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General Motors Corporation

Flint River Sediment Investigation

North American Operations Flint Operations Site

Flint, Michigan

April 26, 2007

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

June 12th, 2007

Kurt Blizzard
General Motors Corporation
MS 489-070-035
920 Townsend St.
Lansing, MI 48921

RE: Review of the April 2007 Flint River Sediment Investigation Report for the General Motors Corporation (GM) Flint Operations Site, GMC, Flint, Michigan.
MID 005-356-712

Dear Mr. Blizzard:

U.S. EPA has completed a review of the April 2007 Flint River Sediment Investigation Report for the General Motors Corporation (GM) Flint Operations Site. As part of this effort, U.S. EPA also completed a technical review of the appendix containing the Screening-Level Ecological Risk Assessment (SLERA) for the Flint River in the vicinity of the General Motors Corporation (GM) Flint Operations Site in Flint, Michigan. The review focused on evaluating the technical adequacy and completeness of the investigation, interpretation of the resultant data, and the SLERA's consistency with EPA guidance such as *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA, 1997) and *Guidelines for Ecological Risk Assessment* (EPA, 1998). Technical comments generated during this review are provided below.

GENERAL COMMENTS ON THE SEDIMENT INVESTIGATION REPORT

1. Several significant technical deficiencies were identified in the SLERA, mostly relating to conclusions drawn based on the assessment of risks posed by contaminant concentrations detected in Flint River sediments and the associated uncertainties. These risk assessment deficiencies result in GM concluding that no further investigation or remediation is required, when further, more detailed evaluation appears to be warranted based on comparison with appropriate ecological screening levels (ESLs) developed by EPA Region 5 and available at http://www.epa.gov/RCRIS-Region-5/ca/edql.htm. Specific

comments on the SLERA below discuss these deficiencies in detail. In addition to revising the SLERA appendix, GM should amend the conclusions of the Sediment Investigation Report itself to reflect the need for additional evaluation.

2. Figures 5 through 30 are difficult to correlate with the locations depicted on Figures 2, 3, and 4. The corresponding river miles should be inserted on Figures 2, 3, and 4 to facilitate comparison with the locations depicted on Figures 5 through 30. Figures depicting the detected concentrations should be developed, similar to Figure 1, to provide a visual representation of the data and their respective locations.

3. Figures 5 through 30 show cumulative sediment concentrations of contaminants from GM/other outfalls and cumulative sediment concentrations of contaminants from non-GM outfalls. It is not clear whether the cumulative count of non-GM outfalls is included in the cumulative count of GM/other outfalls. Clarification should be provided in the text.

4. Section 2.2 indicates that the top two inches of surface sediment samples were collected at all locations using an Ekman grab sampler. According to EPA's Clu-in Technology Innovation Program (http://clu-in.org/programs/21m2/sediment/) Web site, and based on experience, the Ekman grab samplers are typically restricted to low current situations and have been known to lose fine surface sediments during retrieval. In addition, no definitive methodology ensures that a depth of two inches is achieved during sample collection. According to Section 1.2.2, the average monthly flows in the Flint River range from 236 to 1,479 cubic feet per second, which would be considered a moderate current situation.

In addition, Table 1 and the photos depict the sediment grab samples as being primarily zebra mussels, fine to medium sand or silt, and leaves. It is not evident that true 0-2 foot samples were collected at the selected sample locations. If additional sampling will be conducted, samples from the 0-2 foot intervals should also be collected using the sediment coring device previously used to collect samples from 2 feet below the surface to refusal.

SPECIFIC COMMENTS ON THE SEDIMENT INVESTIGATION REPORT

Section 3.2.3, Assessment of Trends for Sediment Core Concentrations

1. This section makes erroneous references to subsurface sediment core sampling locations. The text should be corrected to reference locations FRT 4A and 7C, rather than locations FRT 4C and 7A, as discussed in Section 2.2 (page 10).

2. The second sentence in this section states that "for almost all constituents, the maximum concentrations occur in the 0- to 12-inch layer, and in most cases, in the surface (0- to 2-inch layer)." A similar statement is presented in the second bullet on page 25. On the contrary though, Table 5 indicates that the highest concentrations of several semi-volatile

organic compounds (SVOCs) were found in the 12- to 24-inch layer at core location FRT 7C. The highest concentrations of a few metals were also identified in this layer at core location FRT 2C. The text should be corrected to acknowledge this study result.

Despite the lack of discussion concerning these subsurface findings, Table 3 of the SLERA in Appendix C *does* consider constituent of potential concern (COPC) concentrations detected throughout the core depth. Consequently, the SLERA and relevant conclusions will not need to be revised in response to this comment.

GENERAL COMMENTS ON THE SLERA

1. As indicated in Section 6.0, the conclusion of a SLERA may be:

- There is adequate information to conclude that ecological risks are negligible, and therefore, no need exists for remediation on the basis or ecological risks
- The information is not adequate to make a decision at this point, and the ecological risk assessment process should continue, or
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

Based on several factors (i.e., a comparison with urban background values, a comparison with no effects concentrations [NECs], and the spatially limited nature of exceedances of screening criteria), GM concludes that "ecological risks are low to negligible, and therefore, no need exists for further investigation or remediation within the Flint River on the basis of ecological risk."

This conclusion is premature and inappropriate. As indicated in Section 4.2, Screening-Level Risk Characterization, multiple contaminants in surface and subsurface sediments from the reaches of the Flint River adjacent to and downstream of the GM facility exceeded EPA Region 5's ESLs, suggesting that a potential for adverse ecological effects exists. Further, as indicated in Section 5.2.1, Results for Alternative Screening Values, additional exceedances of less conservative NECs were identified for contaminants in the adjacent and downstream reaches. Finally, if GM had taken the next necessary step and compared the site data with sediment toxicity values from the literature that describe the potential for probable or severe effects on benthos, additional exceedances would have been noted. For example, the highest detected concentration for benzo(a)pyrene is 7 parts per million (ppm) at FRT 7C. The CEQ threshold for probable effects on benthos and the MacDonald et al. consensus-based probable effects concentration are 0.78 and 1.4 ppm, respectively. Thus, not only are concentrations at this site exceeding no effects levels, concentrations are exceeding levels at which we might begin to expect marked community impacts.

Given that concentrations of contaminants exceeded conservative ESLs, less conservative NECs, and probable effects concentrations at this conservative stage of the ecological risk assessment process, the only conclusion that can be reached is that the available information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted. GM should revise the conclusion of the SLERA to indicate that further, more detailed assessment of ecological risks is warranted.

SPECIFIC COMMENTS ON THE SLERA

Section 2.3, Conceptual Site Model, and Figure 1

1. The conceptual site model (CSM) discussed in this section and presented graphically in Figure 1 only addresses risks posed by exposure to benthic invertebrates and fish through direct contact with sediments. No consideration or discussion is provided that addresses higher trophic level aquatic organisms that may be exposed via the food chain or non-aquatic organisms such as raccoons. GM should revise the SLERA to address other potentially exposed ecological receptors.

Section 4.1, Results of Screening Assessment

2. Throughout this section, GM provides a comparison of mean concentrations of contaminants present in the Flint River with ESLs. Typically, the highest measured or estimated concentration is used to estimate exposure. This ensures that potential ecological threats are not missed. GM should revise the SLERA to provide a comparison of the maximum detected concentrations of contaminants in the Flint River with ESLs.

Section 5.1, Uncertainties Analysis

3. A significant source of uncertainty that has not been addressed in this section is that the site may not have been adequately characterized in terms of the ranges of sediment contaminant concentrations. There are three samples each for the unbiased upriver, adjacent, and downriver groups (the number of samples in each transect is irrelevant – they are not independent). As a result, it is unclear if it is reasonable to assume that the small sample sizes are sufficient to describe the actual ranges of contaminants present in the river reaches. It is likely that the result of the small sample size is to underestimate the true means and maxima. This is a significant source of uncertainty that it not identified in the Uncertainties Analysis. GM should revise the SLERA to adequately address this source of uncertainty.

4. This section states, "This uncertainty analysis provides the additional evaluation needed to appropriately interpret the exceedances of ESLs noted in Section 4." The intent of an uncertainty section is to identify information used in the risk characterization that may result in an over- or underestimation of the actual risk. This information can be used in making risk management decisions needed to address the risks posed by the site. At the screening-level stage of the ecological risk assessment process, assumptions and screening criteria are purposely designed to be conservative to avoid prematurely eliminating an actual risk. Interpretation of the exceedances of ESLs is of limited

relevance given that the intent of a SLERA is to determine if more detailed assessment is warranted. The extensive comparison with alternative screening values and regional background concentrations does not change the fact that concentrations of contaminants in sediments exceed screening levels, which indicates that additional, more detailed assessment is warranted.

Section 5.2, Consideration of Alternate Screening Values and Regional Background Concentrations

5. This section provides extensive comparison of detected sediment concentrations to alternative screening values, which are NECs reported by Ingersoll et al. (1996). Two concerns exist with this approach. First, comparison with alternative, less conservative screening criteria is a process typically performed as part of a more detailed assessment such as a baseline ecological risk assessment (BERA). A BERA generally follows Steps 3-8 as outlined in EPA's *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA, 1997). These steps require a significantly more detailed assessment and comprehensive supporting information, which is not provided in the SLERA. As a result, it is inappropriate to make conclusions based on comparisons with alternative screening values without the additional information developed and presented as part of Steps 3-8 of the EPA guidance. GM should revise the SLERA to follow the process outlined in Steps 3-8 of the EPA guidance and to provide the detailed supporting information to go along with a comparison with alternative screening values. Alternatively, GM should revise the SLERA to remove the comparison with alternative screening levels and present this comparison in a subsequent BERA, which appears warranted based on the results of the comparison with ESLs.

Second, it does not appear that the NECs used in the alternative screening comparison are the most appropriate or up-to-date values for comparison with sediment contaminant concentrations. The following sources provide benchmarks, or methodologies for calculating benchmarks, that would be more suitable for comparison with the sediment concentration data collected by GM:

- MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environmental Contamination and Toxicology* 39: 20-31.
- Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and J. Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. *Journal of Great Lakes Research* 22:624-638.
- Suter, G.W. II and C.L. Tsao. 1996. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Freshwater Biota: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-96/R2.

While these sources appear to be more appropriate than the NECs selected by GM, a comparison with multiple sources of screening criteria is the preferred approach. Comparing sediment concentrations in the Flint River with multiple alternative screening values would provide a more definitive and defensible assessment of the potential risks posed to ecological receptors. Therefore, it is recommended that GM revise their comparison with alternative screening values to utilize multiple sources of screening criteria. In addition, any criterion that is selected should be justified to indicate why it is an appropriate benchmark.

Section 6.0, Summary and Conclusions

6. As discussed in SLERA General Comment 1, detected concentrations in sediment from the adjacent and downstream reaches of the Flint River exceed EPA Region 5 ESLs. Therefore, GM's conclusions that "ecological risks are low to negligible" and "therefore, no need exists for further investigation or remediation within the Flint River on the basis of ecological risk" is inappropriate. GM should revise the SLERA (and the Sediment Investigation Report itself) to indicate that additional, more detailed assessment is warranted.

If you would like to discuss these comments, please contact me at 312 886-6181.

Sincerely,

Tammy Moore
Project Manager
Corrective Action Section

ARCADIS BBL
Infrastructure, environment, facilities

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General Motors Corporation

Flint River Sediment Investigation

North American Operations Flint Operations Site

Flint, Michigan

April 26, 2007

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Flint River Sediment Investigation

North American Operations Flint Operations Site

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Tables

Figures

Appendices

1. Introduction

This Flint River Sediment Investigation Report presents the results of the sediment sampling activities within the Flint River (river) implemented on behalf of the General Motors Corporation (GM) in October/November 2006. These activities were performed by ARCADIS of New York, Inc. (ARCADIS BBL, formerly Blasland, Bouck & Lee, Inc. [BBL]) and Exponent, in accordance with a Scope of Work provided to the United States Environmental Protection Agency (USEPA) on October 6, 2006, which was approved by USEPA on October 12, 2006.

1.1 Background

The GM North American Operations (NAO) Flint Operations Site (the Facility) is currently the focus of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Among other tasks, the RFI includes an assessment of the underground storm sewers at the Facility, and the possible impacts of potential discharges of hazardous constituents via infiltration to the storm sewers and subsequent migration into the River. This assessment is documented in the *Resource Conservation and Recovery Act Facility Investigation Phase II Report* (Blasland, Bouck & Lee, Inc. [BBL], 2004) (RFI Phase II Report). GM submitted the RFI Phase II Report to the USEPA on March 30, 2004, in fulfillment of one of the tasks under the RCRA Section 3008(h) Administrative Order on Consent (R8H-5-00-2), effective March 1, 2004. The USEPA provided GM with comments on the RFI Phase II Report in a letter dated September 2, 2004. In its September 2 letter, the USEPA expressed concern that sediment in the River was not sufficiently characterized to discern potential impacts from Facility-related outfalls to the River.

In response to USEPA concerns, GM prepared and submitted a Scope of Work to USEPA in March 2005. That Scope of Work proposed a sediment investigation designed to assess the presence and distribution of PCBs and metals in surface sediment in the River upstream of, adjacent to, and downstream of the Facility. In April 2005, the Michigan Department of Environmental Quality (MDEQ), accompanied by USEPA, conducted biased sediment sampling in the River at a total of six locations upstream of, adjacent to, and downstream of the Facility. Samples adjacent to the facility were located in the immediate vicinity of specific storm water outfalls through which storm water from the Facility and other non-GM sources discharge. Samples collected included a combination of surficial grab samples and core samples. Samples were analyzed for inorganics, PCBs, semivolatile organic constituents (SVOCs), and volatile organic constituents (VOCs). Split samples were collected by BBL at a subset of locations on behalf of GM. Split sample results were reported to USEPA in September 2005.

During several subsequent correspondences and meetings with USEPA since the MDEQ's sediment sampling data became available, GM agreed to conduct further sediment investigation in the River. Consistent with USEPA's request, the objectives of this work were twofold: 1) further assess the presence and distribution of SVOCs, PCBs, and metals in the surficial sediment in the River upstream of, adjacent to, and downstream of the Facility; and 2) provide a data set which is sufficient to support the Screening Level Ecological Risk Assessment (SLERA), as well as further assessing the depth profile of contamination at select representative depositional areas.

Although GM agreed to conduct further sampling, GM maintains the opinion that existing data indicate that the concentrations of anthropogenic constituents in sediment are typical of effects that would be expected from widely-dispersed sources common in urbanized watersheds. Furthermore, GM maintains the opinion that the existing data are adequate to demonstrate that discharges from the Facility have not been a source of constituents above and beyond what would be expected in the absence of the Facility. The multiple samples collected by MDEQ, which included core samples at depth, were located in areas considered most likely to exhibit impacts from the Facility outfalls, and showed low levels of certain chemicals generally in line with expectations, especially when other ubiquitous urban sources remain active (Figure 1).

This report presents the additional sampling and analysis GM proposed in the Scope of Work approved by USEPA on October 12, 2006. It also included an expansion of the analyte list to include SVOCs, in addition to PCBs and metals, based on possible discharges from the Facility.

1.2 Study Area

The Study Area is a section of the River extending approximately 5.2 miles from the C.S. Mott Lake Dam on the upstream end, which is approximately 1.5 miles upstream of the Facility, downstream to the Hamilton Dam, located approximately 1 mile downstream of the Facility in downtown Flint (Figure 1). The Study Area encompasses reaches of the river located upstream of, adjacent to, and downstream of the Facility, including all 17 storm sewer outlets associated with the Facility, of which all share other off-site storm water sources unrelated to the Facility (GM/other outfalls; Figures 2 through 4).

The upstream reach is largely outside the influence of ubiquitous urban sources (e.g., storm drains and urban runoff), and is reflective of an un-urbanized, undeveloped watershed, with only five non-GM outfalls, which appear to drain residential areas. The majority of this reach represents natural undeveloped wooded areas. Sediment quality in the upstream reach is intended to be representative of un-urbanized background conditions; specifically, conditions in the river upstream of areas potentially impacted by the Facility or other point and non-point sources associated with developed areas of the watershed.

The adjacent reach passes through the City of Flint, and is expected to reflect historic and potentially on-going urban sources. Specifically, it contains 27 non-GM outfalls, 17 GM/other outfalls, four bridge crossings, and confluences with Kearsley and Gilkey Creeks. The watershed of the adjacent reach immediately proximate to the river is characterized by several manufacturing facilities unrelated to the Facility (e.g., Lockhart Chemical Company, PPG Coatings and Resins, Kassel Steel Corporation, former E.I. DuPont de Nemours and Company, etc.), along with several large metals/auto recycling facilities, in addition to areas of vast residential and small commercial development.

