
| CHROMIUM | ug/L | 5 | 100 | <20.0 | <20.0 | <20.0 | <10.0 | <2.0 | <2.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <10.0 | <10.0 | <10.0 | <5.0 | <5 |
| COBALT | ug/L | 50 | -- | <20.0 | <20.0 | <20.0 | <50.0 | <100.0. | <100.0 | <50.0 | <50.0 | <50.0 | <50.0 | <50.0 | <50.0 | <10.0 | <10.0 | <20.0 | <50.0 | <50 |
| COPPER | ug/L | 20 | 1000 (S) / 1300 (A) | <10.0 | <10.0 | <10.0 | <25.0 | <20.0 | <20.0 | <10.0 | <10.0 | 11.0 | <10.0 | <20.0 | <20.0 | <10.0 | NA | NA | NA | NA |
| IRON | ug/L | 30 | 300 (S) | 330 | 2200 | 700 | 12500 | 3800 | 3500 | 3000 | 3100 | 3300 | 3200 | 3100 | 3300 | 3480 | 3730 | 3410 | 3340 | 3090 |
| LEAD | ug/L | 2 | 15 (A) | <2.0 | <2.0 | <2.0 | <3.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| MAGNESIUM | mg/L | 0.005 | -- | 29.0 | 29.0 | 19.0 | 42.0 | 28.0 | 28.0 | 27.0 | 28.0 | 26.0 | 28.0 | 28.0 | 28.2 | 29.0 | 32.0 | 31.0 | 31.9 | 28.8 |
| MANGANESE | ug/L | 20 | 50 (S) | 180 | 190 | 140 | 320 | 180 | 190 | 170 | 160 | 174 | 162 | 168 | 189 | 200 | 220 | 200 | 200 | 181 |
| MERCURY | ug/L | 0.2 | 2.0 | <0.1 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.20 | <0.20 |
| NICKEL | ug/L | 20 | 100 (O) | 30 | <20.0 | <20.0 | <40.0 | <40.0 | <40.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <10.0 | <10.0 | <10.0 | <20.0 | <20 |
| POTASSIUM | mg/L | 0.05 | -- | 2 | 1.6 | 15 | < 5 | 1.4 | 1.7 | 1.4 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| SELENIUM | ug/L | 5 | 50 | <4.0 | <4.0 | <4.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| SILVER | ug/L | 1 | 100 (S) | <10.0 | <10.0 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <10.0 | <10.0 | <10.0 | <1.0 | <1.0 |
| SODIUM | mg/L | 0.05 | -- | 20 | 16 | 18 | 38 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| THALLIUM | ug/L | 1.5 | 2.0 | <2.0 | <2.0 | <2.0 | <10.0 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.0 | <1.0 | <1.0 | <1.5 | <1.5 |
| TIN | ug/L | 100 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | <50.0 | <50.0 | <50.0 | <100 | <100 |
| VANADIUM | mg/L | 0.005 | -- | < 0.01 | < 0.01 | < 0.01 | < 0.05 | < 1 | < 1 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.005 | < 0.005 | < 0.01 | <0.01 | 0.02 | <0.005 | <0.005 |
| ZINC | ug/L | 20 | 5000 (S) | 30 | 50 | 20 | 36 | <10.0 | 10 | <10.0 | <10.0 | 21 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20 |
| **VOLATILE ORGANICS VOC'S** | | | | D[1] | ND | ND | D[2] | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| **Method 8260** | | Varies | Varies | D[1] - Carbon Disulfate (2ug/l) | | | D[2] - Carbon Disulfate (2ug/l) | | | | | | | | | | | | | |
| **SEMI-VOLATILE ORGANICS** | | | | D | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8270** | | Varies | Varies | | | | | | | | | | | | | | | | | |
| **PESTICIDES/PCB'S** | | | | ND | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8081** | | Varies | Varies | | | | | | | | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | | | | | | | | | | | |
| TEMPERATURE | °C | -- | -- | 16.1 | 12.2 | 15.6 | 18.9 | 12.2 | 12.8 | 13.3 | 12.8 | 13.9 | 12.8 | NM | 19.2 | 10.4 | 13.9 | 12.7 | 13.8 | 13.0 |
| pH | S.U. | -- | 6.5-8.5 (S) | 7.4 | 7.4 | 7.8 | 7.6 | 7.6 | 7.6 | 6.9 | 6.9 | 7.60 | 7.60 | 7.40 | 7.31 | 7.24 | 6.80 | 7.50 | 7.10 | 7.31 |
| SPECIFIC CONDUCTA | umhos/cm | -- | -- | 575 | 580 | 539 | 590 | 750 | 800 | 750 | 720 | 720 | 730 | 760 | 700 | 840 | 680 | 820 | 720 | 764 |

