EMCON

the i group

603 East Diehl Road, Suite 123, Naperville, Illinois 60563-1477 • **(630) 505-9450** • Fax (630) 505-9454

# TRANSMITTAL

Project/Task No.: 795283.12

TO: Ms. Mirtha Capiro
Project Coordinator for MID 041 793 340
RCRA Enforcement Branch (DE-9J)
U.S. EPA, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DATE: April 19, 2000

RE: GMC Powertrain, Saginaw Metal Casting Operations, Saginaw, Michigan

WE ARE SENDING:

| QUANTITY | DESCRIPTION |
|---|---|
| 2 | Volume I – Phase 1A RFI Report and Phase 1B RFI Workplan – Revision 1 |
| 2 | Attachment A – Amendments to the Quality Assurance Project Plan (QAPP) for Phase 1B |
| 2 | Attachment B – Amendments to the Project Management Plan (PMP) for Phase 1B |
| 2 | Attachment C – Additional Soil Boring Logs |
| 2 | Attachment M – Amendments to the Data Management Plan (DMP) for Phase 1B |
| 2 | Attachment N – Amendments to the Public Involvement Plan (PIP) for Phase 1B |

| For Your: | Sent By: |
|---|---|
| ____ USE | ____ REGULAR MAIL |
| X APPROVAL | X FEDERAL EXPRESS |
| ____ REVIEW/COMMENTS | ____ UPS |
| ____ INFORMATION | ____ COURIER |
| ____ OTHER | ____ OTHER |

COMMENTS: Please replace the June 1999 Volume I with the attached April 2000 Volume I. Attachments A and B are reprinted in their entirety to replace the June 1999 Attachments A and B. The additional boring logs should be added to the June 1999 Attachment C. Attachments M and N are new and should be added to the June 1999 Volume IV. Please note that new binder covers are also included to replace the June 1999 covers of the original submittal.

CC: Distribution List

BY: William K. Steinmann

**Worldwide Facilities Group**
**Environmental & Regulatory Support**
**Remediation Team**

April 19, 2000

Ms. Mirtha Capiro
Project Coordinator for MID 041 793 340
RCRA Enforcement Branch (DE-9J)
U.S. EPA, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

RE: Re: Transmittal of the Phase 1B RFI Workplan, Saginaw Metal Casting Operations, U.S. EPA ID No MID 041-793-340

Dear Ms. Capiro:

Enclosed is the Phase 1B RFI Workplan for the Saginaw Metal Casting Operations Facility in Saginaw, Michigan, which includes the revisions discussed with and agreed upon with the United States Environmental Protection Agency (U.S. EPA). In addition to these previously discussed changes, to assist with the final risk evaluation for the Facility, we have also added eight composite soil samples in Investigative Unit E to be analyzed for manganese. These samples are discussed in Section 5.4.5.2.

We are sending you two complete copies of Volume 1 of the Phase 1B Work Plan, with additional page inserts for Attachments A and B, additional soil borings, and new Attachments M and N. Other volumes/attachments are unchanged from the original draft submittal and were not resent.

Please call if you have questions concerning the submittal. General Motors will mobilize to the Facility four weeks after U.S. EPA approval to proceed.

Sincerely,

Cheryl R. Hiatt
Project Coordinator
General Motors Corp.

**485 West Milwaukee Avenue • Mail Code 482-310-004 • Detroit, MI 48202-3220 • FAX (313) 556-0803**

"I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature: Cheryl R Hiatt

Name: Cheryl R. Hiatt

Title: Project Coordinator

EMCON

# PHASE 1A RCRA FACILITY INVESTIGATION (RFI) REPORT AND PHASE 1B RFI WORKPLAN
Saginaw Metal Casting Operations
Saginaw, Michigan

Volume I

Prepared For:
General Motors Corporation
Worldwide Facilities Group
Remediation Team
Mail Code: 482-310-004
485 West Milwaukee Avenue
Detroit, MI 48202

April 19, 2000

EMCON
Naperville, Illinois

*Environmental Engineers • Scientists • Constructors*

# GENERAL MOTORS CORPORATION

## SAGINAW METAL CASTING OPERATIONS
## WASHINGTON AVENUE AND
## VETERANS MEMORIAL PARKWAY
## SAGINAW, MI
## MID 041 793 340

# PHASE 1A RCRA FACILITY INVESTIGATION (RFI) REPORT AND PHASE 1B RFI WORKPLAN

## APRIL 19, 2000

**EMCON/IT Corporation**
603 EAST DIEHL ROAD, SUITE 123
NAPERVILLE, IL 60563-1477
(630) 505-9450
FAX NO. (630) 505-9454

## DISTRIBUTION LIST

| | |
|---|---|
| **USEPA RCRA Enforcement Branch, Project Coordinator** | Mirtha Capiro (2 copies) |
| **USEPA Senior Chemist** | Brian Freeman |
| **MDEQ Waste Management Division Chief** | Jim Sygo |
| **MDEQ Waste Management Division, District Supervisor** | Ed Haapla (4 copies) |
| **USDOI, East Lansing Field Office** | Dr. Lisa Williams |
| **GM Project Coordinator** | Cheryl R. Hiatt |
| **GM SMCO Environmental Dept.** | Ray Ilkka |
| **GM Legal Counsel** | Tony Thrubis, Esq. |
| **Saginaw City Hall, SMCO Public Repository** | |
| **EMCON Principal-in-Charge** | James J. McGuigan, P.E. |
| **EMCON Project Manager** | William K. Steinmann, CPG |
| **EMCON Document Coordinator** | Heather M. Powell |
| **EMCON Senior Peer Reviewer** | Sally Bilodeau |
| **Environ Quality Assurance Manager** | J. Mark Nielsen |
| **ENVIRON International Corporation, Inc.** | Stephen Song, Ph.D. |
| **Exponent** | Pieter Booth |

# TABLE OF CONTENTS

**Section - Page**

**1.0 INTRODUCTION** ..... 1-1
1.1. Overview ..... 1-1
1.2. Objectives ..... 1-1
1.3. Scope ..... 1-2

**2.0 OVERVIEW OF PHASE 1A INVESTIGATION** ..... 2-1
2.1. Site Description ..... 2-1
2.1.1. Location ..... 2-1
2.1.2. Site/Facility Size and Borders ..... 2-1
2.1.3. Natural and Anthropogenic Features ..... 2-2
2.2. Phase 1A Field Investigation ..... 2-5
2.2.1. Drilling, Soil Sampling, and Well Installation ..... 2-5
2.2.1.1. Monitoring Well Network ..... 2-6
2.2.1.2. Drilling and Soil Sampling ..... 2-6
2.2.1.3. Well Installation ..... 2-9
2.2.2. Well Development and Groundwater Sampling ..... 2-10
2.2.3. Surface Water and Sediment Sampling ..... 2-11
2.2.4. Hydraulic Conductivity Testing ..... 2-11
2.2.4.1. Slug Tests ..... 2-11
2.2.4.2. Pumping Test ..... 2-12
2.2.5. Water Level Study ..... 2-12
2.3. Sample Analyses ..... 2-13
2.3.1. Soil ..... 2-13
2.3.1.1. Physical Parameters ..... 2-13
2.3.1.2. Chemical Parameters ..... 2-13
2.3.2. Groundwater ..... 2-14
2.3.3. Surface Water/Sediment ..... 2-15
2.4. Environmental Setting ..... 2-15
2.4.1. Geology ..... 2-15
2.4.1.1. Regional ..... 2-15
2.4.1.2. Site-Specific ..... 2-16
2.4.2. Hydrogeology ..... 2-18
2.4.2.1. Regional Hydrogeology ..... 2-19
2.4.2.2. Site-Specific Hydrogeologic Conditions ..... 2-19
2.4.2.2.1. Hydrostratigraphic Units ..... 2-19
2.4.2.2.2. Groundwater Flow ..... 2-20
2.4.2.3. Preliminary Hydrogeologic Conceptual Site Model ..... 2-24

## TABLE OF CONTENTS (Continued)

Section - Page

2.4.3. Conceptual Site Model for Potential Human Exposures ..... 2-25
2.4.3.1. Physical Setting ..... 2-25
2.4.3.2. Land Use ..... 2-26
2.4.3.2.1. Historical and Current Land Use ..... 2-27
2.4.3.2.2. Zoning and Future Land Use Plans ..... 2-29
2.4.3.2.3. Likelihood of Future Residential Use ..... 2-29
2.4.3.2.4. Summary of Potentially Exposed Populations ..... 2-32
2.4.3.3. Groundwater Use ..... 2-33
2.4.3.3.1. Sand/Bedrock Aquifer ..... 2-34
2.4.3.3.2. Upper Water-Bearing Zone ..... 2-35
2.4.3.3.3. Summary of Potential Groundwater Exposures ..... 2-35
2.4.4 Ecological Reconnaissance Survey ..... 2-36
2.4.4.1. Surface Water Features ..... 2-36
2.4.4.1.1. Aquatic Biota Survey Methods ..... 2-36
2.4.4.1.2. Deikmann Drain Survey ..... 2-37
2.4.4.1.3. Secondary Settling Pond Survey ..... 2-40
2.4.4.1.4. North Ditch Survey ..... 2-41
2.4.4.1.5. Primary Lagoons Survey ..... 2-42
2.4.4.1.6. Water Reservoir (Lagoon No. 5) Survey ..... 2-43
2.4.4.1.7. Stormwater Ditch Survey ..... 2-45
2.4.4.1.8. Fairchild "Ponds" Survey ..... 2-46
2.4.4.1.9. East Stormwater Ditch Survey ..... 2-46
2.4.4.1.10. Process Water Reservoir Survey ..... 2-46
2.4.4.2. Terrestrial Habitat Characterization ..... 2-47
2.4.4.2.1. Wooded Area No. 1 ..... 2-48
2.4.4.2.2. Type III Solid Waste Landfill ..... 2-49
2.4.4.2.3. Wooded Area No. 2 ..... 2-49
2.4.4.3. Ecological Exposure Pathways Present ..... 2-49
2.4.4.3.1. Aquatic Exposure Pathways ..... 2-50
2.4.4.3.2. Terrestrial Exposure Pathways ..... 2-50

**3.0 DATA VALIDATION AND ASSESSMENT OF PHASE 1A DATA ..... 3-1**
3.1. Description of Data Validation and Assessment ..... 3-1
3.2. Data Quality Objectives ..... 3-1
3.2.1. Estimated Quantitation Limits ..... 3-2
3.2.2. Accuracy ..... 3-2
3.2.3. Precision ..... 3-2
3.2.4. Completeness ..... 3-2

## TABLE OF CONTENTS (Continued)

**Section - Page**

**4.0 SCREENING METHODOLOGY FOR PHASE 1A RFI DATA ..... 4-1**
4.1. Phase 1A Screening Levels ..... 4-1
4.1.1. Soil ..... 4-2
4.1.2. Groundwater ..... 4-3
4.1.3. Sediment and Surface Water ..... 4-4
4.2. Screening Procedure and Results ..... 4-4

**5.0 EVALUATION OF PHASE 1A CHEMICAL DATA AND PROPOSED PHASE 1B SAMPLING ..... 5-1**
5.1. Project Parameters for Analyses ..... 5-1
5.1.1. Field Parameters ..... 5-1
5.1.2. Laboratory Parameters ..... 5-2
5.1.2.1. Organic Compounds ..... 5-2
5.1.2.2. Metals ..... 5-3
5.1.2.3. Additional Parameters ..... 5-4
5.2. Sample Network Design and Rationale ..... 5-4
5.3. Field Procedures ..... 5-5
5.4. Facility-wide Activities ..... 5-6
5.4.1. Investigative Unit A ..... 5-8
5.4.1.1. Phase 1A Data Summary ..... 5-8
5.4.1.1.1.Soil ..... 5-8
5.4.1.1.2.Groundwater ..... 5-8
5.4.1.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-9
5.4.2. Investigative Unit B ..... 5-10
5.4.2.1. Phase 1A Data Summary ..... 5-10
5.4.2.1.1.Soil ..... 5-10
5.4.2.1.2.Groundwater ..... 5-10
5.4.2.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-11
5.4.3. Investigative Unit C ..... 5-13
5.4.3.1. Phase 1A Data Summary ..... 5-13
5.4.3.2. Proposed Phase 1B Activities ..... 5-14
5.4.4. Investigative Unit D ..... 5-14
5.4.4.1. Phase 1A Data Summary ..... 5-14
5.4.4.1.1.Soil ..... 5-14
5.4.4.1.2.Groundwater ..... 5-15
5.4.4.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-15

## TABLE OF CONTENTS (Continued)

**Section - Page**

5.4.5. Investigative Unit E ..... 5-17
5.4.5.1. Phase 1A Data Summary ..... 5-17
5.4.5.1.1.Soil ..... 5-17
5.4.5.1.2.Groundwater ..... 5-18
5.4.5.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-19
5.4.6. Investigative Unit F ..... 5-21
5.4.6.1. Phase 1A Data Summary ..... 5-21
5.4.6.1.1.Soil ..... 5-21
5.4.6.1.2.Groundwater ..... 5-21
5.4.6.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-22
5.4.7. Investigative Unit G ..... 5-22
5.4.7.1. Phase 1A Data Summary ..... 5-22
5.4.7.1.1.Soil ..... 5-22
5.4.7.1.2.Groundwater ..... 5-23
5.4.7.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-24
5.4.8. Investigative Unit H ..... 5-26
5.4.8.1. Phase 1A Data Summary ..... 5-26
5.4.8.1.1.Soil ..... 5-26
5.4.8.1.2.Groundwater ..... 5-27
5.4.8.1.3.Sediment ..... 5-27
5.4.8.1.4.Surface Water ..... 5-28
5.4.8.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-28
5.4.9. Investigative Unit I ..... 5-28
5.4.9.1. Phase 1A Data Summary ..... 5-28
5.4.9.1.1.Soil ..... 5-28
5.4.9.1.2.Groundwater ..... 5-29
5.4.9.2. Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-30
5.4.10. Investigative Unit J ..... 5-31
5.4.10.1.Phase 1A Data Summary ..... 5-31
5.4.10.1.1. Soil ..... 5-31
5.4.10.1.2. Groundwater ..... 5-31
5.4.10.2.Proposed Phase 1B Sampling Locations and Parameter Lists ..... 5-31
5.5. Saginaw River Surface Water And Sediment Sampling Program ..... 5-32
5.5.2.1 Sample Stations ..... 5-33
5.5.2.2 Sample Collection ..... 5-35
5.5.2.3 Sampling and Analysis ..... 5-36
5.5.2.4 Laboratory Analysis ..... 5-38
5.5.2.5 Data Evaluation ..... 5-38

## TABLE OF CONTENTS (Continued)

**Section - Page**

5.6. Quality Assurance/Quality Control ..... 5-40
5.6.1. Data Validation and Assessment ..... 5-41
5.6.2. Data Quality Objectives ..... 5-41
5.7. Project Schedule ..... 5-41

**6.0 BASELINE RISK ASSESSMENT** ..... 6-1
6.1. Human Health Risk Assessment ..... 6-1
6.2. Ecological Risk-Based Screening Approach ..... 6-2
6.2.1. Risk-Based Screening for Direct Media Contact ..... 6-2
6.2.2. Risk-Based Evaluation of Aquatic Food-Web Exposure ..... 6-3

**7.0 BIBLIOGRAPHY** ..... 7-1

## LIST OF TABLES

Table 2-1 Summary of Monitoring Wells Installed
Table 2-2 Soil Sample Designations, Depths, and Analyses, Investigation Areas A through J
Table 2-3 Summary of Monitoring Well Construction Details
Table 2-4 Groundwater Field Parameter Measurements
Table 2-5 Surface Water Field Parameter Measurements
Table 2-6 Summary of Vertical and Horizontal Permeability Testing Results
Table 2-7 Groundwater Sample Designations and Analyses Performed
Table 2-8 Surface Water Sample Designations and Analyses Performed
Table 2-9 Soil Descriptions and Grain Size Distributions
Table 2-10 Summary of Physical Analytical Results
Table 2-11 Sediment Sample Designations and Analyses Performed
Table 2-12 Surface Water Measurements and Elevations
Table 2-13 Scenarios for Potential Human Exposure
Table 3-1 Completeness of Phase 1A Sample Collection and Analysis by Investigation Unit
Table 3-2 Laboratory Completeness
Table 4-1 Phase 1A Screening Levels for Soil and Sediment
Table 4-2 Phase 1A Screening Levels for Groundwater and Surface Water

## LIST OF TABLES (Continued)

Table 4-3 Summary of Detection Frequencies for Phase 1A Soil Analytes with no Screening Levels
Table 4-4 Summary of Screening Evaluation for Phase 1A Soil Characterization Data
Table 4-5 Summary of Screening Evaluation for Phase 1A Groundwater Characterization Data
Table 4-6 Summary of Screening Evaluation for Phase 1A Sediment Characterization Data
Table 4-7 Summary of Screening Evaluation for Phase 1A Surface Water Characterization Data
Table 5-1 Investigative Unit A: Phase 1B Sampling Rationale and AOI Summary
Table 5-2 Investigative Unit B: Phase 1B Sampling Rationale and AOI Summary
Table 5-3 Investigative Unit C: Phase 1B Sampling Rationale and AOI Summary
Table 5-4 Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary
Table 5-5 Investigative Unit E: Phase 1B Sampling Rationale and AOI Summary
Table 5-6 Investigative Unit F: Phase 1B Sampling Rationale and AOI Summary
Table 5-7 Investigative Unit G: Phase 1B Sampling Rationale and AOI Summary
Table 5-8 Investigative Unit H: Phase 1B Sampling Rationale and AOI Summary
Table 5-9 Investigative Unit I: Phase 1B Sampling Rationale and AOI Summary
Table 5-10 Investigative Unit J: Phase 1B Sampling Rationale and AOI Summary
Table 5-11 Summary of Historic PCB Results at the Former #8 Mold Line
Table 5-12 Summary of Proposed Saginaw River Sampling Locations

## LIST OF FIGURES

Figure 1-1 Site Location Map
Figure 1-2 Site Plan (color plan sheet)
Figure 2-1 Sample Locations, Phase IA Investigation
Figure 2-2 Geologic Cross-Sections A-A' and B-B'
Figure 2-3 Geologic Cross-Sections C-C' and D-D'
Figure 2-4 Geologic Cross-Sections E-E' and F-F'
Figure 2-5 Elevation of Bottom of Fill Material
Figure 2-6 Occurrence of Marsh Deposits
Figure 2-7 Structure Map, Top of Bedrock
Figure 2-8 Isopach of Upper Water-Bearing Zone
Figure 2-9 Isopach of Clay, Confining Layer
Figure 2-10 Upper Water-Bearing Zone Groundwater Contour Map

## LIST OF FIGURES (Continued)

Figure 2-11 Bedrock Aquifer Groundwater Contour Map
Figure 2-12 Upper Water-Bearing Zone Groundwater Contour Map Time Series
Figure 2-13 Bedrock Aquifer Groundwater Contour Map Time Series
Figure 2-14 Hydrostratigraphic Cross-Sections A-A' and B-B'
Figure 2-15 Hydrostratigraphic Cross-Sections C-C' and D-D'
Figure 2-16 Soil Inorganic Distribution Isopleths
Figure 2-17 Soil Inorganic Distribution Isopleths
Figure 2-18 Upper Water-Bearing Zone Groundwater Inorganic Distribution Isopleths
Figure 2-19 Upper Water-Bearing Zone Groundwater Inorganic Distribution Isopleths
Figure 2-20 Upper Water-Bearing Zone General Chemistry Distribution Isopleths
Figure 2-21 Subglacial Sand/Bedrock Aquifer General Chemistry Distribution Isopleths
Figure 4-1 Areas Surveyed During the Ecological Reconnaissance
Figure 4-2 Conceptual Model for Critical Ecological Exposure Pathways
Figure 5-1a Investigative Unit A Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-1b Investigative Unit A Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-2a Investigative Unit B Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-2b Investigative Unit B Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations Figure 5-3 Investigative Unit C Phase 1B Proposed Sampling Locations
Figure 5-3 Investigative Unit C Sediment and Surface Water Phase 1A Screening Results
Figure 5-4a Investigative Unit D Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-4b Investigative Unit D Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-4c Investigative Unit D Proposed Sampling Location Details
Figure 5-4d # 8 Mold Line Previous Sample Locations and Phase 1B Proposed Sample Location
Figure 5-5a Investigative Unit E Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-5b Investigative Unit E Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-6a Investigative Unit F Soil Phase 1A Screening Results

## LIST OF FIGURES (Continued)

Figure 5-6b Investigative Unit F Groundwater Phase 1A Screening Results
Figure 5-7a Investigative Unit G Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-7b Investigative Unit G Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-7c Investigative Unit G Proposed Sampling Location Details
Figure 5-8a Investigative Unit H Soil and Sediment Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-8b Investigative Unit H Groundwater and Surface Water Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-9a Investigative Unit I Soil Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-9b Investigative Unit I Groundwater Phase 1A Screening Results and Phase 1B Proposed Sampling Locations
Figure 5-10a Investigative Unit J Soil Phase 1A Screening Results
Figure 5-10b Investigative Unit J Groundwater Phase 1A Screening Results
Figure 5-11 Monitoring Wells for Background Groundwater Quality
Figure 5-12 Proposed Saginaw River Sample Locations
Figure 5-13 Schematic of River Sampling Stations
Figure 5-14 Timeline/Schedule

## LIST OF ATTACHMENTS

A. Amendments to the Quality Assurance Project Plan for Phase 1B
B. Amendments to the Project Management Plan for Phase 1B
C. Soil Boring Logs
D. Slug Test Data and Graphs
E. Water Recycle System Pumping Test Data
F. Water Level Data and Graphs
G. Climatic and River Gauge Data and Hydrograph
H. Phase 1A Data Tables
I. Physical Testing Results
J. Quality Assurance Review Summaries
K. Additional Field Standard Operating Procedures
L. Phase 1A QA/QC Data Tables (Attachment L submitted to U.S.EPA and MDEQ only)
M. Amendments to the Data Management Plan for Phase 1B
N. Amendments to the Public Involvement Plan for Phase 1B

# 1.0 INTRODUCTION

## 1.1. Overview

This Phase 1A RCRA Facility Investigation (RFI) Report and Phase 1B RFI Workplan provides the results of the Phase 1A investigation and the rationale and protocol for implementing the Phase 1B Investigation Activities at the General Motors (GM) Saginaw Metal Casting Operations (SMCO) located at Washington Avenue and Veterans Memorial Parkway in Saginaw, Michigan (U.S. EPA RCRA ID No. MID 041 793 340), henceforth referred to as the Facility.

The Phase 1A Investigation, performed from September 1998 through March 1999, was an initial data acquisition phase concentrating on site-wide soil, surface water, sediment, and groundwater conditions. Information previously submitted in the June 1998 Phase 1A Workplan (Project Management Plan [PMP], Quality Assurance Project Plan [QAPP], Data Management Plan [DMP], Health and Safety Plan, Public Involvement Plan [PIP]) is not repeated here. The analytical results of the Phase 1A Investigation and the Phase 1B Sampling and Analysis Plan are presented in **Section 5** of this document. Modifications to the Phase 1A QAPP required for implementation of Phase 1B are included in **Attachment A**, and amendments to the PMP are presented in **Attachment B**. Amendments to the DMP are presented in **Attachment M** and amendments to the PIP are presented in **Attachment N**.

## 1.2. Objectives

The overall objectives of the SMCO RFI are being achieved through a phased field investigation. During Phase 1A, information was gathered to evaluate the hydrogeologic conditions and the current environmental conditions (i.e., constituent concentrations) at the boundaries of the ten Investigative Units. Phase 1A was performed in late 1998 and early 1999, and the results are summarized in **Section 2.2** of this Phase 1B Workplan and as part of **Section 5**. The overall objectives of the Phase 1B investigation are to further assess the nature and extent of chemical constituents identified during the Phase 1A investigation, to assess the current concentrations of metals in surface water and sediment immediately adjacent to and upstream of the SMCO site, and to evaluate potential areas of interest, if any,

that were not assessed during Phase 1A. The specific objectives of the Phase 1B investigation are as follows:

- Further evaluate the hydrogeologic conditions of the upper water-bearing zone across the site, including further characterization of the groundwater/surface water interactions and the effects of dewatering activities on potential contaminant migration.

- Further evaluate the hydrogeologic conditions of the lower subglacial sand/bedrock aquifer across the site.

- Attempt to determine the sources of substances identified during Phase 1A and relate them, if possible, to the previously identified Areas of Interest (AOIs) or additional areas, if any. Further define the nature and extent of substances identified during Phase 1A.

- Assess specific AOIs where the data collected during Phase 1A and historical information were inadequate to determine whether environmental contamination is present.

- Collect and analyze surface water and sediment samples from within the Saginaw River to determine the current concentrations of specific organic and inorganic parameters in these media and to determine whether any distinction can be made between background concentrations and those concentrations found immediately adjacent to the SMCO site.

- Evaluate the data gathered during Phases 1A and 1B in a baseline human health risk assessment and a screening ecological risk assessment to determine the significance of potential exposures to human and ecological receptors.

## 1.3. Scope

The Phase 1B Workplan, which was developed to meet the above objectives, includes the following tasks:

- Implementation of a subsurface boring program/temporary well (e.g., Geoprobe®) to delineate selected areas of volatile contamination identified in Phase 1A with real time, on-site analytical screening followed by confirmatory laboratory analysis.
- Implementation of a surface water and sediment sampling program within the Saginaw River to characterize the specific organic and inorganic parameter concentrations immediately adjacent to the SMCO site and the upstream, background concentrations.

- Collection of monthly static groundwater elevations to evaluate seasonal variations.
- Advancement of soil borings using a hollow-stem auger drill rig for the purpose of soil sample collection and groundwater monitoring well installations.
- Collection of surface and subsurface soil samples for chemical and physical soils laboratory analysis.
- Conversion of selected soil borings to monitoring wells.
- Collection of groundwater samples from existing Phase 1A monitoring wells and newly installed Phase 1B monitoring wells for chemical laboratory analysis.
- Determination of a site-specific background value for metals and cyanide in groundwater within the upper water-bearing zone and the lower subglacial sand/bedrock aquifer.

The need for further characterization following Phase 1B will be evaluated with respect to the adequacy of characterization of the nature and extent of any releases of constituents to assess human health and ecological risk at the completion of Phase 1B.

During implementation of the Phase 1B field work, field monitoring will be performed for the following reasons:

- Assistance in the selection of soil samples for laboratory analysis.
- Definition of extent of areas with elevated concentrations of volatile organic compounds.
- Field worker health and safety.

Field screening data will include visual and olfactory observations, and measurements using a photoionization detector (PID), a pH/conductivity meter, or other real-time monitoring equipment that can be used on-site (e.g., on site mobile laboratory for volatile screening). The field data requirements are summarized in the QAPP: Part IV of the Phase 1A RFI Workplan (June 1998), or as amended in this Phase 1B Workplan (**Attachment A**).

Soil samples will be collected and analyzed to determine the presence or absence (and associated concentrations) of hazardous constituents in surface and subsurface soil. As mentioned above, soil samples will be field screened during Phase 1B to assist in determining the most appropriate samples for laboratory analyses. Soil samples selected for laboratory analyses (as discussed in **Section 5.1.2**) will be analyzed for the specific parameters listed in **Tables 3a-3f** of **Attachment A** and identified in **Tables 5-1 through 5-10**. If the field screening

results for soil samples from the proposed borings indicate that chemical constituents are present, additional borings may be drilled to delineate the extent of constituents.

Ground-water samples from all Phase 1A and newly installed Phase 1B monitoring wells will also be collected and analyzed for the parameters listed in **Tables 3a-3f** of **Attachment A** and as identified in **Tables 5-1 through 5-10**. Ground-water samples collected from temporary monitoring points (e.g., GeoProbe) will be analyzed for the parameters listed in **Section 1.4.2.4** of **Attachment A** and will be used for field screening purposes only. That is, field screening data will be used to define the extent and assess the presence or absence of hazardous constituents at the locations sampled to determine if constituents may be migrating to or from an Investigative Unit, an AOI, or a group of AOIs; and to determine appropriate placement of groundwater monitoring wells.

Based on the overall conceptual approach to the RFI, the data generated during the successive phases and compiled for the entire RFI project will ultimately be used to:

- Characterize the potential pathways of contaminant migration.
- Characterize the contaminants that have the potential to adversely affect human health and/or the environment.
- Identify potential receptors.
- Support a Baseline Human Health and Ecological Risk Assessment.
- Support the development of corrective measure alternatives (if necessary).

Once the data from Phase 1B have been collected and compiled, the results will be evaluated and statistical analyses/modeling will be performed, if appropriate, to determine whether the nature and extent of releases of hazardous constituents have been adequately characterized. Once the investigation is complete, the results will be used in a baseline risk assessment to evaluate the potential risks to human health and the environment and the need for remedial measures.

# 2.0 OVERVIEW OF PHASE 1A INVESTIGATION

From September 1998 through March 1999, the environmental conditions at the Facility were investigated in accordance with the Phase 1A Sampling and Analysis Plan (Phase 1A SAP). The Phase 1A SAP was presented as Part II of the Phase 1A RCRA Facility Investigation (RFI) Workplan - Task III (June, 1998). The RFI Workplan was approved by the U.S. EPA in their letter to GM dated June 30, 1998.

## 2.1. Site Description

The following sections provide a summary of the Facility and the manufacturing operations which are, or have been, conducted at the Facility.

### 2.1.1. Location

The Facility is located at Washington Avenue and Veterans Memorial Parkway, primarily in the City of Saginaw, and partially in Buena Vista Township (the eastern portion of the Facility), Saginaw County, Michigan. The Facility is located in Sections 5, 7, 8, 9, 17, and 18, Township 12 North, Range 4 East, Saginaw County, Michigan, as indicated on the Site Location Map (**Figure 1-1**).

### 2.1.2. Site/Facility Size and Borders

The Facility is an industrial manufacturing site located on approximately 700 acres, with the current property line as indicated on the site plan (**Figure 1-2**). It is comprised of areas that are zoned as varying degrees of "industrial" on the City of Saginaw and Charter Township of Buena Vista Zoning Maps, 1990 and 1991 versions respectively. Land surrounding the Facility is used primarily for commercial and industrial purposes. South of the Facility is a small residential area, and east of the Facility is agricultural land. The site is bounded by the following:

- The Saginaw River to the west/northwest;
- The City of Saginaw Wastewater Treatment Plant, and the former City of Saginaw Landfill (SCA or Crow Island Landfill) to the north;
- The Buena Vista Wastewater Treatment Plant to the north and east (between the site and I-75);
- Agricultural areas to the east along Outer Drive;
- General businesses including a recycling facility and a former bulk petroleum transfer facility to the south and east;
- Some residential areas to the southeast (along Deikmann Street and Washington Avenue), and;
- General small business areas to the south along Washington Avenue and the west along Sixth Street.

The site is bounded on the south side of the eastern half by a Consumers Power easement. The site is transected by the Chesapeake and Ohio Railroad Company easement, the Veterans Memorial Parkway right-of-way, the City of Saginaw Stormwater Ditch, and a parcel owned by Mr. Larry Fairchild/Tri-County Refuse Company.

### 2.1.3. Natural and Anthropogenic Features

The site plan (**Figure 1-2**) shows the property boundaries and the locations of the three primary manufacturing plants that have historically been located at the Facility: the Grey Iron Plant (now referred to as the currently operating metal casting plant at the Saginaw Metal Casting Operations (SMCO) Facility), and the Former Parts Plant and the Former Nodular Iron Plant, both of which have been demolished.

Ten geographic Investigative Units (IUs), designated as Investigative Unit A through J were delineated in the Phase 1A RFI Workplan to segregate the approximately 700 acre facility into manageable sized areas for the RFI. These ten Investigative Units are graphically depicted in Figure 2-1 and on various other Figures of this Phase 1A Report and Phase 1B RFI Workplan.

As can be seen in **Figure 1-2**, the site is comprised of the following major features for each Investigative Unit:

- **Investigative Unit A.** The Former Sluice Sand Settling Area, located on the north part of the west edge of the site, is currently a vacant field which contains a large staging area for recyclable quench slag. Historically, this area received sluice water from the currently operating metal casting plant, which allowed the sand to settle out and the water to discharge to the Saginaw River. The sand was subsequently reclaimed for use in the plant. This operation was discontinued circa 1983.

- **Investigative Unit B.** The Former Parts Plant, located in the southwestern corner of the site, is currently a vacant field. This plant was utilized by GM primarily for machining and storage of engine blocks and various other metal products.

- **Investigative Unit C.** The Recycle Water Reservoir, located northwest of the currently operating metal casting plant and directly west of the Riverdock Area, stages water which is recirculated from the wastewater treatment system for re-use in the currently operating metal casting plant and comprises part of a closed-loop system.

- **Investigative Unit D.** The located in the southwestern portion of the site, east of the Former Parts Plant, is comprised of the approximately 1.8 million square feet ($ft^2$) currently operating metal casting plant main building and a number of smaller ancillary buildings. The operating metal casting plant currently casts iron and aluminum for automotive engines and cylinder heads. The major manufacturing processes which are utilized to make castings at the currently operating metal casting plant include core-making, melting, molten metal pouring, and cleaning/rough finishing.

- **Investigative Unit E.** The Riverdock area, north of the currently operating metal casting plant, includes a receiving dock and numerous railroad sidings and had historically (since circa 1929) been utilized for bulk materials storage, including sand, limestone, coke and scrap metal. GM stopped receiving bulk raw materials by ship circa 1985. Currently, the primary materials stored in this yard are recyclable core butts, quench slag and casting sand.

  The Advanced Development Lab (formerly the Castings Development Plant), located in the Riverdock Area, to the north/northwest of the currently operating metal casting plant main building, is a small-scale experimental foundry utilized by GM (since 1962) for developing and testing new foundry methods and prototype casting processes. Many of the operations occurring within this facility are small-scale versions of that described for the currently operating metal casting plant above, as well as various other research activities.

  The current Powerhouse, which was constructed in 1965, generates steam for plant processes, currently by burning natural gas. There are three large above-ground tanks to the north of the Powerhouse, formerly used when it operated on fuel oil. Two of these tanks have been certified closed, while one remains operational for emergency backup use, although it is currently empty.

- **Investigative Unit F.** The Advanced Materials Development Center building (AMDC), located east of the currently operating metal casting plant, is utilized

for production of unique automotive components and experimental materials. It has been in operation since 1965, but was utilized as a warehouse prior to conversion in 1988 to its current manufacturing capacity.

The Administration Building (built in 1967), formerly located east of the AMDC is an office building which was originally designed to house GM Central Foundry Administrative staff and subsequently another division of GM. This building was demolished in late 1998. Only the former parking lot remains at this location.

- **Investigative Unit G.** The Former Nodular Iron Plant, located east of the Riverdock area and southwest of the Wastewater Treatment System, was approximately 1.0 million $ft^2$ consisting of the Former Nodular Iron Plant Main Building and a number of smaller ancillary buildings. The Former Nodular Iron Plant formerly cast automotive components from nodular iron, but was closed in December 1987. The manufacturing processes conducted were similar to that of Grey Iron's (core mold making through the hot and cold processes, virgin and scrap iron melting, molten iron pouring and rough cleaning and finishing), with an additional step to add calcium carbide to the molten iron to reduce the sulfur content for the production of nodular iron. The former plant has recently been demolished.

- **Investigative Unit H.** The Wastewater Treatment System, located northeast of the Former Nodular Iron Plant, contains classifiers, mixing tanks, flocculators, treatment tanks, and primary and secondary settling basins. The water passing through the system is recirculated to the water reservoir discussed under IU C, with a small percentage discharged to the City of Saginaw Wastewater Treatment System after pretreatment by GM.

- **Investigative Unit I.** A small building, identified as the Downes School building, was formerly located in the eastern portion of this triangular parcel. During GM's ownership of this building, it was used exclusively as a warehouse for storage of landscaping and earthmoving equipment. This building was demolished in 1988. This area is currently being used by SMCO for bulk sand and recyclable materials staging. In addition, clay from the construction of the on-site landfill has been placed in the northern half of this area and is being stored for future use in capping the on-site landfill in IU J.

- **Investigative Unit J.** The GM On-Site Landfill, located north of the Wastewater Treatment System, is a 60 acre, Michigan PA 641 licensed Type III landfill (industrial monofill) and has been in operation since 1978. The primary materials disposed of are wastewater treatment sediment, filter cake and construction/demolition debris from the Facility. Additional waste core sand,

slag and core butts are received from the GM Saginaw Malleable Iron Plant, which is also located in Saginaw.

## 2.2. Phase 1A Field Investigation

The Phase 1A, site-wide field investigation included drilling and logging exploratory soil borings; installing groundwater monitoring wells; collecting and analyzing soil, groundwater, surface water, and sediment samples; performing hydraulic conductivity testing; and conducting a site-wide water level study. Samples of soil, surface water, sediment, and groundwater were collected and analyzed for various chemical constituents. Additionally, selected soil samples were analyzed for grain size, vertical permeability, density, and porosity. The Phase 1A investigation was performed to characterize the site-wide hydrogeologic and geologic conditions and to assess the current concentrations of potential chemical constituents at the Investigative Unit boundaries, as well as at selected AOIs.

With the exceptions noted herein, all activities were performed consistent with the scope of work and procedures described in the Phase 1A RFI Workplan.

### 2.2.1. Drilling, Soil Sampling, and Well Installation

The proposed scope of work, as described in the Phase 1A RFI Workplan included drilling 69 soil borings and converting them to groundwater monitoring wells (50 shallow wells, 15 intermediate wells, and 4 deep wells). During September, October, and November 1998, EMCON drilled 73 soil borings and converted 63 of the borings to groundwater monitoring wells. Of the 63 wells installed, 42 were screened in the upper water-bearing zone, 14 were screened within the confining layer, and 7 were screened in the deep subglacial sand/bedrock water-bearing zone. The soil boring and well locations were based on the proposed locations identified in the Phase 1A Workplan and on actual conditions encountered in the field. The Phase 1A monitoring well network and soil boring locations are shown on **Figure 2-1.**

With few exceptions, drilling, soil sampling, and well installation activities were performed consistent with the Phase 1A RFI Workplan. However, because of conditions encountered during the drilling and well installation activities, minor modifications to the proposed investigation were necessary. Some modifications/additions to the monitoring well network were also implemented because of site-specific conditions encountered during the field program. Modifications to the Phase 1A RFI Workplan monitoring well network and the field procedures are noted and are described below, where applicable.

### 2.2.1.1. Monitoring Well Network

Fourteen of the initially proposed wells were not installed, 5 were installed at different locations than proposed, and 8 were added to the monitoring well network, as described in the Phase 1A Workplan. In addition, some of the wells that are labeled as intermediate wells (i.e., MW-1####, in accordance with the five-digit well numbering system proposed in the Phase 1A RFI Workplan) are actually screened within the upper water-bearing zone or within the subglacial sand/bedrock aquifer. This determination was made subsequently to the field activities, during the detailed evaluation of hydrologic data collected at the site. **Table 2-1** lists the wells according to the zone they are screened in, and a detailed discussion of the site hydrogeologic conditions is presented in **Section 2.4.**

**Table 2-1** lists all of the monitoring wells that were proposed in the RFI Workplan and those that were added after initiation of the field activities. This table also includes the reasons why the well network was modified. As shown on this table, all of the objectives of the Phase 1A wells were met. These objectives, as described in the Phase 1A RFI Workplan are as follows:

- Identify potential constituents of concern at the Investigative Unit boundaries within the soil and groundwater.
- Characterize the Facility-wide hydrogeologic and geologic conditions.
- Identify potential constituents of concern within the surface water and sediment of selected surface water bodies.
- Identify site-specific data with regard to potential contaminant migration.
- Develop the conceptual site model for human health and ecological risk assessment.
- Identify any additional data needs.
- Develop a Phase 1B Workplan.

### 2.2.1.2. Drilling and Soil Sampling

During the Phase 1A investigation, EMCON collected a total of 224 soil samples for physical and/or chemical analyses, including duplicate samples. Soil samples were collected from Investigative Units A, B, and D through J. No soil samples were collected from Investigative Unit C, which encompasses only the surface water body of the Recycle Water Reservoir. **Table 2-2** lists the soil samples collected from each of the sampled Investigative Units and the analyses performed.

Methods and Procedures. In general, soil samples were collected, stored, and transported using the methods and procedures described in the Phase 1A RFI

Workplan. The following modifications were made to address the site-specific conditions, to assure the data validity, and to meet the data quality objectives:

- Surface soil samples were collected using a decontaminated split-barrel sampler rather than a trowel or a hand auger. Given the availability of the drill rig on site and the relative ease of sampling with the rig rather than by hand, surface samples were collected with the split-barrel sampler.

- Several of the boring locations (MW-00124/90124, MW-01329, MW-11530, MW-11901, MW-12432, MW-13205/93205, MW-13240, MW-13623, and MW-97948) were not sampled continuously because of the presence of flowing sand that resulted in difficult drilling and sampling conditions. To prevent the sand from flowing into the hollow stem augers, these borings were advanced through the sand without sampling until a cohesive unit or until bedrock was encountered.

Organic vapor screening (i.e., photoionization detector [PID] headspace analysis) was not performed for all soil samples due to limited sample recovery and sporadic equipment malfunction. Headspace readings were taken whenever possible. Headspace readings are presented on the boring logs in **Attachment C.**

Most soil cuttings generated during the drilling activities were placed in roll-off bins for temporary storage pending characterization and off-site disposal. If soil borings were drilled in areas where potential contamination was anticipated or if evidence of contamination was noted during the drilling, soil cuttings were placed in labeled 55-gallon drums.

Sample Retention for Chemical and Physical Analyses. The Phase 1A RFI Workplan specified the depths at which subsurface samples would be retained for chemical and physical analyses. The specifications included the following:

- Collecting at least two unsaturated soil samples for chemical analysis at the shallow well locations. At a minimum, samples were to include one from the 0- to 2-foot depth interval and one from just above the capillary fringe. Most drilling locations were also sampled at depths of 4 to 6 feet to assure that a second unsaturated sample was collected above the upper water-bearing zone.

- Collecting unsaturated soil samples for chemical analyses at minimum 15-foot depth intervals at the intermediate well locations.

- Collecting soil samples for physical analyses at each of the intermediate well locations. Samples were to include, at a minimum, one unsaturated

soil sample for each 15-foot interval drilled. In addition, each distinct geologic unit was to be sampled for physical analyses.

- Collecting two samples at each of the intermediate well locations for density testing.

In general, soil samples were retained for physical and chemical analyses as required. **Table 2-2** lists the samples collected from each IU, including the sample locations, designations, depths, and analyses performed. The soil sampling program was modified as follows to meet field conditions encountered during the field activities:

- A 0- to 2-foot soil sample was not collected from MW-02410 due to the presence of concrete at the surface. A sample was collected from this boring at a depth of 2 to 4 feet.

- Because groundwater was encountered at depths less than 4 feet below the ground surface in soil borings SB-198, MW-00909, MW-03235, MW-04854, and MW-06445, soil samples for chemical analysis were not collected just above the capillary fringe of the upper water-bearing zone. Since groundwater was so shallow, only one unsaturated sample (i.e., the 0- to 2-foot sample) was collected from each of these borings for chemical analysis. Given the shallow depths to shallow water in these borings, the analytical results for the surface soil samples are considered to represent capillary fringe soil conditions as well as surface soil conditions.

- A moist zone was encountered in boring MW-04250 at a depth of approximately 3.2 feet. This moist zone was initially thought to be the upper water-bearing zone, so soil samples from below this depth were not collected for chemical analysis. Following additional drilling, it was discovered that the actual depth to first encountered groundwater was 9.8 feet. Therefore, the capillary fringe in this boring was not sampled.

- The requirement to sample at minimum 15-foot intervals was inadvertently not met at two of the soil boring locations. Boring location MW-13205/MW-93205 was not sampled for chemical analysis between depths of 48 and 70 feet, and boring location MW-00124/MW-90124 was not sampled for chemical analysis between depths of 10 and 32 feet or 50 and 82 feet. Based on the analytical data for other samples from these borings, the lack of data for these intervals is not considered significant.