The downstream reach contains 18 non-GM outfalls, and is characterized by increased development over the adjacent and upstream reaches, as it passed through areas near downtown Flint. This area is developed as expected for a city with a population over 100,000. There are variously sized commercial and residential businesses located throughout the area, with the University of Michigan encompassing a large area of the immediate watershed.

Further, Interstate 475, which traverses through the watershed of the adjacent and downstream reaches, contributes significant runoff flow to these reaches of the Study Area, along with the vast lengths of City streets.

Downstream of the Study Area, below Hamilton Dam, the river is channelized and lined with concrete for a distance of 2 miles, and little sediment is expected to be present along the lined reaches of the river.

1.2.1 Study Area Watershed

The Study Area is approximately in the center of the entire river watershed, which encompasses approximately 1,360 square miles in southeastern Michigan, before draining into the Saginaw River and eventually into Saginaw Bay. The Study Area drainage area is approximately 750 square miles. Within the 5.2-mile Study Area, there are contributions from three hydrologic units: upstream river subbasin, the Kearsley Creek subbasin, and a subbasin between Kearsley Creek and Swartz Creek, slightly downstream of the Study Area. Of these three subbasins, the upstream river subbasin and the Kearsley Creek subbasin are both impounded just prior to entering the Study Area; these impoundments may serve as sediment traps that retard the downstream movement of sediment from these tributaries.

The third subbasin within the Study Area drains urban Flint and contains Gilkey Creek in its entirety. On a relative basis, Gilkey Creek accounts for approximately 2 percent of the drainage area (15.6 square miles), Kearsley Creek accounts for approximately 15 percent (115 square miles), and the mainstream of the river upstream accounts for approximately 82 percent (617 square miles). The urban Flint area outside of these watersheds adds approximately 4 square miles, or less than 1 percent to the contributing drainage area; however, this would likely account for much more than 1% of the watershed flow due to the increased areas of impervious cover.

Several tributaries and numerous storm sewer outfalls drain into the river in the Study Area other than the GM/other outfalls. Typical of a developed urban area, much of the runoff from the city is drained via underground pipe to the nearest receiving water. For the river, this includes a relatively extensive area of runoff from industrial, commercial, residential, and other properties (such as roads and railroads) that have a potential to contribute both dissolved and particulate-associated contaminants to the river. The storm sewer outfall locations (i.e., draining more than several blocks) and tributaries are shown on Figures 2 through 4.

1.2.2 Hydrology

USGS flow data from a gage located several miles downstream of the Facility indicate that the average monthly flows in the river range from 236 cubic feet per second (cfs) in August to 1,479 cfs in March (period of record is 1932 to 2003).

Within the Study Area, the river elevation drops approximately 20 feet, from approximately 720 feet at C. S. Mott Dam to approximately 700 feet at Hamilton Dam, and is typically 100 to 300 feet wide. This is consistent with what the Michigan Department of Natural Resources (MDNR) refers to as the Upper Flint basin in the river Assessment Report (Leonardi and Gruhn, 2001), with a low gradient and alternating high- and low-energy areas, except for the increased encroachment of urban and industrial development on and near the shores of the river as it flows through the City of Flint. There are numerous bridge crossings, developed riverbanks (roads and railroads), numerous storm sewer outfalls, and a potable water treatment plant within the 5.2-mile reach of the Study Area. These structures affect river hydraulics, sediment characteristics, and ecological habitat. Where the shore is undeveloped, there is park land, with native trees and other vegetation, with only a few areas of hardened shoreline. Generally the relatively small proportion of natural environment along the river limits the ecological habitat quality in the adjacent and downstream reaches. In addition, urban encroachment results in the incidental introduction of debris and litter, and use of the river as a clandestine disposal site.

1.2.3 Flow Control Structures

There are two dams in the river within the study area reach. The Utah Dam is located in the Study Area approximately 0.5 mile downstream of Kearsley Creek near GM's outfall 002 (Figure 3). It is a steel and concrete sluice gate structure approximately 200 feet wide. The dam is currently secured in the open position and has not been operated in several years; thus it does not impound water. The Hamilton Dam is located at the downstream end of the Study Area, approximately 2 miles downstream of the Utah Dam. It is a concrete structure spanning 200 feet, and has a storage capacity of approximately 100 acre-feet. It is constructed using several parallel Taintor Gates that swing open upward from the bottom of the riverbed, and is used to regulate the levels of the river downstream of the C. S. Mott Dam at Mott Lake. River levels are monitored by the City of Flint at the City's water treatment facility near the crossing of Dort Highway. The following action levels dictate the City's opening and closing of the Hamilton Dam, unless the river level downstream is lower than upstream (in such a case the dam is to be opened to allow flow pass through):

- At 710 feet above mean sea level, dam opened
- At 708 feet above mean sea level, dam closed until level of river marks 710 feet above mean sea level

Action levels for the operation of the Hamilton Dam are governed by the City's NPDES permit for the City's wastewater treatment facility, as well as an agreement with the Holloway Home Association, which controls the river levels to manage ice concerns and weed growth.

In 1963, the United States Army Corps of Engineers in partnership with the City of Flint initiated a flood control project on the river and one of its tributaries. The River Flood

Control Project extends approximately 2 miles from the Hamilton Dam downstream to Third Avenue (Sunset Drive), and approximately 1.5 miles on Swartz-Thread Creek, from the confluence with the river. The riverbed and banks were concrete lined in an effort to control flooding through the downtown area and just downstream. The project, while succeeding in controlling the flooding, also resulted in loss of natural river bed and stream bank habitat for aquatic species (Leonardi and Gruhn, 2001). Per Section 43 of the Operations and Maintenance Manual, Saginaw River Flood Control Project, Sections A, B, C-1, C-2, and D, Flint River Segment at Flint, Michigan (U.S. Army Corps. of Engineers, Detroit, Michigan, 1982), the City of Flint is required to remove sediment accumulation at least annually from the reach of the river that extends from Hamilton Dam upstream approximately 420 feet.

1.3 Purpose and Objectives

As described in the Scope of Work, the objectives of this work were twofold: 1) further assess the presence and distribution of SVOCs, PCBs, and metals in the surficial sediment in the river upstream of, adjacent to, and downstream of the Facility; and 2) provide a data set which is sufficient to support the SLERA to evaluate the ecological significance of discharges from the Facility on sediment quality, as well as further assessing the depth profile of contamination at select representative depositional areas.

Based on those objectives, the following specific questions were presented in the Scope of Work:

- What is the general distribution of SVOCs, PCBs, and inorganics in surficial sediment in the river adjacent to the Facility?
- How do SVOC, PCB, and inorganic concentrations in river sediments adjacent to the facility compare to appropriate site-specific and urban background conditions?
- Are there elevated SVOC, PCB, and inorganic concentrations in sediment at depths that are isolated from benthic invertebrates, but at locations where surface sediment could get scoured, thus exposing these elevated concentrations?
- Do river sediments potentially pose unacceptable ecological risks?

1.4 Report Organization

Section 1 of this report presents the project background, a study area description, and the project purpose and objectives. Section 2 provides a summary of the sediment sampling activities. Section 3 presents results of the data assessment including the sediment characteristics, general trends in analytical chemistry, a statistical analysis, and an evaluation of background concentrations. Section 4 presents a summary of the SLERA, which is provided as Appendix C to this report. The conclusions of the 2006 sediment investigation are presented in Section 5, while Section 6 presents the references cited.

2. Sediment Sampling Activities

As described in the Scope of Work, sediment samples were collected from each of three reaches of the River designated for purposes of this investigation:

- Upstream of the Facility (from C.S. Mott Lake Dam to 1.9 miles downstream of this dam)
- Adjacent to the Facility (2.6 miles)
- Downstream of the Facility to Hamilton Dam (0.7 miles).

The survey and sediment sampling activities were conducted in accordance with the Scope of Work as described below.

2.1 Survey Activities

On October 30 and 31, 2006 BMJ Surveyors, Inc. surveyed the nine regularly-spaced transects established in the Scope of Work along the river throughout the 5.2-mile study area perpendicular to flow direction. Three transects were evenly spaced along each of three reaches described above. As described in the Scope of Work, three additional “biased” transects were established to coincide with locations of Storm Sewer Outfalls 003, 005, and 013, through which the Facility as well as other non-GM outfalls discharge. The location of these twelve transects are illustrated on Figures 2 through 4 as Transects FRT1 through FRT12.

In addition to surveying the transect endpoints, BMJ surveyed the location of the additional non-GM outfalls within the Study Area that were not previously identified.

2.2 Sampling Activities

On October 31, 2006 sampling was initiated working from the furthest downstream transect (FRT 9) in an upstream direction. Work was completed on November 1, 2006 at Transect FRT 1. The river width was measured at each transect, and the river width was divided into three equally spaced segments at each transect to establish three sampling stations (Stations A, B, and C). All field sampling and laboratory analysis activities were performed in accordance with the Quality Assurance Project Plan, Field

Sampling Plan, and Health and Safety Plan prepared and used for the Facility RFI (amended as necessary). All samples were submitted to Merit Laboratories of East Lansing, MI for analysis of SVOCs, PCBs, total organic carbon (TOC), metals, and particle size. Data validation was performed by Conestoga-Rovers and Associates. The resulting validation report is included in Appendix B

Surface Sediment Samples

Surface sediment samples were collected at all locations using an Ekman grab sampler at each of the sample locations. The sediment thickness was determined by manually probing the river bed with a 3/8-inch diameter steel rod, and water depth was also recorded at each of the sample locations. The top 2 inches of sediment (surficial sediment) recovered was described, photographed, and classified as fine- or coarse-grained sediment. Table 1 provides the surficial sediment descriptions. Appendix A presents the field notes and photographs.

? approved in work plan

Within each reach, five of the nine surficial sediment samples from the three evenly-spaced transects established in each reach were randomly selected to be submitted for laboratory analysis. Samples from the following locations were submitted for analysis:

- FRT 1C , FRT 2B, FRT 2C, FRT 3A, and FRT 3B from Transects FRT1 through FRT3 (Figure 2)
- FRT 4A, FRT 4C, FRT 5A, FRT 5B, and FRT 6B from Transects FRT4 through FRT6 (Figure 3)
- FRT 7A, FRT 7C, FRT 8B, FRT 9A, and FRT 9B from Transects FRT7 through FRT9 (Figure 4)

In addition, two surficial samples from each of the three biased transects were randomly-selected from the nine sample locations established along the three spatially-biased transects at the locations of Storm Sewer Outfalls 003, 005, and 013, respectively. The following samples (locations are shown on Figure 3) were submitted for analysis:

- FRT 10A and FRT 10B from Transect FRT10
- FRT 11B and FRT 11C from Transect FRT11

- FRT 12B and FRT 12C from Transect FRT12

A total of 21 surficial sediment samples were submitted for laboratory analysis.

Sediment Core Samples

Four sediment cores were collected from the 36 locations occupied for sediment probing and sampling. Three cores were collected from locations on the regularly spaced transects, one from each of the three reaches. These three cores were collected at the location in each reach exhibiting the thickest sediments based on probing. The fourth core was collected from the location with the thickest sediment indicated by probing on the biased transects at Outfalls 003, 005, and 013. Sediment cores were collected from the following locations:

- FRT 2C which represented the thickest sediment bed at Transects FRT1 through FRT3 (Figure 2)

- FRT 4A which represented the thickest sediment bed at Transects FRT4 through FRT6 (Figure 3)

- FRT 7C which represented the thickest sediment bed at Transects FRT7 through FRT9 (Figure 4)

- FRT 12C which represented the thickest sediment bed at the biased Transects FRT10 through FRT12 (Figure 3)

Sediment cores were manually driven to refusal and collected using Lexan tubing. Subsurface sediment (>2 inches deep) was collected from each core at the 2- to 12-inch depth interval and successive 1-foot depth intervals below the first 12 inches (to the refusal depth). These subsurface sediment samples were described in the field log, homogenized, and photographed. Table 2 provides the subsurface sediment descriptions. Appendix A presents the field notes and photographs.

3. Data Assessment and Results

This section provides the general sediment characteristics and analytical results. After validation of the laboratory results, the analytical data were assessed by river mile (RM) to determine the general spatial trends in sediment concentrations for constituents with two or more detections in surface sediment samples in any reach. Statistical comparisons of concentrations in surface sediments in the unbiased transects and the adjacent biased and unbiased transects were performed for these chemicals. The data were also assessed to evaluate if there were subsurface constituent concentrations at locations where sediment could get scoured, potentially exposing these higher concentrations. Finally, a comparison of sediment data against background concentrations was performed.

3.1 Sediment Characteristics

Surficial sediments in the Study Area were generally comprised of fine to coarse sand with trace silts, clays, gravels, and organics (leaves and shells) (Table 1). Some sampling locations contained primarily zebra mussels (FRT 1A, FRT 2A, FRT 3C, and FRT 7B), while others contained mostly gravel (FRT 5C, FRT 6A, FRT 9C, and FRT 12C). One location, FRT 11A resulted in no recovery of sediments. Three of the four cores (FRT 2C, FRT 4A, and FRT 12C) contained subsurface sediments comprised of primarily fine to coarse sand, while FRT 7C was comprised of mostly silts. These sediment descriptions were generally consistent with the particle size results (Tables 3 through 6). Thirty of the 35 samples (86%) contained particle size results with greater than 50% (by weight) fine to coarse sands. The five remaining samples (FRT 9A [0 to 2 inches], FRT 12C [0 to 2 inches], FRT 7C [2 to 12 inches], FRT 7C [12 to 24 inches], and FRT 7C [24 to 36 inches]) contained greater than 50% (by weight) clay.

The sediment probing survey indicated that sediment thickness in the Study Area ranged from 0 to 8.9 feet, with an average of 2.3 feet and median of 2 feet (Table 1). The five locations with the deepest sediments were found along the sides of the River channel where flow velocities tend to be lowest (the A and C stations, generally west and east bank areas, respectively) characteristic of a typical meandering stream. The greatest sediment thicknesses recorded were 8.9, 7.5, 6.6, 5 and 4.4 feet at locations FRT 7C, 2C, 9A, 12C, and 8C, respectively. Probing at all remaining sampling stations indicated less than 4 feet of sediment.

3.2 Analytical Results Summary

Fully 99% (242 of 245 individual Aroclor analyses) of the PCB results showed non-detectable PCB concentrations at a detection limit of 0.33 ppm (Tables 3 through 6). The maximum detected PCB concentration was 0.5 ppm (blind duplicate of the sample was estimated at 0.2 ppm), or approximately 1.5 times higher than the detection limit. The other two detected concentrations were estimated at 0.02 and 0.1 ppm, respectively. Aroclor 1254 or Aroclor 1260 were detected in these samples. Given the very low PCB concentrations, no further assessment of the PCB results was conducted.

For SVOCs, 90% (2,043 of 2,275 analyses) of results showed non-detectable concentrations. A total of 47 (72%) of the 65 SVOCs were detected only once or not at all within the dataset.

For inorganic constituents, six of the 18 inorganic analytes were infrequently detected. The remaining twelve constituents tended to all be detected in most or all of the samples. Arsenic, barium, cobalt, lead, manganese, and zinc were detected in all surface samples.

Due to the low detection frequencies for some of the chemicals, only SVOC and inorganic constituents with two or more detections in surface sediment concentrations in any reach were further used in assessing general trends and statistical comparisons. Table 7 presents a list of the SVOCs and inorganics that were detected in at least two samples in any reach.

3.2.1 General Spatial Trends in Unbiased Surface Sediment Concentrations

General trends in unbiased surface sediment concentrations (i.e. those results obtained from the three evenly-spaced transects in each reach) with two or more detections within each reach were assessed by plotting the concentrations contaminants by RM (Figures 5 through 30). Numbering of RMs began at the upstream end of the Study Area (i.e. C.S. Mott Lake Dam was set at RM 0.0) and continued to the Hamilton Dam. Non-detected values for constituent concentrations are plotted at one-half their detection limit, and are denoted using a diamond symbol. Estimated values are denoted with a square symbol, and detections are presented as triangles. These figures also illustrate the cumulative number of outfalls from upstream to downstream.

SVOCs and inorganics concentrations were consistently higher at Stations FRT 4C, 7C, 9A, and 9B than the remainder of the river. In addition to these four stations, Station FRT 2C exhibited high concentrations (similar in value to Stations FRT 4C, 7C, 9A, and 9B) for 10 of the 12 inorganic concentrations. Many urban sources have the potential to affect each of these stations, including 50 non-GM outfalls and 17 GM/other outfalls that include contributions from non-GM sources. Station FRT 2C is located in the upstream reach, which is minimally influenced by the urban environment of the City of Flint). Station FRT 4C is situated at the upstream end of the adjacent reach. Eight non-GM outfalls, as well as Kearsley Creek, enter the River in the half-mile stretch of the Study Area upstream of this station.