(S) = Secondary Maximum Contaminant Level
(O) = Ohio EPA Primary Maximum Contaminant Level
ND = NOT DETECTED
NM = NOT MEASURED
(A) = Action Level
D = DETECTED
NA = NOT ANALZED

| PARAMETERS | Units | Detection Limit | MCL/SMCL/ ACTION LEVEL | MW-4D | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5/20/2003 | 11/13/2003 | 5/12/2004 | 10/27/04 | 5/4/05 | 11/2/05 | 4/26/06 | 10/26/06 | 5/8/07 | 11/14/07 | 6/17/08 | 11/4/08 | 7/8/09 |
| **Inorganics** | | | | | | | | | | | | | | | | |
| CYANIDE | mg/L | 5 | 0.2 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| SULFIDE | mg/L | 0.05 | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **Metals** | | | | | | | | | | | | | | | | |
| ALUMINUM | ug/L | | 0.05 to 0.2 mg/L (S) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| ANTIMONY | ug/L | 4 | 6 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| ARSENIC | ug/L | 5 | 50 | <5.0 | 6.3 | 7.2 | <5.0 | 6.5 | 7.3 | 7.2 | 9.5 | 9.4 | 7.5 | 9.0 | 10.4 | <5.0 |
| BARIUM | ug/L | 10 | 2000 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| BERYLLIUM | ug/L | 0.5 | 4.0 | <0.5 | <0.50 | <0.5 | <0.50 | <0.5 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| CADMIUM | ug/L | 5 | 5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| CALCIUM | mg/L | 0.05 | -- | 103 | 110 | 104 | 104 | 106 | 92 | 95 | 108 | 109 | 97 | 97 | 103 | 98 |
| CHROMIUM | ug/L | 5 | 100 | <5 | <5 | <5 | <5 | <5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| COBALT | ug/L | 50 | -- | <50 | <50 | <50 | <50 | <50 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| COPPER | ug/L | 20 | 1000 (S) / 1300 (A) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| IRON | ug/L | 30 | 300 (S) | 3140 | 3030 | 3220 | 2990 | 2950 | 3140 | 3120 | 3600 | 3510 | 3270 | 3140 | 3440 | 3210 |
| LEAD | ug/L | 2 | 15 (A) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MAGNESIUM | mg/L | 0.005 | -- | 29.7 | 30.7 | 29.9 | 30.4 | 30.2 | 27.6 | 27.5 | 30.8 | 30.9 | 28.2 | 28.0 | 29.8 | 28.7 |
| MANGANESE | ug/L | 20 | 50 (S) | 194 | 179 | 199 | 182.0 | 181.0 | 196.0 | 214.0 | 231.0 | 243.0 | 206.0 | 236.0 | 231.0 | 241.0 |
| MERCURY | ug/L | 0.2 | 2.0 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| NICKEL | ug/L | 20 | 100 (O) | <20 | <20 | <20 | <20 | <20 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| POTASSIUM | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| SELENIUM | ug/L | 5 | 50 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| SILVER | ug/L | 1 | 100 (S) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| SODIUM | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| THALLIUM | ug/L | 1.5 | 2.0 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| TIN | ug/L | 100 | -- | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| VANADIUM | mg/L | 0.005 | -- | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 |
| ZINC | ug/L | 20 | 5000 (S) | <20 | <20 | <20 | <20 | <20 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 |
| **VOLATILE ORGANICS VOC'S** | | | | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| **Method 8260** | | Varies | Varies | | | | | | | | | | | | | |
| **SEMI-VOLATILE ORGANICS** | | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8270** | | Varies | Varies | | | | | | | | | | | | | |
| **PESTICIDES/PCB'S** | | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8081** | | Varies | Varies | | | | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | | | | | | | |
| TEMPERATURE | °C | -- | -- | 14.0 | 13.5 | 14.1 | 13.5 | 13.9 | 14.1 | 13.7 | 13.9 | 13.9 | 14.2 | 14.9 | 14.1 | 16.6 |
| pH | S.U. | -- | 6.5-8.5 (S) | 7.19 | 7.31 | 6.75 | 7.39 | 7.43 | 7.42 | 7.30 | 7.35 | 7.35 | 7.29 | 7.38 | 7.27 | 7.38 |
| SPECIFIC CONDUCTA | umhos/cm | -- | -- | 722 | 815 | 639 | 747 | 542 | 673 | 618 | 535 | 535 | 587 | 566 | 489 | 708 |