- Given the highly variable (i.e., interbedded) lithology and the presence of flowing sand at many boring locations, soil samples for physical testing were not collected from each distinct stratigraphic unit at all of the

intermediate well locations. In some cases, the individual units were too thin to sample independently. In other cases, loose sand flowed up into the augers and prevented the collection of samples that were undisturbed and representative of the unit. In yet other cases, the hardness of the clay caused the Shelby tube to bend, preventing collection of a sample. Given the number of samples collected from the various units and the relatively consistent data for samples from similar geologic materials, the available data are considered ample to characterize geologic and hydrogeologic conditions at the site.

### 2.2.1.3. Well Installation

A summary of Phase 1A monitoring well construction details is presented on **Table 2-3.** In general, the wells were installed using the procedures and materials specified in the RFI Workplan. However, the following modifications to the Workplan were made during the field activities to address actual site conditions encountered in the field:

- Double casing was not required for several of the intermediate wells (MW-10000, MW-12728, MW-15450, MW-15964, MW-16080, MW-17661, and MW-17948) because shallow groundwater was not encountered at these locations.

- Double casing was not required for wells MW-15457 and MW-16357. Although these wells are labeled as intermediate wells (i.e., MW-1####), they are actually screened across the upper water-bearing zone. Wells MW-15457 and MW-16357 were drilled and installed to replace proposed shallow wells MW-05457 and MW-06357, where shallow groundwater was not encountered. Since shallow groundwater was not encountered in borings MW-05457 and MW-06357, it was anticipated that MW-15457 and MW-16357 would be installed within the intermediate zone. However, during drilling of the replacement well borings, shallow groundwater was encountered. Therefore, these wells are screened in the upper water-bearing zone.

- Since soil boring SB-298 was drilled to a target depth of only 3 feet to characterize shallow soil and since the boring only penetrated granular materials, it was backfilled with the soil cuttings generated during boring advancement.

- Shallow wells MW-01329 and MW-16357 were installed using polyvinyl chloride (PVC) riser rather than stainless steel riser because of material availability (i.e., stainless steel riser was not available at the time the wells

were installed). All other shallow wells were installed using stainless steel riser. Stainless steel screen was used for all monitoring wells as required.

- Although wells MW-11901, MW-12432, and MW-13205 are labeled as intermediate wells (i.e., MW-1####), they are actually screened within the lower aquifer. During the drilling activities, a potential water-bearing zone was not encountered in the intermediate zone. Therefore, these wells are screened in the lower aquifer.

### 2.2.2. Well Development and Groundwater Sampling

In general, the monitoring wells were developed, purged, and sampled according to the Standard Operating Procedures (SOP) presented in the RFI Workplan. Equipment that was used for developing more than one well was decontaminated between wells, as described in the Decontamination of Field Equipment SOP, presented in the RFI Workplan. Although most of the samples were shipped from the field to the laboratory at the end of each day, some of the groundwater samples were kept on site overnight and shipped to the laboratory the following day. All samples were kept in chilled containers pending shipment to the laboratory.

Groundwater sampling was conducted from November 16, 1998, until December 2, 1998. Samples were collected from 61 of the 63 monitoring wells. Wells MW-12728 and MW-15450, both screened within the confining layer, were not sampled due to insufficient sample volume over a 24-hour period because of poor groundwater recharge within the confining layer at these locations. During well purging and sampling, field parameters were monitored as described in the Phase 1A RFI Workplan. The monitored field parameters included the following:

- Dissolved oxygen (DO).
- pH.
- Oxidation-reduction potential (Eh).
- Specific conductivity.
- Temperature.

The field parameter results that were measured during the well sampling activities are presented on **Table 2-4**.

During sampling, disposable or dedicated equipment was used for all monitoring wells. Well development and purge water generated during the field activities was containerized in polyethylene tanks for temporary on-site storage pending appropriate treatment or disposal. With the exception of the samples that were

held at the site overnight, all field activities were documented and all samples were handled and delivered to the laboratory as specified in the Phase 1A RFI Workplan.

## 2.2.3. Surface Water and Sediment Sampling

Surface water and sediment samples were collected for physical and chemical analysis from November 16 through November 19, 1998, in accordance with the SOP included in the Phase 1A RFI Workplan (June 1998). The sample locations are shown on **Figure 2-1**. The only deviation from the Phase 1A Workplan is that a surface water sample could not be collected at sample location J4 because no surface water was present at the time of sample collection. However, a sediment sample (J4) was collected at this location. Field parameter results that were measured during the surface water sampling activities are presented on **Table 2-5**.

## 2.2.4. Hydraulic Conductivity Testing

### 2.2.4.1. Slug Tests

Slug tests were performed from December 17, 1998, through January 10, 1999. Slug tests included rising-head and/or falling-head, depending upon the relationship between the static water level and the screened interval (i.e., falling head tests were only conducted on monitoring wells where the static water level was above the slotted section of the screen at the time of testing). Equipment that was used in more than one well was decontaminated between wells as described in the RFI Workplan. All slug tests were performed in accordance with the SOP included in the Phase 1A RFI Workplan.

Single-well, hydraulic conductivity testing (slug tests) was performed in all of the 63 Phase 1A monitoring wells consistent with the procedures described in the RFI Workplan. Each well (with the exception of two) was tested three times, and the results of the analyses were averaged for the separate tests. Monitoring wells MW-15964 and MW-16080 could be tested only one time and two times, respectively, because of poor recharge. For four of the monitoring wells tested (MW-00509, MW-04854, MW-12432, and MW-16357) only two test results were averaged because the data for the third test were poor. The poor data likely resulted from the lack of groundwater stabilization and/or recharge prior to initiation of the tests.

All slug test data were analyzed using the method of Bouwer and Rice (1976) and Bouwer (1988). This method of analysis was chosen because of the variable conditions encountered across the site (e.g., unconfined, leaky confined, partially

and fully penetrating screens, etc.). **Table 2-6** provides a summary of the slug test results from the individual monitoring wells. Data, plots, and calculations can be found in **Attachment D** A discussion of the slug test results is in **Section 2.4.2** of this Phase 1B Workplan.

#### 2.2.4.2. Pumping Test

A four-hour pumping test was performed on March 24, 1999, to evaluate hydraulic conditions near the primary lagoons in Area H. This test was conducted as part of the Water Recycle System Workplan prepared by Conestoga-Rovers & Associates to address the MDEQ's concerns of a potential groundwater discharge (Appendix A to the Phase 1A SAP, June 1998). The pumping test consisted of pumping groundwater from monitoring well MW-06951 and monitoring the change in head at five adjacent monitoring wells screened within the upper water-bearing zone. Surface-water measurements were also recorded at the secondary settling pond during performance of the pumping test. **Attachment E** presents the data for the four-hour pumping test

### 2.2.5. Water Level Study

As described in the RFI Workplan, a water level study was performed to determine whether the individual water-bearing units are interconnected and to identify external influences, if any, on the groundwater elevations.

The water level study involved placing a programmable water-level transducer with a built-in data logger into each of the 63 Phase 1A monitoring wells. The transducers were programmed to measure the depth to groundwater every 4 hours for 6 weeks. Depth to water measurements were collected from February 10 through March 24, 1999. **Attachment F** presents the data and hydrographs from the water level study. A discussion of the water level study is in **Section 2.4.2.**

Climatic data for the Saginaw, Michigan area and river gauge data for the Saginaw River were obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Data were obtained for the period from September 1998 through March 1999 (**Attachment G**). A discussion of the climatic data is presented in **Section 2.4.2.**

Depth to groundwater was measured at each monitoring well during the well installation, well development, well sampling, hydraulic conductivity testing, and every four hours during the water level study. Since the conclusion of the water level study (March 24, 1999), no additional depths to water have been measured. In accordance with the approved Phase 1A RFI Workplan, depths to water were to

be measured monthly for twelve months. GM proposes to continue with the monthly measurements through June 2000, which will be initiated prior to this Phase 1B Workplan approval (refer to **Section 5.4**).

## 2.3. Sample Analyses

Unless noted below, soil, surface water, sediment, and groundwater samples were analyzed for the parameters specified in the RFI Workplan. **Table 2-2** and **Tables 2-7** through **2-9** list the sample designations, locations, and analyses performed on each soil, surface water, sediment, and groundwater sample, respectively.

### 2.3.1. Soil

#### 2.3.1.1. Physical Parameters

Fifty-two soil samples were collected for physical testing. Samples were collected from 3 of the shallow well borings, 6 of the deep well borings, and all 14 of the intermediate well borings. All 52 samples were tested for moisture content and grain size distribution, and 31 of the 52 samples were tested for permeability, density, and porosity. The physical test results are presented on **Tables 2-10** and **2-11**. Discussions of the results are presented in **Section 2.4.1** and **2.4.2.**

#### 2.3.1.2. Chemical Parameters

All soil samples were analyzed for the chemical parameters specified in the Phase 1A RFI Workplan (i.e., 40 CFR 264 Appendix IX sublists for metals, volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], and polychlorinated biphenyls [PCBs], total kjeldahl nitrogen [TKN], cyanide and sulfide). Additionally, soil samples collected in Investigative Unit I were additionally analyzed for formaldehyde. Soil samples for laboratory analysis were selected in accordance with the Phase 1A RFI Workplan (i.e., one at the 0- to 2-foot interval, one above the capillary fringe, and an additional sample from approximately 5 to 7 feet below ground surface where the depth to water was greater than 8 feet). Additional samples were collected in unsaturated soil at approximately 15-foot intervals and were selected for chemical analysis based on the depth, visual or olfactory evidence of impact, and/or PID screening results.

For various reasons unrelated to the RFI, soil samples were collected in several additional areas of interest prior to approval of the Phase 1A RFI Workplan. Although these data were not collected as part of the Phase 1A RFI, the results are

included herein because they meet the data quality objectives of the RFI. These additional sampling areas are listed below, along with the purpose of the sampling activities and descriptions of the analytical data obtained for these locations:

Former Nodular Iron Plant, North Parking Lot: Soil and groundwater samples were collected during two separate Phase 2 Environmental Site Assessments related to the sale of this property. Samples collected during the first sampling event in February 1998 were analyzed for VOCs, SVOCs (including the top 10 tentatively identified compounds [TICs]), total metals, dissolved metals (groundwater only), PCBs, and ammonia-nitrogen (groundwater only), as listed in the 40 CFR 264 Appendix IX sublists. Samples collected during the second sampling event in June 1998 were analyzed for SVOCs (including the top 10 TICs), total metals, dissolved metals (groundwater only), PCBs, and ammonia-nitrogen (groundwater only), as listed in the 40 CFR 264 Appendix IX sublists.

Former Leaking Underground Storage Tanks locations related to the former Nodular Iron Plant operations (Former Mill Water Pump House UST NI #9 and Former Cooling Tower Pump House UST NI #7): Soil and groundwater samples were collected from the UST areas in June 1998 and analyzed for the VOCs and SVOCs listed in the 40 CFR 264 Appendix IX sublists (excluding the top 10 TICs).

Downes School Building storage tank locations (former NI #10 UST, and former NI #11 and #12 ASTs): Soil and groundwater samples were collected from the storage tank areas in June 1998 and analyzed for the VOCs and SVOCs listed in 40 CFR 264 Appendix IX sublists (excluding the top 10 TICs).

Soil analytical results are presented in **Attachment H.** A discussion of the findings is presented in **Section 5.4.**

### 2.3.2. Groundwater

All groundwater samples were analyzed for the parameters specified in the Phase 1A RFI Workplan (i.e., 40 CFR 264 sublists for total and dissolved metals, VOCs, SVOCs, and PCBs, and TKN, cyanide, and sulfide). Additionally, groundwater samples from Investigative Unit I were analyzed for formaldehyde. Groundwater analytical results are presented in **Attachment H.** A discussion of the findings is presented in **Section 5.4.**

Two existing monitoring wells were sampled prior to final Phase 1A RFI Workplan approval during the Phase 2 ESAs and UST closure sampling activities to assess the groundwater quality adjacent to two former RCRA treatment units. One groundwater sample was collected from monitoring well MW-2 near the Former

(Original) Calcium Carbide RCRA Treatment Unit (G.4), and one groundwater sample was collected from a well near the Former (Replacement) Calcium Carbide RCRA Treatment Unit (G.5) as part of closure activities. Both samples were collected in June 1998 and were analyzed for 40 CFR 264 Appendix IX sublists of VOCs, SVOCs, PCBs, "Michigan 10" dissolved metals (eight RCRA metals plus nickel and zinc), TKN, cyanide, and sulfide.

### 2.3.3. Surface Water/Sediment

All of the collected surface water and sediment samples were analyzed for the chemical parameters specified in the RFI Workplan. Surface water and sediment analytical results are presented in **Attachment H.** A discussion of the findings is presented in **Section 5.4.**

## 2.4. Environmental Setting

Geologic and hydrogeologic site conditions are described below.

### 2.4.1. Geology

Information regarding regional geology was obtained from published literature. References are listed in **Section 7.** Site-specific geology was characterized during the drilling activities that were performed as part of the Phase 1A Investigation (refer to **Attachment C** for the soil boring logs from the Phase 1A Investigation).

#### 2.4.1.1. Regional

The site lies within the Michigan Basin, a synclinal structure roughly circular in shape. Bedrock in Saginaw County reportedly dips north-northwest toward the deepest part of the basin, which generally underlies Gladwin County approximately 45 miles northwest of Saginaw County. The physiographic province of the project area is the Saginaw-Lake-Border Plain region. It is characterized as a minimal elevational land area with features such as beach ridges, inland dune fields, and sharply defined valleys.

The surficial glacial deposits in the Saginaw area are primarily the result of the Wisconsinan Stage of the Pleistocene Ice Age. As the Saginaw Lobe of the Laurentide Ice Sheet retreated from the Saginaw area, the material transported by the ice was deposited on the ground surface in a series of ridges called end moraines and as relatively flat surfaces called ground moraine or glacial till. During

interglacial periods (i.e., warming conditions during the Wisconsin Glacial Stage), the lobes of the Ice Sheet retreated to the Michigan, Huron-Erie, and Saginaw Basins. Melt water from the glacier could not drain across the encircling moraine to the southwest, and so became ponded between the end moraines and the ice front. When the ice front subsequently re-advanced, it carried additional sediments that were deposited in this glaciolacustrine (lake bed) environment when melting occurred again.

Most of the surficial soils in the Saginaw area consist of glaciolacustrine clays, water-laid tills, and modern alluvium. There are some level areas of sand and common sand ridges that represent bars and beaches produced when post-glacial Lake Huron diminished in size by steps or stages. The glaciolacustrine clays are fine-grained by nature and have low effective permeabilities. Water does not enter readily or move freely within these deposits.

The bedrock directly underlying the glacial deposits in Saginaw County is principally the Middle Carboniferous Saginaw Formation (deposited 290 - 315 million years ago). The Saginaw Formation, composed of sandstone, shale, and some coal, averages 380 feet in thickness.

### 2.4.1.2. Site-Specific

There are four general types of subsurface geologic materials within the Phase 1A study area: fill, fluvial and marsh deposits, glaciolacustrine sediments, and subglacial sand/bedrock. Detailed descriptions of the materials encountered during the Phase 1A drilling program are presented on the exploratory boring logs in **Attachment C**. **Table 2-7** presents the material descriptions and grain size distributions for samples that were submitted for physical testing. **Figures 2-2** through **2-4** are geologic cross-sections, and **Figures 2-5** through **2-9** are geologic maps showing the subsurface distribution of the various units.

Historical aerial photographs and topographic maps indicate that much of the surface of the site was once a marsh. The former marsh area is now overlain by fill in many locations. The fill generally consists primarily of foundry sand, a poorly graded sand and silty sand, with some localized clay zones.

**Fill.** Fill is approximately five to fifteen feet thick throughout most of the site (**Figures 2-2** through **2-4**). However, near the Saginaw River, where significant filling has occurred and where historical former portions of the Saginaw River have been filled in, the fill can be as deep as 24 feet. The fill is also relatively thick (approximately 22 feet) near the Primary Lagoons and the Secondary Settling Ponds. **Figure 2-5** shows the elevation of the bottom of the fill materials, representing the former ground surface prior to filling activities.

Clay from the construction of the on-site landfill was 46.5 feet thick in soil boring MW-07245, which is located in Area I.

Fluvial and Marsh Deposits. Underlying the fill material in some areas near the Saginaw River are unconsolidated sediments that appear to have been deposited in a stream environment (i.e., fluvial deposits or alluvium) or in an adjacent marsh (i.e., overbank or backswamp deposits). The fluvial deposits consist primarily of silty sand and poorly graded sand; traces of fine gravel are present locally, most likely deposited by the Saginaw River. These materials are typically loose, wet, and grey to brownish grey. Locally, shells, shell fragments, and wood debris are common. Three samples of this material were collected for physical testing. The samples were described as silty sand and poorly graded sand, and they contained 0 to 3.0 percent gravel. **Table 2-10** presents the results of the soil physical properties; the soil borings logs are presented in **Attachment C.**

The marsh deposits are primarily silt and clay with traces of sand. Peat up to 3 feet thick was also encountered immediately beneath the fill material in some soil borings. The marsh deposits are typically soft, wet, and grey to black. Locally, shells and organic material, including wood fragments, are common. Six samples of this material were collected for physical testing. Four of these samples were described as lean clay, and two were described as elastic silt with sand. The samples contained 0.8 to 18.1 percent sand (**Table 2-10**), and only one of the six samples contained a trace of gravel (0.1 percent).

**Figure 2-6** indicates the areas where marsh deposits were encountered. Neither fluvial or marsh deposits were encountered in the most eastern and southeastern borings where the fill material is underlain directly by glacial deposits.

Glaciolacustrine Sediments Glaciolacustrine and subglacial sediments were encountered throughout the site during the Phase 1A drilling activities. Glaciolacustrine sediments that were deposited in this lake environment were encountered throughout the site. Subglacial deposits were also encountered beneath the glaciolacustrine sediments in most areas of the site.

The glaciolacustrine sediments encountered at the site consist primarily of grey to brown clay and sandy clay (refer to soil boring logs provided in **Attachment C**). In the upper part of this unit, the clay is typically firm and damp. In many areas of the site, the clay becomes softer with depth, and the moisture content increases notably. This moist to wet clay was considered by field personnel to be a potentially water-bearing unit, so "intermediate" (i.e., confining layer) wells were installed within this zone, where encountered.

Thirty-three soil samples of the glaciolacustrine sediments were collected for physical testing. All of the samples were described as clay (lean clay, sandy lean

clay, lean clay with sand, or sandy silty clay). The samples contained 1.1 to 40.2 percent sand and up to 7.8 percent gravel. Most of the samples contained between 20 and 35 percent sand (**Table 2-10**). The permeability test results for these samples are discussed in the hydrogeology section that follows **(Section 2.4.2)**.

**Subglacial Deposits** The glaciolacustrine sediments are underlain in most areas of the Facility by subglacial deposits. Subglacial deposits are formed or accumulated beneath glaciers in environments such as meltwater streams. At the Facility, the subglacial sediments consist primarily of poorly graded sand and silty sand. These sediments are grey and commonly contain gravel (refer to the soil boring logs provided in **Attachment C**). These saturated sediments are hard yet unconsolidated; during the Phase 1A drilling activities, they frequently flowed up into the hollow stem of the augers. This indicates that this deeper water-bearing zone is under significant hydrostatic pressure, which likely results from the overlying low permeability glaciolacustrine clay acting as a confining layer. Details regarding the hydrogeologic conditions of this water-bearing zone are presented below in **Section 2.4.2.**

Given the difficulty of drilling and sampling within the flowing sands that typify this unit, only one sample of the subglacial sediments was collected for physical testing. The sample contained 41.6% fines (silt and clay), 53.8% sand, and 4.6% gravel (**Table 2-10**). The grain size distribution indicates that it was a silty sand. This is consistent with the field description of the soil as shown on the boring log (**Attachment C**).

Bedrock was encountered in six of the Phase 1A drilling locations at depths ranging from 84 to 106 feet. The bedrock is a hard, fine-grained sandstone. It is primarily light tan to brown with some white and light grey areas. Much of the unit appears massive; however, laminations and cross-bedding were visible in some portions of the sandstone, as shown by grain size and color variations within the unit. Based on the increased hardness of the geologic materials encountered just above the competent bedrock at some of the boring locations, the sandstone seems to be weathered locally. Based on the borings which encountered the weathered or competent bedrock, It appears that the bedrock surface generally slopes toward the southwest **(Figure 2-7)**.

## 2.4.2. Hydrogeology

The following sections describe the regional and site-specific hydrogeologic conditions near the facility.

### 2.4.2.1. Regional Hydrogeology

Regionally, groundwater is transmitted in the coarser-grained glacial deposits (e.g., sands, silts), and in the bedrock where primary and/or secondary porosity provides a flowpath. According to the *Hydrogeologic Atlas of Michigan* (WMU, 1981), the first useable aquifer in the area is the fractured bedrock aquifer, which is isolated from surficial influences by an impervious confining layer. The "impervious" layer likely is comprised of finer-grained glaciolacustrine deposits, as described in **Section 2.4.1**, while the first useable aquifer is the upper weathered and fractured portion of the sandstone unit of the Saginaw Formation, including the subglacial sand deposits, where present (uppermost aquifer), which is encountered approximately 80 to 100 feet below ground surface.

Groundwater in the bedrock aquifer reportedly discharges to the Saginaw River and its tributaries (though not at this location), Saginaw Bay, and Lake Huron.

### 2.4.2.2. Site-Specific Hydrogeologic Conditions

#### 2.4.2.2.1. Hydrostratigraphic Units

Site-specific hydrogeologic conditions were evaluated based on the existing boring records and on data from the monitoring wells installed during the Phase 1A RFI. All borings drilled during the investigation were terminated at depths no greater than the upper few feet of the Saginaw Formation (see **Section 2.4.1**). Three hydrostratigraphic units were identified during the Phase 1A RFI: an upper water-bearing zone; a lower subglacial sand/bedrock aquifer; and a confining clay layer that is located between the upper water-bearing zone and the lower sand/bedrock aquifer. All three hydrostratigraphic units, which consist of one or more geologic depositional units, were identified based on the occurrence of groundwater, the soil type, and on several depth-to-water measurements.

The materials comprising the upper water-bearing zone generally consist of three soil types: black, foundry sand fill, fluvially-deposited sand and gravel, and silt associated with a lower energy, marsh environment. Thin, discontinuous lenses of clay, sandy clay, silty clay, and clayey sand are interbedded within all soil types comprising the upper water-bearing zone.

The upper water-bearing zone was encountered in most locations across the SMCO site. This upper water-bearing zone, where present, is found up to approximately 60 feet thick near the Saginaw River; thinning inland (**Figure 2-8**). Forty-two groundwater monitoring wells were installed within the upper water-bearing zone as part of the Phase 1A RFI. The upper water-bearing zone was not encountered in

the northern portion of Area H near the secondary settling pond, in Area J around the landfill, and within most of Area F (refer to **Figure 2-8**). Saturation was not always encountered where materials comprising the upper water bearing-zone were encountered (i.e., MW-01901 and MW-02728).

The upper water-bearing zone is unconfined throughout most of the site. However, it is confined locally, particularly near the filled-in area at the primary lagoons (Area H). Except in parts of Areas H and I, groundwater within the upper water-bearing zone is generally less than fifteen feet below the ground surface. In parts of Areas H and I, stockpiled clay material up to approximately 40 feet thick overlies the upper water-bearing zone.

Fourteen groundwater monitoring wells were installed within the confining layer. Groundwater within the confining layer occurs at various depths and does not appear to be present within a continuous, permeable unit. Rather, groundwater was found to occur within discontinuous sand and silt seams within the clay throughout the confining unit. The thickness of the confining layer ranges from approximately 15 to 80 feet. It is generally thicker inland and decreases in thickness toward the Saginaw River (**Figure 2-9**). Some, laterally discontinuous sand lenses were identified during implementation of the Phase 1A investigation. The average horizontal hydraulic conductivity of these sand lenses is approximately $4.5 \times 10^{-3}$ centimeters per second (cm/sec), based on the data for two monitoring wells (refer to **Table 2-6** and **Attachment D**). The average horizontal hydraulic conductivity of the clay material comprising the clay confining layer is approximately $4.5 \times 10^{-4}$ cm/sec, based on the results of the individual slug tests (refer to **Table 2-6**). Twenty-seven clay samples and one silt sample were collected from the clay confining layer for vertical permeameter testing (**Table 2-6** and **Attachments G** and **I**). The average vertical permeability from these tests is approximately $5.4 \times 10^{-8}$ cm/sec.

The lower aquifer consists of subglacial deposits (sands and silts), weathered bedrock (non-lithified sand), and competent bedrock (sandstone and conglomerate). Seven groundwater monitoring wells were installed in the lower aquifer during the Phase 1A RFI. Groundwater in the lower aquifer is under confined conditions and is present throughout the site. This lower subglacial sand/bedrock aquifer is believed to be the uppermost aquifer encountered at the SMCO site.

#### 2.4.2.2.2. Groundwater Flow

Horizontal groundwater flow within the upper water-bearing zone is generally to the west-northwest across the site toward the Saginaw River (**Figure 2-10**). Local influences that alter this general flow direction include basement dewatering activities at the former Nodular Iron Plant and those at the currently operating metal

casting plant. The dewatering activities at the former Nodular Iron Plant have been discontinued since the initial collection of data. Therefore, it is possible that groundwater will re-align with the overall flow direction to the northwest in the vicinity of the former Nodular Iron Plant. Dewatering activities at the currently operating metal casting plant are not anticipated to change.

Ground-water recharge to the upper water-bearing zone occurs in the unpaved areas of the site via the infiltration of precipitation. However, groundwater recharge from the surface is not expected to occur through the overlying clay materials that are present in portions of Areas H and I, where locally confined conditions are encountered. Three minor groundwater divides are shown on **Figure 2-10.** The groundwater divides are likely the result of dewatering activities occurring at the SMCO site. Groundwater within the upper water-bearing zone, where not affected by dewatering activities, is expected to discharge to the Saginaw River along the northwestern external border of the SMCO site. The average horizontal hydraulic gradient across the site is approximately 0.005 foot/foot. The horizontal hydraulic gradient steepens to approximately 0.016 foot/foot immediately adjacent to the Saginaw River. The average horizontal hydraulic conductivity of the upper water-bearing zone is approximately $2.2 \times 10^{-1}$ cm/sec, based on the results of the individual slug tests from monitoring wells completed in the fill and native sands and those screened across laterally discontinuous lenses of silt and/or clay (refer to **Table 2-6**). Individual slug test data and results are presented in **Attachment D** to this Phase 1B Workplan.

It appears that flow within the upper water-bearing zone is predominantly horizontal, with significant hydraulic vertical gradients occurring locally around the dewatering activities. Vertical hydraulic gradients are also expected near the Saginaw River.

Three laboratory permeameter tests were completed from samples of the silt and clay lenses collected with Shelby tubes from the clay confining layer. These vertical permeability results averaged approximately $7.3 \times 10^{-7}$ cm/sec (**Table 2-6**). Laboratory reports for the physical properties of the soil collected from the site during the Phase 1A Investigation are included in **Attachment I.**

Beneath the confining layer across the site, groundwater occurs within the subglacial sands and silts and within the sandstone bedrock. Based on the static water elevations, it appears that there is a hydraulic connection between these lower units, and these units, are therefore, considered as one hydrostratigraphic unit. Horizontal groundwater flow through the lower aquifer is to the north-northeast at an approximate horizontal hydraulic gradient of $1.78 \times 10^{-5}$ feet/feet (refer to **Figure 2-11**). Seven slug tests were completed from monitoring wells screened in the lower subglacial sand/bedrock aquifer. The average horizontal

hydraulic conductivity results for wells completed in this lower aquifer is approximately 2.8 x $10^{-3}$ cm/sec (**Table 2-6, Attachment D** and **Attachment I**). The average horizontal hydraulic conductivity for the four wells completed in the competent bedrock was approximately one order of magnitude lower than the three wells completed in the subglacial sand and weathered bedrock (**Table 2-6**).

The vertical hydraulic gradient within the lower aquifer is upward at approximately 0.003 feet/feet. Based on the static water elevations measured within the monitoring wells installed in the lower aquifer, the direction of groundwater flow, and on information contained in literature, it appears groundwater discharge from the lower aquifer is likely Saginaw Bay or Lake Huron. Vertical permeability tests were not completed from the lower aquifer.

On or adjacent to the facility are several surface water bodies that may locally modify groundwater flow patterns in the upper water-bearing zone. Water elevations for the following surface water bodies were evaluated: the water inlet reservoir (Region C), the primary settling lagoons (Region H), the secondary settling lagoons (Region H), lagoon #5 (Region H), and the north ditch (Region H). One staff gauge was placed at the edge of the secondary settling lagoon, and one staff gauge was placed at the edge of the Saginaw River to measure changes in elevation of these surface water bodies. Additional water elevations were surveyed on March 24, 1999; these were measured only as spot elevations. A summary of the staff gauge and other surface water elevations is provided on **Table 2-12**.

Based on the measured surface water and groundwater elevations, it appears likely that all of the above-surface water bodies, with the exception of the primary lagoons, are connected to the upper water-bearing zone to some degree. The results of the four-hour pumping test were inconclusive. The maximum sustainable pumping rate that could be achieved from monitoring well MW-06951 was 0.5 gallon per minute (gpm). Increased pumping beyond this rate caused the well to pump dry. This limited pumping rate and the short duration of the test did not allow for any observable changes in water levels at adjacent monitoring wells or at the secondary settling pond beyond background changes observed across the site during the water level study.

A second pumping test near the Process Water Reservoir (IU C) will be performed during the Phase 1B program (**refer to Section 5**).

Two anthropogenic effects on the shallow groundwater flow were observed prior to and during the water level study. The first was dewatering activities at the currently operating metal casting plant, where the effects of dewatering are apparent in the static water elevations (**Attachment F**). The presence of the basement and the continual dewatering activities create a sink, or inward hydraulic gradient, for groundwater near the currently operating metal casting plant. This

depression in the water table surface creates the observed minor groundwater divides in Areas B and E. The dewatering activities in this area are not anticipated to change in the foreseeable future, so the groundwater flow patterns in the upper water-bearing zone are not expected to alter significantly from those observed during the Phase 1A RFI.

The second observed anthropogenic effect on the shallow groundwater flow patterns is at the Former Nodular Iron Plant. The dewatering activities and the presence of the open basement have created a sink at this location. This depression in the water table surface does not create any observed groundwater divides. It is anticipated that the water table surface will "rebound" and that the groundwater flow patterns will change to reflect an overall flow to the northwest toward the Saginaw River now that the pumps are turned off and the backfilling of the basement is complete and the static water level of the upper water-bearing zone adjusts.

Ground-water discharge of the upper water-bearing zone appears to be to the Saginaw River. Minor groundwater fluctuations were identified in monitoring wells located adjacent to the River (**Attachment F**). These fluctuations were not observed away from the Saginaw River. A comparison of the fluctuations measured in the Saginaw River (**Attachment G**) with those measured in the shallow monitoring wells adjacent to the River indicates that there is a connection between the shallow groundwater and the Saginaw River. The on-site water table appears to rapidly adjust to the River stage. Flow patterns did not appreciably alter during the period of study and only minor water level fluctuations were observed. **Figure 2-12** presents selected upper water-bearing zone groundwater contour maps as measured during the water level study. No groundwater flow reversals were observed during the water level study.

Minor fluctuations of the shallow groundwater were also observed in monitoring wells located near the currently operating metal casting plant. These fluctuations are likely the result of the cycling of the dewatering system at the plant. The shallow, groundwater flow patterns did not appreciably alter during the observed groundwater elevation fluctuations. **Figure 2-12** presents selected upper water-bearing zone groundwater contour maps based on measurements collected during the water level study.

Ground-water flow patterns within the lower subglacial sand/bedrock aquifer did not change throughout the period of study (**Figure 2-13**) and only minor vertical fluctuations were observed (**Attachment F**).

### 2.4.2.3. Preliminary Hydrogeologic Conceptual Site Model

Based on the above evaluations and observations, a preliminary hydrogeologic conceptual site model (HCSM) can be described for the SMCO site (**Figures 2-14** through **2-15**). This HCSM provides an overview of the site hydrogeologic conditions and is not intended to provide specific conditions at any given area of the site. The HCSM is a description of a dynamic system and will be updated, as appropriate, as new information and data are obtained.

**Figures 2-14** and **2-15** were prepared to describe the vertical component of groundwater flow through the site by displaying lines of equal potential in the vertical plane, along groundwater flow paths. As depicted in **Figures 2-14** and **2-15**, groundwater flow occurs predominantly horizontally through the upper water-bearing zone and through the lower subglacial sand/bedrock aquifer. The dashed equipotential lines within the confining unit only represent an approximate groundwater potential (i.e., the elevation which groundwater could obtain if screened within the confining layer) rather than implying groundwater flow. The data used to generate the vertical equipotential figures were collected on February 20, 1999, during the water level study (refer to **Attachment F**).

Shallow groundwater is generally present within 10 feet bgs throughout most of the site where fluvial sand and sand fill materials are present of sufficient thickness. Portions of the site do not contain shallow groundwater; these areas are generally along the southeastern portion of the site, in the northern portion of the site, and in a small area at the southwest corner of the site. Shallow groundwater is located within the fill materials on site and appears to be perched on a clay surface that may represent a former land surface prior to filling (i.e., marsh/wetland). Generally, the upper water-bearing zone is unconfined; it is only confined locally where overlain with clay stockpile material (Investigative Unit I). Groundwater recharge to the upper water-bearing zone appears to be from atmospheric precipitation that infiltrates the surface in uncovered areas of the site. Groundwater generally discharges to the Saginaw River along the western portion of the site.

The upper water-bearing zone is separated vertically from the subglacial sand/bedrock aquifer by an average of approximately 60 feet of clay material that serves as a confining layer. The subglacial sand/bedrock aquifer is under confined conditions and flow appears to be north-northeast across the site. The discharge location for this aquifer is assumed to be either Saginaw Bay or Lake Huron.

Water is sometimes present in the confining layer within discontinuous sand, clayey sand, sandy-clay and/or silt lenses. Based on the observed groundwater elevations, there does not appear to be any continuous unit within the confining layer to allow for groundwater flow.

General water quality parameter distributions (both field and laboratory results) are provided in **Figures 2-16** through **2-21**. These figures describe the general water quality of the upper water-bearing zone and the lower subglacial sand/bedrock aquifer for the Facility (further discussion on the water quality of these water-bearing units is provided in **Section 5.4**).

## 2.4.3. Conceptual Site Model for Potential Human Exposures

During the Phase 1A Investigation, a preliminary conceptual site model (CSM) was developed to describe potential human exposures to constituents in environmental media at the Facility. The CSM identifies potential areas at the facility where exposures may occur and describes the potentially exposed populations and potential exposure pathways under current and reasonably anticipated future land use and groundwater use at and around the facility. The CSM defines the exposure scenarios that will be evaluated in the RFI baseline risk assessment, which will be conducted to assess the health significance of environmental characterization data collected during the RFI field investigation (i.e., Phases 1A and 1B, and additional phases, if any).

The preliminary CSM, based on information reviewed during Phase 1A, is presented in **Table 2-13**. **Table 2-13** describes the potential areas where on-site exposures may occur and the potential exposure scenarios for each of the 10 IUs. It then describes the potential off-site exposures that may occur via groundwater, surface water, or air transport of constituents from the facility. The potential exposure scenarios account for (1) the general physical characteristics of the facility and its surroundings and (2) current and reasonably anticipated future land and groundwater uses on-site and off-site. **Section 2.4.3.1** summarizes briefly the types of information on the physical characteristics of the facility that have been presented elsewhere to the U.S.EPA. The information reviewed during Phase 1A on reasonably anticipated future land use and groundwater use is discussed in detail below in **Sections 2.4.3.1.2** and **2.4.3.1.3**, respectively. A summary of the potentially exposed populations is included at the end of each of these two sections. Any additional information evaluated during completion of the RFI field investigation will be incorporated as appropriate into the CSM for the RFI baseline risk assessment.

### 2.4.3.1. Physical Setting

Characterization of the physical setting has been presented in Sections 2 and 3 of the *DOCC*. Sections 2 and 3 of the *DOCC* report (entitled Facility Description and Environmental Setting, respectively) provided the following site information:

- Location
- Description of facility ownership and operations
- Topography
- Climate
- Surficial soils
- Surface water and drainage features
- Hydrogeology

Additional information collected during Phase 1A regarding geology and hydrogeology at the facility is discussed above in **Sections 2.4.1** and **2.4.2** of this Phase 1B RFI Work Plan.

### 2.4.3.2. Land Use

Information on historical and current land use at and around the Facility was combined with considerations of local land use development patterns to establish reasonably anticipated future land use at the facility. In particular, the likelihood of future residential and recreational land use at each IU was evaluated. This evaluation was conducted according to U.S.EPA guidance (55 FR 8666, March 8, 1990, p. 8710) which states that "the assumption of future residential land use is not a requirement" and "may not be justifiable if the probability that the site will support residential use in the future is small." U.S.EPA guidance (1992C, 1991B) further states that "sites that are surrounded by an operating industrial facility can be assumed to remain as industrial areas unless there is an indication that this assumption is not appropriate." Accordingly, a review of information pertinent to future land use patterns surrounding the Facility was conducted to evaluate the appropriateness of assuming continued industrial land use at each IU. The following were the primary sources of information consulted:

- City of Saginaw Master Plan (2010)
- City of Saginaw Future Land Use Plan Map
- Buena Vista Charter Township Community Development Plan (1997-2017)

The evaluation of information from these sources with respect to land use at the Facility is organized as follows:

1. Historical and Current Land Use
    - Current land use
    - Zoning maps
    - Historical and recent development patterns
    - Site location in relation to urban, residential, commercial, industrial, agricultural, and recreational areas

2. Zoning and Future Land Use Plans
   - Zoning laws
   - Comprehensive community master plans
3. Likelihood of Future Residential Use
   - Population growth patterns and projections
   - Accessibility of site to existing infrastructure
   - Proximity of site to a floodplain

### 2.4.3.2.1. Historical and Current Land Use

The Facility is located in an area of the City of Saginaw (Saginaw) and the Buena Vista Charter Township (Buena Vista) that historically has been and currently is developed largely for industrial and commercial uses. The Facility occupies approximately 700 acres, which has been, at least in part, under industrial use since before 1895, and has been under GM ownership since the 1920s. Through the approximately 75 years of continuous operation, GM has modernized and modified its operations at the Facility. For example, the Advanced Materials Development Center was renovated during the early 1990s for production of unique automotive components and experimental materials. Currently, the fifth set of major modifications and expansions of manufacturing operations are taking place at the currently operating metal casting plant to allow for diversification into the use of aluminum for engine block and cylinder head castings. GM expects that current operations or similar operations will continue at the Facility. The parcels of the 700-acre Facility that are no longer required for GM's continued operations have been or are likely to be sold for commercial and/or industrial uses.

As described in **Section 2.1.2**, land use surrounding the Facility is almost entirely industrial and commercial, with some small areas of residential and agricultural use located near the Facility. The Facility is bounded by: the Saginaw River to the west/northwest, the City of Saginaw Wastewater Treatment Plant and the City of Saginaw Landfill to the north, the Buena Vista Township Wastewater Treatment Plant to the northeast, agricultural areas to the east along Outer Drive, general businesses to the south and east, some residential areas to the southeast, and businesses along the south and west. Within the City of Saginaw, the residential area bordering the Facility is located along the south side of Washington Avenue between Sixth Street and Casimir Street; this neighborhood includes the First Ward Center, Unity Park, the Potter Elementary School and the former Daniel-Heights development. The nearest residential neighborhood located in Buena Vista Township is located north of Washington Avenue between Findley Street and N. 26$^{th}$ Street; this neighborhood is separated from the Facility by other industrially-zoned properties. The Facility is bounded along the southeastern border by a Consumer Power easement. In addition, the Facility is transected by the

Chesapeake and Ohio Railroad Company easement, the Veterans Memorial Parkway right-of-way, the City of Saginaw stormwater ditch, and a parcel owned by the Fairchild/Tri-County Refuse Company.

Hardly any change has occurred in land use classification in Saginaw between 1960 and 1990; industrial land decreased slightly from 11% to 10%, commercial land increased by one-percent to 5%, and residential land decreased from 36% to 33% in 1990 (SMP II-24). To facilitate examination of distinct region of the city, Saginaw's planning commission subdivided the city into seven Planning Districts, such that each district has rather homogeneous characteristics. The Facility is located in Planning District No. 1, an area that encompasses 1,351 acres in the northeast sector of the city. Specific land use in this planning district is characterized as 34.9% industrial (which is the highest percentage of industrial land in all seven Saginaw districts), 18.0% residential, 1.3% commercial, 9.2% public, 5.6% vacant, 5.5% water, and 23.8% transportation (SMP II-27). The majority of the housing in this Planning District is comprised of single family units (approximately 1,900 units), with approximately 135 duplexes and 115 multi-family buildings (SMPII-35).

Although the area of industrial land in this district has changed little, the residential population in the district has declined sharply. In the decades since 1970, the population of District No. 1 has declined 51.6% from 9,319 in 1970 to 4,507 in 1990, as compared to the overall Saginaw population, which declined by 24.4% during the same period (SMP II-54). The number of housing units also fell by 21% (545 units) from 1970 to 1980, and declined an additional 138 units in the following decade (SMP II-32). Fire or city demolition programs destroyed much of this housing, while the State of Michigan seized others for tax reversion. According to the Saginaw Master Plan (II-34), the result is a "continuously declining number of households, lack of reinvestment by the private sector, and likely continued deterioration of residential, commercial, office and industrial facilities."

The Buena Vista Township plan does not provide specific details on the distribution of land use within the township. The plan does indicate that the majority of the area west of Interstate 75 and north of Washington Road, where the Facility is located, is industrial or vacant. Of the residential land use in Census Tract No. 109, in which the Facility is located, 98 percent of the housing is single-family unit Further, the 1990 census data for Buena Vista indicated that 3,839 residents were employed (in comparison to a total population of 10,903) in 1990. In Census Tract No. 109, 312 people (of a total population of 1,283) were employed. According to the Buena Vista Community Development Plan, employment in the township is expected to increase by 10.9% from the 1990 level by 2020 (BVP 28). Employment centers are expected to continue to be focused in the southeast region

(projected to contain 74.6% of all jobs in the township) where the Delphi Saginaw Steering Systems Plant is located (BVP 31).

#### 2.4.3.2.2. Zoning and Future Land Use Plans

The land use plans adopted by Saginaw and Buena Vista were developed to serve as guides for long-range, future land use planning. This development process included public meetings and hearings, in addition to local interviews and surveys, to provide for input from both the public and private sectors.

For the area where the SMCO Facility is located, these plans are intended to maintain existing industries and businesses while expanding commercial/industrial development to promote the growth of new business. This is reflected in the Future Land Use Maps for both Saginaw and Buena Vista which show the area of the SMCO Facility as continued industrial use (SMP VI-2, BVP 66). The surrounding area is designated as a mixture of industrial and light industrial land to the east and west of the Facility, in addition to residential and recreational land south of the Facility in Saginaw. The goal of enhancing industrial/commercial growth in the area containing the Facility is consistent with the cities' strategy to promote economic development and redevelopment in areas that are already heavily developed for industrial and commercial use. The strategy may include industrial redevelopment, wholesale trade development, and construction of new or the redevelopment of existing commercial strips to service existing businesses and industries in an area.

Residential land use plans encourage redevelopment and infill construction in existing residential areas and interspersed vacant land, rather than creating new residential developments. In areas where housing is in poor or fair condition, as exists in the residential areas south of the Facility, rehabilitation or demolition of such housing is planned (BVP 77, 79, SMP VI-1). Buena Vista and Saginaw intend to play active roles in demolishing and rehabilitating housing units in Buena Vista (BVP 80) and implementing the Comprehensive Housing Affordability Strategy, which provides rental and homebuyers assistance, supportive services, and new construction (SMP VI-3). Based on these land use plans, the potential for new residential development at or in the immediate vicinity of the Facility is considered to be unlikely.

#### 2.4.3.2.3. Likelihood of Future Residential Use

The likelihood of future on-site residential land use is discussed below in terms of historical and predicted population trends in the area and the suitability of the Facility property for residential development.