Stations FRT 7C, 9A, and 9B were all located in the downstream reach. Station FRT 7C is located on the western shoreline (opposite of the Facility) approximately one-half mile downstream of the Facility opposite of Gilkey Creek. Stations FRT 9A and 9B are located on the last transect within the Study Area, and are immediately downstream of five non-GM outfalls.

Specific spatial trends are summarized below.

SVOCs

- Aanthracene, carbazole, and fluorene were either not-detected or detected at concentrations below the detection limit (Figures 5, 12, and15).
- Benzo(a)anthracene and phenanthrene exhibit similarly low concentrations throughout the Study Area, with the vast majority of the results below or at the detection limit. Reported and estimated concentrations slightly above the detection limit occur at Stations FRT 9A and 9B (Figures 6 and 17). These stations are immediately downstream of five non-GM outfalls – three on the east shoreline and two on the west shoreline (Figure 4).
- Bis(2-ethylhexyl)phthalate concentrations are detected in only three samples – two estimated values of 0.04 mg/kg and 0.1 mg/kg (Stations FRT 2B and 2C, respectively) in the upstream reach and the highest concentration of 1.77 mg/kg at Station FRT 4A (RM 2.85) (Figure 11). There are six non-GM outfalls and no GM outfalls within approximately one-half-mile upstream of Station FRT 4A.
- Benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, and pyrene reflect a similar pattern, with concentrations ranging from 0.1 to 2.83 mg/kg at Transects FRT 4, 7, and 9, and at or near the detection limit at the

upstream and adjacent transects (Figures 7, 8, 9, 10, 13, 14, 16, and 18; Table 3). Concentrations above the detection limit were consistently observed at Stations FRT 4C, 7C, 9A, and 9B, with the highest concentrations (1.24 to 2.83 mg/kg) detected at Station FRT 9A in each case. Fluoranthene and pyrene were detected (0.48 mg/kg and 0.25 mg/kg, respectively) at Station FRT 5B.

As previously described, Transect FRT 4 is located at the top of the adjacent reach (RM 2.85) downstream of only one GM outfall (Outfall 001). Station FRT 4C is located along the eastern shoreline (Figure 3). Station FRT 7C is located adjacent to a non-GM outfall (Figure 4). Stations FRT 9A and 9B are located on the furthest downstream transect within the Study Area, and are immediately downstream of five non-GM outfalls (Figure 4). Station FRT 5B is located in the middle of the adjacent reach (RM 3.7), downstream of several GM and non-GM outfalls (Figure 3).

Inorganics

- Cobalt concentrations are fairly consistently (e.g., ranging over less than a factor of 10) throughout the Study Area. The maximum concentration occurs at Station FRT 2C (9.93 mg/kg; Figure 23). Station FRT 2C is located in the upstream reach, which is minimally influenced by the urban environment of the City of Flint.

- Concentrations of arsenic, cadmium, nickel, selenium, and vanadium were also fairly consistent (e.g., ranging over less than a factor of 15), with the maximum concentrations for each metal occurring at Transect 9 (Figures 19, 21, 27, 28, and 29). Transect 9 is immediately downstream of five non-GM outfalls – three on the east shoreline and two on the west shoreline (Figure 4).

- Lead appeared to be relatively enriched in sediment at Transects FRT 5 and 9, where the maximum concentration was observed at Station FRT 5A (214 mg/kg) (Figure 25). At Transects 9A and 9B, concentrations of lead were 117 and 72.8 mg/kg, respectively. Transect 5 is located in the middle of the adjacent reach, downstream of several GM and non-GM outfalls (Figure 3), while Transect 9 is immediately downstream of five non-GM outfalls (Figure 4).

- Barium concentrations were all reported as estimated values and maximum concentrations in each reach were similar and the maximum estimated value of 127 mg/kg occurs at Station FRT 9A in the downstream reach (Figure 20).

- Chromium, copper, and zinc all reflect a pattern of generally increasing concentrations in the downstream direction with the maximum concentrations occurring at Transect 8 for chromium (Figure 22) and Transect 9 for copper and zinc (Figures 24 and 30). The greatest difference between maximum values was noted for zinc, which exhibits markedly higher concentrations at Transect FRT 9 located immediately downstream of five non-GM outfalls.
- Manganese concentrations are highly variable, with no clear trends (Figure 26). The maximum concentrations detected in the upstream reach are higher than the concentrations in the adjacent reach.

In addition, as shown in Figures 5 through 30, SVOC and inorganic concentrations generally increase within the downstream reach. This increasing concentration trend from Transect 7 to Transect 9 suggests strong influence from the non-GM outfalls that discharge in this downstream reach.

The statistically-significant differences between reaches were assessed below in accordance with the approved Scope of Work.

3.2.2 Statistical Assessment of Surface Sediment

In accordance with the Scope of Work, concentrations of constituents in surface sediment were compared between the river reaches. For each of the 14 SVOCs and 12 inorganics identified in Table 8, means were compared using t-tests and analysis of variance (ANOVA). However, due to small sample sizes and frequent non-detections for many of the constituents, assumptions of normality (normal distribution, equal variances) were not consistently achieved, potentially limiting the usability of the t-tests. In recognition of the data limitations, medians were compared using the Kruskal-Wallis test as a potentially more reliable measure of central tendency for data that are not normally distributed. All statistics were performed to a 95% confidence ($p<0.05$) using Statgraphics 5.1. One-half of the detection limit was used in computing the mean and median values for non-detected concentrations. Statistical comparisons were performed on surficial samples from the unbiased transects (FRT 1 through FRT 9) in each reach, as well as between the unbiased and biased surface sediment samples from the adjacent reach.

No statistical difference was observed in the mean concentrations of the 26 constituents between the upstream and adjacent geographical groupings (Table 8). Six constituents, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and zinc, had statistically higher mean concentrations in the downstream reach compared to both the upstream and adjacent reaches (Table 8); however, these results are highly influenced by results at two locations: FRT 9A and 9B (Table 3). Transect FRT 9 was immediately downstream of five non GM outfalls – two on the west side and three on the east side of the River (Figure 4). Mean concentrations of benzo(g,h,i)perylene, fluoranthene, fluorene, pyrene, and chromium were statistically higher in the downstream reach (containing 18 non-GM outfalls) compared to the upstream reach; however, statistical differences in the mean concentrations were not found between the adjacent and downstream reaches. These differences in the mean concentrations are highly influenced by results at Transect 9, which is immediately downstream of five non GM outfalls.

The results of the Kruskal-Wallis tests indicated statistically different median concentrations between reaches for six constituents. Median concentrations of benzo(b)fluoranthene and benzo(k)fluoranthene were statistically higher in the downstream reach than both the upstream and adjacent reaches. However, no statistical difference was found for median concentrations between the upstream and adjacent reaches for these chemicals. Median concentrations of four metals, chromium, copper, lead, and zinc were statistically higher in both the adjacent and downstream reaches compared to the upstream reach. Because the metals data contain fewer non-detections and tend to be more normally distributed than the SVOC data, conclusions based on differences of both medians and means can be made with more confidence than for SVOC data in general.

Unbiased sample locations were randomly selected among sediment transect locations, while biased sample locations were purposely placed in areas where impacts, if any, from sewer outfalls draining the GM facility (as well as other, non-GM areas) would potentially be expected. The results of biased and unbiased sediment samples associated with the adjacent reach were compared to assess whether biased locations identified areas that have accumulated higher concentrations than would be randomly distributed in the river from all sources. The results of this comparison are summarized in Table 9. This comparison indicates that, while the constituent concentrations in the biased samples are generally higher than the unbiased samples, there are no significant differences ($p<0.05$) of either the means or medians of these two groups, with only one exception: Indeno(1,2,3-cd)pyrene, which exhibited a significantly higher median concentration in the biased samples; although, this constituent was not detected at significant concentrations in soil and/or groundwater at the Facility as part of the RFI.

Overall, there were a total of 13 constituents showing statistically higher mean and/or median concentrations between the three reaches. These constituents are highlighted in Tables 8 and 9, and include the following:

- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Pyrene
- Chromium (Total)
- Copper
- Lead
- Zinc

These differences in mean and/or median concentrations were often a result of one or two samples from locations bounded by lower concentrations with somewhat elevated concentrations exerting a strong influence on the distribution.

3.2.3 Assessment of Trends Sediment Core Concentrations

Sediment cores were collected to assess the vertical distribution of SVOCs, PCBs, and inorganics. A review of the analytical results for the sediment core samples indicates that for almost all constituents, the maximum concentrations occur in the 0- to 12-inch layer, and in most cases, in the surface (0-2 inch layer). This is particularly true for sediments in the reach adjacent to the facility, as indicated by cores FRT 4C and FRT 12C (near Outfall 013). Contaminant concentrations in core FRT 2C in the upstream reach were uniformly low throughout the core. In core FRT 7A from the downstream reach, many of the constituent concentrations were highest in the 2-12 inch layer, typically only modestly higher than in the surface layer. The greatest difference between the surface (0-2 inch) and the shallow subsurface (2-12 inch) concentrations in core FRT 7A were for zinc (factor of 6.9), lead (factor of 7.2), nickel (factor of 10.5) and chromium (factor of 20).

3.3 Evaluation of Background Concentrations

The background values that were used in this analysis were the typical urban background soil concentrations for polycyclic aromatic hydrocarbons (PAHs) that were compiled by ATSDR (1995), and the mean concentrations of metals in Michigan surface soils for residential, commercial, and industrial land uses in an urban watershed (Murray et al. 2004). Appropriate urban background concentrations for sediment would be preferable to soil data, but such data are not readily available. The soil data compiled by ATSDR (1995) and Murray et al. (2004) are deemed to be a suitable surrogate for sediment data in this analysis, because sediment in river Study Area is expected to be of local terrigenous origin.

The sediment data for the 13 constituents identified in Section 3.2.2 were compared to background values for urban areas to interpret the significance of the concentrations that were measured in the river sediments (refer to Tables 10, 11, 12, and 13). Comparison of these data to urban background values indicates that the concentrations of these constituents are generally within the ranges that would be expected in an urban waterway such as the Flint River, which is impacted by numerous potential sources discharging to the Study Area. Of the constituents that do exceed background values, situations where the sediment concentrations exceed by more than a factor of 3 are limited to a few individual samples.

Concentrations of benzo(a)pyrene, chrysene, lead, and zinc exceeded the urban background values for surface sediment in the adjacent and downstream reaches (Tables 10 and 11). Exceedances of the background values were small, generally within a factor of 2 or 3, and the highest exceedances were associated with samples from stations FRT 5A for lead, FRT 9A and B for the PAHs and zinc for the unbiased dataset, and stations FRT 12C for the samples that were biased to the GM-outfalls. Stations FRT 9A and B are the farthest downstream stations, and are located immediately downstream of five non-GM outfalls. Mean concentrations of metals did not exceed the urban background values, and the mean concentration of benzo[a]pyrene only exceeded by a small margin.

In subsurface sediment, concentrations of benzo(a)pyrene, chrysene, chromium, copper, lead, and zinc at several depth intervals exceeded the urban background levels, but only at downstream locations (Tables 12 and 13). The greatest exceedances of the background values were for station FRT 7C. This station is located adjacent to a non-GM-related outfall and near the mouth of Gilkey Creek, and is thus likely to be predominantly influenced by non-GM sources. Mean concentrations of the inorganics (across all depth intervals) did not exceed the urban watershed background levels. The mean concentrations of benzo(a)pyrene and chrysene across all depth intervals for both unbiased and biased subsurface sediments exceeded the range of urban background levels for these constituents.

3.4 Data Analysis Conclusions

As discussed in Section 3.2, only SVOCs and metals warranted statistical and spatial trend analysis. PCBs were only detected in two samples at very low concentrations; and therefore, were not subject to statistical and/or spatial trend analysis.

As for SVOCs, 90% (2,043 of 2,275 analyses) of results for SVOCs showed non-detectable concentrations, and detectable and/or elevated concentrations of SVOCs were only consistently observed at Stations 4C, 7C, 9A, and 9B, with Stations 9A and B strongly influencing the statistical analyses. However, many urban sources contribute to each of these stations, including the tributaries of Kearsley Creek and Gilky Creek, as well as 50 non-GM outfalls, in addition to the 17 GM outfalls. Specifically, Transect 9 is located immediately downstream of five non-GM outfalls. Additionally, due small sample sizes and frequent non-detections for many of the SVOCs, the statistical evaluations of SVOC concentrations indicated that the comparison of median values using the Kruskal-Wallis test produced potentially more reliable results, in lieu of the use of mean values, t-tests, and ANOVA.

As for metals, Figures 5 through 30 show consistent trends of higher concentrations of select metals occurring downstream, which have been confirmed with statistical analysis. Additionally, conclusions for select metals based on the differences of both the medians and means can be made with more confidence than for the SVOC data in general due to the metals data represented by more non-detections and thus more likely to closely represent a normal distribution.

Based on these conclusions and the more detailed information discussed in Section 3.2.2 and 3.2.3, only the following chemicals warrant further evaluation:

- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Indeno(1,2,3-cd)pyrene
- Chromium (Total)
- Copper
- Lead
- Zinc

This is despite the fact that approximately 50 non-GM outfalls were identified along the Study Reach, which include many potential sources of metals unrelated to the Facility. These seven constituents were detected based on the median statistic to have significant differences in:

1. Unbiased sediment concentrations between either the adjacent or downstream reaches as compared to the upstream reach (see Table 8); and/or

2. Biased sediment concentrations between the adjacent reach as compared to the upstream reach (see Table 9).

As such, these seven constituents are included for further evaluation in the SLERA.

Conclusions regarding other constituents detected based on mean values are not as robust in terms of conclusions regarding differences from upstream sediments due to sensitivity of the mean to single high or low point values that could occur with localized proximately to any one of the numerous outfalls (including approximately 50 non-GM outfalls) in the Study Area. The effect of using the mean value is further compounded in this case due to the large number of non-detect concentrations and the overall relatively low levels of analyzed constituents in the sediments.

The identification of these constituents as warranting further evaluation is supported by the conclusions noted concerning the comparisons of sediment constituent concentrations to urban background values presented in Section 3.3, since only a subset of these seven constituents were identified to exceed urban background values.

4. Screening-Level Ecological Risk Assessment

The process for the river SLERA included the following elements: chemical constituents in sediment were screened against conservative screening values (Region 5 ESLs) to identify the constituents of potential concern (CoPCs) subject to further evaluation, and concentrations of CoPCs were compared to alternate screening values (no-effect concentrations, NECs) that are based on toxicity to benthic invertebrates. Exceedance of an NEC is not necessarily indicative of an adverse effect because the NEC is a concentration below which no adverse effects would be expected. Sediment concentrations were also compared to background levels as part of the uncertainty analysis, to provide additional lines of evidence from which to draw conclusions regarding ecological risk.

Nine PAHs (benzo[a]pyrene, benzo[g,h,i]perylene, benzo[k]fluoranthene, chrysene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, and pyrene) and four metals (chromium, copper, lead, and zinc) were included in the ESL screening in order to identify CoPCs. Comparison of CoPC concentrations to NECs indicates a low probability for adverse effects to benthos. In addition, the spatial distribution of samples with concentrations that exceed NECs indicates that exposure to the CoPCs at levels potentially capable of causing adverse effects would occur over small areas. The background screening showed that levels that were detected in the River Study Area sediment are generally within the range of concentrations that would be considered typical for an urban waterway. Furthermore, elevated levels of CoPCs are not associated exclusively with the locations of Facility-related outfalls, and in many cases, appear to have a greater association with non-GM-related outfalls and tributaries.

Numerous chemical sources have been documented within the Study Area, most of which are non-GM-related. In addition to the 17 Facility-influenced outfalls, there are 50 non-GM-related outfalls, as well as influences from tributaries, as discussed in the Section 1.2 (also refer to Figures 5 through 30). Storm sewers that drain portions of the Facility also drain industrial, commercial, and residential areas outside the boundaries of the Study Area. Tributary drainages and runoff from industrial, commercial, and residential properties, as well as roads and railroads in the Flint metropolitan area, also contribute to the sediment and contaminant load of the River. Thus it is impossible to distinguish specific sources of contaminants to the River.

The weight of evidence as presented in the SLERA is adequate to conclude that ecological risks are low to negligible, and therefore, it is concluded that there is no need for further investigation or remediation within the river on the basis of ecological risk.