(S) = Secondary Maximum Contaminant Level

(O) = Ohio EPA Prima

(A) = Action Level

D = DETECTED

| PARAMETERS | Units | Detection Limit | MCL/SMCL/ ACTION LEVEL | MW-4S | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 10/17/1995 | 1/15/1996 | 4/22/1996 | 7/29/1996 | 2/11/1997 | 4/28/1997 | 7/7/1997 | 10/6/1997 | 6/24/1998 | 12/16/1998 | 7/20/1999 | 4/28/2000 | 11/27/2000 | 5/30/2001 | 10/17/2001 | 5/8/2002 |
| **Inorganics** | | | | | | | | | | | | | | | | | | | |
| CYANIDE | mg/L | 5 | 0.2 | < 0.005 | NA | NA | NA | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.01 | <0.01 | <0.01 | <0.005 |
| SULFIDE | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 1 | 1 | 2 | <0.05 |
| **Metals** | | | | | | | | | | | | | | | | | | | |
| ALUMINUM | ug/L | | 0.05 to 0.2 mg/L (S) | 70.0 | 210.0 | <50.0 | <200.0 | <500.0 | <500.0 | <500.0 | <500.0 | <500.0 | 660.0 | <500.0 | <50.0 | <50.0 | NA | NA | NA |
| ANTIMONY | ug/L | 4 | 6 | <5.0 | <5.0 | <5.0 | <60.0 | 6.5 | <4.0 | <4.0 | 8.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 |
| ARSENIC | ug/L | 5 | 50 | 3.0 | 6.0 | 22.0 | 14.7 | 17.0 | 34.0 | 1.7 | 18.0 | 19.0 | 10.0 | 11.0 | 11.6 | 7.0 | 17.0 | 14.0 | 15.2 |
| BARIUM | ug/L | 10 | 2000 | 420.0 | 420.0 | 570.0 | 660.0 | 560.0 | 520.0 | 604.0 | 458.0 | <10.0 | 469.0 | 532.0 | 487.0 | 409.0 | 531.0 | 455.0 | NA |
| BERYLLIUM | ug/L | 0.5 | 4.0 | <5.0 | <5.0 | <5.0 | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 | <0.2 | <1.0 | <1.0 | <0.50 |
| CADMIUM | ug/L | 5 | 5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <1.0 | <1.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <1.0 |
| CALCIUM | mg/L | 0.05 | -- | 140 | 130 | 130 | 152 | 140 | 130 | 140 | 122 | 130 | 136 | 154 | 131 | 140 | 150 | 140 | 131 |
| CHROMIUM | ug/L | 5 | 100 | <20.0 | <20.0 | <20.0 | <10.0 | <2.0 | <2.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <10.0 | <10.0 | <10.0 | <5.0 |
| COBALT | ug/L | 50 | -- | <20.0 | <20.0 | <20.0 | <50.0 | <100.0 | <100.0 | <50.0 | <50.0 | <50.0 | <50.0 | <50.0 | <50.0 | <10.0 | <10.0 | <20.0 | <50.0 |
| COPPER | ug/L | 20 | 1000 (S) / 1300 (A) | <10.0 | <10.0 | <10.0 | <25.0 | <20.0 | <20.0 | 10.0 | <10.0 | 16.0 | <10.0 | <20.0 | <20.0 | <10.0 | NA | NA | NA |
| IRON | ug/L | 30 | 300 (S) | 4100 | 6900 | 9700 | 9500 | 11000 | 10000 | 8200 | 8600 | 10000 | 10000 | 9400 | 9400 | 8700 | 10300 | 9700 | 8940 |
| LEAD | ug/L | 2 | 15 (A) | <2.0 | <2.0 | <3.0 | <3.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| MAGNESIUM | mg/L | 0.005 | -- | 33.0 | 31.0 | 31.0 | 34.0 | 31.0 | 32.0 | 32.0 | 31.0 | 29.0 | 29.0 | 33.0 | 31.6 | 32.0 | 35.0 | 35.0 | 33.4 |