- Historical and Predicted Population Trends

  Trends in the populations of Saginaw and Buena Vista indicate that the probability of future residential land use at the Facility is small. Between 1970 and 1990, the population of District No. 1 in Saginaw declined significantly from 9,319 in 1970 to 4,507 in 1990, which represent a reduction of approximately 52% (SMP II-54). This decline is significantly larger than that for population of Saginaw as a whole, which declined by approximately 24% during the same period. According to the Saginaw Plan, the sharp decline in population can be attributed to several factors, including migration to newer residential developments in surrounding suburbs, migration caused by the downscaling in the automotive manufacturing industry, and the demolition of substandard housing without replacement (SMP II-6). Saginaw's population is expected to follow recent trends and fall from approximately 69,000 in 1990 to approximately 60,000 residents by 2010 (SMP V-2).

  Similarly, the population of Buena Vista experienced decreases, though more moderate, from a high of 13,687 in 1970, down to 10,900 in 1990, a 20.4% decrease over the twenty year period (BVP 3). The population of tract 109 was 1,283 in 1990 (BVP Census). The Buena Vista community development plan did not discuss population projections.

- Suitability for Residential Development

  There are several features on or near the Facility that are incompatible with potential residential development, in the unlikely event that the Facility would cease operations. First, the Facility contains a licensed landfill and wastewater treatment facilities (including large lagoons), which would make these locations unattractive for potential residential development. Second, the Facility is transected by a major railroad freight line, which would also tend to hinder potential residential development because of potential concerns with noise and safety. Conversely, the Facility's proximity to the rail line makes this location ideal for commerce and continued industrial use. Third, the Facility is bordered by municipal wastewater treatment facilities and a municipal landfill. Finally, Saginaw's plan encourages separation between residential development and other incompatible land uses such as industrial and commercial development (SMP IV-3).

- Potential Future Recreational Use

The probability of future recreational land use on any portion of the Facility is small for three reasons. First, existing parks adequately serve most of Saginaw (SMP V-27), and Saginaw projects no need for recreational areas at the Facility. Second, the highly industrial character of the land surrounding the Facility and the proximity to Interstate-75 make the locations unattractive for recreational areas. Third, Saginaw's planned development of new recreational areas is focused on an area adjacent to the Saginaw River away from the Facility. The City of Saginaw intends to extend the Riverwalk Pathway system from the western edge of the Facility at Sixth Street south to the Wickes Park Drive (SMP VI-20). This would connect activity centers in the downtown area and neighborhoods along the river, as well as expand activities and festivals that occur along the river to develop the riverfront into the year-round "focal axis of the community" (SMP IV-14). For these reasons, the Facility's riverfront and the surrounding area away from the river are not expected to be developed for recreational use.

- Proximity of site to a floodplain

The Facility is located along the Saginaw River, and a large area of the Facility is located within the 100-year floodplain. According to the USGS Flood-Prone Area Map, as well as the Saginaw and Buena Vista Plans, the only portions of the Facility that are outside the 100-year floodplain are IUs B, D, and F (SMP II-2, BVP 44). Further, most of the surrounding land is also within the 100-year floodplain; the areas outside the floodplain are those areas south of IUs B, D, and F. Consequently, both the Saginaw and Buena Vista land use plans indicate the type of development in areas subject to flooding will be restricted, which would encourage industrial and commercial land use, rather than residential development.

### 2.4.3.2.4. Summary of Potentially Exposed Populations

Based on a review of information pertinent to future land use at and around the Facility, an assumption of continued industrial land use at the Facility is considered to be appropriate. Specifically, given the long history of industrial land use at the Facility, GM's plans for continuing operations, the City of Saginaw and Buena Vista Township plans for enhancing industrial/commercial development around the Facility, and the unsuitability of the Facility's location for potential residential development, the probability is small that land use at this location will become residential.

Therefore, the potential for exposure to constituents in soil, sediment and/or surface water at each IU is incorporated into the CSM for the following current and reasonably anticipated future land uses:

- Industrial land use at the Facility; and
- Industrial/commercial, residential, and recreational land uses surrounding the Facility.

The potentially exposed populations under these land uses are as follows:

- On-Facility and off-Facility workers

  The vast majority of workers at the Facility are employed in manufacturing functions, which take place within manufacturing buildings. These workers rarely, if ever, perform job functions that would bring them into contact with the soil, sediment and/or surface water in an IU. For these workers, routine incidental contact with outdoor areas at the Facility may occur during lunch, breaks, and walks to and from parking lots. The extent of such outdoor activities is expected to vary seasonally. A small number of the Facility workers, however, may have more intensive contact with the IUs during maintenance or occasional excavation activities (e.g., replacing pavement, maintenance of underground utilities).

  Facility workers whose duties are to perform waste management functions at the Facility are not considered a potentially exposed population for the purposes of the RFI baseline risk assessment. Such workers include those who manage manufacturing process wastes that are handled in on-site solid waste management units (e.g., dredging sediments from primary settling lagoons, or placing waste foundry sand in the licensed landfill). Potential exposures to these

workers during performance of such job functions are monitored and controlled through procedures and practices established by the Facility.

Based on the similarity of industrial and commercial land use surrounding the Facility, workers at neighboring facilities are expected to have activity patterns similar to those for the majority of the workers at the Facility. That is, the majority of these workers are expected to work mostly indoors and spend little of their work day outdoors.

- Off-Facility residents

  The nearest residents to the Facility are in the residential area southeast of the Facility. They may be exposed to constituents in soil, sediment and/or surface water at the Facility via airborne transport of the constituents off-site. Trespassing by residents onto the Facility is expected to be unlikely because perimeter fencing and guards largely control public access to the Facility. However, for those areas of the Facility that are not fully fenced or guarded, trespassing may occur and trespassers may be exposed to soil, sediment and/or surface water in these specific IUs.

The assessment of these on-site and off-site receptor populations for each relevant exposure medium at each IU under current and reasonably anticipated future land use is summarized on **Table 2-13.**

### 2.4.3.3. Groundwater Use

As discussed in **Section 2.4.2** of this RFI Phase 1B Work Plan, groundwater underlying the Facility is present in a shallow water-bearing zone and in a deeper sand and bedrock aquifer. The shallow water-bearing zone was encountered in the fill and upper, fluvial sand materials and appears to be perched on an approximately 60-foot thick clay layer that separates this water-bearing zone from the sand/bedrock aquifer. In addition, this shallow water-bearing zone does not exist in all areas of the Facility. Except where it is controlled by dewatering activities, the perched shallow groundwater is expected to discharge to the Saginaw River adjacent to the Facility. Groundwater in the deeper sand/bedrock aquifer likely discharges to Saginaw Bay or Lake Huron. Based on the hydrogeologic studies conducted in Phase 1A, it is concluded that the sand/bedrock aquifer represents the uppermost aquifer both regionally and at this facility. Further, this sand/bedrock aquifer is under confined conditions and exhibits an upward hydraulic gradient.

According to the Hydrogeologic Atlas of Michigan, the first usable aquifer in the area of the Facility is the fractured bedrock aquifer. However, since 1948 drinking water for Saginaw (which also supplies water to Buena Vista) has been obtained from the Whitestone Point area in Lake Huron (SMP II-77). A 1994 search of the Michigan Department of Public Health (MDPH) water well records identified 17 domestic or commercial water supply wells located within one mile of the Facility. The records indicate that the wells are located in Carrollton Township (across the Saginaw River from the Facility) and in Buena Vista Township, and are completed in the sand/bedrock aquifer with depths of the wells ranging from 93 to 147 feet. The water well records do not indicate if these wells are currently in use. (See Appendix 3.4, Volume III of the *DOCC* (August 1995)).

The determination of whether a potential exists for exposure to groundwater in the upper water-bearing zone and in the sand/bedrock aquifer should be based on consideration of actual and reasonably expected uses of groundwater. Also relevant are regulations set forth by MDEQ and MDPH (R325.10800 et seq. and R325.1600 et seq., respectively), which establish controls for the installation of drinking water supply wells. The specific factors considered in developing the CSM include the following:

- Regional availability of alternative sources of drinking water;
- Historical and existing uses of groundwater;
- State regulations governing groundwater well construction; and
- Degree of interconnection between the groundwater units.

#### 2.4.3.3.1. Sand/Bedrock Aquifer

The sand/bedrock aquifer has not been used historically and is not currently being used as a drinking water supply at the Facility. As described above, MDPH well records indicate that domestic and commercial wells completed into the sand/bedrock aquifer are located within one mile of the Facility, although, based on the hydrogeologic conceptual model presented in **Section 2.4.2.3**, these wells do not appear to be directly downgradient of the Facility. However, state regulations do not preclude the potential for future potable use of groundwater from the sand/bedrock aquifer at or downgradient of the Facility, with the following constraints:

- Wells must be cased to a depth of at least 25-feet below ground surface;
- Wells must be located outside areas subject to flooding.

#### 2.4.3.3.2. Upper Water-Bearing Zone

In contrast to the sand/bedrock aquifer, the upper water-bearing zone in the vicinity of the Facility has not been used historically, is not currently used, and is not reasonably anticipated to be used in the future as a water supply. Use of groundwater from this zone to support current and reasonably anticipated continued industrial/commercial on-site land use (as discussed above in **Section 2.4.3.1.2**) is highly unlikely. In particular, this water-bearing zone is discontinuous across the Facility and is relatively shallow and has a limited saturated depth, except near the Saginaw River. Because of its generally shallow depth, a well installed into this zone would not be able to satisfy the depth of protective casing specified in the state well construction regulations, as outlined above. Further, its limited extent and saturated depth makes this zone unlikely to be capable of supplying a sufficient quantity of water to serve as a reliable industrial/commercial water supply. Therefore, future development of the upper water-bearing zone at the Facility as a water supply is not reasonably expected. In addition, because the upper water-bearing zone is hydraulically isolated from the sand/bedrock aquifer by a regional clay layer and an upward hydraulic gradient exists across this clay layer, this zone is not anticipated to provide a pathway to the uppermost aquifer. The upper water-bearing zone does provide a potential pathway to the Saginaw River, where nonpotable exposures may occur (the nearest active water supply intake is located in Lake Huron).

#### 2.4.3.3.3. Summary of Potential Groundwater Exposures

Currently, no groundwater from the upper water-bearing unit or the sand/bedrock aquifer is used at or downgradient of the Facility. Drinking water for Saginaw and Buena Vista is obtained from Lake Huron. Use of the sand/bedrock aquifer as a potential future drinking water supply was determined to be a reasonable exposure scenario to be included in the CSM. However, use of the upper water-bearing zone as a drinking water supply was determined to be not reasonably expected, although the upper water-bearing zone is considered a medium for potential transport of constituents to the Saginaw River. Potential human exposures to constituents transported via groundwater to the Saginaw River may result from recreation on the River. Additionally, direct exposures to on-site, shallow groundwater may occur during excavation activities that may be conducted at the facility. These potential exposures to groundwater in the upper water-bearing zone and sand/bedrock aquifer are summarized on **Table 2-13**.

## 2.4.4. Ecological Reconnaissance Survey

An ecological reconnaissance survey was conducted at the Facility on September 7–11, 1997, as part of Phase 1A of the RFI. The ecological reconnaissance survey forms the basis for identifying exposure pathways and areas of interest for the ecological risk-based screening assessment. The following sections describe the methods employed during the ecological reconnaissance survey and the findings regarding habitat characteristics, observations of wildlife, and exposure pathways which are believed to be present on-site. All areas described are shown in the site plan (**Figure 4-1**).

### 2.4.4.1. Surface Water Features

Eight surface water features were identified within the boundaries of the Facility. From north to south, these features include the Deikmann storm-water drain (Deikmann drain), the secondary settling pond, the north ditch, the four primary settling lagoons, the water reservoir (lagoon no. 5), the storm-water ditch just east of the former Nodular Iron plant, the east storm-water ditch (near Fairchild property), and the process water reservoir (see **Figure 4-1**). Each of these water bodies was evaluated for aquatic habitat potential and surveyed for aquatic biota. In addition to these features, previous documents have identified an area just south of the Fairchild property as the "Fairchild ponds." The ecological reconnaissance survey revealed that this area does not contain any surface water bodies. Therefore, this area is considered only as potential terrestrial habitat. A detailed description of this area is provided below.

#### 2.4.4.1.1. Aquatic Biota Survey Methods

The Facility contains several site features that could provide habitat for aquatic communities. These features include industrial ponds, lagoons, water reservoirs, and drainage ditches. A combination of electrofishing and seining techniques were employed during the reconnaissance survey to qualitatively evaluate fish species richness, trophic structure, and food resources (i.e., benthic macroinvertebrate community). All sampling methods are further discussed below.

All fish were identified on site and released alive in the aquatic habitat where they were collected, regardless of the collection method used.

**Electrofishing**—Electrofishing was performed using a Smith-Root Model 12B backpack electroshocker with a ring anode and a rattail cathode. Current, voltage, and duration of charge were adjustable and set to provide optimal shocking

conditions for both large and small fish. Stunned fish were collected using dipnets with insulated handles, then released after censusing.

Electrofishing was performed in all permanent water bodies along shorelines and in ponds or channels where submerged structures or aquatic plant communities were observed or potentially present. Electrofishing from a boat was performed when waters were too deep to wade, in areas with steep embankments or shorelines, and along the perimeter of vegetation patches (i.e., cattail or reedgrass stands) away from the shoreline. A boat was used to electrofish around habitat structures in the interior of a pond or water body (e.g., wholly or partially submerged tree stumps or limbs). Use of a boat maximized efficiency in sampling fish populations in linear habitats such as the Deikmann drain. Pond habitats were generally too deep in the central portions for effective electrofishing.

**Seining**—In addition to electrofishing, aquatic habitat was surveyed using seine nets to capture juvenile fish and aquatic macroinvertebrates. Juvenile fish are frequently found along the shorelines of aquatic systems where habitat structures such as patches of emergent terrestrial or aquatic vegetation, tree limbs and branches, rock, or riprap are present. Seine nets were constructed of 3/16 inch nylon mesh and nets were 10-ft wide and 3-ft high with leadcore line along the bottom edge and a series of floats supporting the upper edge of the net. Seines were pulled along the shoreline with personnel working the end of the net into and around habitat structures in an effort to push small fish and macroinvertebrates out of the habitat structure into open water where they could be caught in the seine. In areas of the shoreline where substantial amounts of submerged debris occurred (e.g., the Stormwater Discharge Ditch - H.3 from the DOCC), seining was ineffective in capturing fish because of the frequency of snagging the seine net on submerged structures. In these instances, electrofishing was the primary method used to assess the fish community.

In addition to electrofishing and seining, an electronic depth sounder was used in all water bodies to characterize bottom depth and bottom profile, and to identify whether underwater structures (e.g., tree stumps and other debris) were present.

#### 2.4.4.1.2. Deikmann Drain Survey

The Deikmann drain is a flood control channel located between the City of Saginaw landfill and IU J. The Deikmann drain originates east of the Facility on the Crow Island State Game Refuge, which is located immediately to the east of Interstate 75. Flow at Crow Island travels west beneath Interstate 75 and continues in a westerly direction towards the Saginaw River.

**Deikmann Drain Habitat Description**—At the upstream end of the Deikmann drain, there is no apparent barrier to movement of fish between the Crow Island State Game Refuge and the Facility. On the downstream portion of the Deikmann drain, there is no permanent connection to the Saginaw River; a flood control gate located immediately east of Highway M-13 regulates flow from the Deikmann drain to the Saginaw River as needed for flood control. Although a metal grate covers the entrance to the flood control gate to prevent large debris from passing, the strength of the current and spacing of the bars on the grate make it unlikely that this gate prevents fish passing from the Deikmann drain into the Saginaw River.

Flow from the Deikmann drain to the Saginaw River can be substantial. During fish sampling on the Deikmann drain on September 10, 1997, Exponent personnel briefly conversed with one of the operators of the pump station. On this occasion, it had been raining in the Saginaw area for several days, and the operator of the gate indicated that 92,000 gpm were passing through the drain.

Water depth in the Deikmann drain is a uniform 3–4 ft throughout its length from Crow Island Road to Interstate 75. The channel substrate is predominantly clay and embankments are relatively steep throughout the length of the drain. Upper portions of the channel banks are vegetated with herbaceous terrestrial vegetation. Only a few small (e.g., about 20–30 $ft^2$) patches of aquatic vegetation were observed growing in or along the shoreline, primarily along the upstream portions of the Deikmann drain near the Interstate 75 overpass.

Two stormwater drainage ditches flow into the Deikmann drain. The first (Ditch 1) is located west of Interstate 75 along the eastern boundary of IU J and immediately west of the Buena Vista publicly owned treatment works (POTW). The channel is approximately 12 to 30 ft wide. Water depth is only 2 ft at the confluence with the Deikmann drain, and 1 ft throughout most of the length of the tributary. There is no apparent source of water for Ditch 1 except local surface runoff and backflow from the Deikmann drain. The channel contains numerous downed tree limbs and anthropogenic debris (e.g., concrete slabs). Upstream portions of this channel were covered with duckweed interspersed with garbage at the time of the site visit (e.g., Styrofoam cups and plastic bottles).

The second ditch (Ditch 2) is located immediately west of and parallel to Crow Island Road on the opposite side of IU J. The channel varies from about 90 ft wide at the confluence with the Deikmann drain to 25 to 30 ft wide about 300 ft upstream. Ditch 2 is also shallow, varying from 3 ft at the confluence to less than 1 ft upstream where the channel narrows. The only apparent sources for water in the tributary are local surface flow and backflow from the Deikmann drain. A large quantity of garbage was in evidence in Ditch 2. Crow Island Road appears to have been the site of frequent illegal dumping.

**Deikmann Drain Fish Community**—The fish community of the Deikmann drain is primarily rough forage fish, including carp (*Cyprinus carpio*) and freshwater drum (*Aplodinotus grunniens*). Other species caught during the survey include pumpkinseed sunfish (*Lepomis gibbosus*), largemouth bass (*Micropterus salmoides*), and a species of minnow that was not identified. Both carp and freshwater drum were common and abundant throughout the length of the Deikmann drain with numerous large (i.e., 2–4 lb) individuals caught with the electrofishing equipment. Only one largemouth bass was caught; it was 4 to 5 in. long. Pumpkinseed sunfish were common and abundant, although all individuals were small (i.e., < 3 in. long), indicating they were less than 2 years of age, and most were young-of-the-year.

**Deikmann Drain Benthic Macroinvertebrate Community**—The benthic macroinvertebrate community identified by seining was depauperate in terms of species richness. However, those species that occurred in Deikmann drain were abundant. The community is almost exclusively corixids (Family: Corixidae) and gomphid dragonfly larvae (Family: Gomphidae). A few chironomids (Family: Chironomidae) were also found attached to floating leaves found in the seines.

**Assessment of Deikmann Drain Habitat Quality**—The Deikmann drain is relatively low-quality aquatic habitat. The absence of bass and older-aged sunfish and the relatively depauperate benthic macroinvertebrate community are consistent with the general lack of riparian habitat features found here. Specifically, the stream is channelized with few bends and no meanders. The substrate of the channel appears to be clay, and lacks any gravel, cobble, or rock substrates. No significant habitat structure is associated with the embankments of the canal, and no substantial habitat structure is provided by aquatic plant communities with features such as tree trunks, tree limbs, and undercut banks.

The connection to the Crow Island State Game Refuge potentially supplies the Deikmann drain with a relatively constant source of fish. However, once these fish arrive in the Deikmann drain, habitat conditions do not appear capable of sustaining any substantial warmwater fish community except for rough (i.e., forage) fish such as carp and freshwater drum. These species are likely successful because they are habitat generalists with omnivorous diets. Although substantial numbers of sunfish were present, they were primarily young-of-the-year fish. The absence of older sunfish in Deikmann drain is likely attributable to the poor habitat quality (i.e., poor structure and clay substrate).

It is possible that habitat conditions and the fish community of the Deikmann drain attract some piscivorous birds or mammals. Most of the carp and drum caught in the Deikmann drain were more than 12-in. long. This size class is beyond the size range that belted kingfishers (*Ceryle alcyon*) consume and at or beyond the upper

end of the size range of fish that great blue herons eat. Herons have, however, been observed standing on the shoreline of the Deikmann drain on several occasions and may be foraging on smaller fish.

### 2.4.4.1.3. Secondary Settling Pond Survey

The secondary settling pond is the largest water body at the Facility. The pond is north and immediately adjacent to the primary lagoons and the water reservoir (lagoon no. 5). The secondary settling pond receives overflow water from the primary lagoons. There is no reverse pathway for flow from the secondary settling pond into either the primary lagoons or the water reservoir.

**Secondary Settling Pond Description**—Shorelines of the secondary settling pond are 2 to 5 ft deep, with the pond bottom uniformly 12 to 16 ft deep. There are no unique habitat features on the pond bottom (e.g., ridges) or any evidence of submerged habitat structure.

The eastern portions of the secondary settling pond are devoid of emergent or submerged aquatic vegetation. Banks are 4 to 12 ft above the surface of the water and relatively steeply graded. Banks are vegetated with various types of herbaceous vegetation, including woody shrubs and a few small trees. No habitat structure (e.g., riprap, concrete blocks, tree trunks, or limbs) is evident.

Western shorelines of the secondary settling pond are primarily dense stands of reedgrass (*Phragmites communis*), scattered small patches of cattails (*Typha* sp.), and willows (*Salix* sp.) intermixed. In the northwestern portion of the secondary settling pond, numerous tree trunks are exposed.

**Secondary Settling Pond Fish Community**—No fish community is present in the secondary settling pond. Both electrofishing and seining techniques failed to produce any fish from this habitat, and no fish were observed moving (i.e., trying to avoid the current) during the electrofishing procedures.

**Secondary Settling Pond Benthic Macroinvertebrate Community**—The benthic macroinvertebrate community is taxonomically depauperate, but those species that occur are abundant. Each seine haul along the shoreline produced hundreds of corixids, several dozen gomphid dragonfly larvae, and numerous chironomids and aquatic beetles (two unidentified species).

**Assessment of Secondary Settling Pond Habitat Quality**—The secondary settling pond seems to afford fair potential habitat for fish and benthic macroinvertebrate populations. Eastern portions of the secondary settling pond provide relatively poor

habitat, lacking habitat structure along shorelines and in the interior of the pond. The best habitat occurs primarily along the western shoreline and in the southwestern extension of the pond. These areas are typically 4 to 8 ft deep with emergent aquatic plants (e.g., reedgrass) and willows intermixed with dense stands of reedgrass.

While little is apparent in the way of food resources for birds, ducks and grebes have been observed on and around the banks of the pond. It is likely that the open water is attractive to waterfowl as a loafing and bathing area.

#### 2.4.4.1.4. North Ditch Survey

The Stormwater Discharge Ditch (H.3 from the DOCC, herein referred to as the North Ditch) is located immediately southwest of the City of Saginaw POTW and north of the former Nodular Iron plant parking area. Before construction of the recycled water system (circa 1988), Saginaw River water was used as process water in a single-pass open loop, and the North Ditch connected the secondary settling pond with the Saginaw River. Since the closed loop process water system has been operational, this ditch has served only as stormwater control and was cut off from the River by blocking the former discharge pipes with flowable fill.

**North Ditch Description**—The North Ditch contains an abundance of habitat structure, including submerged aquatic vascular plants, terrestrial shrubs (e.g., willows) rooted in the shallows, and considerable underwater debris (e.g., sunken tree limbs and branches). Water depth is typically 4 to 6 ft throughout most of the ditch, deepening to 6 to 8 ft at the southernmost end (i.e., closest to the Saginaw River) where sheet piling has been installed. The banks of the ditch are densely vegetated with terrestrial grasses, forbs, woody shrubs, and trees to a lateral distance of 4–8 ft on either side of the ditch.

**North Ditch Fish Community**—The North Ditch contains a diverse fish community. Common species collected by electrofishing were carp, sucker (*Catostomus* sp.), pumpkinseed, green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), black bullhead (*Ameiurus mela*), and brook silverside (*Labidesthes sicculus*). Fish of varying size ranges were caught, including several hundred young-of-the-year sunfish. The size range and abundance of young fish indicates that populations are successfully reproducing in the North Ditch.

**North Ditch Benthic Macroinvertebrate Community**—Seining of the North Ditch was attempted, but constant snagging on submerged structures (e.g., sunken tree limbs) made this technique relatively ineffective. Thus, no meaningful characterization of the benthic macroinvertebrate community was obtained.

**Assessment of North Ditch Habitat Quality**—The North Ditch provides good aquatic habitat. This is reflected in the taxonomic richness of the fish community.

The North Ditch also appears attractive to various wading birds. Great blue herons (*Ardea herodias*) were observed in the ditch during the site investigations. The clear water, shallow water zones, and abundance of overwater perch sites afford suitable habitat conditions for this species. The limited areal extent of the ditch may reduce the number of herons and how frequently individual herons forage in this habitat.

### 2.4.4.1.5. Primary Lagoons Survey

The primary lagoons are located in IU H, immediately northeast of the wastewater treatment plant (WWTP). The four lagoons function as settling ponds for water treatment operations at the WWTP. Overflow from the primary lagoons passes directly from the north end of the lagoons into the secondary settling pond.

**Primary Lagoons Description**—The primary lagoons receive treated water directly from the WWTP and thus are not connected to any aquatic habitat that supports a fish population. The lagoons fill relatively quickly (i.e., within 3–4 weeks) with foundry sand that settles out of the effluent from the WWTP. As a lagoon fills with sediment, water is shunted to the next lagoon in sequence, and the lagoon is allowed to de-water. Following a period of drying, sediments are removed using heavy equipment and classified, then either reused, sold, or deposited in the on-site landfill.

**Primary Lagoons Fish Community**—No fish community is present in the primary lagoons, and none is expected to occur because of the periodic de-watering and sediment removal.

**Primary Lagoons Benthic Macroinvertebrate Community**—Sparse benthic macroinvertebrate fauna were found in sediments and surface water pools of the primary lagoons during surveys on September 11, 1997. Sediments were washed through a stainless-steel sieve from the westernmost lagoon. Only one chironomid larvae was found after sieving sediment at numerous locations. However, small, shallow pools on the surface of the sediments contained numerous small aquatic organisms, possibly copepods. What appeared to be a species of sand fly was also observed on the surface of many of the shallow pools. The tracks of several types of wading birds were abundant on the exposed sediments and in shallow pools, including the tracks of a great blue heron (*Ardea herodias*). Sandpipers (species unknown) and

yellowlegs (*Tringa* sp.) were commonly observed probing the sediments for invertebrates.

**Assessment of Primary Lagoons Habitat Quality**—The primary lagoons provide no habitat for fish. The lagoons appear to be colonized by some species of aquatic macroinvertebrates during the brief cycle of infilling and dredging. However, the presence of shorebirds and wading birds in the lagoons and the act of foraging do not necessarily imply that these birds are successful in obtaining food resources from this habitat. For example, although great blue heron tracks were observed in the sediments of some lagoons, there are no fish present in the lagoons and there is no evidence that other food items typically consumed by great blue herons (e.g., amphibians and crayfish) occur in the lagoons. Similarly, hand sieving of the sediments found no bivalves or other aquatic organisms that are typical prey items of shorebirds and wading birds that probe soft sediments. Thus, the presence of these receptors foraging in the primary lagoons only indicates that the habitat may appear attractive to these birds as a foraging area (i.e., they resemble exposed mudflats and shallow water areas).

### 2.4.4.1.6. Water Reservoir (Lagoon No. 5) Survey

The water reservoir (lagoon no. 5) is located northeast of the WWTP in IU H. The reservoir is adjacent to and immediately west of the primary lagoons and southwest of the secondary settling pond. The impoundment serves as a stormwater collection basin. Ordinarily, there are no physical connections for water transfer between the water reservoir and either the primary lagoons or the secondary settling pond, although there is an overflow pipe from the water reservoir to the secondary settling pond.

**Water Reservoir Description**—The water reservoir is a constructed impoundment. The surface of the reservoir is about 10 ft below the level of the surrounding terrestrial habitats with steeply graded (e.g., about 50–60 percent) embankments when full. The upper portions of the embankments are vegetated with terrestrial grasses, forbs, and woody shrubs; lower portions of the embankments influenced by fluctuations in water level are bare clayey soils.

Water in the reservoir is clear. The bottom substrate was readily visible in shallow portions of the reservoir (e.g., north end and small embayments along southwest shoreline) and for several feet (i.e., up to about 5 ft) in depth along all the shorelines. Mats of filamentous algae were observed throughout the impoundment. They were especially dense in the shallow northern portion of the reservoir and were deposited along the shoreline when the water levels receded. No submerged or emergent vascular plant communities are present.

The water reservoir is one of the deepest impoundments on the facility, exceeding depths of 20 ft in central portions of the reservoir. The north end of the reservoir is consistently less than 4 ft deep and there are shallow (i.e., less than 2 ft deep) embayments at the south end.

**Water Reservoir Fish Community**—No fish were found in the water reservoir. No fish were shocked or seen moving to avoid the electrical current during the electrofishing process. Soft bottom sediments and a relatively steep shoreline prevented using seines to sample the fish and benthic macroinvertebrate communities.

**Water Reservoir Benthic Macroinvertebrate Community**—As mentioned in the previous section, bottom sediments were too soft to permit seining of the shoreline, which prevented sampling of the benthic macroinvertebrate community; however, corixids were relatively common as observed from the boat. Crayfish (species unknown) were observed swimming from shoreline burrows into deeper waters in response to the approach of the electrical current from the backpack shocker. Several dozen shed insect casings, possibly from chironomids, were observed on the surface of the reservoir. The shed casings suggest the presence of at least a limited benthic macroinvertebrate community.

**Assessment of Water Reservoir Habitat Quality**—The water reservoir is poor quality habitat and is not suitable to sustain fish populations. Although the reservoir is a permanent deepwater habitat, it has no connection to other water impoundments with fish populations. No habitat structure (e.g., vascular plant communities, tree trunks and tree limbs, undercut banks, and overhanging shoreline vegetation) that could function as fish spawning habitat, cover, and habitat for prey species (e.g., benthic macroinvertebrates) exists within the reservoir.

The reservoir provides some habitat for benthic macroinvertebrate populations and resources for some vertebrates. As mentioned previously, corixids and crayfish both were observed in the reservoir and the casings of an aquatic macroinvertebrate (possibly chironomid) were commonly observed on the water surface. Barn swallows (*Hirundo rustica*) and tree swallows (*Tachycineta bicolor*) were observed hawking insects over the surface of the water reservoir on several of the visits to this portion of the facility. The reservoir also offers loafing habitat and possible food resources (i.e., algae) for waterfowl such as mallards (*Anas platyrhynchos*), that were commonly observed on the southern end of the reservoir. Raccoon tracks were observed along the banks.

### 2.4.4.1.7. Stormwater Ditch Survey

This ditch is located immediately east of IU G, and appears to originate near the sand classifying operations south of the GM WWTP.

**Description of Stormwater Ditch**—No headwater source of the ditch was apparent, and there was no evidence of flow in the channel. Surface water and groundwater are the likely input sources. No standing water was found at the head of the ditch, although a small (30 $ft^2$) stand of cattails was present, suggesting the presence of subsurface water. The downstream end of the channel is only 8 to 10 in. deep and was covered with duckweed at the time of observation. The banks are raised only 1–2 ft above the channel and are vegetated exclusively with terrestrial herbaceous vegetation and woody shrubs.

**Stormwater Ditch Fish Community**—No fish were observed in this ditch. Except for the southernmost end of the channel, that was covered with duckweed, the channel was shallow and clear of organic debris or other physical habitat structure (i.e., only 1 to 3 in. deep).

**Stormwater Ditch Benthic Macroinvertebrate Community**—No benthic macroinvertebrates were found in this ditch. As mentioned above, most of the channel was either dry or shallow water. No aquatic insects or crayfish were observed.

**Assessment of Stormwater Ditch Habitat Quality**—Based on the habitat conditions present, no fish community is expected in the stormwater ditch. The channel is extremely shallow, creating a stagnant pool with no flow, no consistent source of inflow, and no habitat structure. This ditch does not appear to be connected to any source of fish, either upstream or downstream.

It is also unlikely that the ditch maintains any significant population of benthic macroinvertebrates. It may be colonized by some species of aquatic invertebrates during periods of maximum volume. However, the downstream end of the channel that is covered by duckweed is considered poor aquatic habitat. The vegetation cover blocks light transmission that results in stagnation of the underlying water column. In addition, upstream portions of the ditch are extremely shallow without any habitat structure, only a sandy substrate.

### 2.4.4.1.8. Fairchild "Ponds" Survey

The area referred to in past documents (e.g., EMCON 1995) as the Fairchild "ponds" is shown on **Figure 4-1** on the Facility property immediately south of the Fairchild property. During the site visit in September, this area was observed to consist of bottomland depressions in second-growth hardwood forest. At the time of the site investigations, these depressions were dry and covered with a thick leaf litter. There is no indication that there are permanent or even seasonal aquatic habitats in this area. No understory vegetation is present, and there is no evidence of aquatic or wetland plants. The depressions are not connected to any permanent or seasonal aquatic habitat on site. The only apparent source of water to this area is rainwater accumulation, which would be ephemeral in nature. No aquatic habitat is present.

### 2.4.4.1.9. East Stormwater Ditch Survey

A small ditch flows on the Facility immediately east of the Fairchild property boundary. Flow appears to be eastward along the northern boundary of the Fairchild property, then south into another ditch that parallels the high power transmission lines along the southern boundary of the facility property.

The channel is deeply incised, but narrow, and less than 3 ft wide. At the time of the site visit on September 7, 1997, the water was less than 2 in. deep throughout the channel, and flow was barely perceptible in a southerly direction. Channel substrate is sand, gravel, cobble, and some pebble-sized rock material. The channel banks are overgrown with trees and a relatively dense herbaceous understory of terrestrial vegetation; no aquatic vegetation community is present. No fish or benthic macroinvertebrates were observed. This ditch is not considered viable habitat for fish or aquatic macroinvertebrate populations.

### 2.4.4.1.10. Process Water Reservoir Survey

The process water reservoir is IU C, located northwest of the currently operating metal casting plant. This reservoir is the source of process water for the currently operating metal casting plant. Historically, it functioned as the intake point from the Saginaw River, when the process water system was operated in an open loop. Currently, the process water reservoir receives recycled non-contact cooling water through a discharge culvert in the northeastern portion of the reservoir. This water is pumped back into the currently operating metal casting plant in the southernmost extension of the pond. There is presently no connection between the process water reservoir and any other water impoundment at the facility. The historical

connection to the Saginaw River is normally closed, although makeup water is admitted from the river when needed. The water temperature in the reservoir is elevated well above ambient levels.

**Description of Process Water Reservoir Habitat**—The process water reservoir is a long, relatively narrow (about 100 ft wide) constructed channel that extends in an L-shape from the Saginaw River to the currently operating metal casting plant. The shorelines are relatively shallow (2–4 ft) with depths in mid-channel maintaining a uniform 10–14 ft. Patches of reedgrass are growing along the embankments of the reservoir but not actually in the reservoir. In many places, the embankments are covered by riprap (e.g., concrete blocks) and sunken debris (e.g., tree limbs), primarily in the northeastern portions of the reservoir.

The surface of the reservoir is about 4 to 6 ft below the surface of the surrounding terrestrial habitats. The process water reservoir is surrounded by various commercial and industrial activities, including the sand and gravel company to the northwest, piles of core butts and other foundry materials to the south and east, and plant operations to the south.

**Process Water Reservoir Fish Community**—No fish were found inhabiting the process water reservoir. Both electrofishing and seining failed to capture or detect any fish in the impoundment. One turtle (species unknown) was briefly observed along the shoreline of the southern portion of the reservoir.

**Process Water Reservoir Benthic Macroinvertebrate Community**—The benthic macroinvertebrate community was very similar to that found in the secondary settling pond and Deikmann drain. The community was taxonomically depauperate, but corixids and gomphid dragonfly larvae were common and abundant in the seine hauls. Some chironomids were also captured during fish seining efforts.

**Assessment of Process Water Reservoir Habitat Quality**—The process water reservoir appears to offer relatively low-quality habitat for fish. Although the reservoir is relatively deep, the bottom is a uniform U-shape with little or no habitat structure actually within the pond.

### 2.4.4.2. Terrestrial Habitat Characterization

Most of the Facility property is associated either with the currently operating metal casting plant, the demolished Nodular Iron Plant, the Type III solid waste landfill, or the sand classification operation. The few undeveloped areas are primarily small idle patches in early succession. In general, terrestrial habitats on site are of low to poor quality for most potential receptors.

The active industrial portion of the Facility includes the plant, paved parking and equipment storage areas, and structures associated with plant operations such as the noncontact water cooling towers and material storage areas (e.g., core butt storage areas north of the currently operating metal casting plant). In addition, there are commercial operations on the Facility that do not provide any significant ecological habitat, in particular the sand and gravel operation located immediately northwest of the process water reservoir and the metal recycling operation northeast of the currently operating metal casting plant.

The following section discusses specific areas of the Facility that are the only areas with any habitat for terrestrial organisms. Three such areas were identified. From north to south, these are wooded area no. 1, the reclaimed areas of the active Type III solid waste landfill, and wooded area no. 2, which is south of the Fairchild property (see **Figure 4-1**).

### 2.4.4.2.1. Wooded Area No. 1

This 11-acre tract is located immediately east of Crow Island Road and west of the City of Saginaw landfill. This tract is the most distant parcel from the currently operating metal casting plant.

This area was once part of a residential housing development, though no structures remain (EMCON 1995). The land appears to have been idle for many years, and natural succession is progressing. Mature and second-growth trees are interspersed with numerous clearings and grassy fields. Both overstory and understory vegetation communities are well developed. Numerous deer beds were found on the property, indicating substantial use by white-tailed deer (*Odocoileus virginianus*). A few patches of reedgrass grow in areas without any standing water, suggesting shallow groundwater flow, that the area previously was a pond, or it is a wet area that is drying.

A small pond is located in the southwest corner of the tract, with cattail and reedgrass growing along the borders and algal mats common on the water surface and attached to the substrate. It is unlikely that the pond supports any substantial populations of aquatic organisms. Although the water is clear, depths in the pond do not appear to exceed 2 ft, and the substrate is soft, flocculent organic matter. No fish or benthic macroinvertebrates were observed. However, the pond likely provides water resources for larger vertebrates such as the white-tailed deer. This species was observed on the tract during the site reconnaissance.

#### 2.4.4.2.2. Type III Solid Waste Landfill

The western most portion of the 71-acre GM Type III solid waste landfill is idle land that has been previously disturbed, as evidenced by the terraces in the sloped hillside of the excavated landfill cell. The vegetation community appears to be in an early successional stage, dominated primarily by forbs and grasses. The bottom areas of the landfill are periodically inundated during precipitation events. During the site visit, several dozen waterfowl were observed loafing and bathing in these areas of standing water. It is unlikely these inundated areas receive frequent use by wildlife, because they are essentially ephemeral water bodies. However, the soil appears to stay fairly moist, and stands of reedgrass were observed growing in the bottom of the landfill.

This area currently provides limited and temporary resources for terrestrial organisms including potential loafing, bathing, and perhaps watering areas for waterfowl during migration. The habitat will continue to progress through ecological succession. However, these areas are designated for industrial use and will eventually be buried beneath fill material as the landfill expands. The limited terrestrial habitat will be lost.

#### 2.4.4.2.3. Wooded Area No. 2

Wooded area No. 2 is a tract of forested habitat, covering approximately 15 acres between the southern boundary of the Fairchild property and the southern boundary of the Facility. The habitat is predominantly early second-growth hardwood forest with only a few mature trees interspersed. Limited habitat is available for cavity-nesting birds, and the younger trees provide few nest sites for tree-nesting birds. The absence of a well-developed understory vegetation reduces or eliminates most seed- and fruit-bearing plants and provides little habitat or resources for the aboveground terrestrial invertebrates (e.g., grasshoppers, beetles, caterpillars, moths, and butterflies) that are the prey items of many forest birds.

In general, this habitat is poor quality for ground-dwelling organisms (e.g., small mammals), and is unlikely to provide many resources for the small, forest-dwelling birds that typically forage on the ground or in understory vegetation.

### 2.4.4.3. Ecological Exposure Pathways Present

In order to have a complete exposure pathway, both a contaminant source and a receptor community must be present. A route for receptors to be exposed (e.g., ingestion of contaminated media, food-web bioaccumulation) must also exist which

has the potential to cause significant exposure. The potential for aquatic and terrestrial exposure pathways are separately evaluated below. Complete exposure pathways are illustrated in **Figure 4-2**. These pathways will be evaluated in the ecological risk-based screening assessment in Phase 1B of the RFI.

### 2.4.4.3.1. Aquatic Exposure Pathways

The sediments and surface water of surface water bodies represent potential sources of contaminants for aquatic receptors and terrestrial receptors that forage on aquatic organisms.

**Direct Exposure to Contaminated Media**—Wildlife species may become exposed to contaminated aquatic media via the use of open water areas as loafing areas by transient species, especially waterfowl. The potential for risk due to direct exposure to surface water contaminants will therefore be evaluated for waterfowl.

**Aquatic Food Web Exposures**—Of the eight surface water bodies evaluated, only the North Ditch and the Deikmann drain support fish. A potential pathway therefore exists for exposure of fish-eating birds, such as herons and egrets, only in the North Ditch and Deikmann drain. These two water bodies will be evaluated for the occurrence of bioaccumulative compounds and the potential exposure of piscivorous birds.

Raccoon may be attracted to crayfish, which are relatively abundant in the water reservoir (lagoon no. 5). The occurrence of bioaccumulative compounds and the potential exposure to raccoon which may forage on crayfish will be evaluated for the water reservoir, as well as Deikmann drain and the North Ditch.

Emergent insects, with aquatic larval stages may be a pathway of exposure for insectivorous birds in the water reservoir (lagoon no. 5), where birds have been observed hawking insects. Potential risk to insectivores will be evaluated for this water body.

Foraging by some herbivorous waterfowl may occur in the secondary settling pond, which contains significant quantities of algae. This foraging behavior has not been observed, but will be evaluated for the potential to pose risk.

### 2.4.4.3.2. Terrestrial Exposure Pathways

Given that terrestrial habitat is limited to the three outlying areas of the facility described above, and the fact that there is no known history of hazardous releases or sources in these areas, no completed exposure pathways for terrestrial receptors

have been identified. Furthermore, the quality and extent of terrestrial habitat is minimal, and use of these areas by wildlife species is likely to be very limited, given the setting. The few wildlife species that occasionally use the facility as habitat, such as migratory birds and raccoons, are potentially exposed to contaminants through aquatic exposure pathways only.

# 3.0 DATA VALIDATION AND ASSESSMENT OF PHASE 1A DATA

The objective of the data validation program is to provide a standardized framework for conducting reviews of the field and laboratory data to ensure consistency with the referenced methods in the project-specific *Quality Assurance Project Plan (QAPP)* (EMCON, June 1998).

## 3.1. Description of Data Validation and Assessment

As required by the *QAPP*, all analytical data generated by Columbia Analytical Services (CAS) were subjected to validation by Exponent staff. The data validation procedures used for the project and specified in the *QAPP* conform to the procedures outlined in Functional Guidelines (U.S. EPA 1994a,b). The quality assurance review was conducted to verify that the laboratory's quality assurance and quality control (QA/QC) procedures were documented and sufficiently rigorous to meet the requirements of the referenced analytical methods. Data qualifiers were assigned to some of the results to indicate irregularities in the analyses that could affect the bias, precision, and usability of the reported results. Quality assurance review summaries (**Attachment J**), which summarize the accuracy, precision, and completeness of the data and include data summary tables with qualifiers, were generated by matrix for each parameter to summarize the data validation and assessment of the Phase 1A data.

A total of 90,157 data points were generated during the Phase 1A Investigation. Of these results, 89 percent were non-detects. During validation, 13 percent of the results were qualified as estimated, and 4 percent were rejected.

## 3.2. Data Quality Objectives

Data Quality Objectives (DQOs) for the Phase 1A data were established to identify target parameters for analysis, estimated quantitation limits, and precision, accuracy, and completeness goals for the collection and analysis of investigative samples. A comparison of the Phase 1A results to the project-specific DQOs is provided below. The quality assurance review summaries (**Attachment J**) include additional information regarding the quantitative and qualitative assessment of the project-specific DQOs by matrix and parameter.