5. Conclusions

The Flint River Sediment Investigation was conducted as part of the RFI for the Facility, as an extension of the assessment of the possible impacts of potential discharges of hazardous constituents from the Facility via infiltration to storm sewers and subsequent migration to the river. In April 2005 the MDEQ, with USEPA observing, implemented a sediment sampling program targeted at assessing sediment quality in the river immediately adjacent to outfalls that receive storm water contributions from the Facility. Overall the results of the MDEQ investigation indicated relatively low concentrations of most constituents, in-line with levels typically observed in river sediments in industrialized urban settings. A review of these data, which GM provided to USEPA via letter dated December 1, 2005 suggested minimal facility-related contributions to observed constituent concentrations. Subsequently, USEPA expressed a desire for additional information and requested that GM implement a more extensive sampling program and conduct a screening-level ecological risk assessment. The Flint River Sediment Investigation was conducted to satisfy USEPA's request as described in the scope of work submitted to USEPA on October 6, 2006.

Due to the presence of numerous storm water outfalls discharging to the river adjacent to the Facility and downstream of the facility, the results of the investigation, presented in Section 3 of this report, are inconclusive concerning potential contributions of the facility to the observed distribution of constituents analyzed. Statistical differences in median concentrations of three PAHs (benzo[b]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3-cd]pyrene) and four metals (chromium, copper, lead, and zinc) exist between samples collected in adjacent and downstream sections of the river as compared to the upstream section of the river and exhibit a general increasing trend in the downstream direction through the urban Flint area. However, contaminant contributions of the Facility and the numerous other sources are commingled and indistinguishable and effects of all sources are cumulative. Spatial patterns in sediment concentrations are likely governed by local variations near sources as well as variable sedimentation patterns in the river.

Extensive source control activities have been implemented at the Facility and are on-going. Other industrial, commercial, and urban source activity in the area will likely continue as a source of "background" sediment quality impairment.

This report also presents a comparison of observed sediment concentrations to relevant background values. These comparisons involved 13 constituents exhibiting statistically-significant differences between median or mean concentrations among the Study Area reaches, and show that the concentrations of these constituents are generally within the ranges that would be expected in an urban waterway such as the river, which is impacted by numerous potential sources discharging to the Study Area. Of the constituents that do exceed background values, situations where the sediment concentrations exceed by more than a factor of 3 are limited to a few individual samples.

The SLERA conservatively identified a subset of the eight SVOCs and four metals as CoPCs for further evaluation based on comparison to ESLs and compared these to NECs to provide additional basis to interpret the significance of ESL exceedences. This comparison reveals that for surface sediments, the most relevant strata for evaluation of ecological risk, lead was the only metal with a detected concentration in excess of the NEC value, which only occurred at one location in the reach adjacent to the facility. In the downstream reach, two PAH compounds exceeded the NEC value, at one location and a single PAH compound exceed the NEC value at one other location. Both of these locations are downstream of multiple non-GM outfalls that are present downstream of the Facility. The SLERA also evaluated potential risks by comparison of subsurface values to NEC concentration under the unlikely hypothesis that a hydrodynamic scour event would cleanly remove the surface sediment layer – which is very unlikely considering that during high flow events there is typically a large amount of clean watershed-derived sediment in transport which tends to reduce, not increase exposure due to deposition and mixing. This comparison also indicates negligible to low potential risks that in any case are likely to be spatially-limited based on the very limited number of sample locations with subsurface values exceeding the NEC levels.

Reflecting on the objectives of the investigation as presented in the Scope of Work and Section 1.3 of this report it can be concluded that the investigation, including the SLERA presented in Section 4 and Appendix C, fully satisfies the study objectives. The principal conclusions of the investigation are:

1) There are no discernable impacts of the Facility on sediment quality in the river above those associated with typical urban sources based on comparison to relevant background values and the documented presence of numerous other non-GM sources adjacent to and downstream of the facility.

2) There is adequate information to conclude that ecological risks are low to negligible, and therefore, no need exists for further investigation or

remediation on the basis of ecological risk, regardless of the sources for observed sediment concentrations.

These conclusions are supported by the following specific findings of the investigation which have been previously document in Sections 3 and 4 of this report, as well as Appendix C, which contains the SLERA.

- The distribution of constituents in the river sediments reveals a general trend of increasing concentrations in the downstream direction through the urban Flint Area with the greatest concentrations occur at locations downstream of the facility that receive contributions from numerous non-GM sources located in the downstream reach.

- The maximum concentrations occur in the top 12-inches of the sediment column in nearly all cases and in most cases in the surface layer (0-2 inch layer). Based on these data, there is no substantial inventory at depth that would be potentially subject to erosion resulting in dispersal of constituents downstream, or contributing to any appreciable increase in exposure and risk as a result of potential erosional events. In general, the sediment core sample results together with the sediment probing results suggest that a high rate of sediment accumulation does not occur in the study area.

- Storm sewers that drain portions of the Facility also drain industrial, commercial, and residential areas outside the boundaries of the River Study Area. In addition, there are numerous non-Facility-related anthropogenic sources of metals and SVOCs to the river, including 50 non-GM-related outfalls within the Study Area and influences from tributaries.

- Comparison of CoPC concentrations to toxicity-based NECs and urban background values indicates a low potential for adverse effects to benthos, if any; and that observed sediment concentrations are generally within the ranges that would be expected in an urban waterway such as the river.

- Elevated levels of constituent concentrations in sediment are not associated exclusively with the locations of Facility-related outfalls, and in many cases, appear to have a greater association with non-GM-related outfalls and tributaries due to their location being downstream of non-GM outfalls and when lower concentrations have been observed upstream adjacent to the Facility.

- Ecological receptors' exposure to subsurface sediment represents an unlikely worst-case scenario wherein scour would remove the overlying sediment without disturbing the subsurface layers where elevated constituents occur; risk from this potential exposure scenario is low. For this unlikely scenario, the SLERA weight of evidence indicates a minimal potential for relative increases in potential risks.

6. References

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Tables

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Tables

Table 1
Flint River Sediment Investigation
GM NAO Flint Operations Site, Flint, MI

Flint River Surficial Sediment Sample Descriptions

Location Identification	River Width (feet)	Station Identification	Water Depth (feet)	Probing Depth (feet)	Sample Description
FRT 1A	115	0+29	9.2	1.3	Zebra mussels
FRT 1B	115	0+58	12.8	0.1	Brown fine to medium gravel, little brown medium sand.
FRT 1C	115	0+87	6.5	2.4	Brown fine to medium sand, little leaves, trace coarse sand, trace silt, trace zebra mussels.
FRT 2A	129	0+32	11.0	1.5	Zebra mussels.
FRT 2B	129	0+64	11.2	1.3	Grey brown fine to medium sand, trace coarse sand, trace fine gravel, trace silt, trace organics (leaves, zebra mussels).
FRT 2C	129	0+96	6.5	7.5	Brown very loose silt, little leaves, trace fine to coarse sand.
FRT 3A	150	0+37.5	6.6	3.1	Grey brown fine to medium sand, trace silt, trace organics (leaves)
FRT 3B	150	0+75	8.0	1.2	Grey brown fine to medium sand, trace coarse sand, trace silt, trace fine gravel, trace zebra mussels.
FRT 3C	150	1+12.5	10.0	0.8	Zebra mussels.
FRT 4A	155	0+39	8.6	3.0	Brown silty fine sand, trace medium to coarse sand, trace fine gravel, trace organics (zebra mussels, leaves).
FRT 4B	155	0+78	10.0	2.0	Dark grey brown fine to medium sand, trace coarse sand, trace fine gravel, trace silt, trace organics (zebra mussels, wood).
FRT 4C	155	1+17	10.7	0.2	Brown very loose silt, trace fine sand, trace organics (zebra mussels, leaves).
FRT 5A	159	0+40	8.4	2.6	Grey brown fine to medium sand, trace coarse sand, trace silt, trace organics (zebra mussels, shells).
FRT 5B	159	0+80	9.5	1.5	Grey brown fine sand, trace medium to coarse sand, trace silt, trace organics (leaves, zebra mussels).
FRT 5C	159	1+20	9.0	0.0	Gravel with trace zebra mussels.
FRT 6A	167	0+42	11.0	0.0	Gravel.
FRT 6B	167	0+84	9.7	2.0	Grey brown fine to medium sand, little coarse sand, trace fine to medium gravel, trace silt, trace organics (zebra mussels).
FRT 6C	167	1+26	8.0	2.5	Grey brown silty very fine sand, trace organics (leaves, zebra mussels), trace sheen
FRT 7A	189	0+63	11.0	0.1	Grey brown fine to medium sand, trace coarse sand, trace silt, trace organic (shells, leaves).
FRT 7B	189	1+26	7.0	3.2	Zebra mussels.
FRT 7C	189	1+89	2.1	8.9	Grey brown silty fine sand, trace organics (leaves, twigs).
FRT 8A	194	0+48.5	12.7	0.3	Grey brown fine to medium gravel, trace fine sand, trace silt, trace organics (shells, leaves)
FRT 8B	194	0+97	10.0	2.8	Grey brown fine to coarse sand, little fine to medium gravel, trace silt, trace organics (twigs, shells, wood), trace slag.

Table 1
Flint River Sediment Investigation
GM NAO Flint Operations Site, Flint, MI

Flint River Surficial Sediment Sample Descriptions

Location Identification	River Width (feet)	Station Identification	Water Depth (feet)	Probing Depth (feet)	Sample Description
FRT 8C	194	1+145.5	9.6	4.4	Brown fine sand, trace medium to coarse sand, trace fine gravel, trace organics (leaves).
FRT 9A	188	0+47	3.6	6.6	Brown fine sand, trace silt, leaves, organics (root mass).
FRT 9B	188	0+94	10.7	3.3	Brown fine sand, trace organics, trace medium to coarse sand, leaves, twigs, trace fine gravel.
FRT 9C	188	1+41	14.0	0.0	Gravel.
FRT 10A	185	0+46	7.9	3.3	Dark grey brown fine sand, little silt, trace organics (twigs, zebra mussels) sheen, slight odor.
FRT 10B	185	0+92	9.7	2.1	Grey brown fine to medium sand, trace coarse sand, trace silt, trace organics (shells).
FRT 10C	185	1+38	8.7	1.3	Grey brown fine to medium sand, little coarse sand, trace fine gravel, trace organics (twigs, zebra mussels).
FRT 11A	152	0+38	9.2	0.0	No recovery
FRT 11B	152	0+76	11.5	1.3	Dark grey brown fine to medium sand, trace coarse sand, trace silt, trace fine gravel, sheen present, slight odor.
FRT 11C	152	1+14	9.0	3.6	Grey brown fine to medium sand, trace silt, trace organics (leaves, zebra mussels) slight sheen.
FRT 12A	186	0+46	8.0	5.0	Brown very loose silt, little organic (leaves), trace very fine sand.
FRT 12B	186	0_92	10.1	2.2	Grey brown fine sand, trace medium to coarse sand, trace organic (wood, zebra mussels) trace fine gravel).
FRT 12C	186	1+38	10.0	0.2	Medium to coarse gravel, trace organic (zebra mussels).

NOTES:

1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006
2. Station identification indicates total feet measured from the west bank of the river.
3. All Samples were screened in the field using a photoionization detector. All readings were indicated to be zero.

Table 2
Flint River Investigation
GM NAO Flint Operations Site, Flint, MI

Flint River Subsurface Sediment Core Sample Descriptions

Transect Location: FRT 2C
Penetration (lexan): 6.2

Probing Information (steel rod): 7.5
Recovery: 4.8

Sample ID	Sample Interval (inches below grade)	Description
FRT 2C (2-12)	2-12	Dark grey silty fine sand, trace medium to course sand, trace wood.
FRT 2C (12-24)	12-24	Interbedded dark grey fine sand and silt in 2 inch lenses.
FRT 2C (24-36)	24-36	Interbedded dark grey fine sand and silt in 2 inch lenses.
FRT 2C (36-48)	36-48	Interbedded dark grey fine sand and silt in 2 inch lenses.
FRT 2C (48-57)	48-57	Light grey brown fine to medium sand.

Transect Location: FRT 4A
Penetration (lexan): 3.0

Probing Information (steel rod): 3.0
Recovery: 2.5

Sample ID	Sample Interval (inches below grade)	Description
FRT 4A (2-12)	2-12	Dark grey brown fine to course sand, trace fine gravel, trace wood.
FRT 4A (12-24)	12-24	Grey brown fine sand, trace medium to course sand, trace wood.
FRT 4A (24-30)	24-30	Grey brown fine sand, trace medium to course sand, trace wood.

Transect Location: FRT 7C
Penetration (lexan): 5.8

Probing Information steel rod): 8.9
Recovery: 3.9

Sample ID	Sample Interval (inches below grade)	Description
FRT 7C (2-12)	2-12	Dark grey brown loose silt, trace fine sand, trace organics (rootlets) strong odor.
FRT 7C (12-24)	12-24	Dark grey brown loose silt, trace fine sand, trace organics (rootlets), strong odor.
FRT 7C (24-36)	24-36	Dark grey sandy silt, odor decreasing with depth.
FRT 7C (36-46)	36-46	Dark grey brown sand, little silt, trace odor.

Table 2
Flint River Investigation
GM NAO Flint Operations Site, Flint, MI

Flint River Subsurface Sediment Core Sample Descriptions

Transect Location: FRT 12C
Penetration (lexan): 4.0

Probing Information (steel rod): 5.0
Recovery: 3.0

Sample ID	Sample Interval (inches below grade)	Description
FRT 12C (2-12)	2-12	Dark grey silty fine sand, trace medium to course sand, trace wood.
FRT 12C (12-24)	12-24	Dark grey fin to medium sand , trace silt, trace organics (leaves twigs).
FRT 12C (24-36)	24-36	Dark grey fin to medium sand, trace silt, trace organics (leaves twigs), with silty lens containing a strong odor from 34-36.

NOTES:

1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006

2. All Samples were screened in the field using a photoionization detector. All readings were indicated to be zero.

Table 3
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Surface Sediment Analytical Results for Unbiased Sampling Transects

Sample ID: / Sample Depth(inches BGS): / Date Collected:	Units	FRT 1C 0 - 2 11/01/06	FRT 2B 0 - 2 11/01/06	FRT 2C 0 - 2 11/01/06	FRT 3A 0 - 2 11/01/06	FRT 3B 0 - 2 11/01/06	FRT 4A 0 - 2 11/01/06	FRT 4C 0 - 2 11/01/06	FRT 5A 0 - 2 10/31/06	FRT 5B 0 - 2 10/31/06	FRT 6B 0 - 2 10/31/06	FRT 7A 0 - 2 10/31/06	FRT 7C 0 - 2 10/31/06	FRT 8B 0 - 2 10/31/06	FRT 9A 0 - 2 10/31/06	FRT 9B 0 - 2 10/31/06
Semivolatile Organics (SVOCs)																
2,2'-oxybis(1-Chloropropane) (bis(2-chloroisopropyl) ether)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,4,5-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,4,6-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,4-Dichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,4-Dimethylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,4-Dinitrophenol	mg/kg	0.67 UJ	0.67 UJ	0.67 U	0.67 UJ	0.67 UJ	0.67 UJ	0.67 UJ	0.67 UJ	0.67 U	0.67 UJ	0.67 UJ	0.67 UJ	0.67 UJ	0.67 UJ [0.67 U]	0.67 UJ
2,4-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2,6-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2-Chloronaphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2-Chlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2-Methylnaphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
2-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
2-Nitrophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
3,3'-Dichlorobenzidine	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
3-Methylphenol	mg/kg	0.33 U	0.33 U	0.36	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
3-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
4,6-Dinitro-2-methylphenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
4-Bromophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
4-Chloro-3-methylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
4-Chloroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
4-Chlorophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
4-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
4-Nitrophenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
Acenaphthene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Acenaphthylene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.03 J [0.33 U]	0.33 U
Acetophenone	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.04 J	0.33 U	0.33 U	0.33 UJ	0.33 U	0.06 J [0.33 U]	0.04 J
Atrazine	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Benzaldehyde	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 UJ]	0.33 U
Benzo(a)anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.09 J	0.33 U	0.2 J	0.33 U	0.33 U	0.04 J	0.33 U	0.7 [0.1 J]	0.4
Benzo(a)pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.62 J	0.2 J	0.2 J	0.33 U	0.3 J	0.81 J	0.1 J	1.78 J [1.14]	1.07
Benzo(b)fluoranthene	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.2 J	0.75 J	0.33 UJ	0.2 J	0.33 UJ	0.3 J	0.89 J	0.33 UJ	2.09 J [1.28 J]	1.32 J
Benzo(g,h,i)perylene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.1 J	0.47	0.1 J	0.2 J	0.33 U	0.2 J	0.62 J	0.08 J	1.28 [1.04]	0.75
Benzo(k)fluoranthene	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.2 J	0.53 J	0.2 J	0.2 J	0.07 J	0.3 J	0.82 J	0.33 UJ	1.58 J [1.09 J]	0.88 J
Biphenyl	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
bis(2-Chloroethoxy)methane	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
bis(2-Chloroethyl)ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
bis(2-Ethylhexyl)phthalate	mg/kg	0.33 U	0.04 J	0.1 J	0.33 U	0.33 U	1.77	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.51 UJ	0.33 U	0.76 U [0.46]	0.64 U
Butyl benzylphthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Caprolactam	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Carbazole	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.1 J [0.08 J]	0.09 J
Chrysene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.54	0.1 J	0.3 J	0.06 J	0.3 J	0.66 J	0.1 J	1.48 [0.88]	0.94
Dibenz(a,h)anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.08 J [0.33 U]	0.33 U
Dibenzofuran	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Diethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Dimethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.05 J	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.06 J [0.33 U]	0.33 U
Di-n-butylphthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Di-n-octyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Fluoranthene	mg/kg	0.33 U	0.33 U	0.03 J	0.33 U	0.33 U	0.3 J	1.08	0.2 J	0.48	0.1 J	0.44	1.2 J	0.1 J	2.83 J [1.57 J]	2.05
Fluorene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.09 J	0.33 U	0.33 U	0.33 U	0.33 U	0.1 J	0.33 U	0.1 J [0.1 J]	0.1 J
Hexachlorobenzene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Hexachlorobutadiene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Hexachlorocyclopentadiene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 UJ]	0.33 U
Hexachloroethane	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.1 J	0.39	0.1 J	0.1 J	0.33 U	0.2 J	0.52 J	0.06 J	1.21 [0.86]	0.67
Isophorone	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Naphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Nitrobenzene	mg/kg	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U [0.2 U]	0.2 U
N-Nitrosodi-n-propylamine	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
N-Nitrosodiphenylamine	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ [0.33 UJ]	0.33 UJ
Pentachlorophenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 U	0.67 U [0.67 U]	0.67 U
Phenanthrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.33 U	0.33 U	0.33 UJ	0.33 U	0.44 [0.33 U]	0.3 J
Phenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 U	0.33 U [0.33 U]	0.33 U
Pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.46	0.33 U	0.35	0.33 U	0.33 U	0.41 J	0.33 U	1.94 [0.71]	1.25