| MANGANESE | ug/L | 20 | 50 (S) | 310 | 260 | 360 | 370 | 320 | 340 | 310 | 260 | 303 | 267 | 256 | 279 | 250 | 310 | 260 | 273 |
| MERCURY | ug/L | 0.2 | 2.0 | <0.1 | <0.1 | <0.1 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.20 |
| NICKEL | ug/L | 20 | 100 (O) | <20.0 | <20.0 | <20.0 | <40.0 | <40.0 | <40.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <10.0 | <10.0 | <10.0 | <20.0 |
| POTASSIUM | mg/L | 0.05 | -- | 11 | 9.2 | 8.3 | 11 | 11 | 9.6 | 10 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| SELENIUM | ug/L | 5 | 50 | <4.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| SILVER | ug/L | 1 | 100 (S) | <10.0 | <10.0 | <10.0 | <10.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <10.0 | <10.0 | <10.0 | <1.0 |
| SODIUM | mg/L | 0.05 | -- | 48 | 42 | 39 | 43 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| THALLIUM | ug/L | 1.5 | 2.0 | <2.0 | <2.0 | <2.0 | <10.0 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.0 | <1.0 | <1.0 | <1.5 |
| TIN | ug/L | 100 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | <50.0 | <50.0 | <50.0 | <100.0 |
| VANADIUM | mg/L | 0.005 | -- | < 0.01 | < 0.01 | < 0.01 | < 0.05 | < 1 | < 1 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.005 | < 0.005 | < 0.01 | <0.01 | 0.02 | <0.005 |
| ZINC | ug/L | 20 | 5000 (S) | 20 | 20 | 10 | 23 | <10.0 | 11 | 10 | <10.0 | <10.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 |
| **VOLATILE ORGANICS VOC'S** | | | | D[1] | ND | ND | D[2] | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| **Method 8260** | | Varies | Varies | D[1] - CARBON DISULFIDE (7ug/l) | | | | D[2] - (ACETONE (5ug/l), CARBON DISULFIDE (2ug/l)) | | | | | | | | | | | |
| **SEMI-VOLATILE ORGANICS** | | | | ND | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8270** | | Varies | Varies | | | | | | | | | | | | | | | | |
| **PESTICIDES/PCB'S** | | | | ND | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8081** | | Varies | Varies | | | | | | | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | | | | | | | | | | |
| TEMPERATURE | °C | -- | -- | 17.2 | 16.1 | 16.7 | 18.3 | 13.3 | 12.8 | 13.3 | 15.0 | 13.9 | 14.4 | NM | 13.3 | 12.3 | 13.9 | 14.9 | 14.3 |
| pH | S.U. | -- | 6.5-8.5 (S) | 7.2 | 7.1 | 7.2 | 7.1 | 7.1 | 7.3 | 7.1 | 7.0 | 7.00 | 7.10 | 7.10 | 7.00 | 6.88 | 6.60 | 7.20 | 7.10 |
| SPECIFIC CONDUCTAN | umhos/cm | -- | -- | 871 | 858 | 913 | 890 | 1100 | 1100 | 1100 | 975 | 1050 | 1100 | 1050 | 1110 | 1207 | 990 | 1150 | 980 |

(S) = Secondary Maximum Contaminant Level
(O) = Ohio EPA Primary Maximum Contaminant Level
ND = NOT DETECTED
NM = NOT MEASURED
(A) = Action Level
D = DETECTED
NA = NOT ANALZED