### 3.2.1. Estimated Quantitation Limits

The Phase 1A data were reported to the Estimated Quantitation Limits (EQLs) established in the *QAPP* for all analytical methods except cyanide. Because of an interference with the carbonate content of many of the soil samples, the EQLs for cyanide were elevated for most soil samples collected during Phase 1A. Some individual results for organic and inorganic parameters were reported above the EQL in specific samples because of matrix interferences. With the exception of specific results identified in the individual quality assurance review summaries (**Attachment J**), the Phase 1A data met the EQLs established for the project.

### 3.2.2. Accuracy

The accuracy of the analytical results was evaluated for each analytical method according to the DQOs established in the *QAPP* for matrix spike and analytical spike recoveries, laboratory control sample recoveries, and surrogate compound recoveries. Some results were qualified as estimated because of exceedances of the quality control limits established in the *QAPP* for each method. Overall, the data were acceptable for the uses identified in the Phase 1A RFI Workplan. The quality assurance review summaries in **Attachment J** discuss the assessment of the accuracy of the results by matrix and analyte, identify specific results qualified during the quality assurance review, and include tabulated results of matrix spike and laboratory control sample recoveries.

### 3.2.3. Precision

The precision of the results was evaluated for each analytical method according to the DQOs established in the *QAPP* for matrix spike duplicate results, laboratory duplicate results, and field duplicate results. Some results were qualified as estimated because of exceedances of the quality control limits established in the QAPP for assessment of laboratory and field precision. Overall, the data were acceptable for the uses identified in the Phase 1A RFI Workplan. The quality assurance review summaries in **Attachment J** discuss the assessment of field and laboratory precision the results by matrix and analyte, identify specific results qualified during the quality assurance review, and include tabulated results of matrix spike duplicate, laboratory duplicate, and field duplicate results.

### 3.2.4. Completeness

The field and laboratory completeness of the investigation was evaluated for the Phase 1A data. Field completeness for each analysis in each IU was evaluated by

comparing the total number of investigative samples planned to the actual number of samples collected. The DQO of 90% completeness was met or exceeded with a few exceptions predominantly due to insufficient groundwater available at proposed locations and other minor modifications of the scope made during the field sampling. **Table 3-1** summarizes the field completeness for each analysis by IU. Laboratory completeness was assessed by comparing the total number of valid measurements obtained to the number of measurements generated. The DQO of 95% was met for analyses in each matrix with the exception of VOCs in groundwater and soil for the RFI investigation, which had a higher percentage of data rejected because of exceedances of the control limits for instrument calibration (89 and 87 percent completeness, respectively). **Table 3-2** summarizes the laboratory completeness for each matrix and analysis in each investigation.

# 4.0 SCREENING METHODOLOGY FOR PHASE 1A RFI DATA

The characterization data collected during Phase 1A were evaluated to identify environmental conditions that may warrant further investigation during Phase 1B. During Phase 1A, approximately 80,000 valid analytical measurements were reported. Of the valid analytical measurements, approximately 9,000 results are measurements above detection limits, which consist of approximately 7,000 results for identified compounds and approximately 2,000 results for tentatively identified compounds (TICs). To efficiently evaluate the large amount of characterization data collected, generic risk-based screening levels were used to identify locations where constituents are present at concentrations that may warrant further investigation. **Section 4.1** discusses the screening levels that were used to evaluate the Phase 1A data. The screening procedure and results are discussed in **Section 4.2.** Results of the screening evaluation are considered in combination with other factors in **Section 5** to support the sampling and analysis plan for Phase 1B.

## 4.1. Phase 1A Screening Levels

Screening levels for evaluating the Phase 1A data were taken from generic risk-based cleanup criteria developed by the Michigan Department Environmental Quality (MDEQ) to facilitate implementation of Part 201 (Environmental Remediation) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The Part 201 generic criteria were those published in the January 29, 1999 MDEQ Operational Memorandum #18. The technical bases for the criteria are discussed in detail in MDEQ technical support documents dated August 31, 1998.

Under Part 201, remedial actions may use the Part 201 generic risk-based criteria as cleanup standards. However, the generic criteria do not necessarily represent final cleanup standards. Some generic criteria may address exposure pathways that are not relevant at a site, some generic criteria may not be applicable at a site because reliable institutional controls exist, and less conservative site-specific risk-based cleanup criteria may be used instead. Additionally, some Part 201 generic risk-based criteria for metals are below naturally occurring concentrations in soil (e.g., arsenic) and some criteria for drinking water are not risk-based (e.g., iron and manganese). In general, however, the technical bases for the Part 201 criteria are

similar to generic risk-based criteria published by the U.S.EPA, such as the Soil Screening Levels, the USEPA Region 3 risk-based concentrations, and the U.S.EPA Region 9 preliminary remediation goals.

For evaluation of the Phase 1A data, the Part 201 generic criteria were used simply as generic risk-based screening levels, which are intended to provide a conservative and efficient means of identifying constituents and locations that may warrant further evaluation. A concentration higher than a screening level does not mean that a significant risk exists. Rather, the concentration is identified for review relative to other concentrations of the constituent at other locations and depths, regional background levels, distribution of the constituent in other environmental media, field observations, and previously identified or additional areas of interest (based on operational history in the vicinity of the sample). The results of this review provide one basis for the Phase 1B sampling and analysis plan. They do not provide an assessment of the potential significance of risk associated with the presence of constituents at an Investigative Unit (IU). Such an assessment will be performed at the completion of RFI field investigations, as discussed in **Section 6**.

### 4.1.1. Soil

Part 201 criteria for both the residential land use category (which includes the Commercial I category) and the industrial land use category (which includes the Commercial II, III, and IV categories) were used as Phase 1A screening levels. Although criteria for the residential land use category were used for screening the Phase 1A data, current land use at the facility is industrial/commercial and information reviewed during Phase 1A support a determination that reasonably anticipated future on-site land use will remain industrial/commercial, as discussed in **Section 2.4**. Criteria for the residential land use category are generally (but not always) more conservative than the criteria for the industrial category, so that using both sets of criteria ensured that all potentially significant concentrations in the Phase 1A data (and somewhat more) were identified for review as discussed above. However, in the RFI baseline risk assessment that will be conducted at the completion of field investigations, potential on-site exposures will be evaluated under only industrial/commercial land use, which is the current and reasonably anticipated future land use at the facility, as discussed in **Section 6**.

For screening the Phase 1A soil characterization data, Part 201 generic criteria were selected for the following potentially relevant exposure pathways:

- Direct contact (incidental ingestion and dermal contact)
- Ambient air (inhalation of soil vapor and particulate)
- Indoor air (inhalation of soil vapor via intrusion into building)

Among the three sets of Part 201 generic criteria for soil vapor inhalation via ambient air, the selected criteria were those based on a 5-meter depth of contamination, because groundwater is typically encountered at depths less than 5 meters at the facility. The criteria addressing leaching of constituents to groundwater were not used because virtually all soil samples collected during Phase 1A were taken from bore-holes where groundwater monitoring wells were installed and groundwater quality was directly measured during Phase 1A.

### 4.1.2. Groundwater

Similar to the approach for selecting screening levels for the Phase 1A soil characterization data, Part 201 groundwater criteria for both the residential land use and industrial land use categories were used as Phase 1A screening levels to assess the Phase 1A groundwater data. These criteria address the following exposure pathways:

- Drinking water
- Indoor air (inhalation of groundwater vapor via intrusion into building)

Because the Part 201 residential drinking water criteria are generally more stringent than other Part 201 groundwater criteria, screening the Phase 1A data with these criteria means that groundwater data from hydrogeologic units unlikely ever to be used as a residential drinking water supply were screened with residential drinking water criteria. Additionally, groundwater data from shallow monitoring wells located near the Saginaw River were compared with Part 201 groundwater-surface water interface criteria.

As discussed above in **Section 2.4**, the upper water-bearing zone and the confining clay layer underlying the facility likely lack sufficient yield to support on-site use of groundwater under current and reasonably anticipated continued industrial/commercial land use. In addition, the upper water-bearing zone is hydraulically isolated from the sand/bedrock aquifer by the confining clay layer and an upward hydraulic gradient from the aquifer. The sand/bedrock aquifer, however, could potentially be used as a drinking water supply in the region (because this unit often has high dissolved solids, the natural water quality is poor and the Saginaw area obtains its drinking water from Lake Huron). Screening groundwater data from each hydrogeologic unit against the Part 201 residential drinking water criteria ensured that all potentially significant concentrations in the Phase 1A data (and somewhat more) were identified for review as discussed above. However, in the RFI baseline risk assessment that will be conducted at the completion of field investigations, potential exposures to groundwater will be evaluated for only

reasonably expected groundwater uses and exposure pathways specific to each hydrogeologic unit, as discussed in **Section 6**.

### 4.1.3. Sediment and Surface Water

Because Part 201 criteria do not address surface water or sediments, the Part 201 direct soil contact criteria were used as screening levels for sediment and the Part 201 drinking water criteria were used as screening levels for surface water. These criteria were used to ensure that all potentially significant concentrations in the Phase 1A data (and somewhat more) were identified for review as discussed above. However, in the RFI baseline risk assessment that will be conducted at the completion of field investigations, potential exposures to sediments and surface water will be evaluated for only reasonably expected exposures, as discussed in **Section 6**.

For purposes of screening the Phase 1A data, the following subset of Phase 1A monitoring wells were considered for screening against the Part 201 generic groundwater\surface water interface criteria:

| | | | |
|---|---|---|---|
| MW-00124 | MW-01827 | MW-03240 | MW-04864 |
| MW-00925 | MW-00821 | MW-03746 | |
| MW-01329 | MW-01119 | MW-04250 | |
| MW-01530 | MW-02432 | MW-04757 | |

## 4.2. Screening Procedure and Results

The Phase 1A data were prepared for screening by the following procedure:

1. Data qualified as "rejected" in data validation were eliminated for all use.

2. Replicate analyses were averaged to obtain a representative datum. Where some replicates in a set were reported as above detection and others below detection, the datum was considered detected, to avoid false negative determinations. The concentrations above detection were averaged with the sample quantitation limit (SQL) of the replicates reported below detection.

3. Data reported as above detection were included for screening.

4. For groundwater data for metals, the dissolved (rather than total) concentrations were included for screening, because these concentrations better represent the exposure point concentrations of the metals.

5. Constituents that were reported as positively identified were included for screening.

Constituents included for screening among the Phase 1A data for soil, groundwater, sediment, and surface water are summarized along with their screening levels in **Table 4-1** (Phase 1A screening levels for soil and sediment) and **Table 4-2** (Phase 1A screening levels for groundwater and surface water). Constituents that have no screening level in a medium are summarized on **Table 4-3** with their frequency of detection in that medium, and their minimum, average, and maximum concentrations.

**Tables 4-4** through **4-7** summarize the screening for each environmental medium at each IU. For each medium, the frequency of detection and the minimum, average, and maximum concentrations of each detected constituent with concentration(s) higher than a screening level is shown for each IU. For each constituent, the number of samples in an IU with concentrations higher than the constituent's screening levels is also shown for each of the constituent's screening levels. The locations where the constituent's concentrations are higher than a screening level are shown in bold on **Figures 5-1** through **5-10** with the actual concentrations for the specific samples.

Constituents in environmental media were not screened at this time relative to ecological risk screening values. Rather, the approach for evaluating ecological exposures during Phase 1A focused on a habitat-level screening of potential exposure pathways. As indicated by the ecological reconnaissance survey described in **Section 2.4**, there are no complete pathways of exposure at the site for terrestrial receptors. The ecological reconnaissance identified potential pathways of exposure for receptors using surface water resources. These pathways and the approach for their evaluation are described in **Section 6.2**. Additional screening and evaluation of these pathways is proposed for Phase 1B. This ecological risk assessment approach is consistent with RCRA guidance, which recommends that a preliminary, or screening level, ecological risk assessment should be completed during the RFI.

# 5.0 EVALUATION OF PHASE 1A CHEMICAL DATA AND PROPOSED PHASE 1B SAMPLING

During Phase 1B, specific AOIs and contaminated areas identified during Phase 1A will be further characterized. The following subsections describe the proposed project parameters, sample network, field procedures, facility-wide activities, and the Saginaw River sampling plan. The results from the screening of the Phase 1A data were used in the development of the following Phase 1B scope of work.

## 5.1. Project Parameters for Analyses

### 5.1.1. Field Parameters

Ground-water samples collected during the Phase 1B investigation will be analyzed for the following field parameters:

- pH.
- Turbidity.
- Specific conductance.
- Dissolved oxygen.
- $E_h$°
- Temperature.

The following field measurements will also be made:

- Monthly measurements of the depth to groundwater through June 2000
- Quarterly measurements of the depth to groundwater for two years after June 2000
- Survey measurements of additional well locations (horizontal and vertical), final river sampling locations (horizontal), and shoreline reference points (horizontal)
- Volatile organic compound (VOC) headspace screening
- VOC analysis of soil, soil-vapor, and/or groundwater samples using an on-site mobile laboratory

VOC headspace screening will be performed on soil samples, if sufficient sample volume can be obtained, by inserting a photoionization detector (PID) into a jar

partially filled with sample material, as described in the "Surface Soil Sampling" and "Subsurface Soil Sampling" standard operating procedures (SOPs) contained in the QAPP: Part IV (June 1998). In addition, ambient air monitoring may be performed consistent with the Health and Safety Plan: Part VI requirements (June 1998).

## 5.1.2. Laboratory Parameters

The data collected during Phase 1A were used to help develop the scope of work for the Phase 1B investigation. Evaluation of the Phase 1A data also helped determine the chemical parameter list for the Phase 1B Investigation. The list of target parameters and the rationale for their selection are provided in **Attachment A** (Table 2) and discussed below.

### 5.1.2.1. Organic Compounds

The Phase 1A list of parameters included 61 volatile organic compounds (VOCs) and 109 semivolatile organic compounds (SVOCs) from the Appendix IX groundwater monitoring list as specified in the Phase 1A Workplan and QAPP. The U.S.EPA Contract Laboratory Program (CLP) target compound list (TCL) includes 33 VOCs and 64 SVOCs. **Attachment A** (Table 2A) summarizes the non-TCL compounds detected during the Phase 1A investigation. Organic compounds detected in Phase 1A that are reported differently than on the TCL are 3- and 4-methylphenol coelution and *cis*- and *trans*-1,2-dichloroethene. The *cis*- and *trans*-1,2-dichloroethene isomers were reported as individual compounds for the Phase 1A volatile organic analyses as specified in the Phase 1A QAPP, instead of as total 1,2-dichloroethene, as specified in the TCL, because the two isomers are quantitated separately during the analysis. Similarly, because of spectral overlap, 3- and 4-methylphenol were reported as a coelution for the SVOC analyses, as specified in the Phase 1A QAPP, instead of as 4-methylphenol as specified in the TCL. The *cis*-1,2-dichloroethene isomer was the only non-TCL Appendix IX VOC compounds detected during Phase 1A. Acetophenone, which was detected in one soil sample, is the only SVOC included on the Phase 1A analyte list that is not included in U.S.EPA's TCL. Formaldehyde, a carbonyl compound, which was included in the Phase 1A list of parameters, but is not included in U.S.EPA's TCL or the Appendix IX groundwater monitoring list, was detected in some soil and groundwater samples.

Therefore, for the Phase 1B investigation scope of work, the TCL parameters were selected as the organic parameter list with the addition of formaldehyde, the 3- and 4-methylphenol coelution, and *cis*- and *trans*-1,2-dichloroethene. The 28 additional VOCs and 45 additional SVOCs that were included in the Phase 1A list of parameters will not be included in Phase 1B because they were never detected

during the Phase 1A investigation. The Phase 1B list of parameters was revised to include the 34 TCL VOCs (note 34 VOCs instead of 33, as specified in TCL, because of reporting of individual *cis*- and *trans*- isomers for 1,2-dichloroethene (**Attachment A, Table 3A**) and 64 TCL SVOCs (**Table 3B**). The Phase 1B list of parameters for polychlorinated biphenyl (PCB) Aroclor® mixtures (**Attachment A, Table 3C**) and formaldehyde (**Attachment A, Table 3D**) remains unchanged from the Phase 1A parameter list.

The Phase 1A Workplan also required reporting of the top 10 tentatively identified compounds (TICs) (as ranked by concentration) for SVOC analyses in all matrices. A total of 205 TIC compounds and 2,454 TIC results were reported for the Phase 1A Investigation. Of the 2,454 TIC results, 8 percent were rejected during validation. Of the 205 TIC compounds identified during Phase 1A, over 50 percent were unknown compounds (i.e., unknown PAH, dimethylnaphthalene isomer 2, substituted phenol) and were not used for data analysis or interpretation. The TIC results are difficult to assess because the identification of the compounds is qualitative and is selected using professional judgment when the mass spectrometer library search yields several candidate compounds. CAS registry numbers (CAS RN) were assigned to 68 of the 205 TICs based on the chemical names identified by the laboratory. Assuming that the laboratory's tentative identifications are correct, only 6 of the 68 compounds (1,2,3-trichloro-1-propene, benzoic acid, caprolactam, 2-(2-ethoxyethoxy)-ethanol, *o*-hydroxybiphenyl, and triphenyl ester phosphoric acid) have either U.S.EPA-derived toxicity values or a screening level from U.S.EPA Regions 9 or 3, or from MDEQ. Because toxicity information is also limited or nonexistent for the identified compounds, the data are not used in evaluating risk at the site. Including these TICs would also significantly increase data management requirements. Therefore, TICs for SVOC analysis will not be reported during Phase 1B activities, and this component of analysis does not appear in the Phase 1B QAPP.

### 5.1.2.2. Metals

The analyte list for total and dissolved metals (**Attachment A, Table 3E**) for Phase 1B was revised based on the results from the Phase 1A Investigation. Calcium and iron were not included in the analyte list for Phase 1B as these naturally occurring elements are typically excluded from human health risk assessment evaluation because of their natural abundance and the fact that U.S.EPA has not established human health toxicity values for these parameters. Silver and thallium were not included in the analyte list for Phase 1B, as they were not detected in any of the soil or groundwater samples during Phase 1A (**Attachment A, Table 2B**) and are not known to be related to on-site plant activities. Mercury was detected in only 10 of the 234 soil samples, with a mean concentration of 0.011 mg/kg and a maximum

of 0.6 mg/kg, which is within typical background levels (Dragun 1991, Table 42). Total mercury was detected in 26 percent of the groundwater samples (21 of 82 samples) at a maximum concentration of 0.0002 mg/L (maximum contaminant level [MCL] is 0.002 mg/L). Dissolved mercury was not detected in any of the groundwater samples. Because mercury was not detected in the dissolved fraction of the groundwater, was detected infrequently in soil, and is not known to be related to on-site plant activities, mercury has been excluded from the Phase 1B parameter list. Cobalt, selenium, and tin were not included in the Phase 1B list of parameters because of the infrequency of detection for selenium and tin, and because the maximum concentrations detected in soil for all three of these analytes were well within typical background levels (Dragun 1991, Tables 19, 58, and 74). In addition, cobalt, selenium, and tin were not detected in the dissolved fraction of the groundwater samples in any Phase 1A sample and total cobalt, selenium, and tin were detected in 58, 2, and 9 percent of the groundwater samples, respectively, at concentrations well below Phase 1A screening levels. Table 3E of **Attachment A** identifies the selected metals for which each matrix will be analyzed related to each IU, as described in **Sections 5.4.1** through **5.4.2** and **Tables 5-1** through **5-10**.

#### 5.1.2.3. Additional Parameters

Chromium speciation was added to the list of parameters for Phase 1B to support interpretation of data for human health risk assessment, because the human health toxicity and mobility of chromium varies by valence. Ammonia-nitrogen was added to the Phase 1B list for analysis of selected soil and groundwater samples near the calcium carbide replacement pads to confirm the source of ammonia detected during previous investigations. Acid-volatile sulfide and sequentially extractable metals were not included in the Phase 1B analyte list because the scope of Phase 1B does not include the assessment of bioavailability of total metals in Saginaw River sediment, rather the scope is to determine whether the existing concentrations are elevated due to potential facility contributions. Total Kjeldahl nitrogen and sulfide were not included in the Phase 1B list of parameters because analyses for these parameters are not required to satisfy the objectives of the Phase 1B investigation, and U.S.EPA has not established human health toxicity values for these parameters; therefore, additional data are not useful for conducting the human health risk assessment.

## 5.2. Sample Network Design and Rationale

For the Phase 1A sampling program, the Facility was separated into ten IUs, as shown on **Figure 1-2.** The following sections present the results of the Phase 1A analytical data and the proposed Phase 1B sampling locations and rationale for each

of the ten IUs. In the text and on the figures, each AOI is identified with the applicable IU letter and number, as originally referenced in the *DOCC* (August 1995) (e.g., A.1 is an area of interest located in investigative unit A). The AOIs and the proposed sample locations are shown on **Figures 5-1** through **5-10** (where applicable), and the sample matrices and analytical parameters for each AOI are summarized in **Tables 5-1** through **5-10.**

The proposed Phase 1B sampling and/or monitoring well locations were selected in accordance with the overall approach, which is to evaluate the nature and extent of specific substances identified during the Phase 1A investigation and to investigate specific AOIs where potential environmental contamination exists.

Sampling locations proposed in the Phase 1B Workplan were selected based on consideration of the following criteria:

- A reasonable factual basis exists to suspect a release of hazardous constituents in the area.
- A release of hazardous constituents in the area would not be mitigated by existing structural measures such as sumps.
- Historical uses of the area are unknown.
- Chemical constituents potentially released in the area were not likely to have been detected during the Phase 1A sampling program. Data gaps were identified by evaluating local groundwater flow conditions, mobility of the suspected or potential hazardous constituents, and other area-specific geologic or hydrogeologic conditions.
- Chemical constituents were detected during the Phase 1A sampling program, and additional sampling is required to evaluate the chemical constituents and/or delineate extent.

In addition, the Phase 1B program includes resampling groundwater in all of the existing Phase 1A RFI wells to confirm data collected during the Phase 1A sampling program and an additional program for the collection and analysis of surface water and sediment samples from the Saginaw River.

## 5.3. Field Procedures

All drilling, soil sampling, well installation, well development, and groundwater sampling activities will be performed consistent with the SAP and the SOPs in the Phase 1A RFI Workplan. For Phase 1B field activities that were not performed during Phase 1A, the SOPs are presented in **Attachment K.**

Subsurface soil sampling will be performed at each of the proposed soil boring and monitoring well locations. Laboratory analyses will be performed on at least two soil samples from each shallow well boring: one from the ground surface and one from just above the capillary fringe. Additional soil samples may be analyzed if appropriate (e.g., if water saturation is encountered deeper than 8 feet below ground surface, one additional sample from a depth of approximately 5 to 7 feet below ground surface will be submitted for laboratory analysis). If no water is encountered, a soil sample will be collected 15 feet into the confining clay layer before ending the boring. Saturated soil samples will not be collected for laboratory analysis. Additional samples from selected 15-foot intervals may be analyzed if appropriate.

The above soil sampling and analysis program will not apply to the soil, soil vapor, and/or groundwater screening activities proposed for investigative units B and G. In these two IUs, soil samples will be analyzed only if a potential source area is discovered within the unsaturated soil as determined by visual or olfactory evidence, or significant needle deflections on the PID. Therefore, soil samples may or may not be analyzed depending upon observations made during the field activities. Because of the variability of the Phase 1A sample locations, sample matrices, and potential constituents of concern throughout the site, there has not been any direct correlation established between PID readings and volatile organic analysis from the laboratory. During advancement of the Phase 1B soil borings, which are not expected to encounter any source-related materials and which are intended to be completed to obtain temporary groundwater samples for mobile laboratory analysis, GM will continue to use a subjective method for determining which of the continuously-sampled soil will be submitted to the permanent laboratory for analysis, if any from these areas. This subjective method generally consists of visual and olfactory evidence of suspected contamination and/or significant needle deflections on the PID.

## 5.4. Facility-wide Activities

Activities that will be performed in all of the IUs are as follows:

- All Phase 1A monitoring wells will be resampled and most Phase 1B monitoring wells (exceptions are noted in **Sections 5.4.2.2** and **5.4.6.2**) will be sampled in one site-wide groundwater sampling event. This sampling event will be conducted during the Spring and/or Summer seasons to evaluate seasonal variations, if present, in the Phase 1A monitoring wells (previously sampled in the fall/winter). Generally, the groundwater samples will be analyzed for the Phase 1B parameters and the site-specific list of metals (total and dissolved) to confirm the Phase 1A results. Additionally, most groundwater samples will also

be analyzed for formaldehyde to determine whether the potential concentrations of formaldehyde in groundwater detected in Investigative Unit I are facility-wide (refer to **Attachment A - Tables 3a** through **3f**). Refer to **Sections 5.4.1** through **5.4.2** and **Tables 5-1** through **5.10** for the specific parameters proposed at each monitoring well.

- Site-specific background levels will be established for the site-specific list of metals (**Attachment A, Table 3E**) and cyanide in groundwater in both the upper water-bearing zone and the subglacial sand/bedrock aquifer. The background levels will be established from monitoring wells located in areas of the site upgradient of current and historical plant activities. (See **Figure 5-11** for monitoring wells to be used for background groundwater quality). Background values will be determined based on the 99% upper prediction limit for all appropriate data per metal constituent. All data will be checked for outliers and will also be checked for normality using the Shapiro-Wilk (1965) or the Shapiro-Francia (1972) test of normality, as appropriate. If normality is rejected, the data will be log-transformed and checked for log-normality. If the data are normal or log-normal, standard parametric analyses will be completed to establish the 99% upper prediction limit. If the data are not normal or log-normal, a non-parametric analysis will be used to estimate the upper prediction limit.

- The locations and top-of-casing elevations for all of the new Phase 1B wells will be surveyed using the same datum and coordinate system that was used for the Phase 1A wells. In addition, Phase 1A monitoring well MW-07959 will re-surveyed to confirm the groundwater flow direction in the upper water-bearing zone within IU I.

- Depths to groundwater will be measured and groundwater elevations will be calculated for all Phase 1A and Phase 1B wells. The groundwater elevations will be used to confirm the direction of groundwater flow determined during Phase 1A. Furthermore, gauging of the Phase 1A and Phase 1B wells will be performed quarterly for one year to assess seasonal variations in groundwater conditions.

The following sections summarize the results of the evaluation performed on the Phase 1A data (**Section 4** and **Attachment H**), present the proposed Phase 1B scope of work, and provide rationale for the proposed Phase 1B sampling locations and parameter lists by Investigative Unit (Quality Assurance/Quality Control Data Summary Tables are provided in **Attachment L**).

All proposed sampling locations are approximate; actual locations will be determined in the field. The Field Coordinator will be responsible for selecting the actual locations, in association with the USEPA representative (if present). The

Field Coordinator's responsibilities for Phase 1B will be the same as those described in the RFI Workplan, Section 3.4 of the PMP: Part III. Locations will be selected in accordance with those identified in **Figures 5-1** through **5-10,** taking into account site-specific conditions such as access constraints. The final locations will be documented in the Phase 1B Report.

## 5.4.1. Investigative Unit A

### 5.4.1.1. Phase 1A Data Summary

#### 5.4.1.1.1. Soil

Three metals were detected in soil samples above the Phase 1A screening levels. Arsenic was detected above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg (refer to **Attachment H**). Concentrations of arsenic in soil in Investigative Unit A ranged from 2 mg/Kg to 15 mg/Kg and were above the criterion at nine samples. Four of these samples were from depths greater than twenty feet below ground surface. Chromium (total) was detected above the Part 201 Residential Particulate Soil Inhalation Criterion of 260 mg/Kg (for hexavalent chromium) in one soil surficial soil sample from this IU. Concentrations of chromium ranged from 6 mg/Kg to 292 mg/Kg. Manganese was detected at concentrations above the Part 201 Industrial Particulate Soil Inhalation of 1,500 mg/Kg in two soil samples within Investigative Unit A; only one of which was from a surficial soil sample. Concentrations of manganese ranged from 93 mg/Kg to 5,220 mg/Kg.

No other compound analyzed for was detected at concentrations above the Phase 1A screening levels (refer to **Figure 5-1a**).

#### 5.4.1.1.2. Groundwater

Six parameters were detected above the Phase 1A screening levels within groundwater samples collected in Investigative Unit A (refer to **Attachment H**). 1,2-Dichloropropane was detected in four groundwater samples from this IU. Concentrations of detected 1,2-Dichloropropane ranged from 0.0006 mg/L to 0.0057 mg/L. Only one water sample (MW-10713) was detected above the Part 201 Residential Drinking Water Criterion of 0.005 mg/L at a concentration of 0.0057 mg/L. The duplicate for this sample exhibited a concentration of 0.0045 mg/L.

Dissolved Aluminum was detected in one groundwater sample from this IU at a concentration of 0.39 mg/L, which was above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L.

Two of four groundwater samples collected from monitoring wells located near the Saginaw River were above the Generic Screening Criterion (Groundwater/Surface Water Interface) for dissolved Barium of 0.190 mg/L. The concentrations from the four monitoring wells ranged from 0.145 mg/L to 0.216 mg/L.

Dissolved iron was detected in all eleven groundwater samples collected from Investigative Unit A. Ten concentrations, ranging from 2.02 mg/L to 40.4 mg/L, were detected above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L.

One groundwater sample exhibited a dissolved concentration of lead at 0.011 mg/L, which was above the Part 201 Residential Drinking Water Criterion of 0.004 mg/L. All other groundwater results for dissolved lead were below the estimated quantitation limit.

Ten of the eleven groundwater samples collected from Investigative Unit A exhibited detectable concentrations of dissolved manganese. All ten results were detected at concentrations above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L, ranging in concentration from 0.312 mg/L to 2.31 mg/L.

No other compound was detected above the Phase 1A screening levels (refer to **Figure 5-1b**).

### 5.4.1.2. Proposed Phase 1B Sampling Locations and Parameter Lists

Four surface soil samples (0-2 feet bgs) will be collected within the Former Sluice Sand Settling/Reclaim Area (A.3) (**Figure 5-1a**). These samples will be analyzed for VOCs, SVOCs, PCBs, site-specific metals, cyanide and formaldehyde to further characterize the soil conditions resulting from the placement of sluice sand in the area and concentrations detected in soil from monitoring well MW-00821 (refer to **Section 5.4.1.1.1.**).

One additional surface soil sample will be collected in the southeast corner of IU A to further characterize constituents identified during Phase 1A at Phase 1A monitoring well MW-00713 and will also be analyzed for TCL SVOCs, PCBs and the site-specific metals.

Additionally, two soil borings will be completed within AOI A.3 and soil samples will be collected in accordance with the sampling protocol in the approved Workplan. The soil samples will be analyzed for the Target Compound Lists (TCL)

for VOCs, SVOCs and PCBs, and the site-specific metals, cyanide, and formaldehyde.

This proposed sampling at AOI A.3 will be completed prior to the proposed sampling described for the Saginaw River (**Section 5.5**) to determine whether additional parameters or alternative locations will be added to the river sampling plan.

## 5.4.2. Investigative Unit B

### 5.4.2.1. Phase 1A Data Summary

#### 5.4.2.1.1. Soil

Three Phase 1A constituents were detected above the Phase 1A screening levels from soil samples collected in Investigative Unit B (refer to **Attachment H**). Arsenic was detected in fifteen soil samples collected in this IU. Only one soil sample exhibited a concentration which was above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg at a concentration of 9 mg/Kg. Concentrations of detectable arsenic in soil ranged from 1 mg/Kg to 9 mg/Kg.

Benzo[a]pyrene was detected in four soil samples within this IU; only one of which (MW-00509, 2-4 feet bgs) was detected above the Part 201 Residential Direct Contact Criterion of 1.4 mg/Kg. Concentrations of detectable Benzo[a]pyrene ranged from 0.04 mg/Kg to 2.3 mg/Kg.

Vinyl chloride was detected in one soil sample from this IU (MW-00509, 12-14 feet bgs) at a concentration of 1.7 mg/Kg. This concentration was above the Part 201 Residential Volatilization to Indoor Air Criterion of 0.028 mg/Kg. However, it is likely that the concentrations found in this sample are from the overlying groundwater (**Section 5.4.2.1.2**).

No other compound was detected above the Phase 1A screening levels from this Investigative Unit (refer to **Figure 5-2a**).

#### 5.4.2.1.2. Groundwater

Six Phase 1A constituents were detected above the Phase 1A screening levels from Investigative Unit B (refer to **Attachment H**). Three dissolved metals were detected above the Part 201 Residential Drinking Water Criteria (iron, manganese, and nickel). Detectable concentrations of dissolved Iron from five monitoring wells

ranged from 0.056 mg/L to 6.18 mg/L; three of which were detected above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L. Detected concentrations of dissolved Manganese from five groundwater samples ranged from 0.239 mg/L to 0.263 mg/L. All of these concentrations of dissolved manganese were above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L. Dissolved Nickel was detected in groundwater samples from Investigative Unit B at concentrations of 0.112 mg/L and 0.275 mg/L, all of which were above the Part 201 Residential Drinking Water Criterion of 0.1 mg/L.

Three organic compounds were detected above the Phase 1A screening levels from Investigative Unit B. All three compounds were detected in the groundwater sample collected from monitoring well MW-00509. 1,1-Dichloroethene, cis-1,2-Dichloroethene, and Vinyl chloride were detected at concentrations of 0.015 mg/L, 3.0 mg/L, and 3.0 mg/L, respectively. All three concentrations were above the Part 201 Residential Drinking Water Criteria.

No other compound was detected above the Phase 1A screening levels in groundwater from Investigative Unit B (refer to **Figure 5-2b**).

### 5.4.2.2. Proposed Phase 1B Sampling Locations and Parameter Lists

For screening purposes, soil, soil vapor, and/or groundwater grab samples will be collected at various locations in the northern portion of this IU. It is proposed that the initial samples be collected from an approximate 100 foot radius away from Phase 1A monitoring well MW-00509. The screening samples will be collected using direct-push equipment and analyzed in the field for an abbreviated list of VOCs (vinyl chloride, 1,1-dichloroethane, benzene, toluene, and chlorobenzene) by an on-site mobile laboratory (refer to **Attachment A - Section 1.4.2.4**). This work is proposed to determine the source and extent of VOCs in soil and groundwater detected in well MW-00509 during the Phase 1A investigation. If warranted, based on observations made during the sampling activities, headspace analytical results, and/or analytical results provided by the mobile laboratory, additional locations may be required to delineate the extent of VOCs in groundwater.

At each screening sample location, unsaturated soil samples will be collected continuously. If there is field evidence of soil contamination, selected samples may be retained and shipped to a stationary laboratory for VOCs and metals analyses. All soil vapor and/or groundwater grab samples will be analyzed for selected VOCs by the mobile laboratory (refer to **Section 1.4.2.4** of **Attachment A**).

When the groundwater screening sample results indicate that the lateral and vertical extent of VOCs in groundwater have been delineated within the upper water-bearing zone, groundwater monitoring wells will be installed for confirmation. Up

to four wells will be installed at locations expected to be free of VOCs based on the screening results provided by the mobile laboratory. These will include one downgradient well and up to three crossgradient and/or upgradient wells. Soil samples for laboratory analysis will not be collected from these four groundwater monitoring well locations.

Should the results of the field screening indicate that dissolved VOCs are present at the base of the upper-saturated zone (i.e., top of the confining layer), then a hollow-stem auger (HSA) drill rig will be used to minimize the potential for cross-contamination between the upper saturated zone and the confining layer (i.e., the installation of an outer casing prior to proceeding into the confining layer) and the confining layer soil will be continuously sampled for a maximum of 12 feet below the top of the confining layer at one location downgradient of the extent of contamination, as indicated by the results of the field screening. Unsaturated soil samples may be submitted for analysis, as deemed appropriate (e.g., if visual, olfactory, or PID evidence of contamination is detected). All soil samples submitted for laboratory analysis will be analyzed for VOCs. Saturated soil samples will not be submitted for laboratory analysis.

If saturation (groundwater) is encountered within the upper 12 feet of the confining layer, then a 10-foot long screen will be installed and the well completed as a confining layer well, in lieu of the bottom soil sample described above. If groundwater is not encountered, the boring will be appropriately abandoned, and no well will be installed at this location. Groundwater samples will be collected, if sufficient recharge occurs within 24-hours of purging, from the newly installed confining layer well.

If, during the field screening, free-phase liquid product is encountered at the base of the upper water-bearing zone, then further vertical delineation efforts will not be completed at that location so as not to spread the contamination vertically. Vertical delineation efforts will continue at a location hydraulically downgradient of any free-phase liquid product encountered.

The groundwater samples from Phase 1A well MW-00509 will be analyzed for all of the TCL parameters (VOCs, SVOCs and PCBs), and the site-specific metals, cyanide, and formaldehyde consistent with the Phase 1A well resampling program (refer to **Table 5-2** and **Attachment A**). Since the new Phase 1B wells described above are being installed to confirm that the extent of VOCs in groundwater has been delineated, the samples from the new wells will be analyzed only for the site-specific TCL list of VOCs. Analyzing samples from the new wells for the remaining parameters is not warranted for the following reasons:

- The new Phase 1B wells will likely be located near well MW-00509.
- The groundwater sample from well MW-00509 contained only VOCs at concentrations which were detected above the Phase 1A screening levels.

In addition, four soil borings will be completed in the northeast corner of the IU where there are several AOIs (**Figure 5-2a**). These samples are proposed to further characterize the soil in this area due to the number of historical activities that occurred in this area. Soil samples will be collected at these four locations in accordance with the sampling protocol in the approved Workplan and will be analyzed for the TCL VOCs, SVOCs, PCBs, and the site-specific metals, cyanide, and formaldehyde to characterize soil near the AOIs listed in **Table 5-2.**

## 5.4.3. Investigative Unit C

### 5.4.3.1. Phase 1A Data Summary

Four dissolved metals were detected above the Phase 1A screening levels in the surface water sample collected from IU C (refer to **Figure 5-3** and **Attachment A**). Dissolved aluminum, iron, lead, and manganese were detected at concentrations above the Part 201 Residential Drinking Water Criteria of 0.05, 0.3, 0.004, and 0.05 mg/L, respectively. The detected concentrations of dissolved aluminum, iron, lead, and manganese were 0.303, 0.759, 0.057, and 6.89 mg/L, respectively.

Two total metals and one organic parameter were detected above the Phase 1A screening levels in sediment samples collected from Investigative Unit C (refer to **Figure 5-3** and **Attachment A**). Concentrations of arsenic and lead were detected above the Part 201 Residential Direct Contact Criteria of 6.6 and 400 mg/Kg, respectively. Concentrations of arsenic in sediment from samples C1 and C3 were 65 and 25 mg/Kg, respectively. Concentrations of lead in sediment from samples C1 and C3 were 1,550 and 1,240 mg/Kg, respectively. Polychlorinated biphenyls were detected in sediment samples C1 and C3 at concentrations of 1.5 and 1.0 mg/Kg, respectively. The PCB concentration from sediment sample C1 was above the Part 201 Residential Direct Contact Criterion of 1.2 mg/Kg.

The surface water and sediment samples collected in this area during Phase 1A (**Figure 5-3** and **Attachment A**) did not contain significant concentrations above the Phase 1A screening levels (refer to **Section 4**).

#### 5.4.3.2. Proposed Phase 1B Activities

A second four-hour pumping test will be performed to evaluate hydraulic conditions near the Process Water Reservoir in IU C. This test will be performed as described in the Water Recycle System Workplan prepared by Conestoga-Rovers & Associates (Appendix A to the Phase 1A SAP, June 1998). Groundwater will be pumped from Phase 1A monitoring well MW-00821, located near the Process Water Reservoir. During the four-hour test, the change in head at adjacent monitoring wells screened within the upper water-bearing zone will be measured. The elevation of water in Process Water Reservoir will also be measured during the four-hour pumping test. Groundwater discharge from the pumping test will be directed to the ground surface away from the area being tested so that the discharge will not influence the results of the test.

As Investigative Unit C only contains the Process Water Reservoir and sufficient sampling was conducted during Phase 1A to characterize existing conditions, no additional samples for laboratory analysis will be collected.

## 5.4.4. Investigative Unit D

### 5.4.4.1. Phase 1A Data Summary

#### 5.4.4.1.1. Soil

Five compounds were detected above the Phase 1A screening levels for soil samples collected in Investigative Unit D (refer to **Attachment H**). Arsenic concentrations in soil ranged from 2 mg/Kg to 12 mg/Kg with only one concentration detected above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg.

Concentrations of total chromium in soil from this IU ranged from 3 mg/Kg to 381 mg/Kg. Five concentrations were above the Part 201 Residential Particulate Soil Inhalation Criterion of 260 mg/Kg. Of these five, only two concentrations were from soil samples collected within three feet of the ground surface.

Manganese was detected in all 26 soil samples analyzed from this Investigative Unit ranging in concentration from 166 mg/Kg to 10,900 mg/Kg. Nine of these concentrations were detected above the Part 201 Industrial Particulate Soil Inhalation Criterion of 1,500 mg/Kg: five of the nine concentrations above the Phase 1A screening levels were from samples collected at depths less than three feet bgs.

Two organic compounds were detected at concentrations which were above the Phase 1A screening levels: Benzo[a]pyrene and polychlorinated biphenyls (PCBs). Both compounds, which were detected at concentrations above the Part 201 Residential Direct Contact Criteria, were from samples collected at the Current Equipment Staging Area (D.7 from the *DOCC*). Benzo[a]pyrene was detected in six soil samples collected from Investigative Unit D ranging in concentration from 0.03 mg/Kg to 2.7 mg/Kg with only one concentration detected above the Part 201 Residential Direct Contact Criterion of 1.4 mg/Kg. PCBs were detected in four soil samples collected from this IU in concentrations ranging from 0.1 mg/Kg to 32 mg/Kg with only one concentration detected above the Part 201 Residential Direct Contact Criterion of 1.2 mg/Kg.

No other compound was detected at concentrations above the Phase 1A screening levels within Investigative Unit D (refer to **Figure 5-4a**).

#### 5.4.4.1.2. Groundwater

Only two Phase 1A compounds were detected above the Phase 1A screening levels in groundwater from Investigative Unit D (refer to **Attachment H**). Dissolved Iron was detected in groundwater from all seven monitoring wells located in this IU ranging in concentrations from 0.034 mg/L to 21.5 mg/L. Three concentrations of dissolved iron were above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L from monitoring wells located in the upper water-bearing zone. Concentrations of dissolved manganese ranged from 0.025 mg/L to 0.960 mg/L. Nine concentrations (including three field duplicates) were detected above the Part 201 Residential Drinking Water Criterion of 0.050 mg/L. Four of these groundwater samples were collected from the upper water-bearing zone and two were collected from the clay, confining layer.

No other compound was detected at concentrations above the Phase 1A screening levels within Investigative Unit D (refer to **Figure 5-4b**).

### 5.4.4.2. Proposed Phase 1B Sampling Locations and Parameter Lists

Eight surface soil samples will be collected from the Current Equipment Staging Area - D.7 (**Figure 5-4a**). These samples will be analyzed for TCL SVOCs and PCBs, and the site-specific metals to further characterize constituents identified at Phase 1A sample locations MW-00812, SB-198 and SB-298 (one additional surface soil sample will be collected in the southeast corner of IU A and is described in **Section 5.4.1.2**). One intermediate monitoring well (MW-10912) will be installed within the clay confining layer to investigate 1,2-Dichloropropane which was detected in Phase 1A monitoring well MW-10713. The boring will be sampled in

accordance with the sampling protocol in the approved Workplan and analyzed for TCL VOCs, SVOCs, PCBs and the site-specific metals. Groundwater from the well will also be sampled and analyzed for TCL VOCs, SVOCs and PCBs, and site-specific metals, formaldehyde and cyanide.

One surface soil sample will be collected from the Historical PCB Accumulation/Storage Area (D.3). This sample will be analyzed for PCBs to determine if there was a release to the surface soil.

Five soil borings will be advanced in the unpaved areas along the east side of the currently operating metal casting plant. These samples will be collected in accordance with the sampling protocol in the approved Workplan and will be analyzed for TCL SVOCs, PCBs, site-specific metals, cyanide, and formaldehyde to characterize soil in this general high-use area.