Table 3
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Surface Sediment Analytical Results for Unbiased Sampling Transects

Sample ID: / Sample Depth(inches BGS): / Date Collected:	Units	FRT 1C 0 - 2 11/01/06	FRT 2B 0 - 2 11/01/06	FRT 2C 0 - 2 11/01/06	FRT 3A 0 - 2 11/01/06	FRT 3B 0 - 2 11/01/06	FRT 4A 0 - 2 11/01/06	FRT 4C 0 - 2 11/01/06	FRT 5A 0 - 2 10/31/06	FRT 5B 0 - 2 10/31/06	FRT 6B 0 - 2 10/31/06	FRT 7A 0 - 2 10/31/06	FRT 7C 0 - 2 10/31/06	FRT 8B 0 - 2 10/31/06	FRT 9A 0 - 2 10/31/06	FRT 9B 0 - 2 10/31/06
Pesticides/Polychlorinated Biphenyls (PCBs)																
Aroclor-1016 (PCB-1016)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1221 (PCB-1221)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1232 (PCB-1232)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1242 (PCB-1242)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1248 (PCB-1248)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1254 (PCB-1254)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U
Aroclor-1260 (PCB-1260)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.02 J	0.33 U	0.33 U [0.33 U]	0.33 U
Inorganics																
Antimony	mg/kg	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U [0.3 U]	0.3 U
Arsenic	mg/kg	2.41	2.09	12.1	1.61	1.51	3.2	6.62	3.31	3.51	2.98	4.28	3.83	2.32	15.8 J [8.86 J]	7.39
Barium	mg/kg	18.3 J	7.5 J	90.6 J	11.2 J	7.5 J	28.9 J	73.2 J	20.2 J	22.8 J	19.4 J	29.4 J	38.8 J	26.1 J	127 J [110]	52.6 J
Beryllium	mg/kg	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U [0.5 U]	0.5 U
Cadmium	mg/kg	0.2 U	0.2 U	0.99	0.2 U	0.2 U	0.26	0.33	0.3	0.2 U	0.2 U	0.23	0.45	0.2 U	1.69 [2.09]	0.88
Chromium (Total)	mg/kg	2 U	2 U	5.5	2 U	2 U	22.4	7	11.4	4.8	5.2	5.9	7.5	41.2	26 [22.6]	15.8
Cobalt	mg/kg	1.21	1.07	9.93	1	0.99	1.57	2.97	1.42	1.19	2.33	1.55	2.23	1.77	7.15 [4.94]	2.76
Copper	mg/kg	2.3	1 U	15.5	1.9	1 U	13.5	31.2	25.9	15.8	10.9	13.7	33	4.6	106 [66.3]	16.6
Cyanide (total)	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	1	0.1 U [0.1 U]	0.1 U
Lead	mg/kg	3.6	3.5	13.1	3	2.4	15.4	26	214	16.8	12.2	23.9	34	8.2	118 [116]	72.8
Manganese	mg/kg	195	107	872	121	104	550	596	265	207	498	331	164	1,430	663 [662]	584
Mercury	mg/kg	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.15 [0.094]	0.05 U
Nickel	mg/kg	1.5	1 U	10.7	1.5	1 U	4.2	6.5	2.6	2.1	3.2	3.2	4.7	3	14.1 [10.7]	7.3
Selenium	mg/kg	0.2 U	0.2 U	0.48	0.2 U	0.2 U	0.23	0.33	0.28	0.2 U	0.39	0.44	0.2 U	0.27	0.73 [0.82]	0.6
Silver	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.24 U [0.33 U]	0.1 U
Thallium	mg/kg	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U [0.5 U]	0.5 U
Vanadium	mg/kg	1.5	1 U	8.2	1.1	1 U	1.9	6.6	1.5	1.5	1.6	1.9	3.2	1.9	10.7 [9.6]	2.9
Zinc	mg/kg	11.7 J	8.2 J	42.9 J	10.9 J	8.2 J	28.2 J	72.3 J	43.1 J	37.6 J	30.6 J	49.8 J	94 J	30.8 J	324 J [281]	312 J
Miscellaneous																
Total Organic Carbon (TOC)	mg/kg	95	26	420	37	20	140	170	25	50	20	42	45	15 U	470 J [160 J]	89
Total Solids	%	72	81	40	75	79	64	47	77	73	86	60	57	75	23 [25]	54
Field Parameters																
Clay	%wt	(2)	(2)	(2)	4.84	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	51.48 [60.33]	(2)
Coarse Sand	%wt	7.16	6.21	26.63	0	2.52	11.34	6.24	3.04	0.93	10.88	3.15	0.24	26.2	0 [0]	7.81
Fine Sand	%wt	55.1	33.06	20.1	74.68	52.6	33.51	39.71	36.52	75.91	14.94	57.58	82.93	5.84	0 [0]	26.94
Grain Density	mm	0.361	0.51	1.269	0.315	0.407	0.577	0.362	0.523	0.31	0.867	0.352	0.149	1.751	0.005 [0.004]	0.632
Gravel	%wt	3.68	1.67	8.65	0	1.41	7.03	26.94	4.72	4.98	4.54	0.44	0	16.65	0 [0]	1.62
Medium Sand	%wt	32.89	58.68	40.7	14.46	43.03	45.16	13.78	53.94	14.91	68.39	34.94	3.27	50.42	0 [0]	56.01
Silt	%wt	(2)	(2)	(2)	6.01	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	48.52 [39.67]	(2)
Silt/Clay	%wt	1.17	0.38	3.92	10.85	0.44	2.97	13.32	1.78	3.26	1.26	3.89	13.56	0.9	100 [100]	7.61

NOTES:

1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006.
2. All samples were screened in the field using a photoionization detector. All readings were indicated to be zero.
3. Samples were analyzed for semivolatile organic consitituents (SVOCs) polychlorinated biphenyls (PCBs), and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
4. U-Analyte was not detected at the presented detection limit.
5. J-The presented value is estimated.
6. [ ] - Field duplicate results are reflected using brackets.
7. (2) - Not differentiated.
8. Abbreviations:
   > mg/kg = milligrams per kilogram, dry weight
   > % = percent
   > % wt = percent by weight
   > mm = millimeters
   > BGS = below ground surface

Table 4
2006 Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Surface Sediment Analytical Results for Biased Sampling Transects Near
GM Outfalls 003, 005, and 013

Sample ID: Sample Depth(inches BGS): Date Collected:	Units	FRT 10A 0 - 2 10/31/06	FRT 10B 0 - 2 10/31/06	FRT 11B 0 - 2 11/01/06	FRT 11C 0 - 2 11/01/06	FRT 12B 0 - 2 10/31/06	FRT 12C 0 - 2 10/31/06
Semivolitile Organics (SVOCs)							
2,2'-oxybis(1-Chloropropane) (bis(2-chloroisopropyl) ether)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,4,5-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,4,6-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,4-Dichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,4-Dimethylphenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,4-Dinitrophenol	mg/kg	0.67 U	0.67 UJ	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
2,4-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2,6-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2-Chloronaphthalene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2-Chlorophenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2-Methylnaphthalene	mg/kg	0.33 U	0.33 U	0.03 J [0.33 U]	0.33 U	0.33 U	0.33 U
2-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
2-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
2-Nitrophenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
3,3'-Dichlorobenzidine	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
3-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
3-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
4,6-Dinitro-2-methylphenol	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
4-Bromophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
4-Chloro-3-methylphenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
4-Chloroaniline	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
4-Chlorophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
4-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
4-Nitrophenol	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
Acenaphthene	mg/kg	0.33 U	0.33 U	0.1 J [0.33 U]	0.33 U	0.33 U	0.33 U
Acenaphthylene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Acetophenone	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Anthracene	mg/kg	0.33 U	0.33 U	0.3 J [0.33 U]	0.33 U	0.33 U	0.33 U
Atrazine	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Benzaldehyde	mg/kg	0.33 UJ	0.33 U	0.33 U [0.33 UJ]	0.33 UJ	0.33 UJ	0.33 UJ
Benzo(a)anthracene	mg/kg	0.33 U	0.33 U	0.62 [0.33 U]	0.33 U	0.33 U	0.09 J
Benzo(a)pyrene	mg/kg	0.73	0.2 J	1.14 [0.59]	0.2 J	0.3 J	0.83
Benzo(b)fluoranthene	mg/kg	0.88 J	0.33 UJ	1.09 [0.64 J]	0.3 J	0.3 J	0.88 J
Benzo(g,h,i)perylene	mg/kg	0.65	0.33 U	0.65 [0.47]	0.2 J	0.2 J	0.69
Benzo(k)fluoranthene	mg/kg	0.51 J	0.33 UJ	0.92 [0.47 J]	0.2 J	0.3 J	0.75 J
Biphenyl	mg/kg	0.33 U	0.33 U	0.04 J [0.33 U]	0.33 U	0.33 U	0.33 U
bis(2-Chloroethoxy)methane	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
bis(2-Chloroethyl)ether	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
bis(2-Ethylhexyl)phthalate	mg/kg	0.3 J	0.33 U	0.1 J [0.2 J]	0.05 J	0.05 J	0.38
Butyl benzylphthalate	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U

Table 4
2006 Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Surface Sediment Analytical Results for Biased Sampling Transects Near
GM Outfalls 003, 005, and 013

Sample ID: Sample Depth(inches BGS): Date Collected:	Units	FRT 10A 0 - 2 10/31/06	FRT 10B 0 - 2 10/31/06	FRT 11B 0 - 2 11/01/06	FRT 11C 0 - 2 11/01/06	FRT 12B 0 - 2 10/31/06	FRT 12C 0 - 2 10/31/06
Semivolitile Organics (SVOCs) cont.							
Caprolactam	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Carbazole	mg/kg	0.05 J	0.33 U	0.3 J [0.04 J]	0.33 U	0.33 U	0.08 J
Chrysene	mg/kg	0.58	0.1 J	0.97 [0.46]	0.2 J	0.2 J	0.65
Dibenz(a,h)anthracene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Dibenzofuran	mg/kg	0.33 U	0.33 U	0.1 J [0.33 U]	0.33 U	0.33 U	0.33 U
Diethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Dimethyl phthalate	mg/kg	0.33 U	0.33 U	0.04 J [0.3 J]	0.33 U	0.33 U	0.33 U
Di-n-butylphthalate	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Di-n-octyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Fluoranthene	mg/kg	1.05	0.2 J	2.37 J [0.87 J]	0.38	0.37	1.29
Fluorene	mg/kg	0.1 J	0.33 U	0.2 J [0.1 J]	0.33 U	0.33 U	0.07 J
Hexachlorobenzene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Hexachlorobutadiene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Hexachlorocyclopentadiene	mg/kg	0.33 UJ	0.33 U	0.33 U [0.33 UJ]	0.33 UJ	0.33 UJ	0.33 UJ
Hexachloroethane	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.5	0.33 U	0.59 [0.42]	0.2 J	0.2 J	0.58
Isophorone	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Naphthalene	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Nitrobenzene	mg/kg	0.2 U	0.2 U	0.2 U [0.2 U]	0.2 U	0.2 U	0.2 U
N-Nitrosodi-n-propylamine	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
N-Nitrosodiphenylamine	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ [0.33 UJ]	0.33 UJ	0.33 UJ	0.33 UJ
Pentachlorophenol	mg/kg	0.67 U	0.67 U	0.67 U [0.67 U]	0.67 U	0.67 U	0.67 U
Phenanthrene	mg/kg	0.33 U	0.33 U	1.65 J [0.33 UJ]	0.33 U	0.33 U	0.33 U
Phenol	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Pyrene	mg/kg	0.2 J	0.33 U	1.55 [0.05 J]	0.33 U	0.33 U	0.46
Pesticides/Polychlorinated Biphenyls (PCBs)							
Aroclor-1016 (PCB-1016)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1221 (PCB-1221)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1232 (PCB-1232)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1242 (PCB-1242)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1248 (PCB-1248)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1254 (PCB-1254)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.1 J
Aroclor-1260 (PCB-1260)	mg/kg	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Inorganics							
Antimony	mg/kg	0.3 U	0.3 U	0.3 U [0.3 U]	0.3 U	0.3 U	0.3 U
Arsenic	mg/kg	5.19	3.5	2.1 [2.55]	2.14	3.83	18.6
Barium	mg/kg	39.9	14.9 J	18.8 J [13.4]	18.5 J	30.9 J	146 J
Beryllium	mg/kg	0.5 U	0.5 U	0.5 U [0.5 U]	0.5 U	0.5 U	0.5 U
Cadmium	mg/kg	0.38	0.2 U	0.2 U [0.2 U]	0.2 U	0.2	1.41
Chromium (Total)	mg/kg	8.2	2.8	5.5 [2.7]	3	10.5	22.8
Cobalt	mg/kg	1.97	1.18	1.22 [1.09]	1.12	2.38	5.48
Copper	mg/kg	24.4	3.3	7 [7.4]	17.8	9.1	73.2
Cyanide (total)	mg/kg	0.1 U	0.1 U	0.1 U [0.1 U]	0.1 U	0.1 U	0.1 U
Lead	mg/kg	35.3	9.1	10.8 [11.1]	10.1	18.7	124
Manganese	mg/kg	321	204	262 J [151 J]	151	476	955
Mercury	mg/kg	0.05 U	0.05 U	0.05 U [0.05 U]	0.05 U	0.05 U	0.122
Nickel	mg/kg	4.7	3.6	2.3 [2.2]	1.8	4.5	16.2
Selenium	mg/kg	0.29	0.2 U	0.2 U [0.2 U]	0.2 U	0.2 U	1.08
Silver	mg/kg	0.1 U	0.1 U	0.1 U [0.1 U]	0.1 U	0.1 U	0.13 U
Thallium	mg/kg	0.5 U	0.5 U	0.5 U [0.5 U]	0.5 U	0.5 U	0.5 U
Vanadium	mg/kg	3.6	1.4	1.3 [1.2]	1.1	1.7	13.9
Zinc	mg/kg	105	18.1 J	42.4 J [32.5]	25.4 J	62 J	316 J

Table 4
2006 Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Surface Sediment Analytical Results for Biased Sampling Transects Near GM Outfalls 003, 005, and 013