| PARAMETERS | Units | Detection Limit | MCL/SMCL/ ACTION LEVEL | MW-4S | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/1/2002 | 5/20/2003 | 11/13/2003 | 5/12/2004 | 10/27/04 | 5/4/05 | 11/2/05 | 4/26/06 | 10/26/06 | 5/8/07 | 11/14/07 | 6/17/08 | 11/4/08 | 7/8/09 |
| **Inorganics** | | | | | | | | | | | | | | | | | |
| CYANIDE | mg/L | 5 | 0.2 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| SULFIDE | mg/L | 0.05 | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| **Metals** | | | | | | | | | | | | | | | | | |
| ALUMINUM | ug/L | | 0.05 to 0.2 mg/L (S) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| ANTIMONY | ug/L | 4 | 6 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| ARSENIC | ug/L | 5 | 50 | 8.6 | 11.6 | 9.8 | 12.2 | <5.0 | 6.5 | 7.3 | 7.2 | 9.5 | 9.4 | 7.5 | 9.0 | 10.4 | <5.0 |
| BARIUM | ug/L | 10 | 2000 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| BERYLLIUM | ug/L | 0.5 | 4.0 | <0.50 | <0.5 | <0.50 | <0.5 | <0.50 | <0.5 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| CADMIUM | ug/L | 5 | 5.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| CALCIUM | mg/L | 0.05 | -- | 144 | 164 | 160 | 159 | 104 | 106 | 92.4 | 95.0 | 108.0 | 109.0 | 97.3 | 97.3 | 103.0 | 98.4 |
| CHROMIUM | ug/L | 5 | 100 | <5 | <5 | <5 | <5 | <5 | <5 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| COBALT | ug/L | 50 | -- | <50 | <50 | <50 | <50 | <50 | <50 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| COPPER | ug/L | 20 | 1000 (S) / 1300 (A) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| IRON | ug/L | 30 | 300 (S) | 8600 | 9590 | 7530 | 9180 | 2990 | 2950 | 3140 | 3120 | 3600 | 3510 | 3270 | 3140 | 3440 | 3210 |
| LEAD | ug/L | 2 | 15 (A) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| MAGNESIUM | mg/L | 0.005 | -- | 34.9 | 37.9 | 35.1 | 36.7 | 30.4 | 30.2 | 27.6 | 27.5 | 30.8 | 30.9 | 28.2 | 28.0 | 29.8 | 28.7 |
| MANGANESE | ug/L | 20 | 50 (S) | 235 | 266 | 218 | 271 | 182 | 181 | 196 | 214 | 231 | 243 | 206 | 236 | 231 | 241 |
| MERCURY | ug/L | 0.2 | 2.0 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| NICKEL | ug/L | 20 | 100 (O) | <20 | <20 | <20 | <20 | <20 | <20 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 | <10.0 |
| POTASSIUM | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| SELENIUM | ug/L | 5 | 50 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| SILVER | ug/L | 1 | 100 (S) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| SODIUM | mg/L | 0.05 | -- | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| THALLIUM | ug/L | 1.5 | 2.0 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <1.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| TIN | ug/L | 100 | -- | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| VANADIUM | mg/L | 0.005 | -- | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 | <4.0 |
| ZINC | ug/L | 20 | 5000 (S) | <20 | <20 | <20 | <20 | <20 | <20 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 | <20.0 |
| **VOLATILE ORGANICS VOC'S** | | | | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| **Method 8260** | | Varies | Varies | | | | | | | | | | | | | | |
| **SEMI-VOLATILE ORGANICS** | | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8270** | | Varies | Varies | | | | | | | | | | | | | | |
| **PESTICIDES/PCB'S** | | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Method 8081** | | Varies | Varies | | | | | | | | | | | | | | |
| **Field Parameters** | | | | | | | | | | | | | | | | | |
| TEMPERATURE | °C | -- | -- | 15.0 | 14.2 | 15.5 | 14.7 | 13.5 | 13.9 | 14.1 | 13.7 | 13.9 | 13.9 | 14.2 | 14.9 | 14.1 | 16.6 |
| pH | S.U. | -- | 6.5-8.5 (S) | 6.96 | 6.90 | 7.00 | 6.42 | 7.39 | 7.43 | 7.42 | 7.30 | 7.35 | 7.35 | 7.29 | 7.38 | 7.27 | 7.38 |
| SPECIFIC CONDUCTAN | umhos/cm | -- | -- | 1123 | 1069 | 741 | 920 | 747 | 542 | 673 | 618 | 535 | 535 | 587 | 566 | 489 | 708 |

(S) = Secondary Maximum Contaminant Level

(O) = Ohio EPA Primar

(A) = Action Level

D = DETECTED