One soil sample will also be placed at the location of the Former Poly-Lok Process Equipment Building (D.10) and will be analyzed for TCL VOCs, SVOCs, PCBs, site-specific metals, cyanide, and formaldehyde.

A minimum of six soil samples will be collected around each of the two known diesel fuel spills (D.31 and D.35) to delineate the nature and extent of residual contamination, if any (see **Figure 5-4c** for sample locations). Soil sampling will be performed as required for closure by the MDEQ, and the samples will be analyzed for VOCs, SVOCs, and PCBs.

Soil samples will be collected at up to five locations in the area surrounding the #8 Mold Line (D.28) where there was reportedly a release of PCBs in October 1987 (**Figure 5-4c**). If possible, the soil borings will be completed to similar elevations as the previous PCB detection's in soil (approximately 568 feet above mean seal level or approximately twelve feet below the basement floor – refer to **Figure 5.4d** and **Table 5-11** for historic PCB results and sampling locations). Soil samples will be collected every five feet vertically in unsaturated soil beginning at this approximate elevation so that a minimum of three soil samples per boring will be collected, if possible. The soil samples will be analyzed for PCBs to determine the horizontal extent of contamination. One of the soil borings will be advanced through the former excavation as close as possible to the maximum, previously detected concentration and sampling will begin approximately at twelve feet below the basement floor to determine the vertical extent of PCBs in soil. Soil samples from this boring will be completed as outlined above. If saturated conditions are encountered in this boring and if site conditions allow (this is a very active portion of the plant with limited accessibility), this boring may be converted to a groundwater monitoring well.

Four soil borings and one new monitoring well will be completed in accordance with the sampling protocol in the approved Workplan at the Railroad Tracks West of the Cupola Cooling Towers (D.32) (**Figure 5-4c**). Soil samples will be analyzed for TCL VOCs, SVOCs, and PCBs.

The Phase 1B investigation of this IU will include evaluating the hydraulic influence of the building and the drains on the subsurface. This task will require a detailed evaluation of available as-built drawings for the building and an analysis of potential migration pathways. If it is determined during this evaluation that additional wells are warranted in this IU, the wells will be drilled and installed as part of the Phase 1B field activities. An addendum to this Workplan will be provided prior to completing any additional sampling in this area.

## 5.4.5. Investigative Unit E

### 5.4.5.1. Phase 1A Data Summary

#### 5.4.5.1.1. Soil

Six Phase 1A compounds were detected at concentrations which were above the Phase 1A screening levels within IU E (refer to **Attachment H**). Concentrations of arsenic in soil ranged from 2 mg/Kg to 19 mg/Kg. Five of the 35 soil samples collected from this Investigative Unit (including one duplicate) exhibited concentrations of arsenic which were above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg. Total Chromium concentrations ranged from 3 mg/Kg to 467 mg/Kg. Six soil samples (including one duplicate sample) were detected at concentrations above the Part 201 Residential Particulate Soil Inhalation Criterion of 260 mg/Kg. Only one soil sample exhibited a concentration greater than the Part 201 Residential Direct Contact Criterion for lead of 400 mg/Kg. Concentrations of lead in soil samples in this IU ranged from 4 mg/Kg to 2,030 mg/Kg. Eleven soil samples exhibited concentrations of manganese above the Part 201 Industrial Particulate Soil Inhalation Criterion of 1,500 mg/Kg, ranging in concentration from 74 mg/Kg to 12,100 mg/Kg.

Polychlorinated biphenyls were detected in nine soil samples collected from within Investigative Unit E. Of the nine samples, four were detected above the Part 201 Residential Direct Contact Criterion of 1.2 mg/Kg. Detectable concentrations of PCBs in soil within this IU ranged from 0.2 mg/Kg to 52 mg/Kg. One soil sample contained 1,1-dichloroethene at a concentration of 0.077 mg/Kg (MW-02320, 2-6'), which is above the Phase 1A Screening Level of 0.065 mg/Kg for Volatilization

to Indoor Air. The duplicate sample collected from this depth did not contain a detectable concentration of 1,1-dichloroethene.

No other compound was detected above the Phase 1A screening levels within Investigative Unit E (refer to **Figure 5-5a** and **Attachment H**).

#### 5.4.5.1.2. Groundwater

Four inorganic compounds and one organic compound were detected at concentrations above the Phase 1A screening levels from sixteen groundwater samples, representative of twelve monitoring wells, collected in Investigative Unit E (refer to **Figure 5-5b** and **Attachment H**).

Of the four inorganic compounds, three compounds (Aluminum, Iron, and Manganese) were detected at concentrations above the Part 201 Residential Drinking Water Criteria. Detectable concentrations of dissolved Aluminum from the groundwater collected at one monitoring well (MW-03240) was above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L at a concentration of 0.369 mg/L and in the field duplicate from the sample monitoring well at a concentration of 0.720 mg/L. Concentrations of dissolved Iron in groundwater within this IU ranged from 0.139 mg/L to 102 mg/L. Thirteen (including three field duplicates) of the detected concentrations of dissolved Iron were above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L. Dissolved Manganese was detected in the sixteen groundwater samples collected from this IU at concentrations from 0.060 mg/L to 5.47 mg/L. All detectable concentrations of dissolved Manganese were above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L. Dissolved Barium in groundwater from one monitoring well located adjacent to the Saginaw River was above the Groundwater/Surface Water Interface Criterion of 0.19 mg/L. Detected concentrations of dissolved Barium ranged in concentration from 0.027 mg/L to 0.362 mg/L.

Polychlorinated biphenyls were detected in one monitoring well (MW-03235) within Investigative Unit E at a concentration of 0.0016 mg/L and a field duplicate concentration of 0.0015 mg/L. These concentrations above the Part 201 Residential Drinking Water Criterion of 0.0005 mg/L.

No other compound was detected within Investigative Unit E above the Phase 1A screening levels (refer to **Figure 5-5b** and **Attachment H**).

### 5.4.5.2. Proposed Phase 1B Sampling Locations and Parameter Lists

Surface soil samples (0 to 2 feet below ground surface) will be collected at eighteen locations in the northern portion of the IU (**Figure 5-5**). All of the samples will be analyzed for site-specific metals, PCBs, and SVOCs to determine the extent of contamination identified in soil samples from Phase 1A borings MW-03734 and MW-03235. Some sampling around the PCB and lead exceedances may occur ahead of the Phase 1B RFI Workplan activities to assist in meeting State Due Care responsibilities.

Two surface soil samples will be collected in the Current Core Sand Staging Area (E.9) in the southwestern portion of the IU, and will be analyzed for site-specific metals and formaldehyde to characterize soil conditions resulting from the placement of core sand in this area. PCBs will also be added to the analyte list to specifically provide additional delineation efforts of previous concentrations detected within the surface soil at Phase 1A monitoring wells MW-03235 and MW-03734.

Soil samples will be collected from up to four soil borings in the area surrounding well MW-02320. Samples will be collected using direct-push equipment and analyzed for VOCs to delineate the extent of 1,1,1-TCA and 1,1-DCE in soil detected in boring MW-02320 during Phase 1A.

Three soil borings will be completed surrounding Phase 1A monitoring well MW-02228 to further characterize the extent of arsenic, chromium, and manganese detected at that location. Soil samples are proposed to be collected from 0-2 feet and 4-6 feet from each of the three soil borings and will be analyzed for the site-specific metals.

One soil boring will be advanced near the former ADL Waste 1,1,1-TCA Satellite Drum Accumulation Area (E.1) and the former ADL PCB Accumulation/Storage Area (E.2). Soil samples will be collected in accordance with the sampling protocol in the approved Workplan and analyzed for TCL VOCs and PCBs to characterize the soil conditions that may be associated with these AOIs.

In addition to the above sampling, eight composite soil samples will be collected from IU E to be analyzed for manganese and grain size distribution as part of additional information for the human health risk assessment (**Figure 5-5a**). The eight samples will be composited from four sample subsets within IU E (the subsets are designated with similar superscripts on **Figure 5-5a**). Each sample subset will include the collection of four discrete samples (one at each sample location depicted) at two depth intervals; one from 0 to 0.5 feet bgs, and one from 0 to 2.0 feet bgs. The two depth intervals will be composited into two separate samples

(i.e., one from each depth range). Analysis of each composited sample will consist of grain size distribution and total manganese.

In May 1999, three drums were encountered on the south side of the Process Water Reservior by the currently operating metal casting plant during general cleanup of the Facility. It appeared that at least one drum contained hydraulic fluid. A geophysical survey/test pit confirmation program will be performed in the area where drums were discovered on May 18, 1999 (refer to **Figure 5-5a**). The geophysical survey will be completed utilizing ground penetrating radar (GPR), electromagnetic (EM), and/or other geophysical technique applicable for this environmental setting. Anomalies in the data generated which may indicate a buried drum, or similar container, will be verified through the advancement of a test pit, or series of test pits, at those locations. Where an anomaly is subsequently determined not to be an environmental concern (e.g., slag, chunk of metal, etc.), the test pit will be completed and backfilled with material taken from the test pit and no samples will be collected. All test pit/excavation activities will not extend beyond the groundwater surface.

Areas where waste materials are encountered during the geophysical survey/test pit operations (including any potential releases during excavation) will be appropriately characterized to determine potential risks posed by any residual contamination. If a drum, barrel, or other similar container is discovered that may represent a current, or future environmental concern, the object in question will be subsequently removed from the subsurface through excavation. Subsequent excavation activities, unless an immediate threat to human health or the environment exists, will likely take place after preparation of a staging area and potential contents disposal can be arranged. Any waste materials generated during these activities will be appropriately characterized for disposal purposes.

A minimum of one monitoring well will be installed along the south side of the Process Water Reservoir to characterize the groundwater quality downgradient of the known and potential areas of buried drums discussed above (refer to **Figure 5-5b**). The proposed screen interval for this well is as follows:

- MW-01223: 4 - 14 feet.

The actual screen interval will also be determined in the field based on geologic and hydrogeologic conditions encountered during drilling. The groundwater sample from this new well will be analyzed for all of the TCL parameters, site-specific metals, cyanide, and formaldehyde.

One monitoring well (MW-03423) will be installed, following the sampling protocol in the approved Workplan, south of the Power House in the southern portion of IU E to assist in determining the actual groundwater flow direction in IU F. Soil

samples will be analyzed for TCL VOCs, SVOCs, PCBs and site-specific metals. Groundwater from the new well will be analyzed for TCL VOCs, SVOCs, PCBs, site-specific total and dissolved metals, cyanide and formaldehyde. A groundwater sample will be collected from a temporary screen located at the base of the upper water-bearing zone prior to the installation of the proposed monitoring well MW-03423. This sample will be submitted to the permanent laboratory for analysis of VOCs.

## 5.4.6. Investigative Unit F

### 5.4.6.1. Phase 1A Data Summary

#### 5.4.6.1.1. Soil

Three Phase 1A compounds were detected at concentrations above the Phase 1A screening levels from Investigative Unit F (refer to **Figure 5-6a** and **Attachment H**). Arsenic was detected in nineteen soil samples collected from this IU at concentrations ranging from 1 mg/Kg to 9 mg/Kg; only three of which were above the Part 201 Residential Direct Contact Criteria of 6.6 mg/kg. Manganese was detected in soil ranging from 135 mg/Kg to 1,860 mg/Kg. Only one soil sample (collected from four to six feet bgs) was detected at a concentration above the Part 201 Industrial Particulate Soil Inhalation Criterion of 1,500 mg/Kg.

Benzo[a]pyrene was detected in one duplicate soil sample (MW-02728, 0-2 feet) collected from Investigative Unit F at a concentration of 10 mg/Kg, which was above the Part 201 Residential Direct Contact Criterion of 1.4 mg/Kg. The original 0-2 feet sample did not detect the presence of benzo[a]pyrene at a detection limit of 0.3 mg/Kg.

No other compound was detected above the Phase 1A screening levels within the soil at Investigative Unit F (refer to **Figure 5-6a** and **Attachment H**).

#### 5.4.6.1.2. Groundwater

Dissolved Iron and Manganese were the only two detected compounds which were above the Phase 1A screening levels for groundwater samples collected from Investigative unit F (refer to **Figure 5-6b** and **Attachment H**). Detectable concentrations of dissolved Iron ranged from 0.163 mg/L to 4.54 mg/L. Two groundwater samples exhibited concentrations of dissolved Iron above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L. Concentrations of dissolved

Manganese ranged from 0.10 mg/L to 0.88 mg/L; all detected at concentrations above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L.

No other compound was detected above the Phase 1A screening levels within the groundwater at Investigative Unit F (refer to **Figure 5-6b** and **Attachment H**).

#### 5.4.6.2. Proposed Phase 1B Sampling Locations and Parameter Lists

One monitoring well (MW-03423) will be installed west of the Former North Filling Station USTs (F.1) in IU E to assist in determining the groundwater flow direction in this general area. The installation and sampling of this well is discussed in **Section 5.4.5.2.**

The existing Phase 1A monitoring wells will be sampled, and the groundwater samples will be analyzed for all of the Phase 1B parameter list. Since the soil and groundwater samples collected in this area during Phase 1A (**Figure 5-6**) contained only limited concentrations above the Phase 1A soil and/or groundwater screening levels and adequate sampling of specific AOIs was completed during Phase 1A, no additional sampling is proposed in IU F.

## 5.4.7. Investigative Unit G

#### 5.4.7.1. Phase 1A Data Summary

##### 5.4.7.1.1. Soil

Four Phase 1A compounds were detected above the Phase 1A screening levels in soil samples collected from IU G (refer to **Figure 5-7a** and **Attachment H**). Seven soil samples exhibited concentrations of arsenic which were above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg. Analytical results for arsenic in soil ranged in concentration from 1 mg/Kg to 13 mg/Kg across the Facility. Detectable concentrations of total Chromium in soil from this IU ranged from 3 mg/Kg to 487 mg/Kg, with three concentrations detected above the Part 201 Residential Particulate Soil Inhalation Criterion of 260 mg/Kg. Only two of the three concentrations above the Phase 1A screening levels for total chromium were from samples collected less than two feet below ground surface. Concentrations of Manganese in soil ranged from 77 mg/Kg to 11,400 mg/Kg. Six samples exhibited concentrations of total Manganese above the Part 201 Industrial Particulate Soil Inhalation Criterion of 1,500 mg/Kg. Five of the six concentrations above the Phase 1A screening levels were detected in samples collected less than two feet bgs.

Benzo[a]pyrene was detected in nine soil samples collected from Investigative Unit G, ranging in concentration from 0.1 mg/Kg to 5 mg/Kg. Two of the nine detections were above the Part 201 Residential Direct Contact Criterion of 1.4 mg/Kg. Both of the samples were collected from the former Nodular Iron Plant North Parking Lot.

No other compound was detected above the Phase 1A screening levels within the soil at Investigative Unit G (refer to **Figure 5-7a** and **Attachment H**).

#### 5.4.7.1.2. Groundwater

Six Phase 1A compounds were detected at concentrations above the Phase 1A screening levels in groundwater samples collected from Investigative Unit G (refer to **Figure 5-7b** and **Attachment H**). Of the compounds which were detected at concentrations above the criteria, three were inorganic and three were organic compounds.

Dissolved Aluminum, dissolved Iron, and dissolved Manganese were detected above the Part 201 Residential Drinking Water Criteria of 0.05 mg/L, 0.3 mg/L, and 0.05 mg/L, respectively. Dissolved Aluminum ranged from 0.02 mg/L to 0.888 mg/L and were detected above the criterion in nine groundwater samples collected from Investigative Unit G. Dissolved Iron ranged in concentration from 0.027 mg/L to 12.8 mg/L and was above the criterion in six groundwater samples collected from this IU. Dissolved Manganese ranged in concentration from 0.002 mg/L to 1.27 mg/L and was detected above the criterion in eleven groundwater samples.

Benzene, Bis[2-ethylhexyl]phthalate, PCBs, and Vinyl chloride were detected at concentrations above the Part 201 Residential Drinking Water Criteria of 0.005 mg/L, 0.006 mg/L, 0.002 mg/L, and 0.0005 mg/L, respectively. Benzene was only detected in one groundwater sample (MW-17) at a concentration of 0.069 mg/L. Bis[2-ethylhexyl]phthalate was only detected in two groundwater samples from the Nodular Iron Plant North Parking Lot at concentrations of 0.010 mg/L and 0.011 mg/L. PCBs in groundwater were detected at concentrations above the criterion in one sample at a concentration of 0.0006 mg/L. Vinyl chloride was only detected in one groundwater sample (MW-04434) from Investigative Unit G at a concentration of 0.0082 mg/L.

No other compound was detected above the Phase 1A screening levels within the groundwater at Investigative Unit G (refer to **Figure 5-7b** and **Attachment H**).

### 5.4.7.2. Proposed Phase 1B Sampling Locations and Parameter Lists

One soil sample is proposed to be collected from the former Nodular Iron Plant North Parking Lot to further characterize the extent of manganese detected in this area. The soil sample is proposed to be collected from 0-2 feet bgs (refer to **Figure 5-7a**).

For screening purposes, soil, soil vapor, and/or groundwater grab samples will be collected in the former underground storage tank (UST) area near Phase 1A well MW-04434. The screening samples will be collected using direct-push equipment and analyzed in the field for an abbreviated list of VOCs by an on-site mobile laboratory (refer to **Attachment A - Section 1.4.2.4**). This work is proposed to determine the source and extent of contaminated groundwater detected in well MW-04434 during the Phase 1A investigation. Samples will be collected at a minimum of four locations surrounding well MW-04434. If warranted based on observations made during the sampling activities (e.g. visual or olfactory evidence of contamination), headspace analytical results, and/or analytical results provided by the mobile laboratory, additional locations may be required to delineate the extent of contamination.

Because of the variability of the Phase 1A sample locations, sample matrices, and potential constituents of concern throughout the site, there has not been any direct correlation established between PID readings and volatile organic analysis from the laboratory. During advancement of the Phase 1B soil borings, which are not expected to encounter any source-related materials and which are intended to be completed to obtain temporary groundwater samples for mobile laboratory analysis, GM will continue to use a subjective method for determining which of the continuously-sampled soil will be submitted to the permanent laboratory for analysis, if any from these areas. This subjective method generally consists of visual and olfactory evidence of suspected contamination and/or significant needle deflections on the PID.

At each screening sample location, unsaturated soil will be collected continuously. If there is field evidence of soil contamination based on olfactory, visual and PID evidence, selected samples may be retained and shipped to a stationary laboratory and analyzed for VOCs in accordance with the protocol in the approved QAPP and Amendments to the QAPP (**Attachment A**). All soil vapor or groundwater grab samples will be analyzed for VOCs by the mobile laboratory. For field screening purposes, the VOC list has been modified to include the compounds described in **Attachment A - Section 1.4.2.4**).

When the screening sample results indicate that the lateral and vertical extent of contamination has been delineated within the upper water-bearing zone, groundwater monitoring wells will be installed for confirmation. Up to four shallow

wells will be installed at locations expected to be free of VOC-contamination based on the screening results provided by the mobile laboratory. These will include one downgradient well and up to three crossgradient and/or upgradient wells.

Should the results of the field screening indicate that dissolved VOCs are present at the base of the upper-saturated zone (i.e., top of the confining layer), then a hollow-stem auger (HSA) drill rig will be used to minimize the potential for cross-contamination between the upper saturated zone and the confining layer (i.e., the installation of an outer casing prior to proceeding into the confining layer) and the confining layer soil will be continuously sampled for a maximum of 12 feet below the top of the confining layer at one location downgradient of the extent of contamination, as indicated by the results of the field screening. Unsaturated soil samples may be submitted for analysis, as deemed appropriate (e.g., if visual, olfactory, or PID evidence of contamination is detected). All soil samples submitted for laboratory analysis will be analyzed for VOCs. Saturated soil samples will not be submitted for laboratory analysis.

If saturation (groundwater) is encountered within the upper 12 feet of the confining layer, then a 10-foot long screen will be installed and the well completed as a confining layer well, in lieu of the bottom soil sample described above. If groundwater is not encountered, the boring will be appropriately abandoned, and no well will be installed at this location. Groundwater samples will be collected, if sufficient recharge occurs within 24-hours of purging, from the newly installed confining layer well.

If, during the field screening, free-phase liquid product is encountered at the base of the upper water-bearing zone, then further vertical delineation efforts will not be completed at that location so as not to spread the contamination vertically. Vertical delineation efforts will continue at a location hydraulically downgradient of any free-phase liquid product encountered.

Soil samples from the four new shallow groundwater monitoring wells will be collected in accordance with the sampling protocol in the approved Workplan and analyzed for TCL VOCs and PCBs. The groundwater sample from Phase 1A well MW-04434 will be analyzed for the Phase 1B parameter list consistent with the Phase 1A well resampling program. Since the new Phase 1B wells are being installed to confirm that the extent of VOC- and PCBs in groundwater has been delineated, the samples from the new wells will be analyzed only for VOCs and PCBs.

Four soil borings will also be advanced in each of the following areas: the Former Virgin Oils Storage Pad (G.8) directly behind the former Nodular Iron House, the Former Nodular Iron Plant Oil House USTs South (G.12), and the Former Oil House UST West (G.14) to characterize the soil quality at these AOIs (**Figure 5-7c**). Soil

samples will be collected in accordance with the sampling protocol in the approved Workplan and analyzed for site-specific metals and TCL VOCs, SVOCs and PCBs.

Four soil borings will be completed, in accordance with the sampling protocol in the approved Workplan, at the Former Nodular Iron Plant Core Sand Staging Area (G.9) to characterize soil conditions resulting from the placement of core sand in this area. Soil samples will be analyzed for site-specific metals and formaldehyde.

All useable existing wells located near the "Calcium Carbide Replacement Pad" wells will be sampled, and one groundwater monitoring well (MW-04836) will be drilled and installed within the footprint of the former building location (**Figure 5-7**). These activities are proposed to assess groundwater conditions near the south calcium carbide pad (G.5 from the *DOCC*) where ammonia and dissolved arsenic have been detected in past sampling of the groundwater. The groundwater samples from three wells (existing monitoring wells MW-17 and MW-18, and the newly installed monitoring well MW-04836) will be analyzed for benzene, ammonia, and the site-specific metals (total and dissolved). In addition, soil samples from the boring for the installation of MW-04836) will be analyzed for ammonia, in accordance with the soil sampling protocol established during the Phase 1A Investigation.

## 5.4.8. Investigative Unit H

### 5.4.8.1. Phase 1A Data Summary

#### 5.4.8.1.1. Soil

Three Phase 1A compounds were detected in soil above the Phase 1A screening levels in samples collected from Investigative Unit H (refer to **Figure 5-8a** and **Attachment H**). Concentrations of Arsenic in soil ranged from 2 mg/Kg to 12 mg/Kg. Arsenic concentrations were detected above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg in one soil sample. Concentrations of Manganese were detected above the Part 201 Industrial Particulate Soil Inhalation Criterion of 1,500 mg/Kg in four soil samples from Investigative Unit H. Concentrations of Manganese ranged from 186 mg/Kg to 3,380 mg/Kg.

Benzo[a]pyrene was detected in two soil samples collected from this IU. Only one of which was detected at a concentration above the Part 201 Residential Direct Contact Criterion of 1.4 mg/Kg. The two soil sample concentrations of Benzo[a]pyrene were 0.6 mg/Kg and 3.3 mg/Kg.

No other compound was detected above the Phase 1A screening levels within the soil at Investigative Unit H (refer to **Figure 5-8a** and **Attachment H**).

#### 5.4.8.1.2. Groundwater

Five Phase 1A compounds were detected at concentrations above the Phase 1A screening levels within the groundwater from Investigative Unit H (refer to **Figure 5-8b** and **Attachment H**).

Four dissolved metals (Aluminum, Iron, Manganese, and Nickel) were detected at concentrations above the Part 201 Residential Drinking Water Criteria (0.05 mg/L, 0.30 mg/L, 0.05 mg/L, and 0.1 mg/L, respectively). All detectable concentrations of dissolved Aluminum, ranging from 0.06 mg/L to 0.283 mg/L, were above the criterion. Detectable concentrations of dissolved Iron ranged from 0.022 mg/L to 0.325 mg/L; four of which were detected above the criterion. Three detectable concentrations of dissolved Nickel were observed in Investigative Unit H ranging from 0.023 mg/L to 0.11 mg/L; only one of which was detected above the Phase 1A screening levels.

Dissolved Vanadium was detected above the Groundwater/Surface Water Interface Criterion of 0.012 mg/L in the groundwater sample collected from the monitoring well (MW-04864) located on the City of Saginaw Wastewater Treatment Plant, approximately 300 feet from the Saginaw River. The concentration of dissolved Vanadium in this monitoring well was 0.016 mg/L.

No other compound was detected above the Phase 1A screening levels within the groundwater at Investigative Unit H (refer to **Figure 5-8b** and **Attachment H**).

#### 5.4.8.1.3. Sediment

Two metals were detected at concentrations above the Phase 1A screening levels in sediment samples collected from Investigative Unit H (refer to **Figure 5-8a** and **Attachment H**). Arsenic concentrations in sediment ranged from 9.0 mg/Kg to 47 mg/Kg; all of which are above the Part 201 Residential Direct Contact Criterion of 6.6 mg/Kg. Lead concentrations in sediment ranged from 221 mg/Kg to 2,490 mg/Kg. Lead concentrations were detected above the Part 201 Residential Direct Contact Criterion of 400 mg/Kg in four of the six sediment samples collected from this IU.

Polychlorinated biphenyls were detected in all six sediment samples from this IU. Concentrations of PCBs ranged from 0.3 mg/Kg to 7.0 mg/Kg, with five

concentrations above the Part 201 Residential Direct Contact Criterion of 1.2 mg/Kg.

No other compound was detected above the Phase 1A screening levels within the sediment at Investigative Unit H (refer to **Figure 5-8a** and **Attachment H**).

#### 5.4.8.1.4. Surface Water

Five surface water samples were collected from this Investigative Unit. Two compounds were detected above the Phase 1A screening levels. Detected concentrations of dissolved aluminum ranged from 0.052 mg/L to 0.067 mg/L, both of which are above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L. Detected concentrations of dissolved manganese ranged from 0.040 mg/L to 6.57 mg/L. Four of the five detected concentrations were above the Part 201 Drinking Water Criterion of 0.050 mg/L.

No other compound was detected above the Phase 1A screening levels within the surface water at Investigative Unit H (refer to **Figure 5-8b** and **Attachment H**).

### 5.4.8.2. Proposed Phase 1B Sampling Locations and Parameter Lists

Four soil borings will be advanced to the water table surface within the Temporary Classified Sand Staging Areas (H.4) in the southern half of the IU (**Figure 5-8a**). Soil samples will be collected for laboratory analysis in accordance with the Phase 1A protocol. These samples will be analyzed for site-specific metals and formaldehyde to evaluate the conditions resulting from the placement of sand in the area (refer to **Section 5.4.9.1**).

Adequate characterization of surface water and sediment was completed during Phase 1A. Therefore, no additional sampling of these media is proposed.

## 5.4.9. Investigative Unit I

### 5.4.9.1. Phase 1A Data Summary

#### 5.4.9.1.1. Soil

Three Phase 1A compounds were detected at concentrations above the Phase 1A screening levels from IU I (refer to **Figure 5-9a** and **Attachment H**). Arsenic and Manganese were detected in twenty-seven soil samples collected from this IU at concentrations ranging from 1 mg/Kg to 10 mg/Kg and 145 mg/Kg to 3,230

mg/Kg, respectively. Only one soil sample was detected at a concentration above the Part 201 Residential Direct Contact Criteria of 6.6 mg/Kg for Arsenic. Two soil samples were detected above the Part 201 Industrial Particulate Soil Inhalation Criteria of 1,500 mg/Kg for Manganese.

Formaldehyde was detected in fourteen soil samples collected from IU I at concentrations ranging from 11 mg/Kg to 78 mg/Kg, of which thirteen were detected above the Part 201 Residential Volatilization to Indoor Air Criterion of 12 mg/Kg.

No other compound was detected above the Phase 1A screening levels within the soil at IU I (refer to **Figure 5-9a** and **Attachment H**).

#### 5.4.9.1.2. Groundwater

Ten Phase 1A compounds were detected at concentrations above the Phase 1A screening levels for groundwater samples collected from IU I (refer to **Figure 5-9b** and **Attachment H**). Dissolved Aluminum was detected at concentrations ranging from 0.054 mg/L to 1.86 mg/L. Four groundwater samples were detected at concentrations above the Part 201 Residential Drinking Water Criteria of 0.05 mg/L for dissolved Aluminum. Detectable concentrations of dissolved Iron ranged from 0.054 mg/L to 3.21 mg/L. Four groundwater samples exhibited concentrations of dissolved Iron above the Part 201 Residential Drinking Water Criterion of 0.3 mg/L. Concentrations of dissolved Manganese ranged from 0.058 mg/L to 5.82 mg/L; all were detected at concentrations above the Part 201 Residential Drinking Water Criterion of 0.05 mg/L.

Dissolved 1,2-Dichloropropane was detected in one groundwater sample from IU I at a concentration of 0.0063 mg/L which is above the Part 201 Residential Drinking Water Criteria of 0.005 mg/L. Concentrations of 2,4-Dimethylphenol were detected at concentrations ranging from 0.027 mg/L to 0.89 mg/L. Only one groundwater sample was detected above the Part 201 Residential Drinking Water Criteria of 0.370 mg/L. 3- and 4-Methylphenol Coelution concentrations ranged from 0.011 mg/L to 0.46 mg/L in samples collected from IU I. Only one groundwater sample was detected above the Part 201 Residential Drinking Water Criterion for 4-Methylphenol which is 0.037 mg/L.

Dissolved concentrations of benzene in the groundwater ranged from 0.001 mg/L to 0.016 mg/L; one sample of which was detected above the Part 201 Residential Drinking Water Criteria of 0.005 mg/L. Dissolved Cyanide was detected at concentrations ranging from 0.01 mg/L to 0.42 mg/L. One groundwater sample was detected at a concentration above the Part 201 Residential Drinking Water Criterion of 0.2 mg/L. Detected concentrations of dissolved Formaldehyde ranged

from 0.058 mg/L to 1.5 mg/L with only one sample detected at a concentration above the Part 201 Residential Drinking Water Criterion of 1.3 mg/L. Dissolved Phenol was detected at concentrations ranging from 0.014 mg/L to 5.2 mg/L; only one groundwater sample was detected above the Part 201 Residential Drinking Water Criterion of 4.4 mg/L.

No other compound was detected above the Phase 1A screening levels within the groundwater at IU I (refer to **Figure 5-9b** and **Attachment H**).

### 5.4.9.2. Proposed Phase 1B Sampling Locations and Parameter Lists

Monitoring well MW-07959 will be resurveyed to confirm the top-of-casing elevation measured during Phase 1A. This is required because the groundwater elevation calculated during Phase 1A is inconsistent with the groundwater elevations calculated for other shallow wells in the vicinity (refer to **Figure 2-10**). If the resurveyed elevation is consistent with that reported during the Phase 1A program, an additional shallow groundwater monitoring well will be installed east of MW-07959 on GM property across Outer Drive (**Figure 5-9**). The additional well will be installed to further assess the groundwater flow direction in this area of the Facility.

One deep groundwater monitoring well (MW-96939) will be installed in the subglacial sand/bedrock aquifer at the southern edge of the IU (**Figure 5-9**). A groundwater sample will be collected from this well and will be analyzed for the TCL parameters, site-specific metals, cyanide, and formaldehyde. This well will be installed to further evaluate potential sources of the VOCs detected in well MW-97948.

Four soil borings will be drilled in the southern portion of the IU, and samples of the foundry sand fill will be collected from the depth interval anticipated to represent the future ground surface after GM finishes grading in the area. The depth to the anticipated ground surface will be extrapolated from the current ground surface in areas where additional soil removal is not planned. In general, it is expected that soil will ultimately be removed to within approximately one foot of the upper water-bearing zone. Therefore, only a surface soil sample will be collected from each of the four locations. The collected soil samples will be analyzed for site-specific metals and formaldehyde to evaluate the conditions resulting from the historical placement of sand in the area.

## 5.4.10. Investigative Unit J

### 5.4.10.1. Phase 1A Data Summary

#### 5.4.10.1.1. Soil

Arsenic was the only Phase 1A compound detected at concentrations above the Phase 1A screening levels from IU J (refer to **Figure 5-10a** and **Attachment H**). Arsenic was detected in seven soil samples collected from this IU at concentrations ranging from 3 mg/Kg to 9 mg/Kg. Only one soil sample was detected at a concentration above the Arsenic Part 201 Residential Direct Contact Criteria of 6.6 mg/Kg.

No other compound was detected above the Phase 1A screening levels within the soil at IU J (refer to **Figure 5-10a** and **Attachment H**).

#### 5.4.10.1.2. Groundwater

Manganese was the only Phase 1A compound detected at concentrations above the Phase 1A screening levels for groundwater samples collected from IU J (refer to **Figure 5-10b** and **Attachment H**). Dissolved Manganese was detected at concentrations ranging from 0.036 mg/L to 0.062 mg/L. Two groundwater samples were detected at concentrations above the Part 201 Residential Drinking Water Criteria of 0.05 mg/L for dissolved Manganese.

No other compound was detected above the Phase 1A screening levels within the groundwater at IU J (refer to **Figure 5-9b** and **Attachment H**).

### 5.4.10.2. Proposed Phase 1B Sampling Locations and Parameter Lists

The landfill within this IU (**Figure 5-10**) is a licensed facility that is regulated under MDEQ. Furthermore, the area is underlain by clay, and none of the soil or groundwater samples collected during the Phase 1A program contained significant concentrations that were detected above the Phase 1A screening levels (**Sections 2.5.1 and 2.5.2**). Therefore, no additional investigation in this area is proposed beyond the Phase 1A well resampling activities.

## 5.5. Saginaw River Surface Water And Sediment Sampling Program

### 5.5.1. Description and Purpose

The objective of the Saginaw River sampling program is to evaluate current chemistry of the water column and river bottom sediments along the SMCO Site relative to background conditions. The principal fate and transport pathway of concern identified during Phase 1A is ongoing discharge of shallow groundwater to the river. Therefore, this program will focus on the COIs:

- Detected above MDEQ's Part 201 Groundwater/Surface Water Interface (GSI) screening levels in shallow groundwater monitoring located near the Saginaw River,
- Detected above screening levels in soils or sediments that potentially contributed historical run-off to the river, and/or
- Are potential degradation products of the above COIs

Groundwater from the unconfined water-bearing unit at the SMCO site is believed to discharge to the Saginaw River. The COIs detected in SMCO monitoring wells screened in the upper water-bearing unit would therefore be expected to migrate toward the Saginaw River. COIs in shallow groundwater at SMCO are generally found at trace concentrations or they are undetected. These low concentrations of COIs in groundwater discharged to the Saginaw River would be attenuated via mixing and dispersion with a proportionately large volume of river water relative to volumes of discharging groundwater. Although no measurable effect on Saginaw River water chemistry is expected, the surface water sampling program is designed to evaluate the effect of discharge of shallow groundwater into the river.

COIs are transported via the groundwater pathway in a soluble form. However, there is a theoretical possibility that some fraction of the COIs that may not be fully attenuated within the aquifer and river bed could ultimately adsorb onto sediments at the sediment/surface water interface, thereby potentially accumulating in sediments at levels above regional background concentrations. The sediment sampling program is designed to determine whether COIs from site-related groundwater or from runoff from site soils and/or sediments are accumulating in river sediment at concentrations statistically greater than background concentrations for the Saginaw River.

As part of the selection for analytes for the river sampling program, groundwater quality was evaluated in all shallow wells along the shoreline:

- MW-00124
- MW-00925
- MW-01329
- MW-01530
- MW-08127
- MW-02432
- MW-03240
- MW-03746
- MW-04250
- MW-04757
- MW-04684

As discussed in **Section 4.1.2**, the Phase 1A screening levels for groundwater that discharges to surface water include the MDEQs Part 201 GSI Criteria. This criterion was used to screen all of the above monitoring wells (as discussed in **Section 4.2**). This is a very conservative screening approach because attenuation between the well point and the surface water interface has not been accounted for in the screening. No organic compounds were detected above GSI criteria in groundwater at the shallow wells near the River. Although only a limited number of inorganics were found to exceed GSI criteria in groundwater at the shallow wells near the River, samples for the river sampling program will be analyzed for the full suite of 13 site-specific metals established for Phase 1B based on the findings of the Phase 1A RFI. In addition, specific organic parameters found to exceed the Phase 1A screening criteria in IUs A, C, E, and G (although away from the river) will also be analyzed. Using the complete list of site-specific metals and specific organic parameters for the river samping program is intended to assist in comparison of the river sampling data with the Phase 1B site-wide groundwater sampling event (**Attachment A, Table 3E**).

The scope of work proposed in **Section 5.5.2** will also identify whether selected organic COIs, which exceeded Phase 1A screening levels in IUs A, C, E, and G, are currently present above statistical background within the Saginaw River near-shore sediment or surface water resulting from potential historical run-off, including selected potential associated degradation products. The selected organic COIs are presented in **Section 5.5.2.4.** In order to determine the potential for these COIs to have originated from the SMCO site, the selected COIs will be analyzed in all initial proposed sediment samples and all surface water samples.

### 5.5.2 Scope of Work

#### 5.5.2.1 Sample Stations

Surface water and sediment samples will be obtained from co-located stations along the east (along-site) and west (cross-stream) banks of the river (**Figure 5-12**).

Each station will consist of a designated block (two-dimensional area) of river within which samples will be collected (**Figure 5-13**). **Table 5-12** summarizes the proposed sampling design. Stations have been selected to represent the following:

- Areas that are most likely to intercept groundwater monitored by Phase 1A monitoring wells
- Areas that are most likely to show current influences, if any, from former on-site point source discharges.
- Upstream and cross-channel background locations that are geographically removed from the potential influence of releases from the SMCO facility and are therefore representative of regional background conditions.

Stations will be aligned with several representative near-shore monitoring wells located within the SMCO site boundaries (MW-01530, MW-03240, MW-03746, MW-04757). At each former on-site point source discharge locations, a trio of stations is planned: upstream of, as close as possible to, and downstream of the point source location.

A minimum of eight independent samples are required to reliably establish background, as per USEPA (1989) and CARStat (1999) statistical guidelines. The background database will include the eight samples from station SD/SW-9. These samples will be distributed over approximately 2000 feet of shoreline upstream of the SMCO site. Samples from stations SW/SD-1 through SD/SW-7 may be incorporated into the background database to provide additional statistical power if water and sediment quality is comparable to SD/SW-9 and other background locations reported for the Saginaw River. Historical data, summarized in GM's Technical Memorandum on Saginaw River Sediment Chemistry in the Vicinity of the Saginaw River Metal Casting Operations Facility (Exponent 1998), may be used to provide additional data on background areas and the site vicinity to supplement the near shore data derived from this investigation.

Sampling stations will be near-shore to maximize likelihood of identifying residues associated with settlable solids and avoid the dredged navigational channels (a maximum of 40 feet from shore or shoreward of dredged navigational channels, whichever is less). As discussed above, sediment samples will be collected adjacent to, upstream of and downstream of each former on-site discharge point.

Each sample station (other than the immediate upstream background station SW/SD-9, as described above) will cover approximately 100 linear feet of shoreline commencing at an accessible point approximately 15 feet from shore, out to a maximum of 40 feet from shore. One surface water sample and four sediment samples will be collected from each station. A greater number of sediment samples

is proposed to adequately characterize spatial variability within each sampling location. Sediment samples will be collected randomly within each station. All four sediment samples will be submitted to the laboratory, but only one sample per station will initially be analyzed. For stations positioned to evaluate the groundwater to surface water pathway, the sediment sample situated closest to the corresponding surface water sample from that same station, will be analyzed. For all stations, the sample selected for initial analysis will be that which is within approximately 15 feet of the shore, if possible. The remaining three samples will be held pending review of the data. Criteria for analyzing the held samples are described under Data Evaluation. Analysis of four sediment samples from each station would provide the minimum number of observations specified in USEPA and CARStat statistical guidelines for calculation of a station statistic (such as confidence limit), should such analysis be warranted following review of the initial data. All background sediment samples collected from SD/SW-9 will be submitted for laboratory analysis.

Proposed sample stations locations are approximate; actual locations will be determined in the field. The Field Coordinator will be responsible for selecting the actual locations. Sample station locations, both along the site and in other areas, will be adjusted as necessary based on observations of shoreline features (such as rip rap and bulkheads that could confound results), and accessibility. Final locations will be established and confirmed with Global Positioning System (GPS) equipment. Shoreline reference points will also be located by GPS.

Sampling and analysis at AOI A.3 will occur prior to implementation of the Saginaw River program. Should the results of the AOI A.3 sampling indicate the need to revise the surface water/sediment sampling stations (particularly background) or modify the list of parameters, an Addendum will be prepared. For example, if soil concentrations in AOI A.3 exceed Phase 1A screening criteria, proposed background locations in the area west of 6$^{th}$ Street will be moved further upstream.

### 5.5.2.2 Sample Collection

#### 5.5.2.2.1 Surface Water

Sampling, from a suitable work boat, will be sequential, downstream-through-upstream at a common nominal distance from the shoreline. Co-located samples will be obtained approximately 15 feet from the shoreline at all stations, unless bottom channel conditions require station adjustment. Should the total depth be less than 4 feet, stations will be relocated away from the shore to a depth sufficient to collect a sample as described below. Samples will be collected no sooner than three days following a storm event, to minimize transient storm effects on river flow.

To capture solutes released to the water column from groundwater, discrete surface water samples will be obtained near the bottom of the water column to maximize the possibility of detecting inputs from groundwater discharge prior to dilution in the entire water column. Specifically, the sampled interval would be 1-3 feet above the river bed, collected in a 2-foot Kemmerer-type sampling device, aligned vertically in the water column. The 1-foot separation between the river bed and sample should be adequate to prevent entrainment of bottom sediments into the samples. Surface water sampling will be performed sequentially (preferably in a one-day effort) until completed to minimize temporal variations in water quality.

#### 5.5.2.2.2 Sediment

Sediments will be sampled within a 30-day period following surface water sampling. Surficial sediment samples will be collected with a stainless-steel, van Veen or Eckman grab sampler to target the 0-2-inch (0-5-cm) depth horizon.

Sediment samples will be evaluated (sieved) in the field to determine general grain size characteristics (percent gravel, sand and fines). Background samples may be recollected at the discretion of the Field Team Leader to provide samples with particle profiles comparable to downstream samples.

A total 96 discrete sediment samples is to be collected (30 to be initially submitted for analysis and 66 to be held pending data review) and 28 surface waters (**Table 5-13**). Three surface water sample duplicates, seven sediment sample duplicates (splits of single grab samples;) and one field blank per matrix for each day of sampling will be also collected for QC purposes. For the sediment duplicates, three will initially be analyzed, and the rest held. Should additional sediment samples be analyzed at a later date, analysis will be performed on extra retained sediment duplicates so that a final rate of one duplicate per ten samples is achieved.

### 5.5.2.3 Sampling and Analysis

Standard Operating Procedures (SOPs) for surface water and sediment sampling appear in the Quality Assurance Project Plan.

Prior to sampling at a station, samplers and all related equipment will be washed with Alconox®, and then rinsed with river water, methanol, dilute nitric acid, and distilled/deionized water.

Surface water sampling will precede sediment sampling. At each surface water sample location, depth to bottom will be measured to 1) ensure that the vessel is not in the navigational channel and 2) determine the appropriate depth for the

surface water sampler. Turbidity will be measured after any disturbance due to the boat presence (e.g., anchoring) has settled and prior to deployment of the sampling device. The turbidity in the surface water sample should be equal to or lower than the initial water column turbidity. This will ensure that extraneous sediments have not been included in the water sample that could bias the results.

Each sediment grab sample will be evaluated for acceptability according to whether the following criteria are met:

- The overlying water is not visibly turbid due to disturbance by the boat
- The planned penetration depth of the grab sampler is achieved
- Each sample retrieved within a station block consists of sediments comparable in physical characteristics to the other samples from the station block

If a grab sample fails to meet any of the acceptance criteria or consists predominantly of rock, gravel or debris, it will be rejected and discarded away from the station. If the specified penetration depth is not achieved after three attempts, the station may be relocated. If relocation of the station does not improve the penetration depth, the station may be temporarily abandoned and another sampling device or alternate station selected.