Sample ID: Sample Depth(inches BGS): Date Collected:	Units	FRT 10A 0 - 2 10/31/06	FRT 10B 0 - 2 10/31/06	FRT 11B 0 - 2 11/01/06	FRT 11C 0 - 2 11/01/06	FRT 12B 0 - 2 10/31/06	FRT 12C 0 - 2 10/31/06
Miscellaneous							
Total Organic Carbon (TOC)	mg/kg	52	19	32 [28]	32	34	200
Total Solids	%	53	79	83 [77]	73	66	20
Field Parameters							
Clay	%wt	(2)	(2)	(2) [(2)]	(2)	(2)	57.92
Coarse Sand	%wt	1.38	0.44	11.73 [9.34]	0.2	6.42	0
Fine Sand	%wt	84.87	79.7	50.08 [50.22]	88.66	23.63	0
Grain Density	mm	0.201	0.325	0.407 [0.387]	0.294	0.605	0.004
Gravel	%wt	3.22	0	5.37 [12.14]	0	4.73	0
Medium Sand	%wt	3.81	19.31	31.2 [25.41]	8.24	63.58	0
Silt	%wt	(2)	(2)	(2) [(2)]	(2)	(2)	42.08
Silt/Clay	%wt	6.73	0.55	1.62 [2.89]	2.9	1.64	100

NOTES:
1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006.
2. All samples were screened in the field using a photoionization detector. All readings were indicated to be zero.
3. Samples were analyzed for semivolatile organic consitituents (SVOCs) polychlorinated biphenyls (PCBs), and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
4. U-Analyte was not detected at the presented detection limit.
5. J-The presented value is estimated.
6. [ ] - Field duplicate results are reflected using brackets.
7. (2) - Not differentiated.
8. Abbreviations:
   - > mg/kg = milligrams per kilogram, dry weight
   - > % = percent
   - > % wt = percent by weight
   - > mm = millimeters
   - > BGS = below ground surface

Table 5
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Unbiased Sampling Transects

Sample ID: Sample Depth(inches BGS): Date Collected:	Units	FRT 2C 2 - 12 11/01/06	FRT 2C 12 - 24 11/01/06	FRT 2C 24 - 36 11/01/06	FRT 2C 36 - 48 11/01/06	FRT 2C 48 - 57 11/01/06	FRT 4A 2 - 12 11/01/06	FRT 4A 12 - 24 11/01/06	FRT 7C 2 - 12 10/31/06	FRT 7C 12 - 24 10/31/06	FRT 7C 24 - 36 10/31/06	FRT 7C 36 - 46 10/31/06
Semivolitile Organics (SVOCs)												
2,2'-oxybis(1-Chloropropane) (bis(2-chloroisopropyl) ether)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4,5-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4,6-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4-Dichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4-Dimethylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4-Dinitrophenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 UJ	0.67 UJ	0.67 U	0.67 U	1 U [1 U]	1 U	0.33 U	0.33 U
2,4-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.67 U	0.67 U
2,6-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2-Chloronaphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2-Chlorophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2-Methylnaphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.3 J [1 U]	1 U	0.33 U	0.33 U
2-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
2-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
2-Nitrophenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
3,3'-Dichlorobenzidine	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
3-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
3-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
4,6-Dinitro-2-methylphenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
4-Bromophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
4-Chloro-3-methylphenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
4-Chloroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
4-Chlorophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
4-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
4-Nitrophenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
Acenaphthene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	0.8 J	0.05 J	0.33 U
Acenaphthylene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	2	0.05 J	0.33 U
Acetophenone	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	2	0.06 J	0.33 U
Atrazine	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Benzaldehyde	mg/kg	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	1 UJ [1 UJ]	1 UJ	0.33 UJ	0.33 UJ
Benzo(a)anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	2	0.33 U	0.33 U
Benzo(a)pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.33 U	1 U [1 U]	7	0.53	0.33 U
Benzo(b)fluoranthene	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.1 J	0.33 UJ	2 J [1 J]	4 J	0.3 J	0.33 UJ
Benzo(g,h,i)perylene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.1 J	0.33 U	1 U [1 U]	3 J	0.35	0.33 U
Benzo(k)fluoranthene	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.33 UJ	0.1 J	0.33 UJ	1 J [0.8 J]	4 J	0.3 J	0.33 UJ
Biphenyl	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
bis(2-Chloroethoxy)methane	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
bis(2-Chloroethyl)ether	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
bis(2-Ethylhexyl)phthalate	mg/kg	0.09 J	0.07 J	0.09 J	0.33 U	0.33 U	0.33 U	0.33 U	13 J [7 J]	1 U	0.33 U	0.33 U
Butyl benzylphthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Caprolactam	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Carbazole	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Chrysene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.1 J	0.33 U	2 [1]	7	0.38	0.33 U

Table 5
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Unbiased Sampling Transects

Sample ID: Sample Depth(inches BGS): Date Collected:	Units	FRT 2C 2 - 12 11/01/06	FRT 2C 12 - 24 11/01/06	FRT 2C 24 - 36 11/01/06	FRT 2C 36 - 48 11/01/06	FRT 2C 48 - 57 11/01/06	FRT 4A 2 - 12 11/01/06	FRT 4A 12 - 24 11/01/06	FRT 7C 2 - 12 10/31/06	FRT 7C 12 - 24 10/31/06	FRT 7C 24 - 36 10/31/06	FRT 7C 36 - 46 10/31/06
Semivolitile Organics (SVOCs) cont.												
Dibenz(a,h)anthracene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Dibenzofuran	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Diethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Dimethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Di-n-butylphthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Di-n-octyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Fluoranthene	mg/kg	0.03 J	0.33 U	0.33 U	0.33 U	0.33 U	0.2 J	0.33 U	2 [0.8 J]	7	0.39	0.33 U
Fluorene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.1 J	0.33 U
Hexachlorobenzene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Hexachlorobutadiene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Hexachlorocyclopentadiene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 UJ	0.33 UJ	1 UJ [1 UJ]	1 UJ	0.33 UJ	0.33 UJ
Hexachloroethane	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 UJ	0.33 U	0.33 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.09 J	0.33 U	1 U [1 U]	3 J	0.3 J	0.33 U
Isophorone	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Naphthalene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Nitrobenzene	mg/kg	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1 U [1 U]	1 U	0.2 U	0.2 U
N-Nitrosodi-n-propylamine	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
N-Nitrosodiphenylamine	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ	0.33 U	0.33 U	0.33 UJ	0.33 UJ	1 UJ [1 UJ]	1 UJ	0.33 UJ	0.33 UJ
Pentachlorophenol	mg/kg	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	1 U [1 U]	1 U	0.67 U	0.67 U
Phenanthrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1	0.33 U	0.33 U
Phenol	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	1 U	0.33 U	0.33 U
Pyrene	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	1 U [1 U]	12	0.33 U	0.33 U
Pesticides/Polychlorinated Biphenyls (PCBs)												
Aroclor-1016 (PCB-1016)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1221 (PCB-1221)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1232 (PCB-1232)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1242 (PCB-1242)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1248 (PCB-1248)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U
Aroclor-1254 (PCB-1254)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.5 [0.2 J]	0.33 U	0.33 U	0.33 U
Aroclor-1260 (PCB-1260)	mg/kg	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U [0.33 U]	0.33 U	0.33 U	0.33 U

Table 5
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Unbiased Sampling Transects

Sample ID: / Sample Depth(inches BGS): / Date Collected:	Units	FRT 2C 2 - 12 11/01/06	FRT 2C 12 - 24 11/01/06	FRT 2C 24 - 36 11/01/06	FRT 2C 36 - 48 11/01/06	FRT 2C 48 - 57 11/01/06	FRT 4A 2 - 12 11/01/06	FRT 4A 12 - 24 11/01/06	FRT 7C 2 - 12 10/31/06	FRT 7C 12 - 24 10/31/06	FRT 7C 24 - 36 10/31/06	FRT 7C 36 - 46 10/31/06
Inorganics												
Antimony	mg/kg	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U [0.3 U]	0.3 U	0.3 U	0.3 U
Arsenic	mg/kg	9.14	5.11	4.22	3.17	0.94	3.61	3.72	6.32 [6.19]	8.28	3.38	1.45
Barium	mg/kg	36	45.2	9.5	8.2	3.6	13.6	11.8	146 [106]	139	44.2	33.8
Beryllium	mg/kg	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U [0.5 U]	0.5 U	0.5 U	0.5 U
Cadmium	mg/kg	0.24	0.21	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	5.98 [5.47]	3.82	0.2 U	0.2 U
Chromium (Total)	mg/kg	8.9	6.5	2.1	2 U	2 U	2.5	2 U	153 [119]	64.4	6.5	2.3
Cobalt	mg/kg	2.86	3.43	1.05	1.46	0.65	1.2	1.48	4.86 [4.89]	11.2	2.45	1.61
Copper	mg/kg	7	8.1	1.7	1.2	1 U	7.3	1.7	138 [132]	127	7.9	3.4
Cyanide (total)	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U [0.1 U]	0.1 U	0.1 U	0.1 U
Lead	mg/kg	6.6	8.9	1.6	1.6	1 U	7.9	1.8	245 [197]	183	10.3	3.8
Manganese	mg/kg	569	389	78.2	31.3	22	162	50.3	396 [289]	336	189	167
Mercury	mg/kg	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.114 [0.112]	0.335	0.05 U	0.05 U
Nickel	mg/kg	5.3	5	1.4	1.2	1 U	2.1	1.5	49.8 [38.1]	34.7	3.9	2.2
Selenium	mg/kg	0.44	0.41	0.27	0.2 U	0.2 U	0.38	0.2 U	0.41 [0.39]	0.57	0.28	0.2 U
Silver	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	2.75 [1.99]	0.31 U	0.1 U	0.1 U
Thallium	mg/kg	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.51 [0.5 U]	0.5 U	0.5 U	0.5 U
Vanadium	mg/kg	8.4	6	1.9	1.5	1 U	1.6	2.2	6.4 [6.3]	9.5	5.2	3.3
Zinc	mg/kg	29.7	34.8	6	6.1	3.7	14.7	12.4	647 [643]	338	22.2	11.5
Miscellaneous												
Total Organic Carbon (TOC)	mg/kg	50	37	22	30	12 U	19	23	120 [100]	180	89	47
Total Solids	%	63	73	68	71	83	79	77	62 [63]	51	66	75
Field Parameters												
Clay	%wt	(2)	(2)	(2)	(2)	1.07	(2)	(2)	61.14 [58.15]	63.38	59.02	11.15
Coarse Sand	%wt	10.24	0.42	1.78	0.74	0	12.44	5.85	0 [0]	0	0	0
Fine Sand	%wt	47.24	65.36	56.15	80.52	64.29	42.39	68.42	0 [0]	0	0	53.45
Grain Density	mm	0.35	0.292	0.338	0.283	0.339	0.473	0.272	0.004 [0.004]	0.004	0.004	0.097
Gravel	%wt	6.82	0	7.11	2.9	0	16.88	7.33	0 [0]	0	0	0
Medium Sand	%wt	26.77	22.49	30.54	9.21	30.88	23.83	12.57	0 [0]	0	0	0.89
Silt	%wt	(2)	(2)	(2)	(2)	3.77	(2)	(2)	38.86 [41.85]	36.62	40.98	34.5
Silt/Clay	%wt	8.92	11.73	4.41	6.63	4.83	4.46	5.83	100 [100]	100	100	45.66

NOTES:

1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006.
2. All samples were screened in the field using a photoionization detector. All readings were indicated to be zero.
3. Samples were analyzed for semivolatile organic consitituents (SVOCs) polychlorinated biphenyls (PCBs), and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
4. U-Analyte was not detected at the presented detection limit.
5. J-The presented value is estimated.
6. [ ] - Field duplicate results are reflected using brackets.
7. (2) - Not differentiated.
8. Abbreviations:
   > mg/kg = milligrams per kilogram, dry weight
   > % = percent
   > % wt = percent by weight
   > mm = millimeters
   > BGS = below ground surface

Table 6
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Biased Transects Near GM Outfalls 003, 005, and 013

Sample ID: Sample Depth(in BGS): Date Collected:	Units	FRT 12C 2 - 12 11/01/06	FRT 12C 12 - 24 11/01/06	FRT 12C 24 - 36 11/01/06
Semivolitile Organics (SVOCs)				
2,2'-oxybis(1-Chloropropane) (bis(2-chloroisopropyl) ether)	mg/kg	0.33 U	0.33 U	0.33 U
2,4,5-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U
2,4,6-Trichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U
2,4-Dichlorophenol	mg/kg	0.33 U	0.33 U	0.33 U
2,4-Dimethylphenol	mg/kg	0.33 U	0.33 U	0.33 U
2,4-Dinitrophenol	mg/kg	0.67 U	0.67 U	0.67 U
2,4-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U
2,6-Dinitrotoluene	mg/kg	0.33 U	0.33 U	0.33 U
2-Chloronaphthalene	mg/kg	0.33 U	0.33 U	0.33 U
2-Chlorophenol	mg/kg	0.33 U	0.33 U	0.33 U
2-Methylnaphthalene	mg/kg	0.33 U	0.33 U	0.33 U
2-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U
2-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U
2-Nitrophenol	mg/kg	0.33 U	0.33 U	0.33 U
3,3'-Dichlorobenzidine	mg/kg	0.67 U	0.67 U	0.67 U
3-Methylphenol	mg/kg	0.33 U	0.33 U	0.33 U
3-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U
4,6-Dinitro-2-methylphenol	mg/kg	0.67 U	0.67 U	0.67 U
4-Bromophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U
4-Chloro-3-methylphenol	mg/kg	0.33 U	0.33 U	0.33 U
4-Chloroaniline	mg/kg	0.67 U	0.67 U	0.67 U
4-Chlorophenyl phenyl ether	mg/kg	0.33 U	0.33 U	0.33 U
4-Nitroaniline	mg/kg	0.67 U	0.67 U	0.67 U
4-Nitrophenol	mg/kg	0.67 U	0.67 U	0.67 U
Acenaphthene	mg/kg	0.09 J	0.33 U	0.33 U
Acenaphthylene	mg/kg	0.33 U	0.33 U	0.33 U
Acetophenone	mg/kg	0.33 U	0.33 U	0.33 U
Anthracene	mg/kg	0.1 J	0.33 U	0.33 U
Atrazine	mg/kg	0.33 U	0.33 U	0.33 U
Benzaldehyde	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ
Benzo(a)anthracene	mg/kg	0.74	0.2 J	0.33 U
Benzo(a)pyrene	mg/kg	1.77	0.99	0.2 J
Benzo(b)fluoranthene	mg/kg	2.2 J	1.18 J	0.3 J
Benzo(g,h,i)perylene	mg/kg	1.41	0.82	0.2 J
Benzo(k)fluoranthene	mg/kg	1.45 J	0.93 J	0.2 J
Biphenyl	mg/kg	0.33 U	0.33 U	0.33 U
bis(2-Chloroethoxy)methane	mg/kg	0.33 U	0.33 U	0.33 U
bis(2-Chloroethyl)ether	mg/kg	0.33 U	0.33 U	0.33 U
bis(2-Ethylhexyl)phthalate	mg/kg	0.8	0.6	0.66
Butyl benzylphthalate	mg/kg	0.33 U	0.33 U	0.33 U
Caprolactam	mg/kg	0.33 U	0.33 U	0.33 U
Carbazole	mg/kg	0.2 J	0.08 J	0.33 U
Chrysene	mg/kg	1.54	0.88	0.2 J

Table 6
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Biased Transects Near GM Outfalls 003, 005, and 013