After a sediment sample is judged acceptable, the overlying water will be gently drained off and the upper 2 inches of sediment collected. A clean plastic ruler will be used to ensure that the sampling criterion for adequate penetration depth is met and that the correct amount (i.e., 2 inches) of sediment has been removed. Sediment touching the sides of the grab sampler will not be collected. If insufficient sample volume is available, a second grab sample will be collected and combined with the first sample. Samples will be mixed with large stainless-steel spoons or a stainless-steel paddle to achieve a uniform texture and color. The homogenized sediment will be subsampled and transferred to sample containers. Large objects, such as rocks, twigs, gravel, and macrobenthic organisms, will be excluded from the sample during homogenization. The relative amount and type of material removed will be noted in the station sample log. All leftover sediment material will be returned to the river.

#### 5.5.2.4 Laboratory Analysis

Samples will be analyzed for the following:

- 13 site-specific metals
- benzo(a)pyrene
- 1,1-dichloroethene
- 1,2-dichloropropane
- polychlorinated biphenyls (PCBs)
- vinyl chloride
- 1,1-dichloroethane
- chloroethane.

A determination as to the need to analyze any held sediment samples will be made within the appropriate parameter-specific holding time.

For the 13 site-specific metals, surface water samples will be analyzed for dissolved constituents. This approach has been selected because the dissolved fraction corresponds to the migration pathway from groundwater to surface water. In addition, applicable regulatory criteria, National Water Recommended Quality Criteria (WQC; USEPA, 1994, 1999) for the protection of freshwater aquatic life from chronic effects (Continuous Criterion Concentrations) and Michigan DNR Chronic Water Quality Values for Protection of Aquatic Life in Ambient Waters (Michigan DEQ, 1997) are almost all based on the presence of dissolved inorganics in the water column. Therefore, should comparisons to regulatory values be warranted, the database will be appropriate. Additional analyses will be performed on the form of metal specified by the WQC (e.g., total recoverable aluminum).

#### 5.5.2.5 Data Evaluation

As discussed in **Section 5.1**, the purpose of the surface water and sediment sampling program is to determine whether sufficient evidence exists to show that constituents above the Phase 1A screening criteria and potentially attributable to the SMCO facility are at concentrations showing a statistically significant increase over background in surface water and sediment in the Saginaw River. This determination will be made by statistical comparison of data from the downstream

samples with data from the upstream or background samples, including any relevant regional background data. In statistical terms, the determination will test the null hypothesis that the mean concentration of a constituent at a downstream sampling location is the same as the mean background concentration. The alternate hypothesis is that the mean concentration of the constituent at the downstream location is higher than the mean background concentration.

The null hypothesis for each constituent at each downstream sampling location will be tested at a 0.01 level of significance. That is, the probability of a false positive outcome in each comparison will be 0.01 (or 1 chance in a 100 of incorrectly concluding that the mean concentration of a constituent at a downstream location is higher than the mean background concentration). Because multiple constituents and multiple downstream sampling locations will be tested in the determination of the facility's effect on surface water and sediment, the overall level of significance will be higher than 0.01. That is, the chance of one or more false positive conclusions among the multiple comparisons will be higher than 1 in a 100.

Ideally, the overall level of significance should not exceed 0.05; otherwise, the tests would have too high a probability (more than 1 chance in 20) of dictating further action where none is actually warranted. For the number of constituents and downstream locations specified in the sampling program, the overall level of significance will be higher than 0.05 when single comparisons (one constituent at one downstream location) are tested at the 0.01 level. However, techniques to limit the overall rate of false positive error to 0.05 will not be used initially, because these techniques are more complex and are often considered in conjunction with explicit control of false negative errors. Instead, the single comparisons at the 0.01 level of significance will be considered conservative screening-level comparisons. Depending on the number of constituents and locations where the null hypothesis is initially rejected, additional evaluation, including control of the overall false positive rate and analysis of additional samples, will be considered before making final conclusions regarding the facility's effects on surface water and sediment.

The single comparisons will be performed using either hypothesis tests or statistical intervals. For example, the one-sided Student's t-test for two population means can be used where the concentrations of a constituent in the background samples and in the downstream samples are approximately normal (e.g., the null hypothesis of normality is not rejected at the 0.01 level of significance in the Shapiro-Wilk test). Equivalently, a one-sided prediction interval (or an upper prediction limit, which is essentially an upper confidence limit for a future observation) could be used instead. Where the concentrations of a constituent are not sufficiently normal (e.g., the null hypothesis of normality is rejected at the 0.01 level of significance), a nonparametric hypothesis test or a prediction limit constructed using bootstrap techniques will be used. Nonparametric bootstrap techniques do not rely on any

assumptions about the distribution of the data. Instead, they use the actual data set as the empirical distribution function of the underlying probability distribution. In the parametric or nonparametric calculations, nondetect results will be substituted with one-half the sample quantitation limit (SQL) when necessary (e.g., in calculating the sample mean and sample standard deviation).

An individual comparison will determine whether the mean concentration of a constituent at a downstream sampling location is higher than the mean background concentration at a 0.01 level of significance. A one-sided hypothesis test or prediction limit that does not reject the null hypothesis at a 0.01 level of significance would mean that there is insufficient evidence to show that the mean concentration of the constituent at that location is higher than the mean background level. Conversely, a one-sided test or prediction limit that rejects the null hypothesis at the 0.01 level of significance would mean that there is sufficient initial evidence to suggest that the mean concentration of the constituent at a downstream location might be higher than the mean background level. In this case, the overall false positive rate and the analysis of additional samples at the downstream location will be considered in reaching a final conclusion regarding the acceptance or rejection of the null hypothesis.

Where additional samples from a downstream location are analyzed, a hypothesis test or prediction limit that accounts for the additional data will be used to retest the null hypothesis. For example, the three additional samples from the same downstream station on hold at the laboratory could be analyzed and the data would be combined with the initial sample for comparison to the background data using either an appropriate t-test or prediction limit for multiple samples.

If the difference in mean concentrations of a constituent at a downstream station and background are determined to be statistically significant (as discussed above), then the data for the constituent at the downstream location may be evaluated using appropriate risk screening criteria as discussed in **Section 6.2.**

## 5.6. Quality Assurance/Quality Control

The objective of the data validation program is to provide a standardized framework for conducting reviews of the field and laboratory data to ensure compliance with the referenced methods in the project-specific quality assurance project plan (QAPP) (**Attachment A**).

### 5.6.1. Data Validation and Assessment

All analytical data generated by Columbia Analytical Services (CAS) will be subjected to complete data validation. Analyses performed for soil physical characteristics and the field screening data will not be subjected to complete validation, as discussed in the QAPP (**Attachment A**). The data validation procedures specified in the QAPP conform to the procedures outlined in Functional Guidelines (U.S. EPA 1994 a, b). Data qualifiers will be assigned to the reported results, as necessary, to indicate irregularities in the analyses that could affect the bias, precision, or usability of the reported results.

### 5.6.2. Data Quality Objectives

Data Quality Objectives (DQOs) for the Phase 1B data were established to identify target parameters for analysis, estimated quantitation limits, instrument calibration and performance parameters, and the frequency of collection and analysis of field and laboratory quality control samples. The DQOs for Phase 1B are included in the QAPP (**Attachment A**).

## 5.7. Project Schedule

The Phase 1B assessment activities will begin according to an approved schedule following USEPA's approval of this Workplan. A project schedule has been developed for use in completing Phase 1B in a timely fashion. This schedule does not account for unanticipated/unavoidable conditions such as prolonged or extreme adverse weather conditions. If such conditions are expected to result in significant delays in the project schedule, USEPA will be notified immediately and a revised schedule will be submitted with a request for written USEPA approval of the extended timeline.

The Phase 1B field program is anticipated to begin within four weeks of final USEPA approval of this Workplan. Activities to be performed during the four-week post-approval period include the following:

- Negotiating a contract with the drilling firm(s).
- Mobilizing equipment to the site.
- Staking out approximate soil sample and well locations.
- Completing final preparations necessary to initiate the Phase 1B field activities.

During the four-week post-approval start-up period (see **Figure 5-14)** the Field Coordinator will visit the site to stake out the approximate soil sample, boring, and well locations. If it is necessary to make a significant modification to one or more of the approximate locations, the Field Coordinator will select an alternative location approved by the Project Manager. The Field Coordinator will document the reasons for aborting the proposed location and the rationale for selecting the new location.

Once the project is initiated, field activities (including borehole advancement and sample collection) will begin and will continue until the tasks identified in this SAP have been completed.

The Phase 1B field program will be performed consistent with the schedule shown on **Figure 5-14.** In accordance with the Order, GM will provide USEPA with monthly progress reports on the implementation of the RFI Workplan on or before the 10th day of each month. The actual dates of schedule milestones shown on **Figure 5-14** will depend on the date of final USEPA approval of the Workplan. GM will make every reasonable effort to adhere to this schedule and the time requirements established in the Order. If there is a need to modify the RFI schedule, GM will notify USEPA immediately.

Sample analyses will begin soon after the first samples are received at the laboratory and will extend four to six weeks following delivery of the final samples to the laboratory. Data validation will begin following receipt of the analytical data from the first samples collected and will continue until all generated data are verified. Data validation is anticipated to be completed within 8 weeks following completion of laboratory analysis. A draft Phase 1B summary report will be prepared within 120 days of completion of the data validation.

Based on the tasks proposed herein and the time line presented in **Figure 5-14,** GM will submit a draft Phase 1B Report to USEPA. Once USEPA has reviewed the Phase 1B Report and sent written comments, GM would welcome the opportunity to meet with USEPA to discuss any questions or comments they may have. The Phase 1B Report will then be revised to address any USEPA written comments (or any modifications discussed in the meeting), and the Final Phase 1B Report will be submitted within 45 days following the meeting with the USEPA.

# 6.0 BASELINE RISK ASSESSMENT

Site characterization data collected during the phased RFI field investigation will be evaluated in a baseline risk assessment to determine the human health and environmental significance of constituent concentrations in soil, groundwater, sediment and surface water at the facility. The results of the baseline risk assessment will provide the basis for identifying specific solid waste management units (SWMUs) and areas of interest (AOIs) that warrant a corrective measures study (CMS).

## 6.1. Human Health Risk Assessment

A human health risk assessment will be conducted to evaluate the health significance of constituent concentrations under current and reasonably anticipated future land use, groundwater use, and surface water use at and near the facility. A detailed preliminary conceptual site model (CSM) was developed during Phase 1A to describe potential human exposures to constituents in environmental media at the facility. The preliminary CSM is presented in **Table 2-13** and the information reviewed during Phase 1A on reasonably anticipated future land use and groundwater use is discussed in **Section 2.4.3**. The preliminary CSM defines the exposure scenarios that are expected to be evaluated in the baseline risk assessment. Any additional information evaluated during Phase 1B (or additional phases) of the RFI field investigation will be incorporated as appropriate into the CSM for the human health risk assessment.

In general, potential human exposures identified in the CSM will be estimated using relevant standard default exposure factors from USEPA guidance with adjustments, as appropriate, to account for site-specific conditions. The toxicity of constituents will be assessed using USEPA-derived toxicity values from USEPA's Integrated Risk Information System (IRIS). For constituents lacking USEPA-derived toxicity values, toxicity values from USEPA's Health Effects Assessment Summary Tables (HEAST) and provisional toxicity values from the National Center for Environmental Assessment (NCEA) would be considered. The estimates of potential exposures and toxicity will be combined to estimate cumulative cancer and noncancer risk. Estimates of risk under reasonable maximum exposures (RME) will be compared with USEPA criteria to determine whether potential human exposure pathways at a SWMU or AOC warrant corrective measures.

For potential exposures to groundwater that is a current or reasonably expected drinking water source, the significance of such exposures will be evaluated using maximum contaminant levels (MCLs) established under the Safe Drinking Water Act. Constituent concentrations in groundwater at current and reasonably expected future points of drinking water exposure will be compared with MCLs, or similar risk-based drinking water criteria for constituents lacking MCLs. Similarly, for potential exposures to surface water in the Saginaw River, the significance of such exposure will be evaluated using appropriate ambient water quality criteria. Constituent concentrations measured during Phase 1B in the Saginaw River, that are attributed to the Facility, will be compared as appropriate with these human health-based ambient water quality criteria. The baseline risk assessment will also include modeling of chemical constituents in the river by transport of constituents from individual AOIs (via shallow groundwater) to estimate the contribution of constituents from each of the AOIs.

## 6.2. Ecological Risk-Based Screening Approach

A screening-level risk assessment will be conducted during Phase 1B of the RFI. The screening-level assessment will evaluate chemical exposure pathways and areas of interest identified during Phase 1A (see **Figure 4-2**). As noted in **Section 2.4.4,** use of this active industrial site by wildlife habitat is spatially and temporally limited.

### 6.2.1. Risk-Based Screening for Direct Media Contact

The potential for unacceptable risk from chemicals in surface water and sediment from surface water bodies on and immediately adjacent to the Facility will first be evaluated by comparing detected chemical concentrations in these media with available and appropriate ecological risk-based screening criteria. The criteria to be employed will include:

- EPA chronic ambient water quality criteria (surface water)
- Freshwater no effect concentrations (NECs) from Ingersoll (1996) (sediment).

Direct contact with substances in surface water is also a potential exposure pathway for migratory waterfowl, which may use the surface water impoundments as loafing areas. Exposure of loafing waterfowl to contaminants from drinking and incidental ingestion of surface water from these areas will also be evaluated.

This comparison is a preliminary evaluation of any chemical exposure pathways for ecological communities that potentially exist at the site. This preliminary evaluation determines whether any pathways for detected chemicals can be eliminated from further evaluation on the basis of lack of potential for adverse ecological impacts. Two outcomes are possible from the screening criteria comparison:

- Concentrations of detected chemicals are below criteria, indicating that ecological risks are negligible and, therefore, there is no need for further evaluation or risk management on the basis of ecological risk.

- Concentrations of detected chemicals exceed criteria, indicating a potential for adverse ecological effects. Consequently, a more thorough assessment of the pathway is warranted.

The criteria comparison does not result in quantitative risk characterization. Only the absence (not the presence) of significant risk can be established by comparison to criteria alone. If the possibility of risk cannot be ruled out, further assessment will be required for those exposure pathways and receptor communities. In this event, GM will evaluate risk from the pathways using appropriate screening-level approaches, such as simple food-web models or analysis of ecological significance of risk. If necessary, GM will propose a course of action for further evaluation, which is consistent with applicable federal and state regulatory guidance for ecological risk assessment.

### 6.2.2. Risk-Based Evaluation of Aquatic Food-Web Exposure

Detected chemicals in surface water and sediment samples collected onsite during Phase 1A will be reviewed for the potential to bioaccumulate in the aquatic environment, and detected concentrations of chemicals with bioaccumulative potential will be conservatively modeled to predict the range of potential exposure for wildlife that are likely to forage in each area for which food-web exposure pathways have been identified:

- The exposure pathway for piscivorous wildlife will be evaluated for the Deikmann drain and stormwater discharge ditch.

- The exposure pathway for omnivorous mammals that prey on crayfish will be evaluated for the water reservoir (lagoon no. 5). Evidence of raccoons has been observed on the banks, and it is possible that raccoons forage on crayfish. This pathway will also be evaluated for Deikmann drain and the stormwater discharge ditch.

- The exposure pathway for insectivorous birds will be evaluated at the water reservoir (lagoon no. 5). Birds have been observed hawking insects at this water body.

- The exposure pathway for herbivorous waterfowl will be evaluated in the secondary settling pond. Loafing waterfowl may forage to some extent on algae, although this behavior has not been observed.

For each of these pathways, the potential for chemical exposure to cause risk will be evaluated by conservatively modeling the bioaccumulation of detected chemicals through the aquatic food web, and comparing the estimated exposure to available published effect thresholds. If ecologically significant risk is deemed to be present for any pathway, additional evaluation procedures or risk management actions may be recommended.

The existence of exposure pathways for chemicals in the Saginaw River surface water and sediment will be evaluated based on Saginaw River samples collected during Phase 1B.

# 7.0 BIBLIOGRAPHY

Aerial Photograph. GM SMCO Recyclable Materials Staging Piles. 1990.

"Aquifer Vulnerability to Surface Contamination in Michigan." Center for Remote Sensing and Department of Geography. Michigan State University, East Lansing, Michigan. 1992.

Baronski, Darwin, Saginaw City Park Division. Personal Communication with Amy A. Landgraf, EMCON. May 7, 1995.

"Birds and Bird Finding in the Saginaw Bay Area." Ron J. Weeks. 1995. Clare, Michigan: Campbell Printing, Inc.

Bouwer, H., and R.C. Rice, 1976, A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells, Water Resources Research, Vol. 12, No. 3, pp. 423-428.

Bouwer, H., 1988, The Bouwer and Rice Slug Test - An Update, Groundwater, Vol. 27, No. 3, pp. 304-309

Brauer, Sue, USEPA RCRA Enforcement. Telephone Interview with Chris Curtin, EMCON. February 2, 1994 and October 13, 1994.

CARStat Compliance Assessment Remediation Statistics, 1999. Version 2.0. User's Guide. Robert D. Gibbons, Ltd. And Discerning Systems, Inc.

"City of Saginaw and Charter Township of Buena Vista Zoning Maps." City of Saginaw Planning and Zoning Departments. 1990 and 1991.

EMCON. 1995. General Motors Corporation, Saginaw Casting Complex, Saginaw, Michigan, RCRA facility investigation (RFI) Task I: Description of Current Conditions (DOCC) report. EMCON, Lisle, IL.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 7, 1994.

Cooper, Scott, USEPA Environmental Science Division. Telephone Interview with Chris Curtin, EMCON. June 28, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 8, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 8, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 7, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan, EMCON. June 6, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 8, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 8, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan and Chris Curtin, EMCON. June 8, 1994.

General Motors Personnel. Personal Interview with Doug Dorgan, EMCON. June 7, 1994.

GM Former Parts Plant RCRA Hazardous Waste Drum Storage Area Correspondence to USEPA Region V Administrator. General Motors Corporation. April 4, 1983.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to MDNR. General Motors Corporation. July 13, 1983.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to MDNR. General Motors Corporation. September 4, 1984.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to MDNR. General Motors Corporation. April 7, 1987.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to MDNR. General Motors Corporation. January 19, 1988.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to MDNR. General Motors Corporation. September 27, 1991.

GM Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Response to October 19, 1994 Correspondence from MDNR. General Motors Corporation. November 11, 1994.

GM Former Parts Plant RCRA Hazardous Waste Drum Storage Area Correspondence to MDNR. General Motors Corporation. February 20, 1989.

GM Former Grey Iron Oil House UST (GI #1) Correspondence to MDNR. General Motors Corporation. March 17, 1993.

GM Former Gasoline UST (GI #4) Correspondence. General Motors Corporation. October 5, 1992.

GM Former Garage Annex UST Service Maintenance Site (GI #5) Termination Pumping Letter to MDNR. General Motors Corporation. October 5, 1992.

GM Powerhouse Fuel Oil ASTs Activity Report. Michigan Department of Natural Resources. March 7, 1984.

GM Former Nodular Iron Plant Oil House RCRA Hazardous Waste Drum Storage Area Correspondence to MDNR. General Motors Corporation. July 13, 1983.

GM Basement Sumps Internal Memo. General Motors Corporation. November 9, 1976.

GM Basement Sumps Internal Memo. General Motors Corporation. November 29, 1976

GM Basement Sumps Internal Memo. General Motors Corporation. April 5, 1977.

GM Basement Sumps Correspondence to MDNR. General Motors Corporation. January 3, 1989.

GM Basement Sumps Internal Memo. General Motors Corporation. November 5, 1991.

GM Basement Sumps Correspondence to MDNR. General Motors Corporation. November 15, 1991.

GM Basement Sumps Correspondence to MDNR. General Motors Corporation. February 18, 1993.

GM Basement Sumps Meeting Record with MDNR. General Motors Corporation. June 9, 1993.

GM Basement Sump Correspondence to MDNR. General Motors Corporation. August 16, 1993.

GM Basement Sump Correspondence to MDNR. General Motors Corporation. February 24, 1994.

GM Basement Sump Correspondence to MDNR. General Motors Corporation. March 10, 1994.

GM Elevator Hydraulic Leaks Internal Memo. General Motors Corporation. November 13, 1976.

GM Stormwater Discharge Ditch Correspondence to MDNR. General Motors Corporation. March 10, 1994.

GM Landfill Correspondence to MDNR. General Motors Corporation August 30, 1989.

"Hydrogeologic Atlas of Michigan, USEPA Underground Injection Control Program." Department of Geology College of Arts and Sciences. Western Michigan University, Kalamazoo, Michigan 1981.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella azteca and the midge Chironomus riparius. J. Great Lakes Res. 22(3):602–623.

MDEQ, 1997. Water Quality Standards, Part 4. R 323.1057 Toxic Substances (integrated), Promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

MDNR Former Parts Plant RCRA Hazardous Waste Drum Storage Area correspondence to GM. Michigan Department of Natural Resources. July 19, 1988.

MDNR Former Parts Plant Electric Department PCB Storage Area correspondence to GM. Michigan Department of Natural Resources. June 27, 1983.

MDNR Molten Cyanide Dip Tanks and Emergency Dump Tank UST Activity Report. Michigan Department of Natural Resources. February 2, 1984.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Inspection Report. Michigan Department of Natural Resources. June 27, 1983.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Inspection Report. Michigan Department of Natural Resources. June 22, 1984.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Inspection Report. Michigan Department of Natural Resources. April 7, 1987.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Inspection Report. Michigan Department of Natural Resources. January 17, 1988.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Inspection Report. Michigan Department of Natural Resources. September 9, 1991.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Letter of Compliance. Michigan Department of Natural Resources. August 18, 1987.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Revised Closure Plan Correspondence. Michigan Department of Natural Resources. November 24, 1992.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Revised Closure Plan Approval Letter. Michigan Department of Natural Resources. March 31, 1993.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence regarding June 17, 1994 meeting with GM. Michigan Department of Natural Resources. July 27. 1994.

MDNR Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area Correspondence to GM. Michigan Department of Natural Resources. October 19, 1994.

MDNR Current Equipment Staging Area Internal Memo. Michigan Department of Natural Resources. March 17, 1994.

MDNR Former Grey Iron Oil House UST (GI #1) Correspondence to GM. Michigan Department of Natural Resources. March 17, 1993.

MDNR Former Grey Iron Oil House UST (GI #2 and #3) Correspondence to GM. Michigan Department of Natural Resources. July 6, 1993.

MDNR Former Gasoline UST (GI #4) Correspondence to GM. Michigan Department of Natural Resources. March 12, 1994.

MDNR Former Garage Annex UST Service Maintenance Site (GI #5) Correspondence to GM. Michigan Department of Natural Resources. March 12, 1993.

MDNR Former Garage/Oil Water Separator UST (GI #7) No Further Action Letter to GM. Michigan Department of Natural Resources. January 8, 1993.

MDNR Former Garage Annex Oil/Water Separator UST (GI #8) No Further Action Letter to GM. Michigan Department of Natural Resources. January 8, 1993.

MDNR Former Cooling Tower UST (GI #10) Corrective Action Complete Correspondence Letter to GM. Michigan Department of Natural Resources. September 2, 1994.

MDNR Powerhouse Fuel Oil ASTs Air Quality Division Activity Report. Michigan Department of Natural Resources. August 18, 1983

MDNR Powerhouse Fuel Oil ASTs Activity Report. Michigan Department of Natural Resources. January 6, 1984.

MDNR Former Mill Water Pump House UST (NI #9) Meeting Record. Michigan Department of Natural Resources. September 27, 1993.

MDNR Allegedly Buried Drums File Note. Michigan Department of Natural Resources. May 23, 1995.

MDNR ERD Incident Report Regarding Allegedly Buried Drums. Michigan Department of Natural Resources. May 24, 1991.

MDNR Allegedly Buried Drums Internal Message. Michigan Department of Natural Resources. November 6, 1990.

MDNR Former Nodular Iron Plant Oil House RCRA Hazardous Waste Drum Storage Area Inspection Report. Michigan Department of Natural Resources. June 27, 1983.

MDNR Former Nodular Iron Plant Oil House RCRA Hazardous Waste Drum Storage Area Inspection Report. Michigan Department of Natural Resources. July 16, 1990.

MDNR Former RCRA Hazardous Waste Control Tank (AST) Disapproval Letter for a Closure Plan. Michigan Department of Natural Resources. April 28, 1988.

MDNR Former RCRA Hazardous Waste Control Tank (AST) Closure Plan Approval Letter. Michigan Department of Natural Resources. June 10, 1988.

MDNR Former RCRA Hazardous Waste Control Tank (AST) Request for Further Work Correspondence. Michigan Department of Natural Resources. April 3, 1989.

MDNR Former RCRA Hazardous Waste Control Tank (AST) Meeting Record. General Motors Corporation and the Michigan Department of Natural Resources. August 8, 1989.

MDNR Former Nodular Iron Plant Waste Paint Shed RCRA Hazardous Waste Drum Storage Area Inspection Report. Michigan Department of Natural Resources. August 25, 1982.

MDNR Former Nodular Iron Plant Waste Paint Shed RCRA Hazardous Waste Drum Storage Closure Plan Disapproval Letter. Michigan Department of Natural Resources. April 28, 1988.

MDNR Former Nodular Iron Plant Waste Paint Shed RCRA Hazardous Waste Drum Storage Closure Plan Approval Letter. Michigan Department of Natural Resources. June 10, 1988.

MDNR Former Nodular Iron Plant Waste Paint Shed RCRA Hazardous Waste Drum Storage Meeting Record. Michigan Department of Natural Resources and General Motors Corporation. August 8, 1989.

MDNR Former (Original) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Disapproval Letter. Michigan Department of Natural Resources. April 28, 1988.

MDNR Former (Original) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Approval Letter. Michigan Department of Natural Resources. June 10, 1988.

MDNR Former (Original) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Approval Letter. Michigan Department of Natural Resources. September 26, 1988.

MDNR Former (Original) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Internal Memo. Michigan Department of Natural Resources. December 10, 1991.

MDNR Former (Replacement) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Disapproval Letter. Michigan Department of Natural Resources. February 5, 1986.

MDNR Former (Replacement) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Disapproval Letter. Michigan Department of Natural Resources. April 28, 1988.

MDNR Former (Replacement) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Approval Letter. Michigan Department of Natural Resources. June 10, 1988.

MDNR Former (Replacement) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Closure Plan Approval Letter. Michigan Department of Natural Resources. September 26, 1988.

MDNR Former (Replacement) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" Internal Memo. Michigan Department of Natural Resources. December 10, 1991.

MDNR Basement Sumps Compliance Sampling Inspection Report. Michigan Department of Natural Resources. October 3, 1991.

MDNR Basement Sumps Notice of Non-Compliance. Michigan Department of Natural Resources. February 3, 1993.

MDNR Basement Sumps Correspondence to GM. Michigan Department of Natural Resources. March 18, 1993.

MDNR Former Virgin Oils Storage Pad Internal Memo. Michigan Department of Natural Resources. June 25, 1989.

MDNR Former Nodular Iron Plant Oil House USTs South (NI #3, #4, #5, and #6) Meeting Record. Michigan Department of Natural Resources. September 27, 1993.

MDNR Stormwater Discharge Ditch Report. Michigan Department of Natural Resources. November 12, 1976.

MDNR Stormwater Discharge Ditch Memo. Michigan Department of Natural Resources. December 15, 1977.

MDNR Former Downes School Building USTs (NI #10, #11, #12) Meeting Record. Michigan Department of Natural Resources. September 27, 1993.

Michigan Water Resource Commission Correspondence to GM. Michigan Water Resource Commission. October 14, 1971.

Michigan Surface Water Quality Division Memo to the Office of Toxic Materials Control. March 20, 1978.

Nationwide Environmental Title Research. Title Search Report. GM SMCO, Saginaw, Michigan. January 4, 1995.

Office of Toxic Materials Control Memo to Michigan Surface Water Quality Division. February 27, 1978.

Reeves, Doug, Michigan Department of Environmental Quality Wildlife Biologist. Personal Communication with Amy A. Landgraf, EMCON. May 18, 1995.

"Soil Survey of Saginaw County, Michigan." United States Department of Agriculture, Soil Conservation Service. January 1994.

Shapiro, S.S., and M.B. Wilk, 1965, An Analysis of Variance Test for Normality (Complete Samples), Biometrika, Vol. 52, pp. 591-611

Shapiro, S.S., and R.S. Francia, 1972, An approximate analysis of Variance Test for Normality, Journal of American Statistical Association, 67 (337): 215-6

USEPA, 1989. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities. Interim Final Guidance. Office of Solid Waste, Waste Management Division, Washington, D.C. EPA/530-SW-89-026.

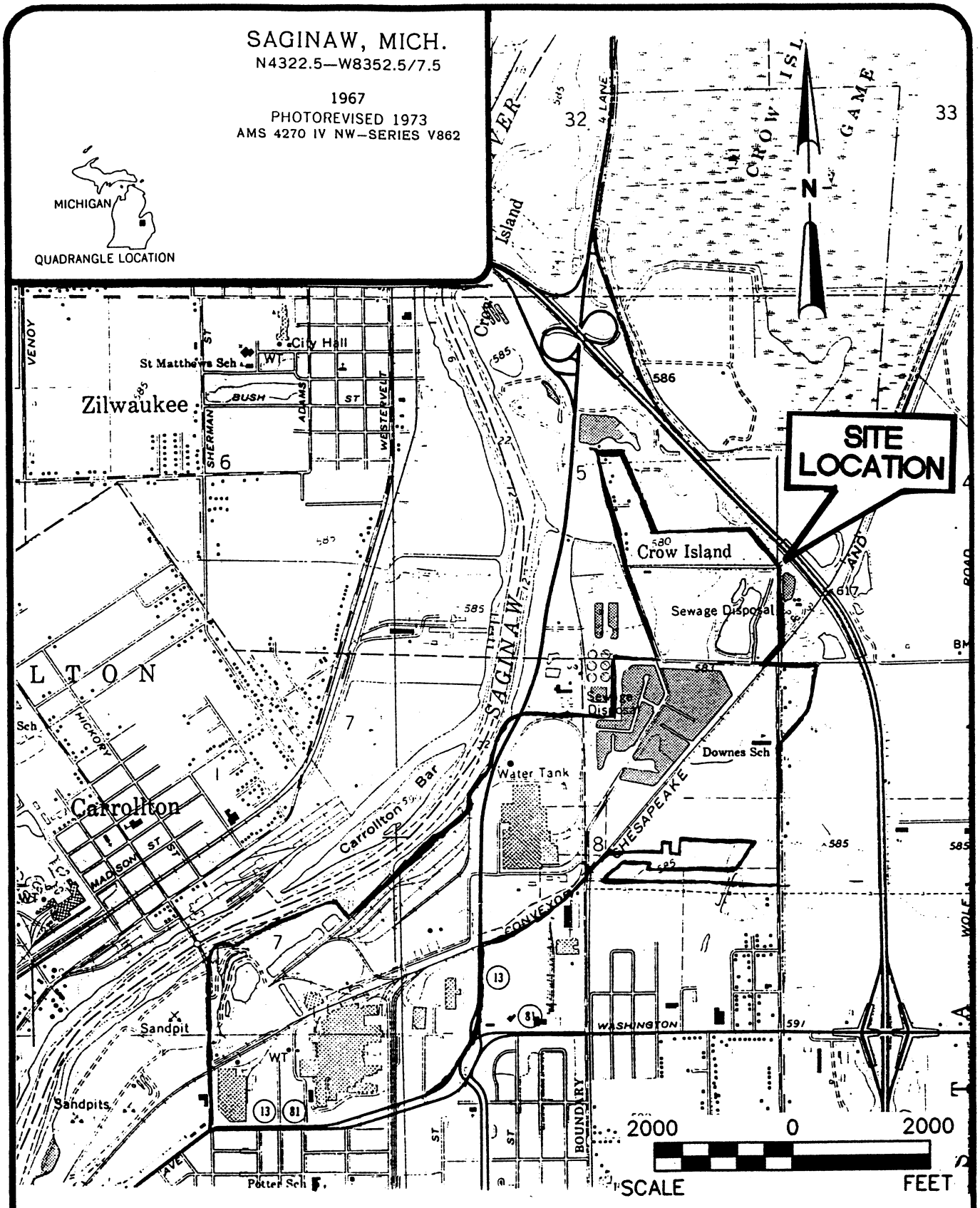
USEPA, 1994. Water Quality Standards Handbook: Second Edition. Office of Water. EPA 823-B-94-005a.

USEPA, 1999. National Recommended Water Quality Criteria – Correction. Office of Water. EPA 822-Z-99-001.

Weather Report. Saginaw, Michigan. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center. January 1980-December 1993.

Western Michigan University (WMU), 1981, Hydrogeologic Atlas of Michigan, College of Arts and Sciences, Department of Geology.

Wilk, M.B., and Shapiro, S.S., 1968, The joint assessment of normality of several independent samples, Technometrics, 10, No. 4, pp. 825-839




emcon

DATE 4/30/99
DWN AMC
APP BKS
REV
PROJECT NO.
84068-063.009

FIGURE 1-1
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

SITE LOCATION MAP

# SITE PLAN

**Saginaw Metal Casting Operations**

## SAGINAW, MICHIGAN

**KEY**

- PROPERTY LINE
- FENCE
- SURFACE WATER
- RECYCLE SYSTEM WATER
- ROADS/PAVED AREAS
- DIRT ROADS/PATHS
- RAILROAD TRACKS
- OPERATING BUILDINGS
- FORMER OPERATING BUILDINGS
- ON-SITE BUILDINGS NOT OWNED/OPERATED BY GM
- CITY LIMIT LINE

N

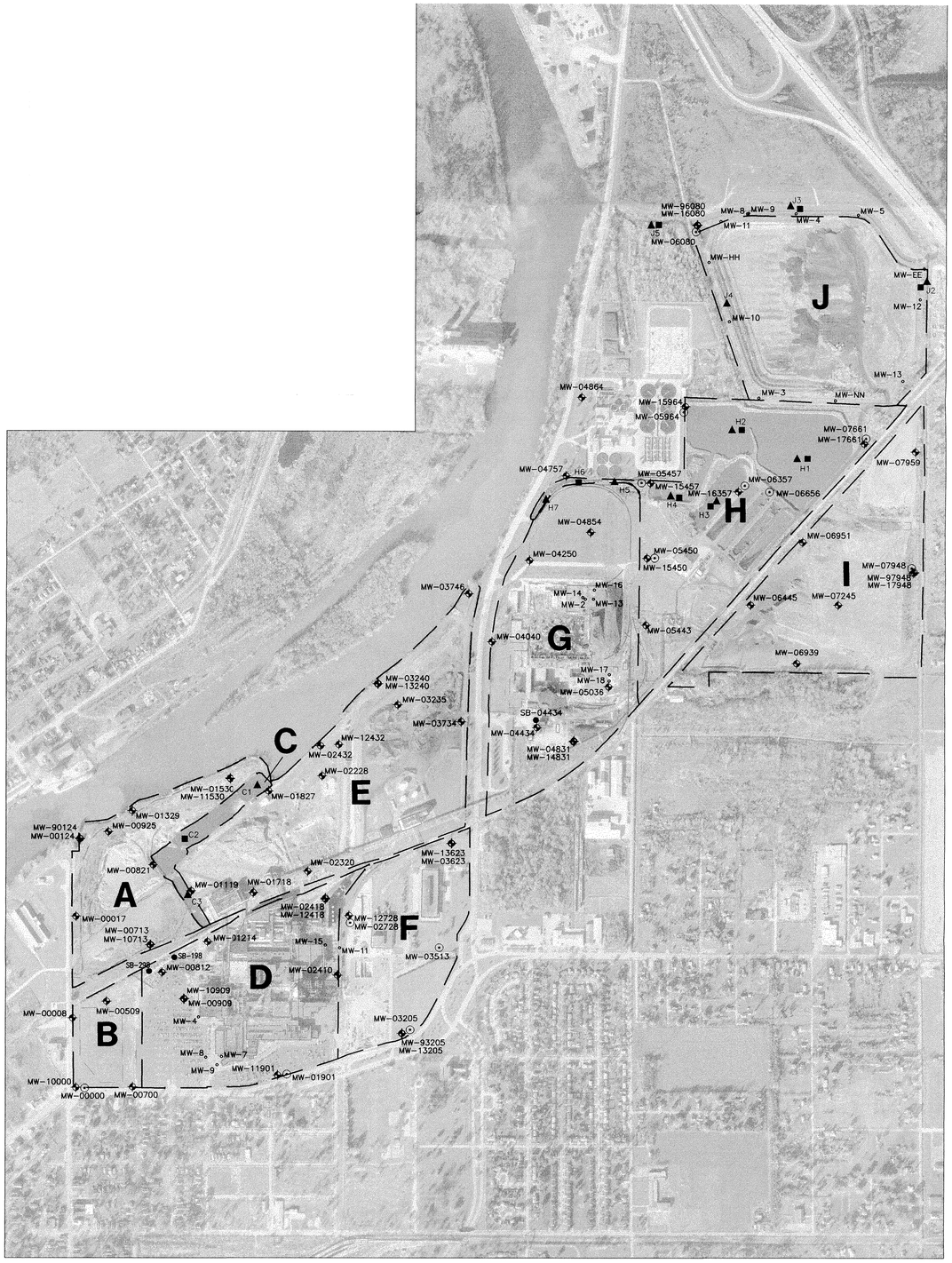
300 0 300
Scale in Feet

SAGINAW RIVER
CARROLTON SAND BAR
APPROXIMATE PROPERTY LINE
VACANT WOODED AREA
CROW ISLAND ROAD
CITY OF SAGINAW LANDFILL
I-75
GAGE (DEIKMANN) DRAIN
TYPE III SOLID WASTE LANDFILL
BUENA VISTA POTW
BAY ROAD
CITY OF SAGINAW POTW
SECONDARY SETTLING POND
WATER RESERVOIR (LAGOON #5)
PRIMARY LAGOONS
FORMER SCALE HOUSE
PUMP HOUSE
FORMER DOWNES SCHOOL BUILDING (DEMOLISHED 1986)
WWTP
CLASSIFIERS
FORMER NODULAR IRON PLANT
MILL WATER PUMP HOUSE
$CoC_2$ BUILDING
FAIRCHILD PROPERTY
M-13 HIGHWAY
GUARD HOUSE
OIL STORAGE BUILDING
PAINT SPRAY BUILDING
ELECTRICAL SUBSTATION
RADIATION PHOTOGRAPH BUILDING
PUMPING STATION
SCALE HOUSE
CHEVROLET PROPERTY
LOADING DOCK
PROCESS WATER RESERVOIR
CITY OF SAGINAW STORMWATER DITCH
RIVER DOCK CRANE REPAIR BUILDING
RIVER DOCK MAINTENANCE BUILDING
POWER HOUSE
SAND SLURING PUMP HOUSE
ADVANCED DEVELOPMENT FOR FORMED MELT CASTING PLANT (CDP)
FOUNDRY EMISSION BUILDING
CUPOLA COOLING TOWERS
CITY OF SAGINAW STORMWATER DITCH OPERATING FACILITY
AMDC
ADMINISTRATION BUILDING
DEIKMANN ST.
OUTER DRIVE
CONSUMERS POWER SUBSTATION
OIL HOUSE
SCRAP REMELT BUILDING
BRIQUETTING OPERATION
STORAGE BUILDING
SAND STORAGE BUILDING
SERVICE GARAGE
GREY IRON PLANT
FORMER PARTS PLANT (DEMOLISHED 1985)
STORMWATER BASIN
C & O RAILROAD R.O.W.
SIXTH STREET
SEVENTH STREET
EIGHTH STREET
NINTH STREET
TENTH STREET
FOURTEENTH STREET
WASHINGTON AVENUE
CITY OF SAGINAW
TOWNSHIP OF BUENA VISTA

**PREPARED BY:**

EMCON

N:\DWG\84068063\009\NAGMSP05.DWG PLOT 1=300 3/12/99




N

## LEGEND

| | |
|---|---|
| MW-00713 | PHASE 1A WELL |
| | EXISTING WELL LOCATION |
| | PROPOSED PHASE 1A SHALLOW WELL; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT |
| | PHASE 1A SOIL BORING |
| | SEDIMENT SAMPLE LOCATION |
| | SURFACE WATER SAMPLE LOCATION |
| J1 | SAMPLE LOCATED OFF-SITE WITHIN GAGE (DEIKMANN) DRAIN (BASE MAP NOT AVAILABLE FOR THIS LOCATION) |
| | INVESTIGATIVE UNIT BOUNDARY |
| A | INVESTIGATIVE UNIT DESIGNATION |

NOTES:

1. AERIAL BASE MAP SOURCE: ADVANCED MAPPING TECHNOLOGIES, PORT HURON, MICHIGAN, NOVEMBER 1997.
2. EXISTING WELLS MW-2 AND MW-17 SAMPLED FOR PHASE 1A INVESTIGATION. ALL OTHER EXISTING WELLS NOT SAMPLED.

0 600 1200
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY PPV
APP BY JJM

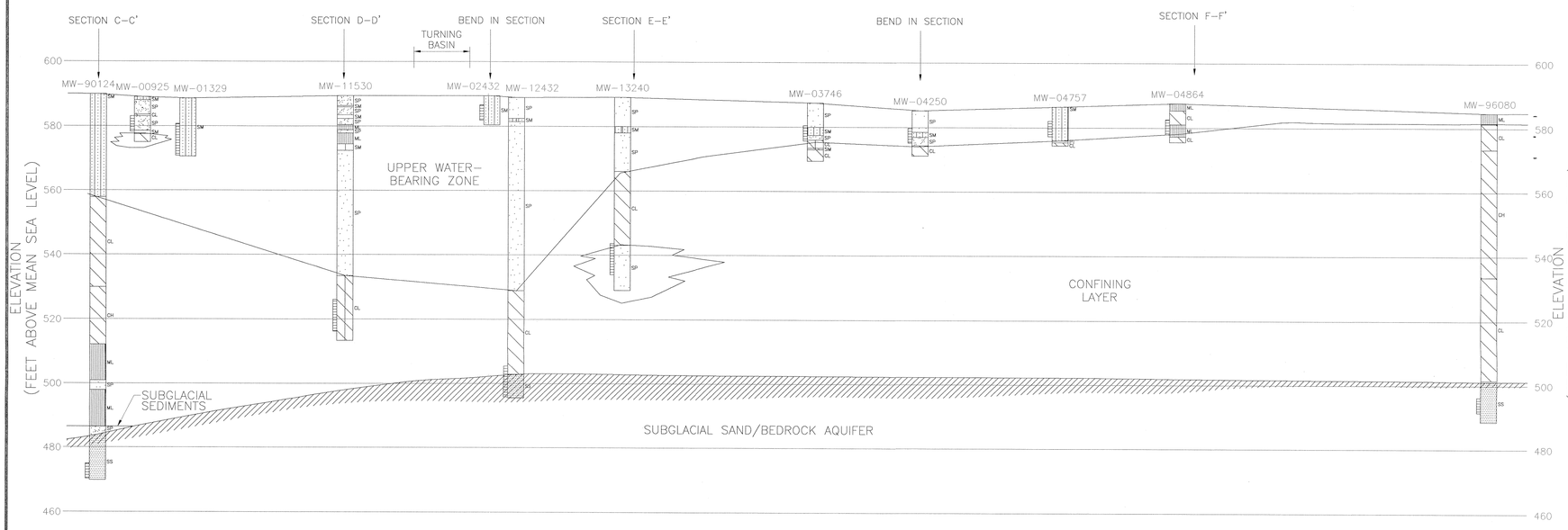
EMCON

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**PHASE 1A INVESTIGATION**
**SAMPLE LOCATIONS**

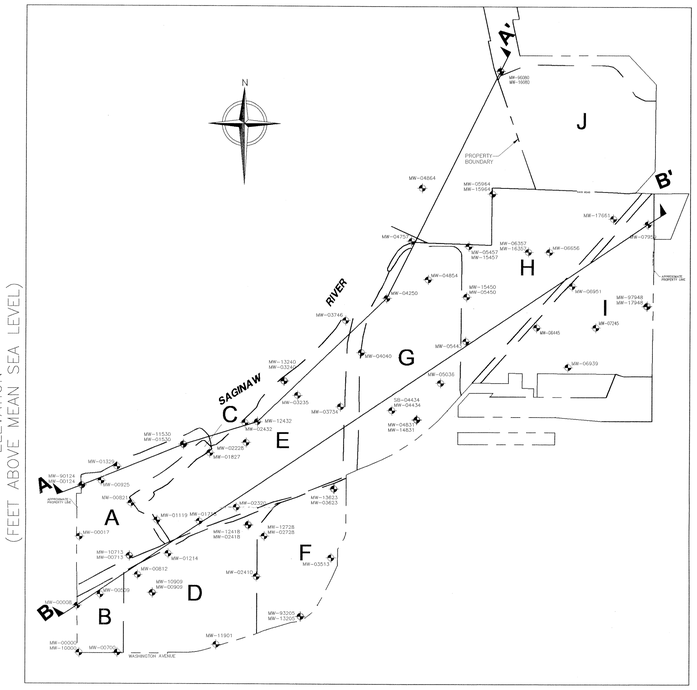
FIGURE NO. **2-1**
PROJECT NO. 84068-063.009

1" 1/2" 0" 1"
Software Projects N:\DWG\OMGNAW\84068\63\009\Gm_v2.dwg Tue, 11/Aug/00 05:05pm ddovalo
XREF Files: Nopmd02.dwg
WMSE Files: Smcu.tif
Dimension 1 Dimension 1 Dimension 1 Dimension 1



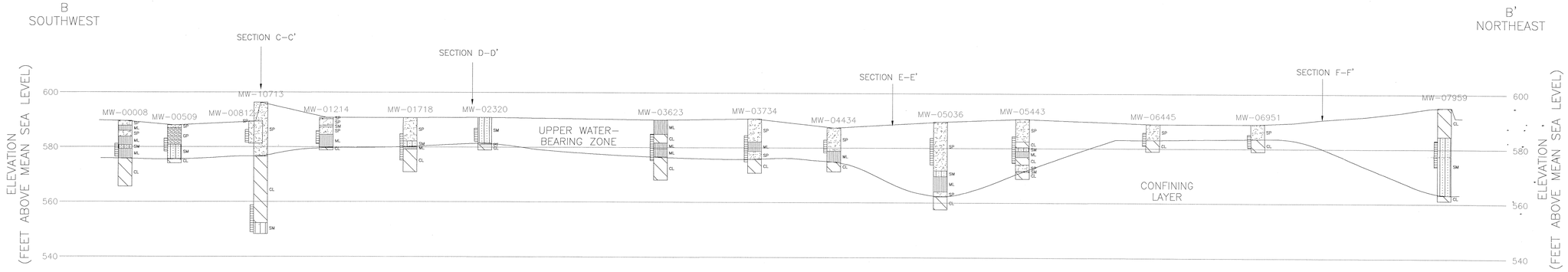

## SECTION A-A'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'




## LOCATION MAP

SCALE: 1"=1000'

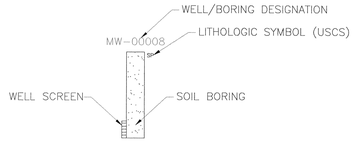



## SECTION B-B'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'

LEGEND

- GP — POORLY–GRADED GRAVEL
- SP — POORLY–GRADED SAND
- SM — SILTY SAND
- ML — SILT, SANDY SILT
- MH — ELASTIC SILT WITH SAND
- CL — LEAN CLAY
- CH — FAT CLAY
- SS — SANDSTONE WITH LOCAL WEATHERING AT SURFACE




NOTES:

1. DUE TO THE SCALE, ACTUAL SURFACE TOPOGRAPHY BETWEEN WELLS IS NOT DEPICTED.
2. ALL CORRELATIONS BETWEEN GEOLOGIC UNITS HAVE BEEN APPROXIMATED BASED ON AVAILABLE GEOLOGIC INFORMATION. FOR CLARITY, PINCH–OUTS ARE NOT SHOWN. DASHED WHERE INFERRED.
3. SOIL BORING/MONITORING WELL LOCATIONS DEPICTED ON THE CROSS–SECTIONS ARE PROJECTED 90° TO THE CROSS–SECTION LOCATION LINE.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/1/99 — DWN BY AMC — DES BY BKS — CHK BY PPV — APP BY JJM

EMCON

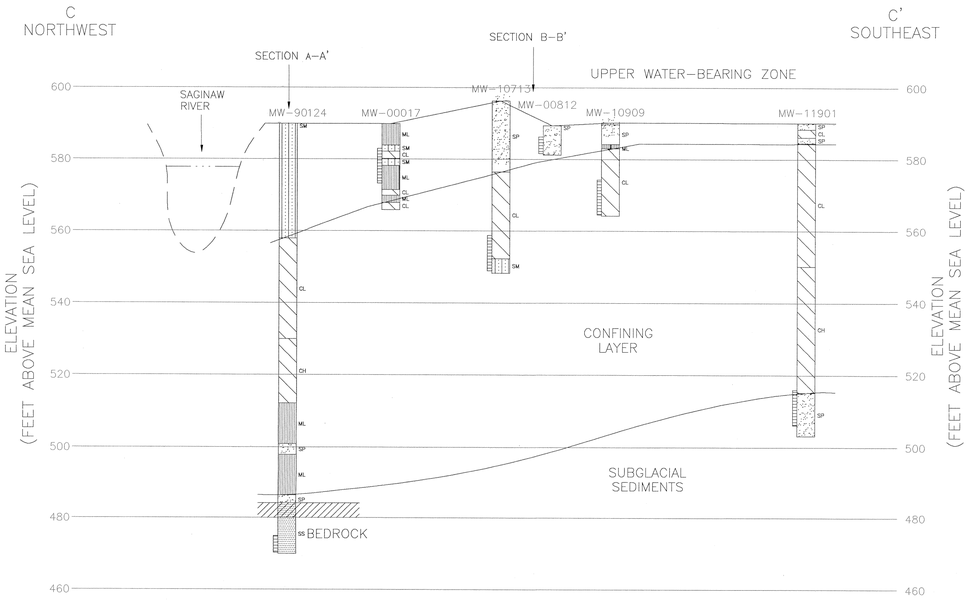
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**GEOLOGIC CROSS SECTIONS A-A' AND B-B'**

FIGURE NO. **2-2**

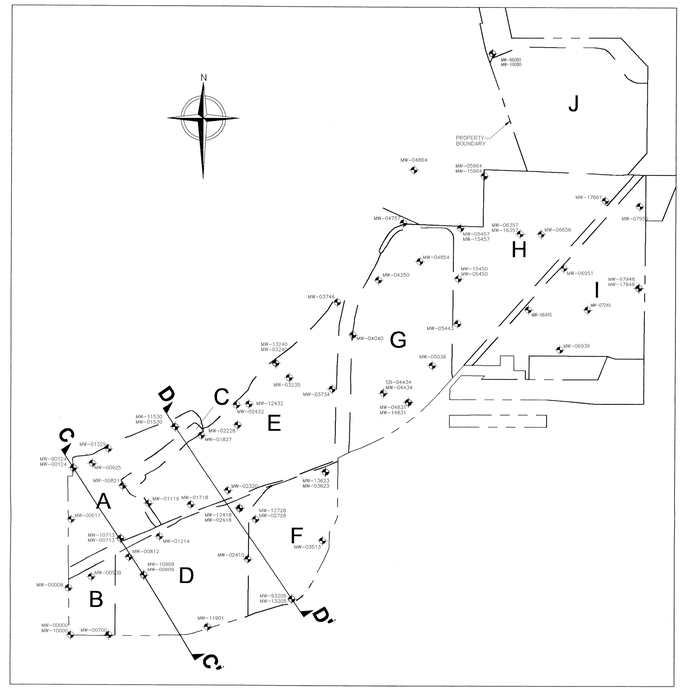
PROJECT NO. 84068–063.009

1" 1/2" 0"
IMAGE Files: <No Images>
XREF Files: Nogmbo01.dwg
N:\DWG\GM\SAGINAW\84068\63\1009\Nogmsc01.dwg Wed, 12/Apr/00 02:34pm jodokal
Plotted By: jodokal Plotscale: 1 Plotdate: 4
Drawing: Nogmsc01.dwg Created: Wednesday, April 12, 2000 02:34:00 PM



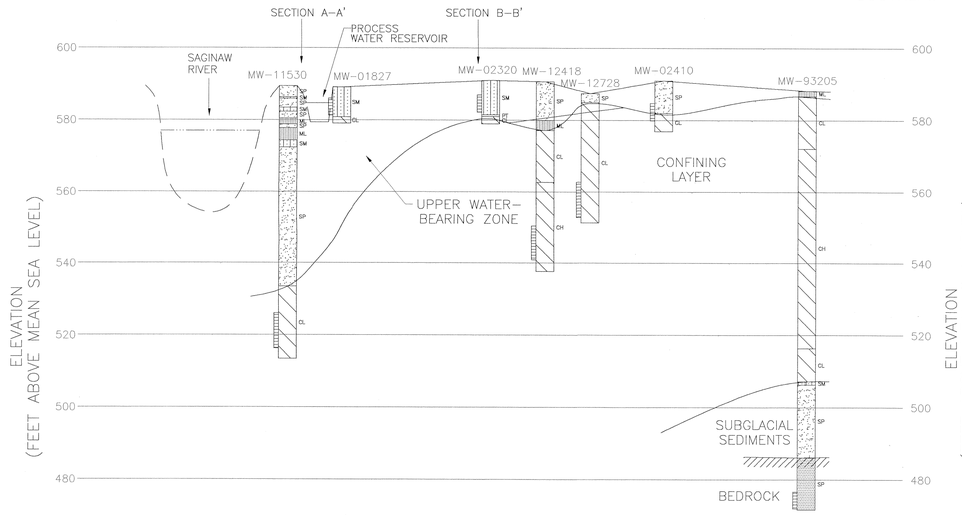

## SECTION C-C'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'




## LOCATION MAP

SCALE: 1"=1000'

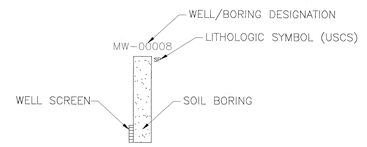



## SECTION D-D'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'

## LEGEND

- GP — POORLY–GRADED GRAVEL
- SP — POORLY–GRADED SAND
- SM — SILTY SAND
- ML — SILT, SANDY SILT
- MH — ELASTIC SILT WITH SAND
- CL — LEAN CLAY
- CH — FAT CLAY
- SS — SANDSTONE WITH LOCAL WEATHERING AT SURFACE




NOTES:

1. DUE TO THE SCALE, ACTUAL SURFACE TOPOGRAPHY BETWEEN WELLS IS NOT DEPICTED.
2. ALL CORRELATIONS BETWEEN GEOLOGIC UNITS HAVE BEEN APPROXIMATED BASED ON AVAILABLE GEOLOGIC INFORMATION. FOR CLARITY, PINCH–OUTS ARE NOT SHOWN.
3. SOIL BORING/MONITORING WELL LOCATIONS DEPICTED ON THE CROSS–SECTIONS ARE PROJECTED 90° TO THE CROSS–SECTION LOCATION LINE.
4. ELEVATION OF THE SAGINAW RIVER BASED ON ELEVATION MEASUREMENTS COMPLETED ON MARCH 24,1999. THE CHANNEL DEPTH AND SHAPE IS APPROXIMATED.

| REV. | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY PPV
APP BY JJM

emcon

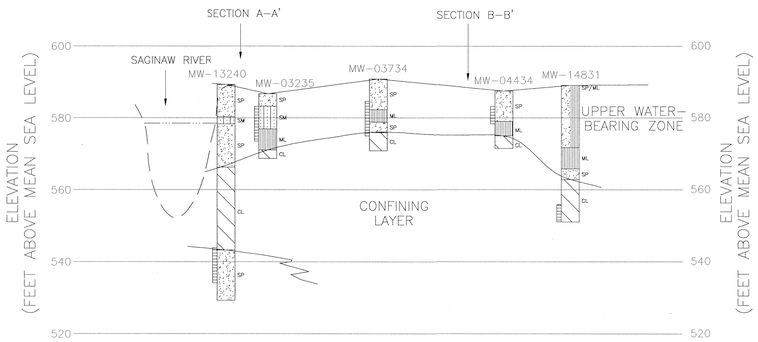
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**GEOLOGIC CROSS SECTIONS C-C' AND D-D'**

FIGURE NO. **2-3**

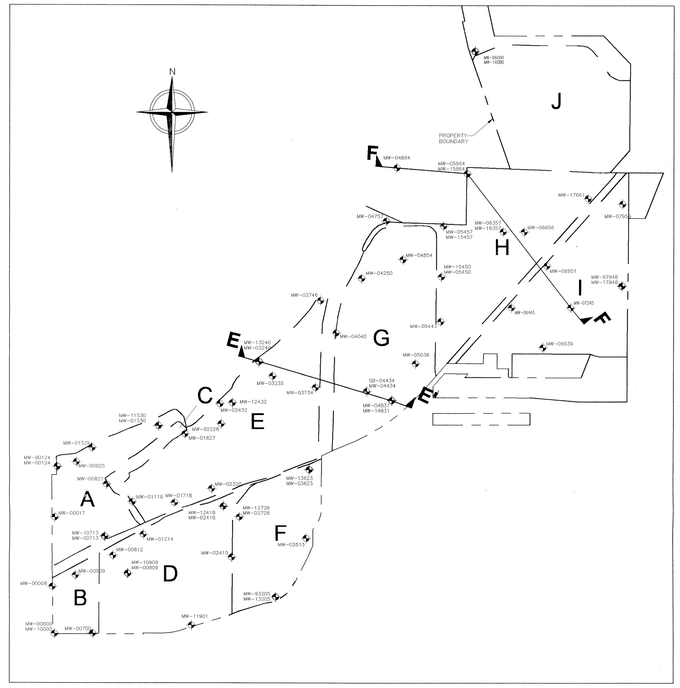
PROJECT NO. 84068–063.009

1" 1/2" 0"
IMAGE Files: <None>
XREF Files: hsp-mw02.dwg Wells, 12/Apr/00 03:57pm jbotsiel
N:\GM\SAGINAW\SAGBOSS\GIS\Maps\cs02.dwg Scales: 1 Plotted: 1
Scales: Project: N:\GIS\LPRO\<none> Dimmode: 0 Ltscale: 1



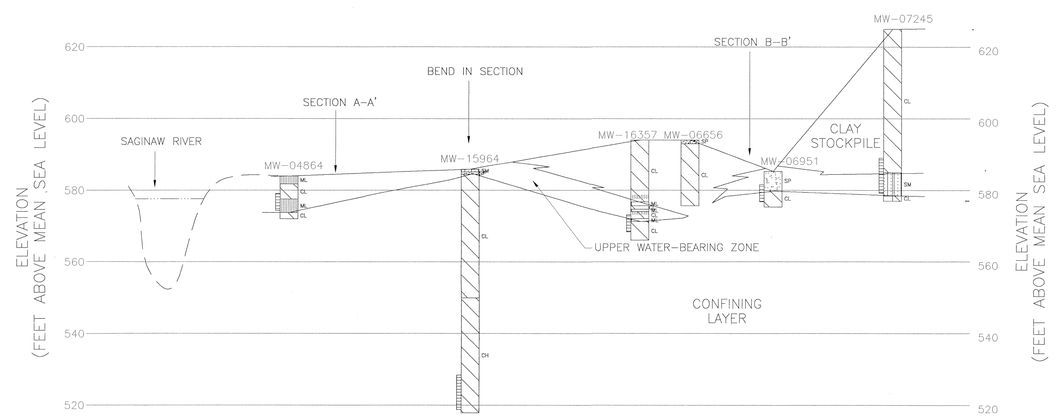

## SECTION E-E'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'




## LOCATION MAP

SCALE: 1"=1000'

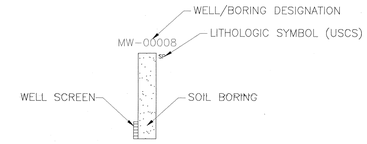



## SECTION F-F'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'

## LEGEND

- GP — POORLY–GRADED GRAVEL
- SP — POORLY–GRADED SAND
- SM — SILTY SAND
- ML — SILT, SANDY SILT
- MH — ELASTIC SILT WITH SAND
- CL — LEAN CLAY
- CH — FAT CLAY
- SS — SANDSTONE WITH LOCAL WEATHERING AT SURFACE




NOTES:

1. DUE TO THE SCALE, ACTUAL SURFACE TOPOGRAPHY BETWEEN WELLS IS NOT DEPICTED.
2. ALL CORRELATIONS BETWEEN GEOLOGIC UNITS HAVE BEEN APPROXIMATED BASED ON AVAILABLE GEOLOGIC INFORMATION. FOR CLARITY, PINCH–OUTS ARE NOT SHOWN.
3. SOIL BORING/MONITORING WELL LOCATIONS DEPICTED ON THE CROSS–SECTIONS ARE PROJECTED 90° TO THE CROSS–SECTION LOCATION LINE.
4. ELEVATION OF THE SAGINAW RIVER BASED ON ELEVATION MEASUREMENTS COMPLETED ON MARCH 24,1999. THE CHANNEL DEPTH AND SHAPE IS APPROXIMATED.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY PPV
APP BY JJM

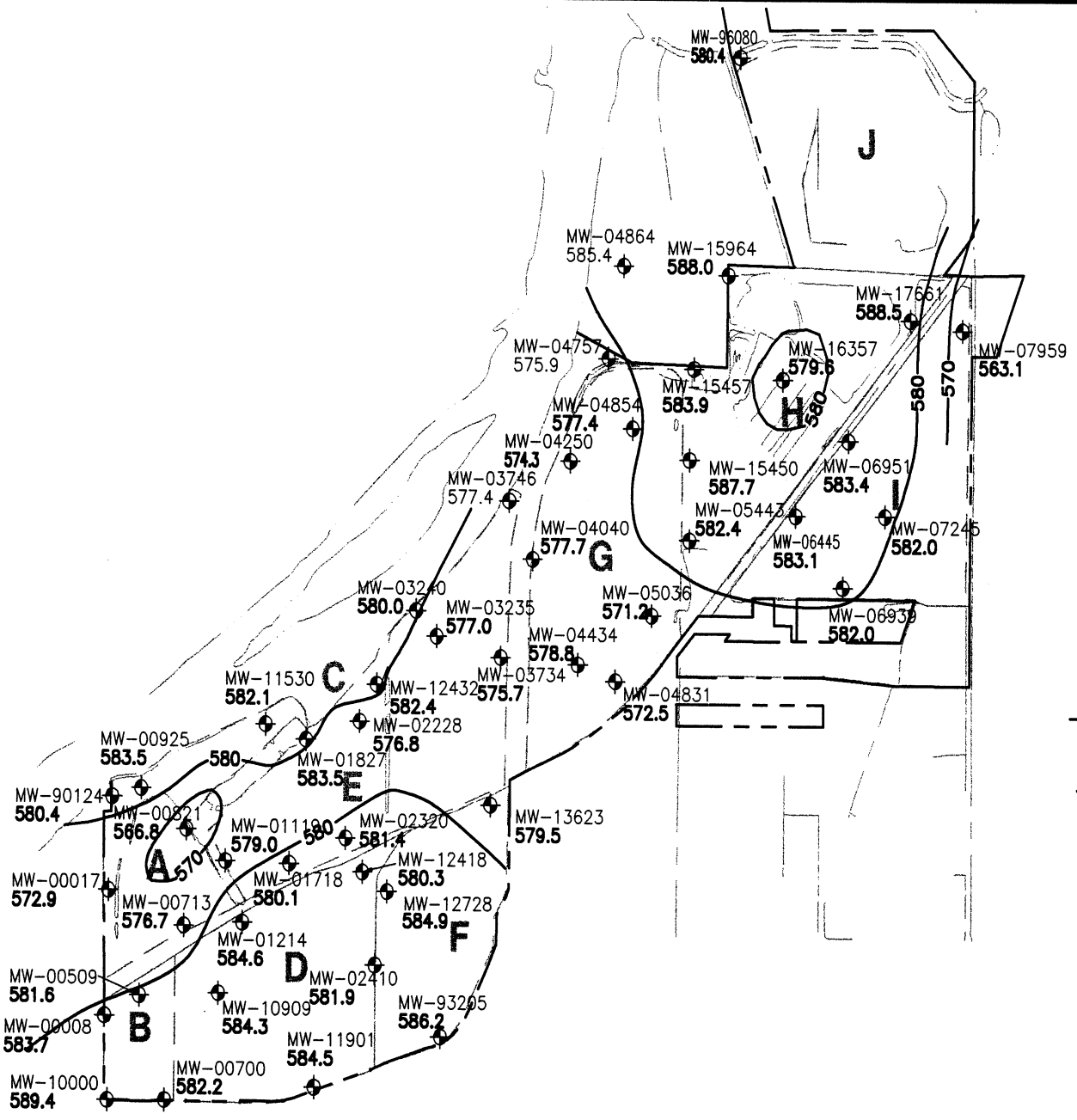
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**GEOLOGIC CROSS SECTIONS E-E' AND F-F'**

FIGURE NO. **2-4**
PROJECT NO. 84068–063.009

1" 1/2" 0"
IMAGE Files: <No Images>
XREF Files: Name=<None>
N:\DWG\GM\SAGINAW\84068X63\DGN\Nepmm03.dwg Thu, 13/Apr/00 08:31pm jbatchel
Sstress Project: N:\SSRA\PROJ\<none> Dimstyle: 0 Ltscale: 1 Plotscale: 1




N

## LEGEND

| | |
|---|---|
| MW-12432 | PHASE IA RFI SOIL BORING/ MONITORING WELL LOCATION |
| 584.3 | ELEVATION OF BOTTOM OF FILL MATERIAL |
| 580 | ELEVATION CONTOUR BOTTOM OF FILL MATERIAL (CONTOUR INTERVAL = 10 FEET) |
| | APPROXIMATE PROPERTY BOUNDARY |

0 1000 2000

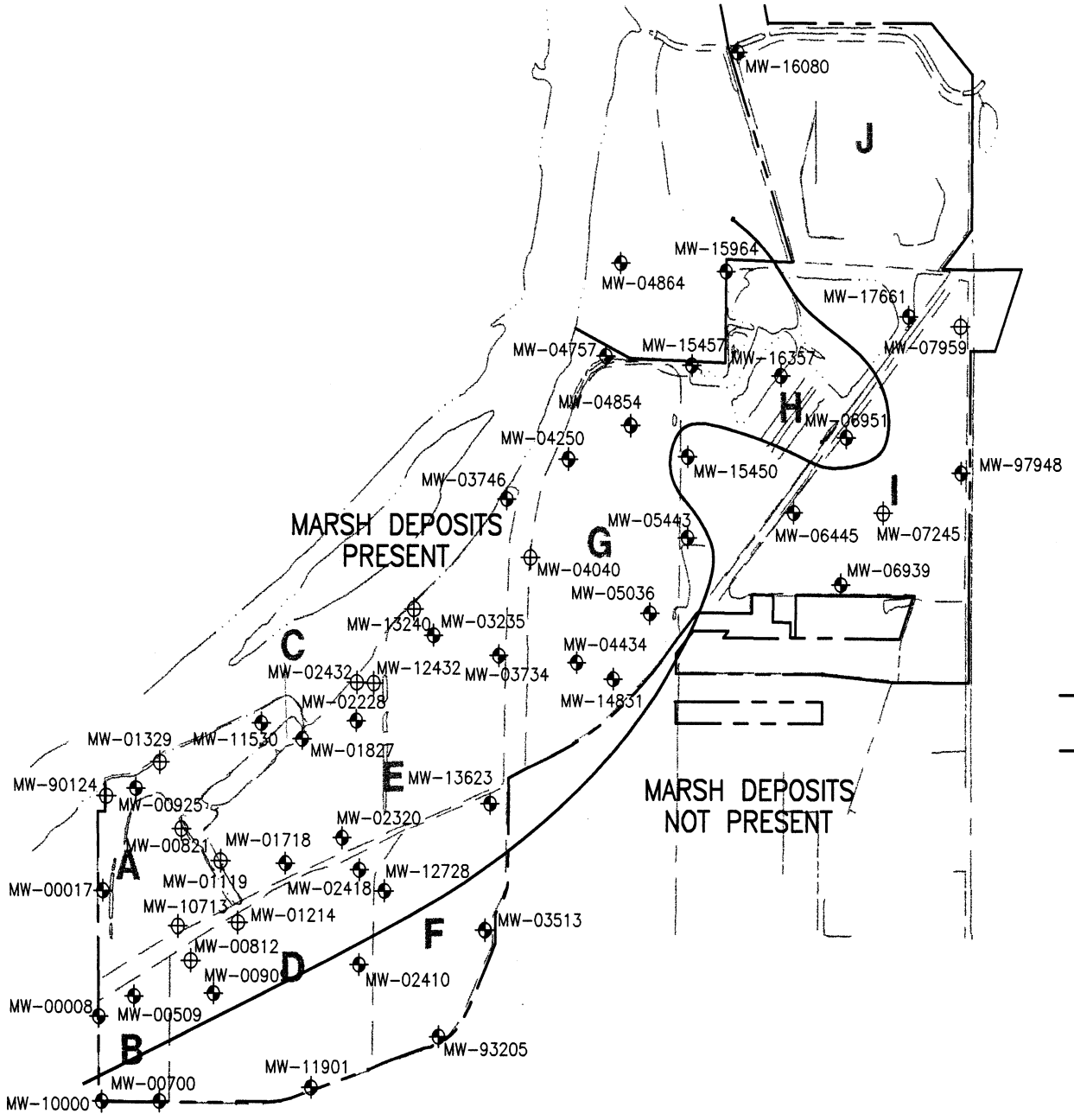
SCALE IN FEET

EMCON

DATE 6/4/99
DWN AMC
APP BKS
REV
PROJECT NO. 84068-063.009

**FIGURE 2-5**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN
**ELEVATION OF BOTTOM OF FILL MATERIAL**

IMAGE Files: SMCO.tif
XREF Files: <No Xrefs>
ENE-NAPERV1/DATA: N:\DWG\84068063\009\NAGMGE08.DWG Mon, 07/Jun/99 09:28am acobb
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 1 Ltscale: 0.5 Psltscale: 1
1" 1/2" 0" 1"



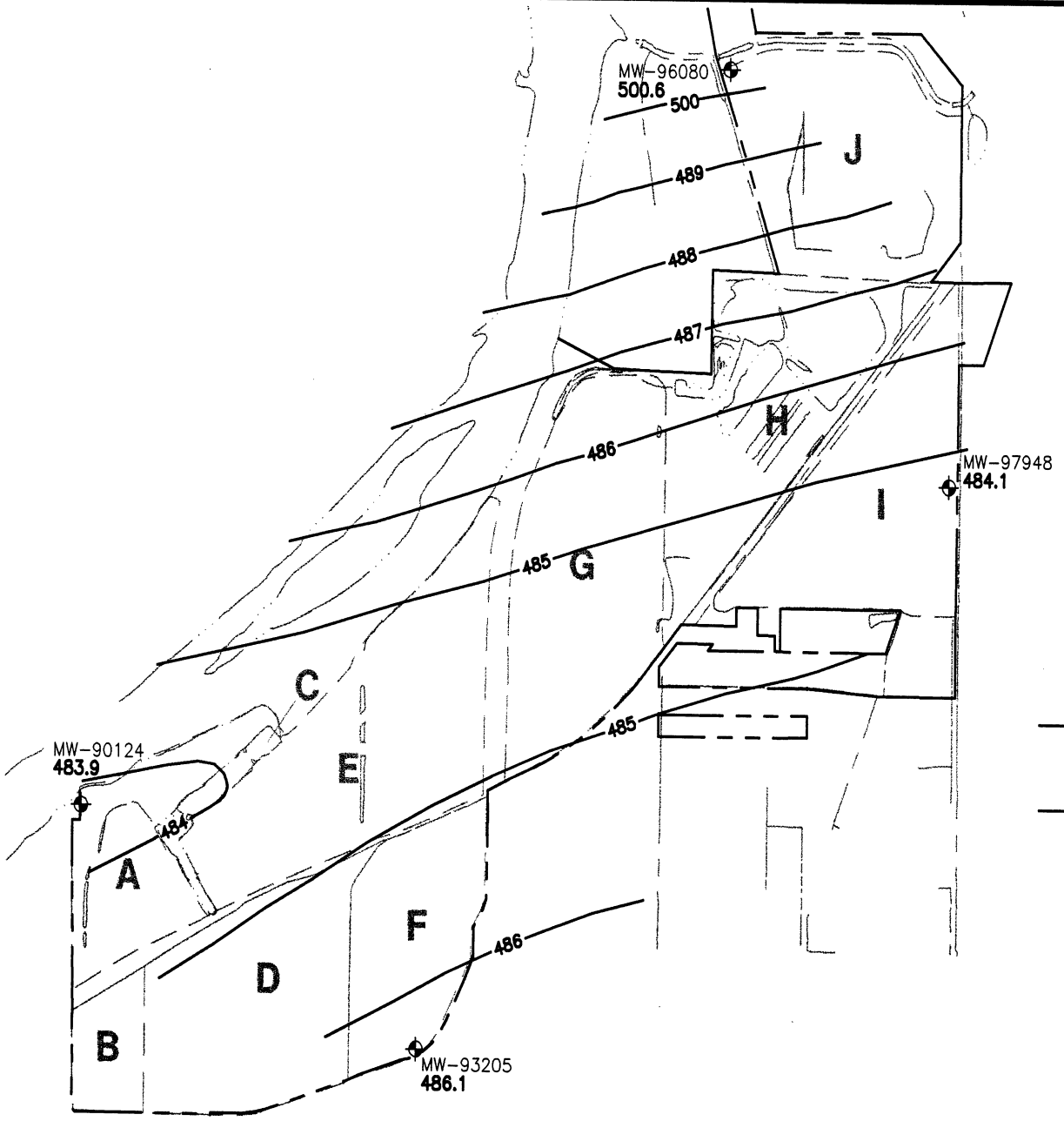

EMCON

DATE 6/4/99
DWN AMC
APP BKS
REV
PROJECT NO. 84068-063.009

**FIGURE 2-6**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**OCCURRENCE OF MARSH DEPOSITS**

IMAGE Files: SMCO.tif
XREF Files: <No Xrefs>
ENE-NAPERV1/DATA: N:\DWG\B4068063\009\NAGMGE11.DWG Mon, 07/Jun/99 09:31am acobb
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 1 Ltscale: 0.5 Paltscale: 1
1" 1/2" 0" 1"




## LEGEND

| | |
|---|---|
| MW-12432 ⊕ | PHASE IA RFI SOIL BORING/ MONITORING WELL LOCATION |
| 492.1 | ELEVATION OF TOP OF BEDROCK (FEET ABOVE MEAN SEA LEVEL) |
| 500 | ELEVATION CONTOUR OF TOP OF BEDROCK, DASHED WHERE INFERRED (CONTOUR INTERVAL = 1 FOOT) |
| — — — | APPROXIMATE PROPERTY BOUNDARY |

0 1000 2000

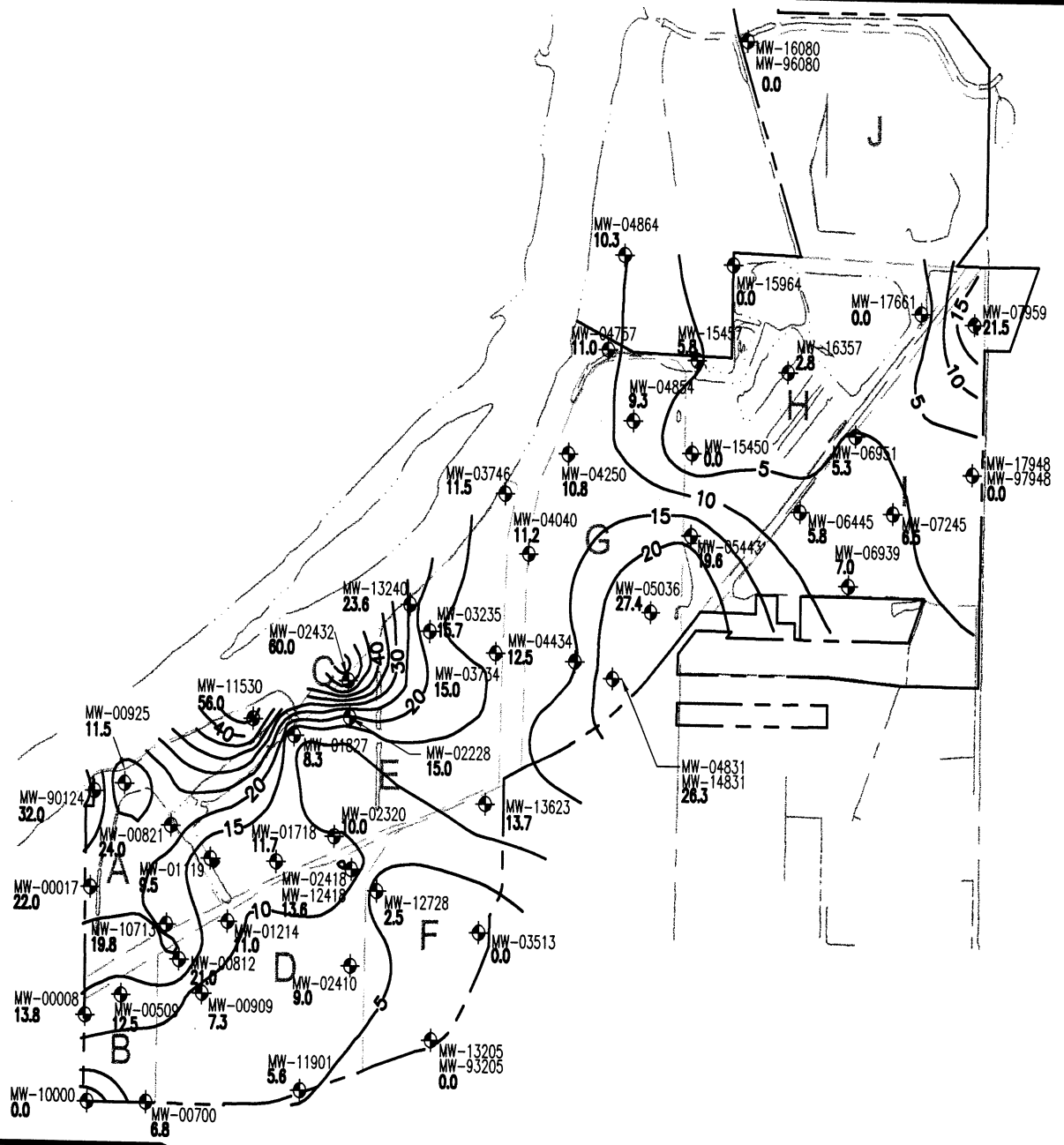
SCALE IN FEET

EMCON

| | |
|---|---|
| DATE | 6/4/99 |
| DWN | AMC |
| APP | BKS |
| REV | |
| PROJECT NO. | 84068-063.009 |

**FIGURE 2-7**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN
**STRUCTURE MAP**
**TOP OF BEDROCK**

1" 1/2" 0" 1"
ENE-NAPERV1/DATA: N:\DWG\84068063\009\NAGMGE06.DWG Fri, 04/Jun/99 02:42pm tskidmore
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 1 Ltscale: 0.5 Psltscale: 1
XREF Files: <No Xrefs>
IMAGE Files: SMCO.tif




EMCON

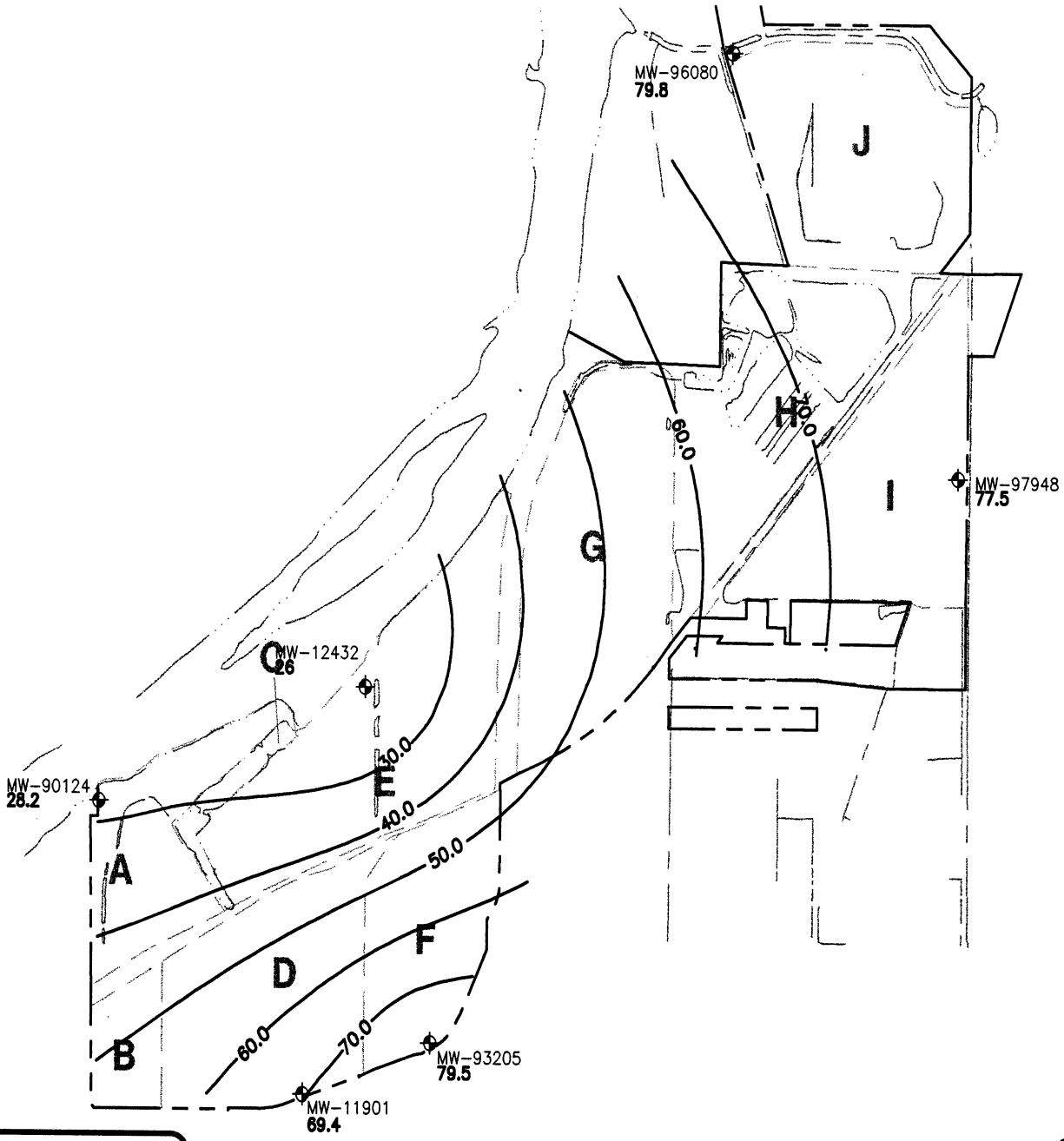
DATE 6/4/99
DWN AMC
APP BKS
REV
PROJECT NO.
84068-063.009

**FIGURE 2-8**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**ISOPACH OF UPPER WATER-BEARING ZONE**

IMAGE Files: SMCO.tif
XREF Files: <No Xrefs>
ENE-NAPERV1/DATA: N:\DWG\84068063\009\NAGMGE13.DWG Fri, 04/Jun/99 02:39pm tskidmore
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 0 Ltscale: 0.5 Psltscale: 1

1" 1/2" 0" 1"




N

## LEGEND

| | |
|---|---|
| MW-02320 | PHASE IA RFI SOIL BORING/ MONITORING WELL LOCATION |
| 79.5 | THICKNESS OF CONFINING CLAY LAYER (FEET) |
| 30.0 | ISOPACH LINE, LINE OF EQUAL THICKNESS OF CONFINING LAYER (CONTOUR INTERVAL = 10 FEET) |
| | APPROXIMATE PROPERTY BOUNDARY |

0 1000 2000

SCALE IN FEET

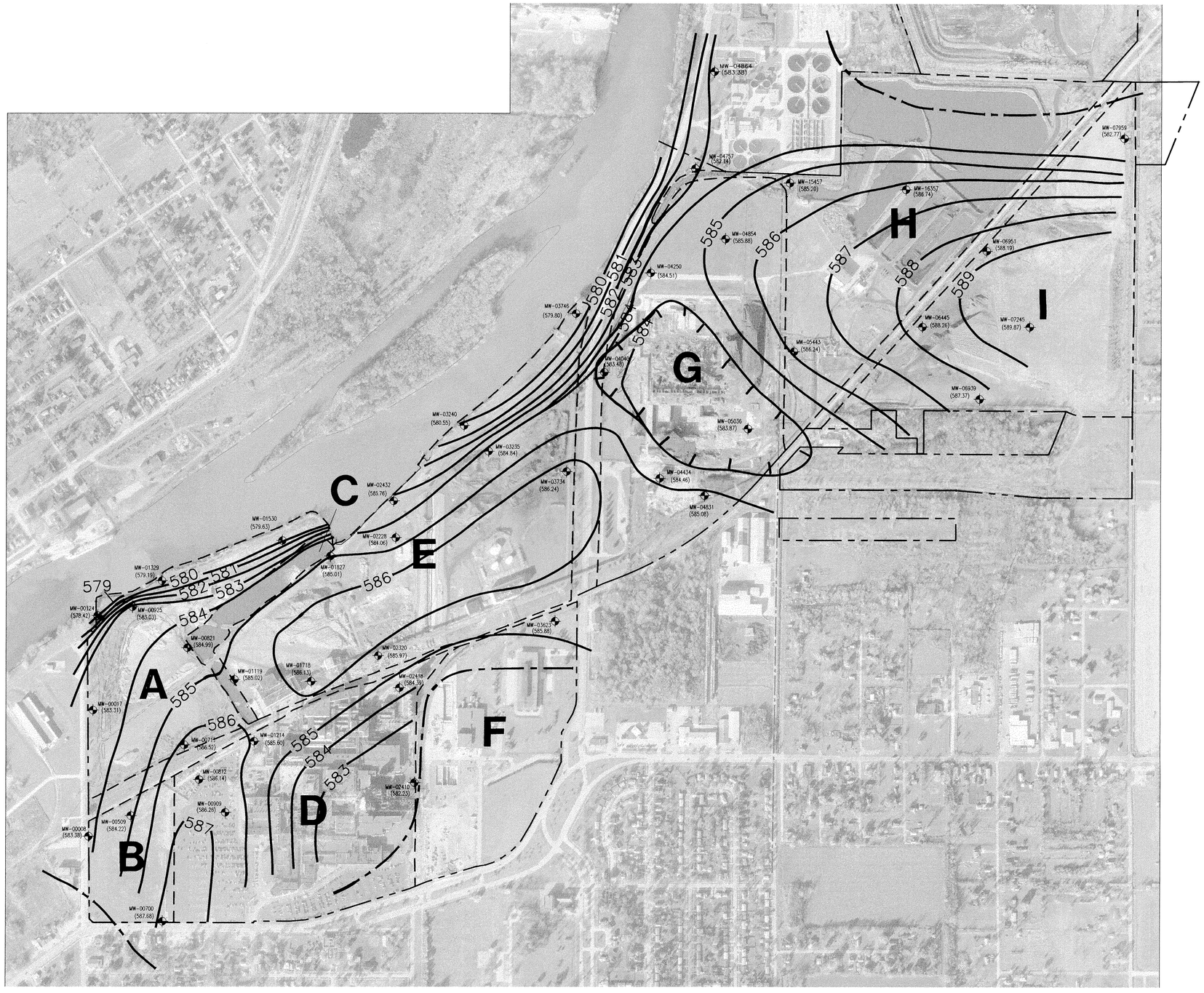
EMCON

DATE 6/4/99
DWN AMC
APP BKS
REV
PROJECT NO.
84068-063.009

**FIGURE 2-9**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**ISOPACH OF CLAY, CONFINING LAYER**


IMAGE Files: SMCO.tif
XREF Files: <No Xrefs>
ENE-NAPERV1/DATA: N:\DWG\84068063\009\NAGMCE14.DWG Mon, 07/Jun/99 09:32am acobb
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 1 Ltscale: 0.5 Paltscale: 1
1" 1" 1/2" 0"




N

## LEGEND

- MW-05036 — PHASE IA RFI MONITORING WELL LOCATION
- (585.87) — STATIC WATER ELEVATION (2/10/99)
- 584 — GROUNDWATER EQUIPOTENTIAL LINE (CONTOUR INTERVAL = 1.0 FEET)
- APPROXIMATE BOUNDARY OF UPPER WATER-BEARING ZONE
- APPROXIMATE PROPERTY BOUNDARY
- INVESTIGATIVE UNIT BOUNDARY

NOTE:
AERIAL BASE MAP SOURCE: ADVANCED MAPPING TECHNOLOGIES, PORT HURON, MICHIGAN, NOVEMBER 1997.