Sample ID: Sample Depth(in BGS): Date Collected:	Units	FRT 12C 2 - 12 11/01/06	FRT 12C 12 - 24 11/01/06	FRT 12C 24 - 36 11/01/06
Semivolitile Organics (SVOCs) cont.				
Dibenz(a,h)anthracene	mg/kg	0.33 U	0.33 U	0.33 U
Dibenzofuran	mg/kg	0.06 J	0.33 U	0.33 U
Diethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U
Dimethyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U
Di-n-butylphthalate	mg/kg	0.33 U	0.33 U	0.33 U
Di-n-octyl phthalate	mg/kg	0.33 U	0.33 U	0.33 U
Fluoranthene	mg/kg	3.05	1.69	0.41
Fluorene	mg/kg	0.2 J	0.1 J	0.33 U
Hexachlorobenzene	mg/kg	0.33 U	0.33 U	0.33 U
Hexachlorobutadiene	mg/kg	0.33 U	0.33 U	0.33 U
Hexachlorocyclopentadiene	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ
Hexachloroethane	mg/kg	0.33 U	0.33 U	0.33 U
Indeno(1,2,3-cd)pyrene	mg/kg	1.16	0.69	0.1 J
Isophorone	mg/kg	0.33 U	0.33 U	0.33 U
Naphthalene	mg/kg	0.33 U	0.33 U	0.33 U
Nitrobenzene	mg/kg	0.2 U	0.2 U	0.2 U
N-Nitrosodi-n-propylamine	mg/kg	0.33 U	0.33 U	0.33 U
N-Nitrosodiphenylamine	mg/kg	0.33 UJ	0.33 UJ	0.33 UJ
Pentachlorophenol	mg/kg	0.67 U	0.67 U	0.67 U
Phenanthrene	mg/kg	0.88	0.33 U	0.33 U
Phenol	mg/kg	0.33 U	0.33 U	0.33 U
Pyrene	mg/kg	2.02	0.84	0.33 U
Pesticides/Plolychlorinated Biphenyls (PCBs)				
Aroclor-1016 (PCB-1016)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1221 (PCB-1221)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1232 (PCB-1232)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1242 (PCB-1242)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1248 (PCB-1248)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1254 (PCB-1254)	mg/kg	0.33 U	0.33 U	0.33 U
Aroclor-1260 (PCB-1260)	mg/kg	0.33 U	0.33 U	0.33 U
Inorganics				
Antimony	mg/kg	0.3 U	0.3 U	0.3 U
Arsenic	mg/kg	7.38	1.74	1.88
Barium	mg/kg	75.7	9.8	23.9
Beryllium	mg/kg	0.5 U	0.5 U	0.5 U
Cadmium	mg/kg	0.83	0.2 U	0.4
Chromium (Total)	mg/kg	16	8.4	7.2
Cobalt	mg/kg	3	0.9	2.33
Copper	mg/kg	48	8.9	13.1
Cyanide (total)	mg/kg	0.1 U	0.1 U	0.1 U
Lead	mg/kg	72.3	14	20.8
Manganese	mg/kg	452	114	127
Mercury	mg/kg	0.089	0.05 U	0.05 U
Nickel	mg/kg	9.2	2.3	3.2
Selenium	mg/kg	0.47	0.2 U	0.2 U
Silver	mg/kg	0.11 U	0.1 U	0.1 U
Thallium	mg/kg	0.5 U	0.5 U	0.5 U
Vanadium	mg/kg	7.6	1 U	1 U
Zinc	mg/kg	229	41.2	44.1

Table 6
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Subsurface Sediment Analytical Results for Biased Transects Near GM Outfalls 003, 005, and 013

Sample ID: / Sample Depth(in BGS): / Date Collected:	Units	FRT 12C 2 - 12 11/01/06	FRT 12C 12 - 24 11/01/06	FRT 12C 24 - 36 11/01/06
Miscellaneous				
Total Organic Carbon (TOC)	mg/kg	88	27	26
Total Solids	%	41	76	78
Field Parameters				
Clay	%wt	(2)	(2)	(2)
Coarse Sand	%wt	0.4	0.35	0.24
Fine Sand	%wt	54.18	82.09	80.87
Grain Density	mm	0.195	0.311	0.302
Gravel	%wt	0	0.86	0.22
Medium Sand	%wt	24.78	15.49	14.84
Silt	%wt	(2)	(2)	(2)
Silt/Clay	%wt	20.64	1.21	3.83

NOTES:
1. Sampling was performed by representatives from ARCADIS of New York, Inc. and Exponent during the week of October 30, 2006.
2. All samples were screened in the field using a photoionization detector. All readings were indicated to be zero.
3. Samples were analyzed for semivolatile organic consitituents (SVOCs) polychlorinated biphenyls (PCBs), and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
4. U-Analyte was not detected at the presented detection limit.
5. J-The presented value is estimated.
6. [ ] - Field duplicate results are reflected using brackets.
7. (2) - Not differentiated.
8. Abbreviations:
   - > mg/kg = milligrams per kilogram, dry weight
   - > % = percent
   - > % wt = percent by weight
   - > mm = millimeters
   - > BGS = below ground surface

Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Statistics for Surface Sediment Analytical Results for Unbiased Transects

Constituent	Detection Frequency			Maximum Detected Value (mg/Kg)			Average Value (mg/Kg)		
	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Semivolatile Organics (SVOCs)									
2,2'-oxybis(1-Chloropropane) (bis(2-chloroisopropyl) ether)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4,5-Trichlorophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4,6-Trichlorophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4-Dichlorophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4-Dimethylphenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4-Dinitrophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,4-Dinitrotoluene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2,6-Dinitrotoluene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Chloronaphthalene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Chlorophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Methylnaphthalene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Methylphenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Nitroaniline	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
2-Nitrophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
3,3'-Dichlorobenzidine	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
3-Methylphenol	1 of 5	0 of 5	0 of 5	0.36	--	--	0.20	--	--
3-Nitroaniline	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Bromophenyl phenyl ether	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Chloro-3-methylphenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Chloroaniline	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Nitroaniline	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
4-Nitrophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Acenaphthene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Acenaphthylene	0 of 5	0 of 5	1 of 5	--	--	0.098 (J)	--	--	0.15
Acetophenone	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Anthracene	0 of 5	1 of 5	2 of 5	--	0.04 (J)	0.11 (J)	--	0.14	0.13
Atrazine	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Benzaldehyde	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Benzo(a)anthracene	0 of 5	2 of 5	3 of 5	--	0.20 (J)	0.4 (J)	--	0.16	0.23
Benzo(a)pyrene	0 of 5	4 of 5	5 of 5	--	0.62 (J)	1.46 (J)	--	0.28	0.75
Benzo(b)fluoranthene	0 of 5	3 of 5	4 of 5	--	0.75 (J)	1.69 (J)	--	0.30	0.87
Benzo(g,h,i)perylene	0 of 5	4 of 5	5 of 5	--	0.47	1.16	--	0.21	0.56
Benzo(k)fluoranthene	0 of 5	5 of 5	4 of 5	--	0.53 (J)	1.34 (J)	--	0.24	0.70
Biphenyl	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
bis(2-Chloroethyl)ether	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	2 of 5	1 of 5	0 of 5	0.10 (J)	1.77	--	0.13	0.49	--
Butyl benzylphthalate	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Caprolactam	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Carbazole	0 of 5	0 of 5	2 of 5	--	--	0.10 (J)	--	--	0.14
Chrysene	0 of 5	5 of 5	5 of 5	--	0.54	1.18	--	0.24	0.64
Dibenz(a,h)anthracene	0 of 5	0 of 5	1 of 5	--	--	0.12 (J)	--	--	0.16
Dibenzofuran	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Diethyl phthalate	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Dimethyl phthalate	1 of 5	0 of 5	1 of 5	0.05 (J)	--	0.12 (J)	0.14	--	0.15
Di-n-butylphthalate	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Di-n-octyl phthalate	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Fluoranthene	1 of 5	5 of 5	5 of 5	0.03 (J)	1.08	2.2 (J)	0.14	0.43	1.20
Fluorene	0 of 5	1 of 5	3 of 5	--	0.09 (J)	0.10 (J)	--	0.15	0.13
Hexachlorobenzene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Hexachlorobutadiene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Hexachlorocyclopentadiene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Hexachloroethane	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	0 of 5	4 of 5	5 of 5	--	0.39	1.04	--	0.17	0.50
Isophorone	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--

Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Statistics for Surface Sediment Analytical Results for Unbiased Transects

Constituent	Detection Frequency			Maximum Detected Value (mg/Kg)			Average Value (mg/Kg)		
	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Naphthalene	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Nitrobenzene	0 of 5	0 of 5	0 of 5	--	--		0.10	0.10	
N-Nitrosodi-n-propylamine	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
N-Nitrosodiphenylamine	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Pentachlorophenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Phenanthrene	0 of 5	1 of 5	2 of 5	--	0.2 (J)	0.30	--	0.17	0.22
Phenol	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Pyrene	0 of 5	2 of 5	3 of 5	--	0.46	1.33	--	0.26	0.66
Total SVOC Detects	**5 of 325**	**38 or 325**	**51 of 325**						
Pesticides/Polychlorinated Biphenyls (PCBs)									
Aroclor-1016 (PCB-1016)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	0 of 5	0 of 5	1 of 5	--	--	0.02 (J)	--	--	0.14
Total Pests/PCBs Detects	**0 of 35**	**0 of 35**	**1 of 35**						
Inorganics									
Antimony	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Arsenic	5 of 5	5 of 5	5 of 5	12.10	6.62	12.33	3.94	3.92	6.03
Barium	5 of 5	5 of 5	5 of 5	90.6 (J)	73.2 (J)	118.5 (J)	27.02	32.90	53.08
Beryllium	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Cadmium	1 of 5	3 of 5	4 of 5	0.99	0.33	1.89	0.28	0.22	0.71
Chromium (Total)	1 of 5	5 of 5	5 of 5	5.50	22.40	41.20	1.90	10.16	18.94
Cobalt	5 of 5	5 of 5	5 of 5	9.93	2.97	6.05	2.84	1.90	2.87
Copper	3 of 5	5 of 5	5 of 5	15.50	31.20	86.15	4.14	19.46	30.81
Cyanide (total)	0 of 5	0 of 5	1 of 5	--	--	1.00	--	--	0.24
Lead	5 of 5	5 of 5	5 of 5	13.10	214.00	117.00	5.12	56.88	51.18
Manganese	5 of 5	5 of 5	5 of 5	872.00	596.00	1430.00	279.80	423.20	634.30
Mercury	0 of 5	0 of 5	1 of 5	--	--	0.12	--	--	0.04
Nickel	3 of 5	5 of 5	5 of 5	10.70	6.50	12.40	2.94	3.72	6.12
Selenium	1 of 5	4 of 5	4 of 5	0.48	0.39	0.78	0.18	0.27	0.44
Silver	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Thallium	0 of 5	0 of 5	0 of 5	--	--	--	--	--	--
Vanadium	3 of 5	5 of 5	5 of 5	8.20	6.60	10.15	2.36	2.62	4.01
Zinc	5 of 5	5 of 5	5 of 5	42.9 (J)	72.3 (J)	312 (J)	16.38	42.36	157.82
Total Inorganic Detects	**42 of 90**	**57 of 90**	**60 of 90**						

Notes:
1. Upstream = Transects FRT 1, 2, and 3;
   Adjacent = Transects FRT 4, 5, 6;
   Downstream = Transects FRT 7, 8, and 9.
2. -- = No detected values
3. J = Estimated value.
4. When computing averages, a value of half the detection limit was used for samples that were qualified as non-detect.
5. mg/Kg = milligram per kilogram

Table 8
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Statistical Tests on Surface Sediment Results for Unbiased Transects

Constituent	Mean			Median		
	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Anthracene	0.17	0.14	0.13	0.17	0.17	0.17
Benzo(a)anthracene	0.17	0.16	0.24	0.17	0.17	0.17
Benzo(a)pyrene	0.17	0.28	0.75	0.17	0.2	0.81
Benzo(b)fluoranthene	0.17	0.3	0.87	0.17	0.2	0.89
Benzo(g,h,i)perylene	0.17	0.21	0.56*	0.17	0.17	0.62
Benzo(k)fluoranthene	0.17	0.24	0.7	0.17	0.2	0.82
bis(2-Ethylhexyl)phthalate	0.13	0.49	0.27	0.17	0.17	0.26
Carbazole	0.17	0.17	0.14	0.17	0.17	0.17
Chrysene	0.17	0.24	0.64	0.17	0.2	0.66
Fluoranthene	0.14	0.43	1.2*	0.17	0.3	1.2
Fluorene	0.17	0.15	0.13*	0.17	0.17	0.1
Indeno(1,2,3-cd)pyrene	0.17	0.17	0.5	0.17	0.1	0.52
Phenanthrene	0.17	0.18	0.24	0.17	0.17	0.17
Pyrene	0.17	0.26	0.67*	0.17	0.17	0.41
Arsenic	3.9	3.9	6	2.09	3.31	4.28
Barium	27	33	53	11.2	22.8	38.8
Cadmium	0.28	0.22	0.71	0.1	0.26	0.45
Chromium (Total)	1.9	10.2	18.9*	1	7	15.8
Cobalt	2.8	1.9	2.9	1.07	1.57	2.23
Copper	4.1	19.5	30.8	1.9	15.8	16.6
Lead	5.1	56.9	51.2	3.5	16.8	34
Manganese	280	423	634	121	498	584
Nickel	2.9	3.7	6.2	1.5	3.2	4.7
Selenium	0.17	0.27	0.44	0.1	0.28	0.44
Vanadium	2.4	2.6	4	1.1	1.6	2.9
Zinc	16.4	42.4	158	10.9	37.6	94

NOTES:

1. Shading indicates significant differences among groups at 95% confidence level.
2. * = Although Downstream mean is significantly different than Upstream mean, Downstream mean was not significantly different than Adjacent mean.
3. Means were compared using t-tests and ANOVA.
4. Medians were compared using Kruskal-Wallis Test.
5. All analyses were done using Statgraphics 5.1.

Table 9
Flint River Sediment Investigation, GM NAO Flint Operations Site, Flint, MI

Summary of Statistical Tests on Surface Sediment Results for Unbiased and Biasd Adjacent Transects

	Mean		Median	
Constituent	Adjacent Unbiased	Adjacent Biased	Adjacent Unbiased	Adjacent Biased
Anthracene	0.14	0.19	0.17	0.17
Benzo(a)anthracene	0.16	0.23	0.17	0.17
Benzo(a)pyrene	0.28	0.57	0.2	0.515
Benzo(b)fluoranthene	0.30	0.60	0.2	0.59
Benzo(g,h,i)perylene	0.21	0.43	0.17	0.425
Benzo(k)fluoranthene	0.24	0.48	0.2	0.405
bis(2-Ethylhexyl)phthalate	0.49	0.18	0.17	0.135
Carbazole	0.17	0.16	0.17	0.17
Chrysene	0.24	0.45	0.2	0.39
Fluoranthene	0.42	0.94	0.3	0.715
Fluorene	0.15	0.15	0.17	0.17
Indeno(1,2,3-cd)pyrene	0.17	0.37	0.1	0.35
Phenanthrene	0.18	0.42	0.17	0.17
Pyrene	0.26	0.45	0.17	0.185
Arsenic	3.9	5.9	3.31	3.665
Barium	33	45	22.8	24.85
Cadmium	0.22	0.37	0.26	0.1
Chromium (Total)	10	8.8	7	6.85
Cobalt	1.9	2.2	1.57	1.595
Copper	19	22	15.8	13.45
Lead	57	35	16.8	14.75
Manganese	423	395	498	291.5
Nickel	3.7	5.5	3.2	4.05
Selenium	0.27	0.30	0.28	0.1
Vanadium	2.6	3.8	1.6	1.55
Zinc	42	95	37.6	52.2

NOTES:

1. Shading indicates significant differences among groups at 95% confidence level.
2. Means were compared using t-tests and ANOVA.
3. Medians were compared using Kruskal-Wallis Test.
4. All analyses were done using Statgraphics 5.1.

Table 10
Flint River Sediment Investigation' GM NAO Flint Operations Site, Flint, MI

Comparison of Surface Sediment Analytical Results for Unbiased Transects to Regional and Urban Background Levels

		Background Levels				Upstream					
		Urban		Statewide							
Sample ID:						FRT 1C	FRT 2B	FRT 2C	FRT 3A	FRT 3B	
Sample Depth (in BGS):						0–2	0–2	0–2	0–2	0–2	
Date Collected:	Units	Min	Max	Min	Max	11/01/06	11/01/06	11/01/06	11/01/06	11/01/06	Mean
SVOCs											
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*
Benzo[g,h,i]perylene	mg/kg	0.9	47 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*
Chrysene	mg/kg	0.251	0.64 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Fluoranthene	mg/kg	0.2	166 [a]	--	--	0.17 *U*	0.17 *U*	0.03 *J*	0.17 *U*	0.17 *U*	0.14 *J*
Fluorene	mg/kg	--	--	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Pyrene	mg/kg	0.145	147 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Inorganics											
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	1.0 *U*	1.0 *U*	5.5	1.0 *U*	1.0 *U*	1.9
Copper	mg/kg	30	113 [b]	<2	25 [c]	2.3	0.5 *U*	15.5	1.9	0.5 *U*	4.1
Lead	mg/kg	93	160 [b]	<5	50 [c]	3.6	3.5	13.1	3.0	2.4	5.1
Zinc	mg/kg	120	257 [b]	<5	170 [c]	11.7 *J*	8.2 *J*	42.9 *J*	10.9 *J*	8.2 *J*	16.4 *J*

Table 10
Flint River Sediment Investigation' GM NAO Flint Operations Site, Flint, MI

Comparison of Surface Sediment Analytical Results for Unbiased Transects to Regional and Urban Background Levels

Sample ID:		Background Levels				Adjacent											
		Urban		Statewide		FRT 4A		FRT 4C		FRT 5A		FRT 5B		FRT 6B			
Sample Depth (in BGS):						0–2		0–2		0–2		0–2		0–2			
Date Collected:	Units	Min	Max	Min	Max	11/01/06		11/01/06		10/31/06		10/31/06		10/31/06		Mean	
SVOCs																	
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	0.20	*J*	0.62	*J*	0.20	*J*	0.20	*J*	0.17	*U*	0.28	*J*
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	0.20	*J*	0.75	*J*	0.17	*UJ*	0.20	*J*	0.17	*UJ*	0.30	*J*
Benzo[g,h,i]perylene	mg/kg	0.9	47 [a]	--	--	0.10	*J*	0.47		0.10	*J*	0.20	*J*	0.17	*U*	0.21	*J*
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	0.20	*J*	0.53	*J*	0.20	*J*	0.20	*J*	0.07	*J*	0.24	*J*
Chrysene	mg/kg	0.251	0.64 [a]	--	--	0.20	*J*	0.54		0.10	*J*	0.30	*J*	0.06	*J*	0.24	*J*
Fluoranthene	mg/kg	0.2	166 [a]	--	--	0.30	*J*	1.08		0.20	*J*	0.48		0.10	*J*	0.43	*J*
Fluorene	mg/kg	--	--	--	--	0.17	*U*	0.09	*J*	0.17	*U*	0.17	*U*	0.17	*U*	0.15	*J*
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	0.10	*J*	0.39		0.10	*J*	0.10	*J*	0.17	*U*	0.17	
Pyrene	mg/kg	0.145	147 [a]	--	--	0.17	*U*	0.46		0.17	*U*	0.35		0.17	*U*	0.26	
Inorganics																	
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	22.4		7		11.4		4.8		5.2		10.2	
Copper	mg/kg	30	113 [b]	<2	25 [c]	13.5		**31.2**		**25.9**		15.8		10.9		19.5	
Lead	mg/kg	93	160 [b]	<5	50 [c]	15.4		26		**214**		16.8		12.2		**56.9**	
Zinc	mg/kg	120	257 [b]	<5	170 [c]	28.2	*J*	72.3	*J*	43.1	*J*	37.6	*J*	30.6	*J*	42.4	*J*

Table 10
Flint River Sediment Investigation' GM NAO Flint Operations Site, Flint, MI

Comparison of Surface Sediment Analytical Results for Unbiased Transects to Regional and Urban Background Levels

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Sample ID:		Background Levels				Downstream FRT 7A	FRT 7C	FRT 8B	FRT 9A	FRT 9B	
Sample Depth (in BGS):		Urban		Statewide		0–2	0–2	0–2	0–2	0–2	
Date Collected:	Units	Min	Max	Min	Max	10/31/06	10/31/06	10/31/06	10/31/06 AVE	10/31/06	Mean
SVOCs											
Benzo[a]pyrene	mg/kg	0.165	0.22 a	--	--	0.30 J	0.81 J	0.10 J	1.46 J	1.07	0.75 J
Benzo[b]fluoranthene	mg/kg	15	62 a	--	--	0.30 J	0.89 J	0.17 UJ	1.685 J	1.32 J	0.87 J
Benzo[g,h,i]perylene	mg/kg	0.9	47 a	--	--	0.20 J	0.62 J	0.08 J	1.16	0.75	0.56 J
Benzo[k]fluoranthene	mg/kg	0.3	26 a	--	--	0.30 J	0.82 J	0.17 UJ	1.335 J	0.88 J	0.70 J
Chrysene	mg/kg	0.251	0.64 a	--	--	0.30 J	0.66 J	0.10 J	1.18	0.94	0.64 J
Fluoranthene	mg/kg	0.2	166 a	--	--	0.44	1.20 J	0.10 J	2.2 J	2.05	1.20 J
Fluorene	mg/kg	--	--	--	--	0.17 U	0.10 J	0.17 U	0.1 J	0.10 J	0.13 J
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 a	--	--	0.20 J	0.52 J	0.06 J	1.035	0.67	0.50 J
Pyrene	mg/kg	0.145	147 a	--	--	0.17 U	0.41 J	0.17 U	1.325	1.25	0.66 J
Inorganics											
Chromium (Total)	mg/kg	27	55 b	<2	65 c	5.9	7.5	41.2	24.3	15.8	18.9
Copper	mg/kg	30	113 b	<2	25 c	13.7	**33**	4.6	**86.2**	16.6	**30.8**
Lead	mg/kg	93	160 b	<5	50 c	23.9	34	8.2	**117**	**72.8**	**51.2**
Zinc	mg/kg	120	257 b	<5	170 c	49.8 J	94 J	30.8 J	**302.5** J	**312** J	157.8 J

Note: Sampling was performed by ARCADIS BBL and Exponent during the week of October 30, 2006.
Samples were analyzed for SVOCs, PCBs, and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI
Non-detects shown at half the detection limit.
Boxed values exceed the upper range (max) of urban background values.[a,b]
Bold values exceed the upper range (max) of reference site background values.[c]

- BGS - below ground surface
- *J* - estimated value
- mg/kg - milligrams per kilogram, dry weight
- PAH - polycyclic aromatic hydrocarbon
- PCB - polychlorinated biphenyl
- SVOC - semivolatile organic compound
- *U* - undetected at detection limit shown

[a] Background soil concentrations of PAHs in urban soil (ATSDR 1995).

[b] Mean concentrations of metals in Michigan surface soils for residential, commercial, and industrial land uses (Murray et al. 2004).

[c] Statewide reference sediment chemistry for all ecoregions (MDEQ 1999).

Table 11
Flint River Investigation, GM NAO Flint Operations Site, Flint, MI

Comparison of Surface Sediment Analytical Results for Biased Sampling Transects Regional and Urban Background Levels

		Background Levels				Adjacent						
		Urban		Statewide								
Sample ID:						FRT 10A	FRT 10B	FRT 11B	FRT 11C	FRT 12B	FRT 12C	
Sample Depth (in BGS):						0–2	0–2	0–2	0–2	0–2	0–2	
Date Collected:	Units	Min	Max	Min	Max	10/31/06	10/31/06	11/01/06 AVE	11/01/06	10/31/06	10/31/06	Mean
SVOCs												
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	[0.73]	0.20 *J*	[0.865]	0.20 *J*	[0.30] *J*	[0.83]	[0.52] *J*
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	0.88 *J*	0.17 *UJ*	0.865 *J*	0.30 *J*	0.30 *J*	0.88 *J*	0.57 *J*
Benzo[g,h,i]perylene	mg/kg	0.9	47 [a]	--	--	0.65	0.17 *U*	0.56	0.20 *J*	0.20 *J*	0.69	0.41 *J*
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	0.51 *J*	0.17 *UJ*	0.695 *J*	0.20 *J*	0.30 *J*	0.75 *J*	0.44 *J*
Chrysene	mg/kg	0.251	0.64 [a]	--	--	0.58	0.10 *J*	[0.715]	0.20 *J*	0.20 *J*	[0.65]	0.41 *J*
Fluoranthene	mg/kg	0.2	166 [a]	--	--	1.05	0.20 *J*	1.62 *J*	0.38	0.37	1.29	0.82 *J*
Fluorene	mg/kg	--	--	--	--	0.10 *J*	0.17 *U*	0.15 *J*	0.17 *U*	0.17 *U*	0.07 *J*	0.14 *J*
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	0.50	0.17 *U*	0.505	0.20 *J*	0.20 *J*	0.58	0.36 *J*
Pyrene	mg/kg	0.145	147 [a]	--	--	0.20 *J*	0.17 *U*	0.8 *J*	0.17 *U*	0.17 *U*	0.46	0.33 *J*
Inorganics												
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	8.2	2.8	4.1	3.0	10.5	22.8	8.6
Copper	mg/kg	30	113 [b]	<2	25 [c]	24.4	3.3	7.2	17.8	9.1	**73.2**	22.5
Lead	mg/kg	93	160 [b]	<5	50 [c]	35.3	9.1	11	10.1	18.7	**124**	34.7
Zinc	mg/kg	120	257 [b]	<5	170 [c]	105	18.1 *J*	37.5 *J*	25.4 *J*	62 *J*	[**316**] *J*	94 *J*

Note: Sampling was performed by ARCADIS BBL and Exponent during the week of October 30, 2006.
Samples were analyzed for SVOCs, PCBs, and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
Non-detects shown at half the detection limit.
Boxed values exceed the upper range (max) of urban background values.[a,b]
Bold values exceed the upper range (max) of reference site background values.[c]

BGS - below ground surface
J - estimated value
mg/kg - milligrams per kilogram, dry weight
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
U - undetected at detection limit shown

[a] Background soil concentrations of PAHs in urban soil (ATSDR 1995).

[b] Mean concentrations of metals in Michigan surface soils for residential, commercial, and industrial land uses (Murray et al. 2004).

[c] Statewide reference sediment chemistry for all ecoregions (MDEQ 1999).

Table 12
Flint River Investigation, GM NAO Flint Operations Site, Flint, MI

Comparison of Subsurface Sediment Analytical Results for Unbiased Sampling Transects to Regional and Urban Background Levels

Sample ID:		Background Levels				Upstream					
		Urban		Statewide		FRT 2C	FRT 2C	FRT 2C	FRT 2C	FRT 2C	
Sample Depth (in BGS):						2 - 12	12 - 24	24 - 36	36 - 48	48 - 57	
Date Collected:	Units	Min	Max	Min	Max	39022	39022	39022	39022	39022	Mean
SVOCs											
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*
Benzo[g,h,i]perylene	mg/kg	0.9	47 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*	0.17 *UJ*
Chrysene	mg/kg	0.251	0.64 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Fluoranthene	mg/kg	0.2	166 [a]	--	--	0.03 *J*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.14 *U*
Fluorene	mg/kg	--	--	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Pyrene	mg/kg	0.145	147 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*	0.17 *U*
Inorganics											
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	8.9	6.5	2.1	1.0 *U*	1.0 *U*	3.9
Copper	mg/kg	30	113 [b]	<2	25 [c]	7.0	8.1	1.7	1.2	0.5 *U*	3.7
Lead	mg/kg	93	160 [b]	<5	50 [c]	6.6	8.9	1.6	1.6	0.5 *U*	3.8
Zinc	mg/kg	120	257 [b]	<5	170 [c]	30	35	6	6	4	16.1

Table 12
Flint River Investigation, GM NAO Flint Operations Site, Flint, MI

Comparison of Subsurface Sediment Analytical Results for Unbiased Sampling Transects to Regional and Urban Background Levels

Sample ID:		Background Levels				Adjacent			Downstream				
		Urban		Statewide		FRT 4A	FRT 4A		FRT 7C	FRT 7C	FRT 7C	FRT 7C	
Sample Depth (in BGS):						2–12	12–24		2–12	12–24	24–36	36–46	
Date Collected:	Units	Min	Max	Min	Max	11/01/06	11/01/06	Mean	10/31/06 AVE	10/31/06	10/31/06	10/31/06	Mean
SVOCs													
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	0.20 *J*	0.17 *U*	0.18 *J*	[0.5] *U*	[7.00]	[0.53]	0.17 *U*	[2.05]
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	0.10 *J*	0.17 *UJ*	0.13 *J*	1.5 *J*	4.00 *J*	0.30 *J*	0.17 *UJ*	1.49
Benzo[g,h,i]perylene	mg/kg	0.9	47 [a]	--	--	0.10 *J*	0.17 *U*	0.13 *J*	0.5 *U*	3.00 *J*	0.35	0.17 *U*	1.00
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	0.10 *J*	0.17 *UJ*	0.13 *J*	0.9 *J*	4.00 *J*	0.30 *J*	0.17 *UJ*	1.34
Chrysene	mg/kg	0.251	0.64 [a]	--	--	0.10 *J*	0.17 *U*	0.13 *J*	[1.5]	[7.00]	0.38	0.17 *U*	[2.26]
Fluoranthene	mg/kg	0.2	166 [a]	--	--	0.20 *J*	0.17 *U*	0.18 *J*	1.4 *J*	7.00	0.39	0.17 *U*	2.24
Fluorene	mg/kg	--	--	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.5 *U*	0.50 *U*	0.10 *J*	0.17 *U*	0.32
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	0.09 *J*	0.17 *U*	0.13 *J*	0.5 *U*	3.00 *J*	0.30 *J*	0.17 *U*	0.99
Pyrene	mg/kg	0.145	147 [a]	--	--	0.17 *U*	0.17 *U*	0.17 *U*	0.5 *U*	12.0	0.17 *U*	0.17 *U*	3.21
Inorganics													
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	2.5	1.0 *U*	1.8	**[136]**	[64.4]	6.5	2.3	52.3
Copper	mg/kg	30	113 [b]	<2	25 [c]	7.3	1.7	4.5	**[135]**	**[127.0]**	7.9	3.4	**68.3**
Lead	mg/kg	93	160 [b]	<5	50 [c]	7.9	1.8	4.9	**[221]**	**[183.0]**	10.3	3.8	**104.5**
Zinc	mg/kg	120	257 [b]	<5	170 [c]	15	12	13.6	**[645]**	**[338]**	22	12	**254.2**

Note: Sampling was performed by ARCADIS BBL and Exponent during the week of October 30, 2006.
Samples were analyzed for SVOCs, PCBs, and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
Non-detects shown at half the detection limit.
Boxed values exceed the upper range (max) of urban background values.[a,b]
Bold values exceed the upper range (max) of reference site background values.[c]

BGS - below ground surface
J - estimated value
mg/kg - milligrams per kilogram, dry weight
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
U - undetected at detection limit shown

[a] Background soil concentrations of PAHs in urban soil (ATSDR 1995).

[b] Mean concentrations of metals in Michigan surface soils for residential, commercial, and industrial land uses (Murray et al. 2004).

[c] Statewide reference sediment chemistry for all ecoregions (MDEQ 1999).

Table 13
Flint River Investigation, GM NAO Flint Operations Site, Flint, MI

Comparison of Subsurface Sediment Analytical Results for Biased Sampling Transects to Regional and Urban Background Levels

		Background Levels				Adjacent			
Sample ID:		Urban		Statewide		FRT 12C	FRT 12C	FRT 12C	
Sample Depth (in BGS):						2–12	12–24	24–36	
Date Collected:	Units	Min	Max	Min	Max	11/01/06	11/01/06	11/01/06	Mean
SVOCs									
Benzo[a]pyrene	mg/kg	0.165	0.22 [a]	--	--	[1.77]	[0.99]	0.20 *J*	[0.99] *J*
Benzo[b]fluoranthene	mg/kg	15	62 [a]	--	--	2.20 *J*	1.18 *J*	0.30 *J*	1.23 *J*
Benzo[ghi]perylene	mg/kg	0.9	47 [a]	--	--	1.41	0.82	0.20 *J*	0.81 *J*
Benzo[k]fluoranthene	mg/kg	0.3	26 [a]	--	--	1.45 *J*	0.93 *J*	0.20 *J*	0.86 *J*
Chrysene	mg/kg	0.251	0.64 [a]	--	--	[1.54]	[0.88]	0.20 *J*	[0.87] *J*
Fluoranthene	mg/kg	0.2	166 [a]	--	--	3.05	1.69	0.41	1.72
Fluorene	mg/kg	--	--	--	--	0.20 *J*	0.10 *J*	0.17 *U*	0.16 *J*
Indeno[1,2,3-cd]pyrene	mg/kg	8	61 [a]	--	--	1.16	0.69	0.10 *J*	0.65 *J*
Pyrene	mg/kg	0.145	147 [a]	--	--	2.02	0.84	0.17 *U*	1.01
Inorganics									
Chromium (Total)	mg/kg	27	55 [b]	<2	65 [c]	16.0	8.4	7.2	10.5
Copper	mg/kg	30	113 [b]	<2	25 [c]	**48.0**	8.9	13.1	23.3
Lead	mg/kg	93	160 [b]	<5	50 [c]	**72.3**	14.0	20.8	35.7
Zinc	mg/kg	120	257 [b]	<5	170 [c]	**229**	41	44	104.8

Note: Sampling was performed by ARCADIS BBL and Exponent during the week of October 30, 2006.
Samples were analyzed for SVOCs, PCBs, and metals, as well as total organic carbon and particle size distribution, by Merit Laboratories of East Lansing, MI.
Non-detects shown at half the detection limit.
Boxed values exceed the upper range (max) of urban background values.[a,b]
Bold values exceed the upper range (max) of reference site background values.[c]

BGS - below ground surface
J - estimated value
mg/kg - milligrams per kilogram, dry weight
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
U - undetected at detection limit shown

[a] Background soil concentrations of PAHs in urban soil (ATSDR 1995).

[b] Mean concentrations of metals in Michigan surface soils for residential, commercial, and industrial land uses (Murray et al. 2004).

[c] Statewide reference sediment chemistry for all ecoregions (MDEQ 1999).

ARCADIS BBL

Figures

Figures

Figures