0 400 800
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

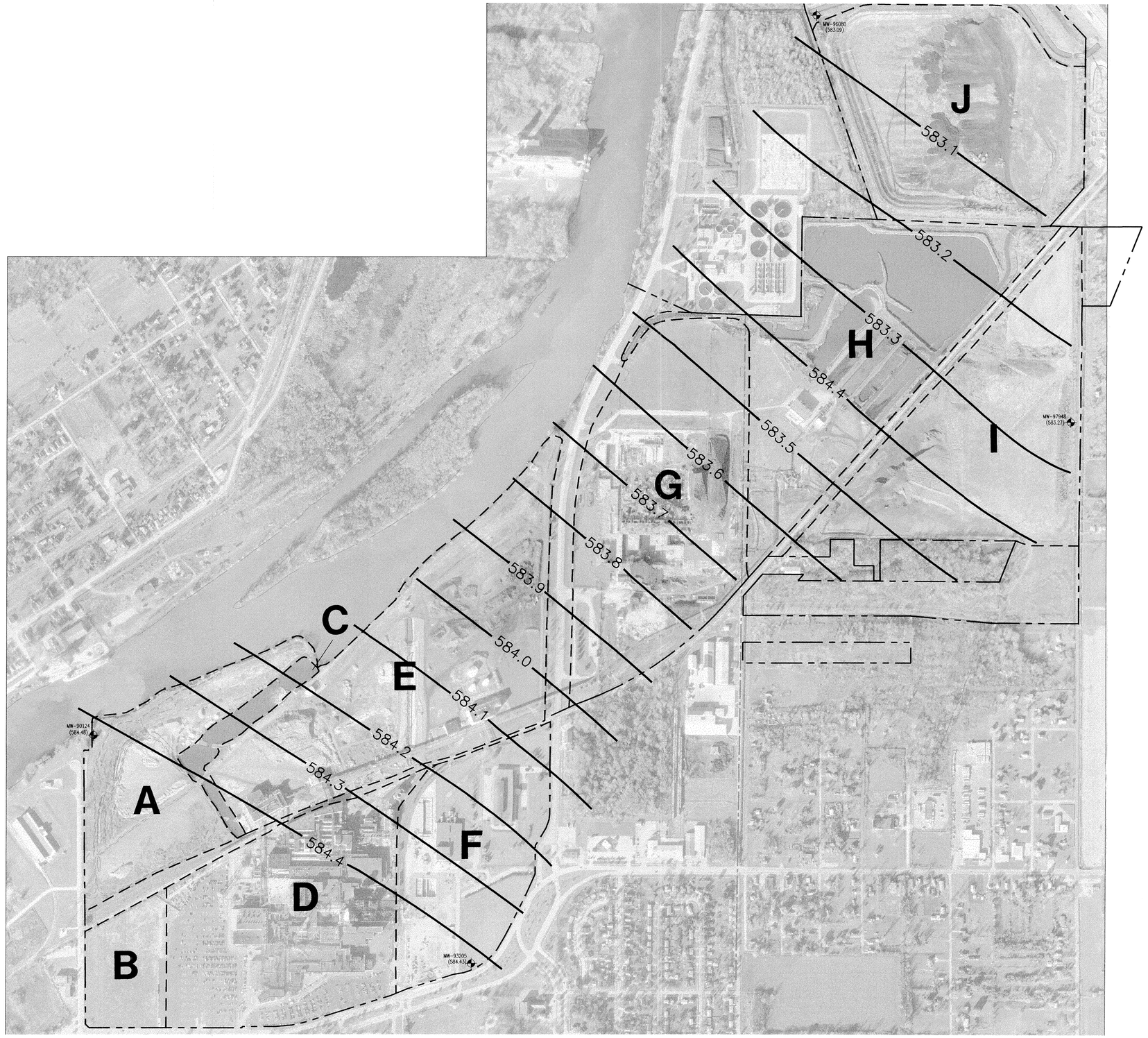
DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY PPV
APP BY JJM

EMCON

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN
**UPPER WATER-BEARING ZONE**
**GROUNDWATER CONTOUR MAP**
**FEBRUARY 10, 1999**

FIGURE NO.
**2-10**
PROJECT NO.
84068-063.009

1" 1/2" 0" 1"
N:\DWG\GM\SAGINAW\84068063\000\Wagmap63.dwg Thu, 13/Apr/00 01:11pm taldimore
Softdesk Project: N:\SOFT\PROJ\84068063 Dimscale: 1 Viewres: 0.5 Palfaces: 1
WMAT Files: SMOO1.tif
WMAT Files: Symbol01.dwg




N

LEGEND

| | |
|---|---|
| MW–05036 | PHASE IA RFI MONITORING WELL LOCATION |
| (583.27) | STATIC WATER ELEVATION (2/25/99) |
| 583.50 | GROUNDWATER EQUIPOTENTIAL LINE (CONTOUR INTERVAL = 0.1 FEET) |
| | APPROXIMATE PROPERTY BOUNDARY |
| | INVESTIGATIVE UNIT BOUNDARY |

NOTE:

AERIAL BASE MAP SOURCE: ADVANCED MAPPING TECHNOLOGIES, PORT HURON, MICHIGAN, NOVEMBER 1997.

0 400 800
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99 | DWN BY AMC | DES BY BKS | CHK BY PPV | APP BY JJM

emcon

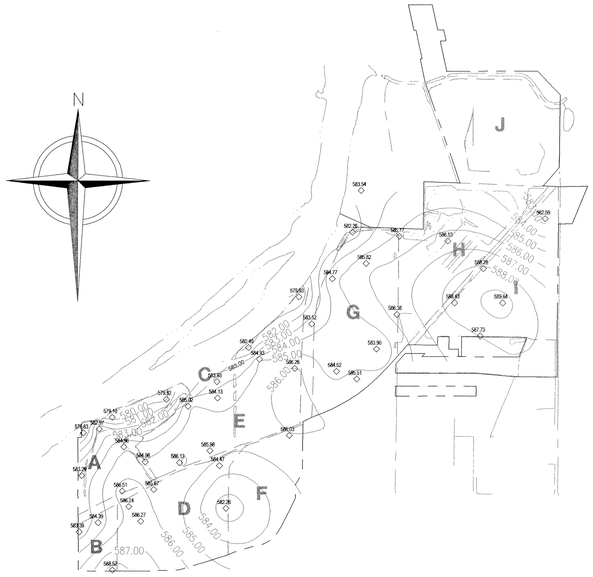
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**BEDROCK AQUIFER GROUNDWATER CONTOUR MAP**
**FEBRUARY 25, 1999**

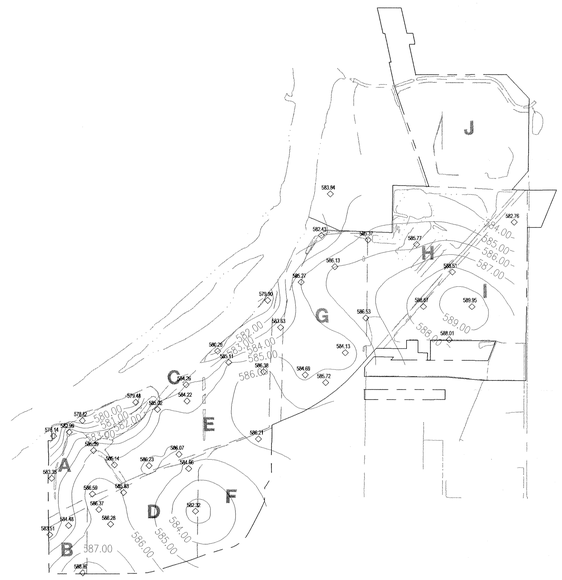
FIGURE NO. **2-11**

PROJECT NO. 84068–063.009

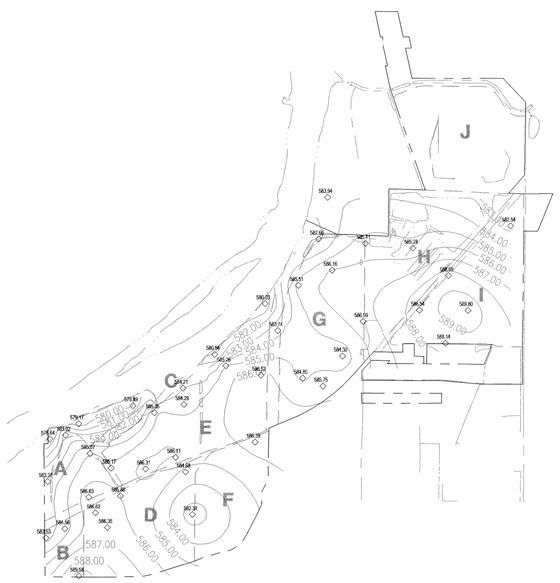
IMAGE Files: SMOD.tif
XREF Files: Phase1.dwg
N:\DWG\GMSAGINAW\#4068063\009\Normal\4.dwg Mon, 17/Apr/00 01:58pm taldimore
Emcon Project: N:\SRSK\PROJ\#4068063 Dimscale: 1 Lscale: 0.5 Pltscale: 1
1" 1/2" 0" 1"



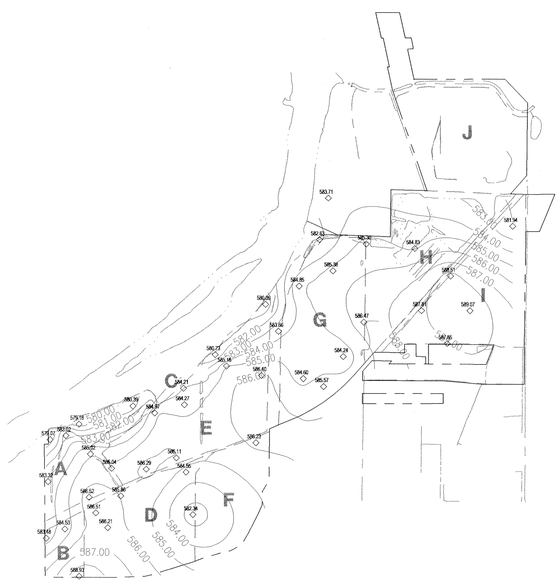

**FEBRUARY 15, 1999**
**12:00 NOON**



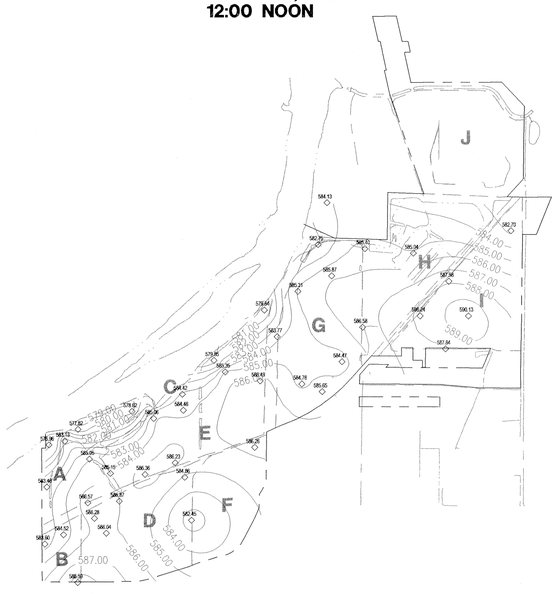

**FEBRUARY 20, 1999**
**12:00 NOON**



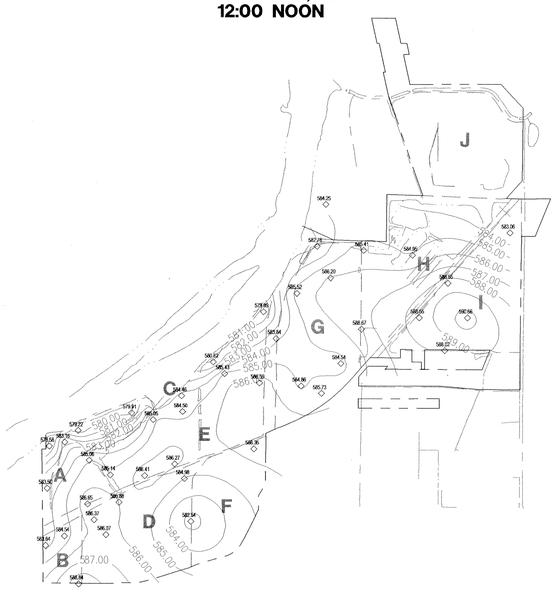

**FEBRUARY 25, 1999**
**12:00 NOON**



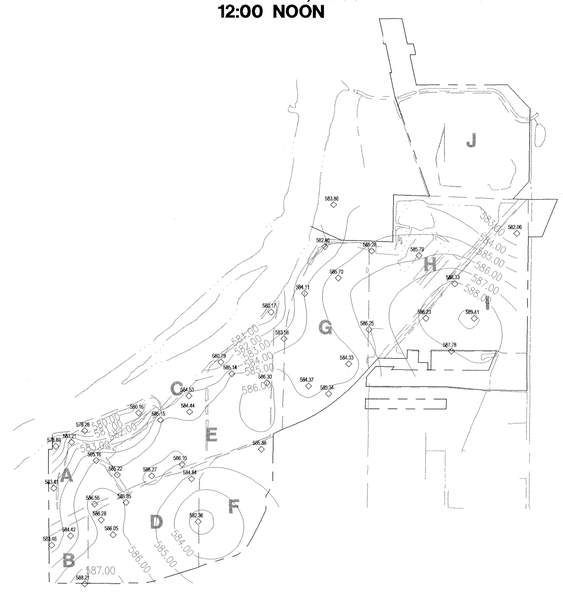

**FEBRUARY 28, 1999**
**12:00 NOON**



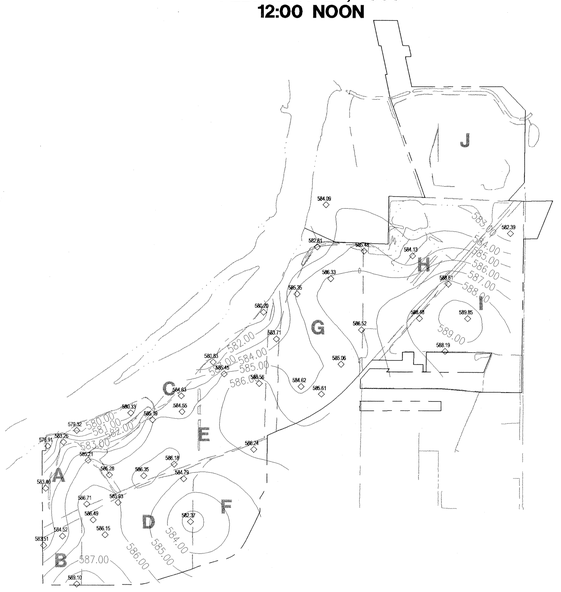

**MARCH 6, 1999**
**12:00 NOON**




**MARCH 7, 1999**
**12:00 NOON**




**MARCH 17, 1999**
**12:00 NOON**




**MARCH 23, 1999**
**12:00 NOON**

LEGEND

| | |
|---|---|
| 586.11 | GROUNDWATER ELEVATION (FEET MSL) |
| ◇ | PHASE 1A RFI MONITORING WELL LOCATION |
| 586.00 | ISOCONCENTRATION LINE |
| | APPROXIMATE PROPERTY BOUNDARY |

0 1200 2400
SCALE IN FEET

NOTE:
CONTOUR INTERVALS = 1.00 FOOT.

| REV. | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | DATE OF ISSUE 6/4/99 | | DWN BY AMC | DES BY WKS | CHK BY | APP BY |

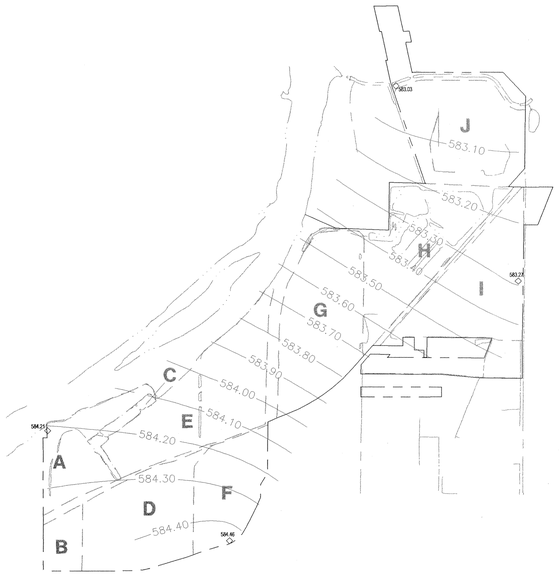
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

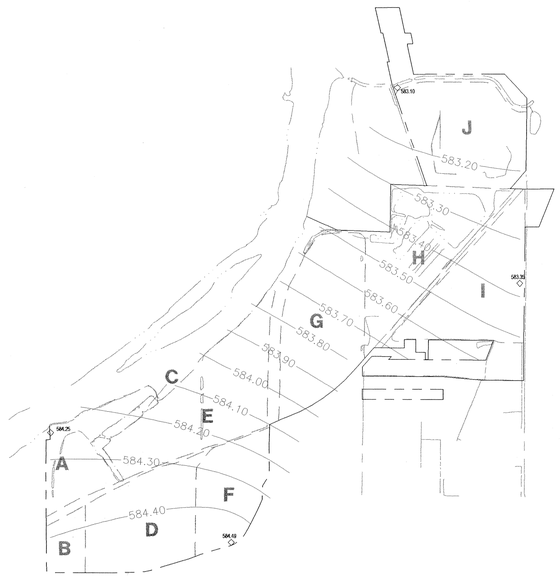
**UPPER WATER-BEARING ZONE**
**GROUNDWATER CONTOUR MAP TIME SERIES**

FIGURE NO.
**2-12**
PROJECT NO.
84068-063.009

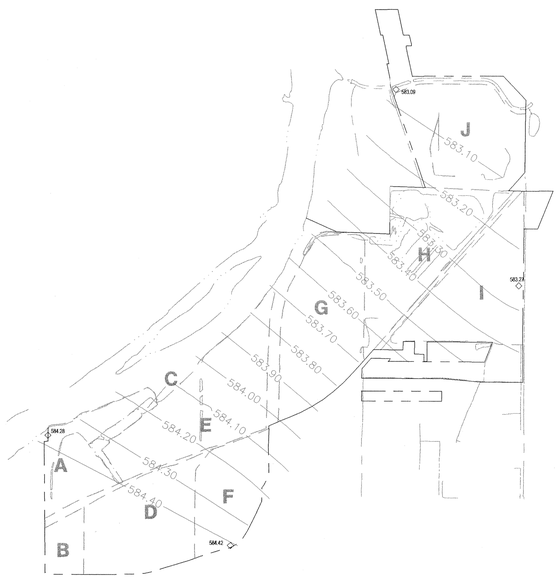
IMAGE Files <No Images>
XREF Files <No XREFs>
/ N:\DWG\GAC\Saginaw\84068063\009\Reports\Fig-2-12.dwg Thu, 13/Apr/00 01:12pm jbatchel
Sinclair Project: N:\SSDS\PROJ\<none> Dmscale - 1 Lscale 0.5 Pltscale 1
1" 1/2" 0" 1"



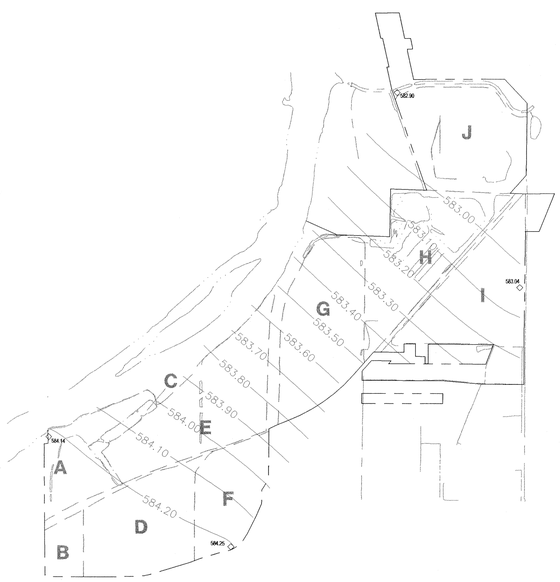

**FEBRUARY 15, 1999**
**12:00 NOON**



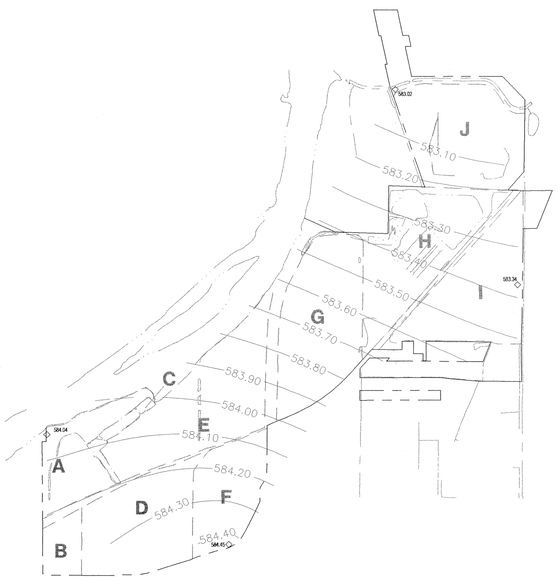

**FEBRUARY 20, 1999**
**12:00 NOON**



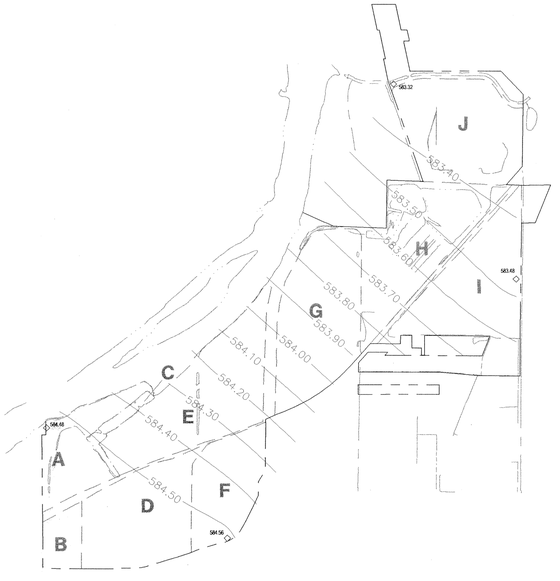

**FEBRUARY 25, 1999**
**12:00 NOON**



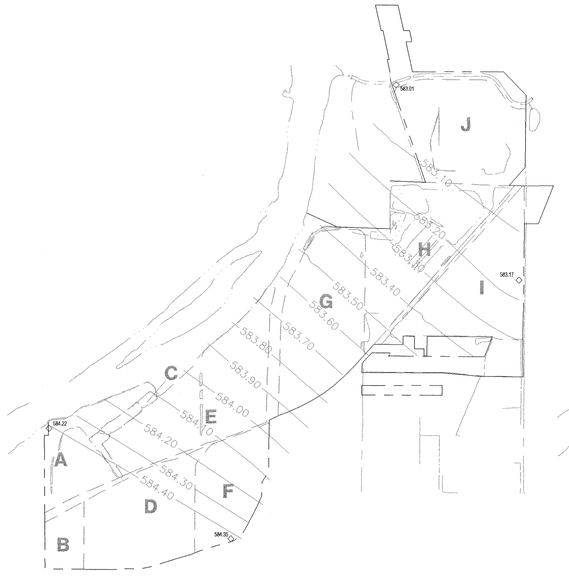

**FEBRUARY 28, 1999**
**12:00 NOON**



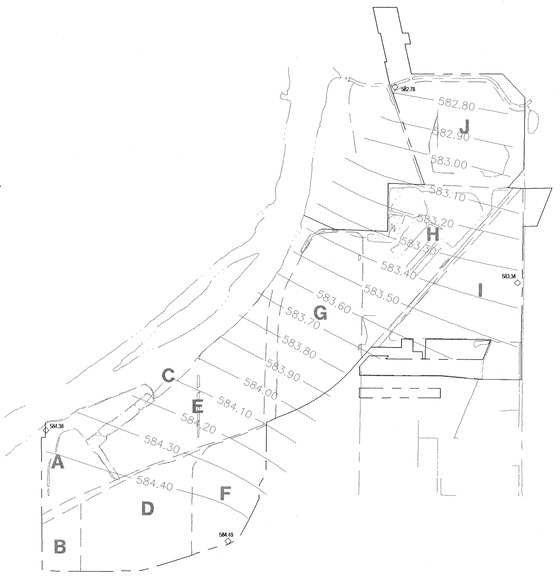

**MARCH 6, 1999**
**12:00 NOON**




**MARCH 7, 1999**
**12:00 NOON**




**MARCH 17, 1999**
**12:00 NOON**




**MARCH 23, 1999**
**12:00 NOON**

NOTE:
CONTOUR INTERVALS = 0.10 FEET.

LEGEND

584.45 GROUNDWATER ELEVATIONS (FEET MSL)

◇ PHASE 1A RFI MONITORING WELL LOCATION

150 ISOCONCENTRATION LINE

APPROXIMATE PROPERTY BOUNDARY

0 1200 2400
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | DATE OF ISSUE 6/4/99 | DWN BY AMC<br>DES BY BKS | CHK BY<br>APP BY | | | |

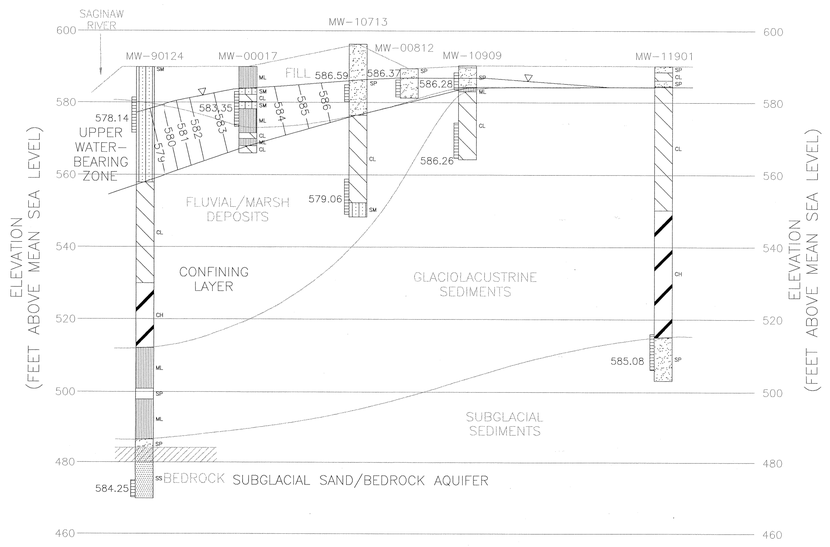
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**BEDROCK AQUIFER**
**GROUNDWATER CONTOUR MAP TIME SERIES**

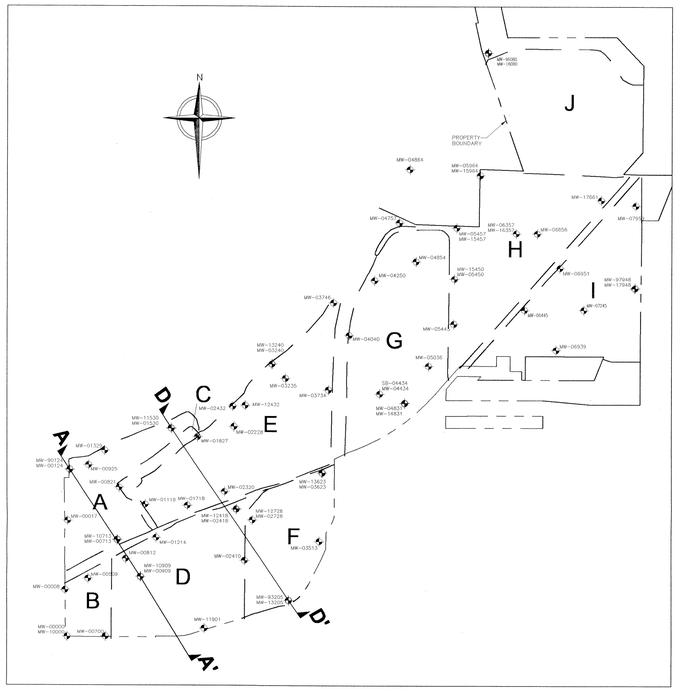
FIGURE NO.
**2-13**
PROJECT NO.
84068-063.009

IMAGE Files: <No Images>
XREF Files: Hdgrndx01.dwg
Plotted: Thursday, May 06, 1999 - 2:08pm Jbabbitt
J:\N1\DWG\GAGDAWA\84068A51\001\Hydrothetic Maps\Hdgrndx01.dwg
Synetics Project: N:\SYSPRO\<none> Linestyle: 0.5 Pltscale: 1
1" 1 1/2" 0" 1"



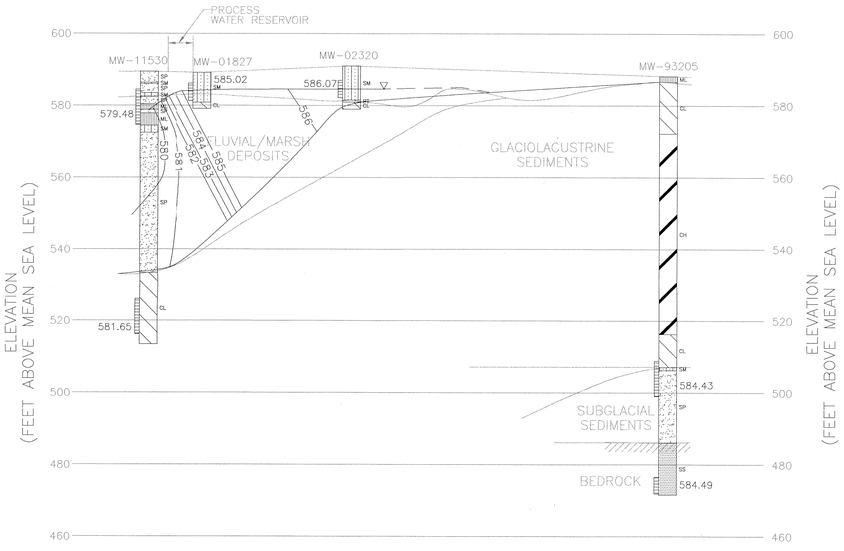

## SECTION A-A'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'




## LOCATION MAP

SCALE: 1"=1000'




## SECTION B-B'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'

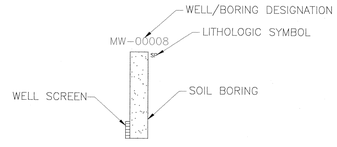
## LEGEND

- GP — POORLY-GRADED GRAVEL
- SP — POORLY-GRADED SAND
- SM — SILTY SAND
- ML — SILT, SANDY SILT
- MH — ELASTIC SILT WITH SAND
- CL — LEAN CLAY
- CH — FAT CLAY
- SS — SANDSTONE WITH LOCAL WEATHERING AT SURFACE

583.86 — STATIC WATER LEVEL (2/20/99)

584 — GROUNDWATER EQUIPOTENTIAL LINE

▽ — WATER TABLE SURFACE




NOTES:

1. DUE TO THE SCALE, ACTUAL SURFACE TOPOGRAPHY BETWEEN WELLS IS NOT DEPICTED.
2. ALL CORRELATIONS BETWEEN GEOLOGIC UNITS HAVE BEEN APPROXIMATED BASED ON AVAILABLE GEOLOGIC INFORMATION. FOR CLARITY, PINCH-OUTS ARE NOT SHOWN.
3. SOIL BORING/MONITORING WELL LOCATIONS DEPICTED ON THE CROSS-SECTIONS ARE PROJECTED 90° TO THE CROSS-SECTION LOCATION LINE.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY PPV
APP BY JJM

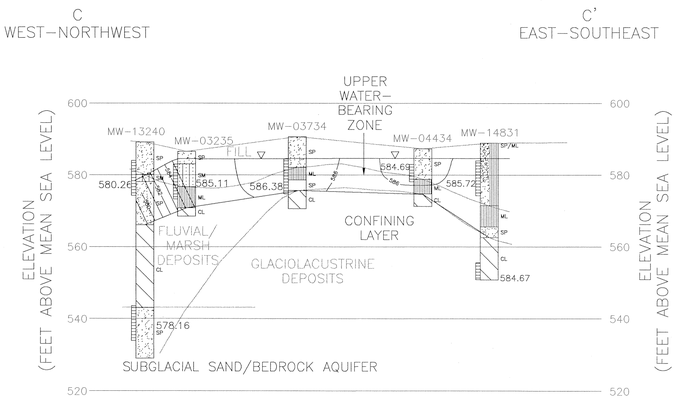
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**HYDROSTRATIGRAPHIC CROSS-SECTIONS**

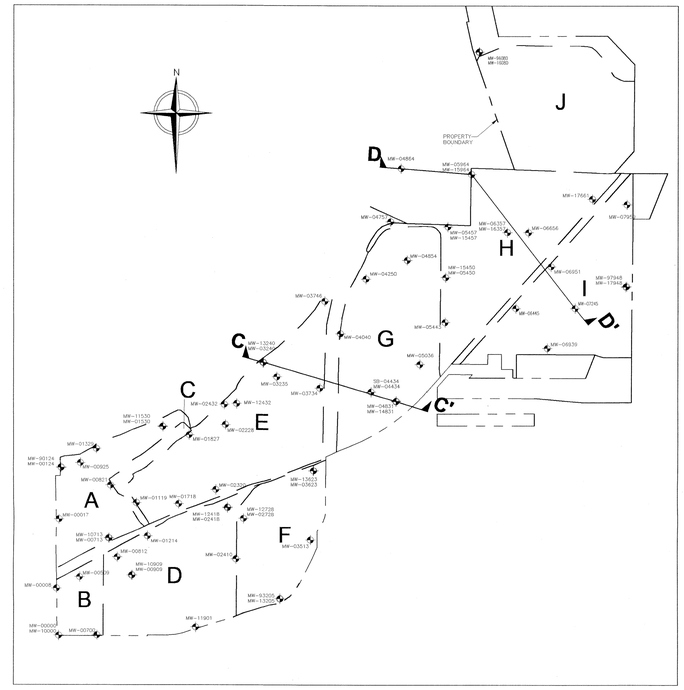
FIGURE NO. **2-14**
PROJECT NO. 84068-063.009

1" 1/2" 0"
IMAGE Files: <No Images>
Xref Files: Number.dwg
N:\DWG\GRAGHAM\84068A57\000\Topo\04.dwg Thu Mar 11 02:55pm jbatstel
Saveas Project: N:\SDS\PROJ\<none> Dimstyle: 0 Ltscale: 1 Plotscale: 1



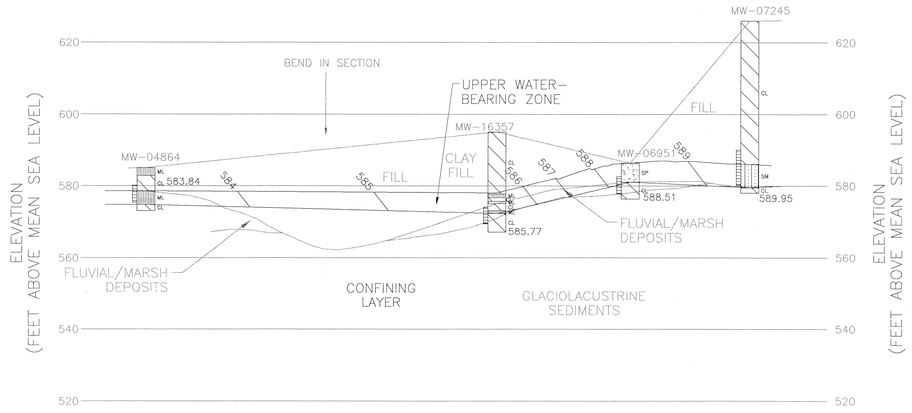

## SECTION C-C'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'




## LOCATION MAP

SCALE: 1"=1000'

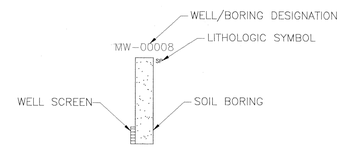



## SECTION D-D'

SCALE: HORIZ.: 1"=400'
VERT.: 1"=20'

## LEGEND

| | | | |
|---|---|---|---|
| GP | POORLY–GRADED GRAVEL | 583.86 | STATIC WATER LEVEL (2/20/99) |
| SP | POORLY–GRADED SAND | 584 | GROUNDWATER EQUIPOTENTIAL LINE |
| SM | SILTY SAND | ▽ | WATER TABLE SURFACE |
| ML | SILT, SANDY SILT | | |
| MH | ELASTIC SILT WITH SAND | | |
| CL | LEAN CLAY | | |
| CH | FAT CLAY | | |
| SS | SANDSTONE WITH LOCAL WEATHERING AT SURFACE | | |




NOTES:

1. DUE TO THE SCALE, ACTUAL SURFACE TOPOGRAPHY BETWEEN WELLS IS NOT DEPICTED.
2. ALL CORRELATIONS BETWEEN GEOLOGIC UNITS HAVE BEEN APPROXIMATED BASED ON AVAILABLE GEOLOGIC INFORMATION. FOR CLARITY, PINCH–OUTS ARE NOT SHOWN.
3. SOIL BORING/MONITORING WELL LOCATIONS DEPICTED ON THE CROSS–SECTIONS ARE PROJECTED 90° TO THE CROSS–SECTION LOCATION LINE.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99 — DWN BY AMC — DES BY BKS — CHK BY PPV — APP BY JJM

emcon

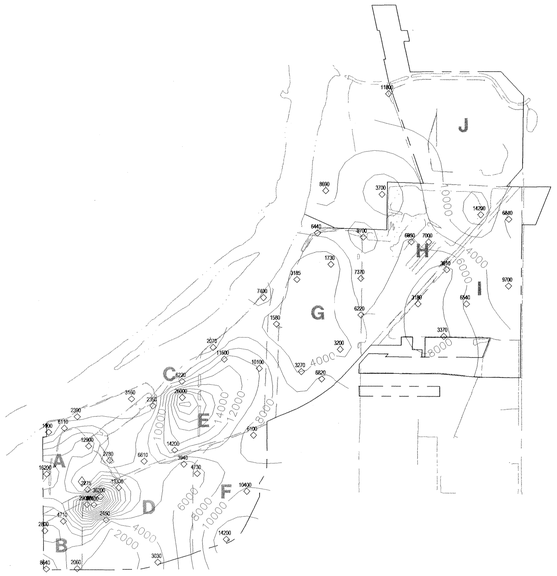
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**HYDROSTRATIGRAPHIC CROSS-SECTIONS**

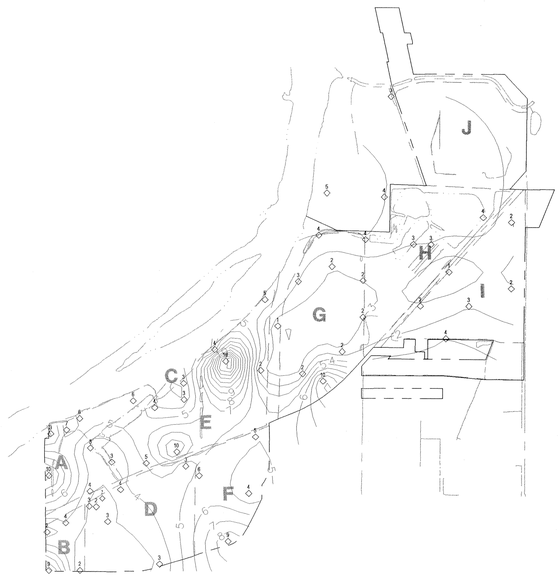
FIGURE NO. **2-15**

PROJECT NO. 84068–063.009

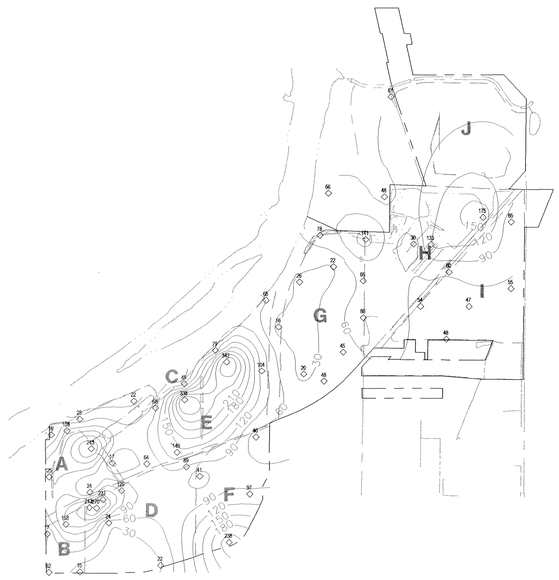
1" 1/2" 0" 1"
IMAGE Files: <No Images>
XREF Files: <No Xrefs>
N:\DWG\GM\SAGINAW\84068\63\009\Vsgmm05.dwg Thu, 13/Apr/00 03:43pm jbotzki
Software Project: N:\SOFT\PROJ\<none> Drawscale @ 1in=1in 1 Plotscale: 1



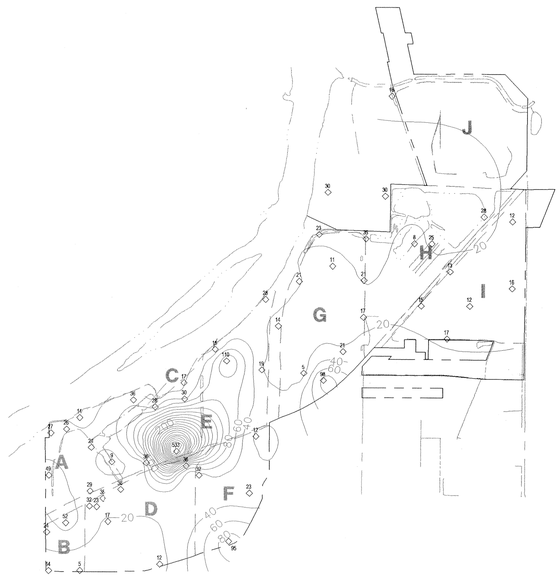

**TOTAL ALUMINUM**
**(CONTOUR INTERVAL = 2,000 mg/Kg)**




**TOTAL ARSENIC**
**(CONTOUR INTERVAL = 1 mg/Kg)**




**TOTAL BARIUM**
**(CONTOUR INTERVAL = 30 mg/Kg)**




**TOTAL COPPER**
**CONTOUR INTERVAL = 20 mg/Kg)**

NOTE:
SAMPLE DEPTHS RANGE FROM 0 TO 3 FEET BGS.
ALL UNITS IN mg/Kg.

LEGEND

| | |
|---|---|
| 23 | CONSTITUENT CONCENTRATION |
| ◇ | PHASE 1B RFI MONITORING WELL LOCATION |
| 80 | ISOCONCENTRATION LINE |
| — — — | APPROXIMATE PROPERTY BOUNDARY |

0 1200 2400
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY WKS
CHK BY
APP BY

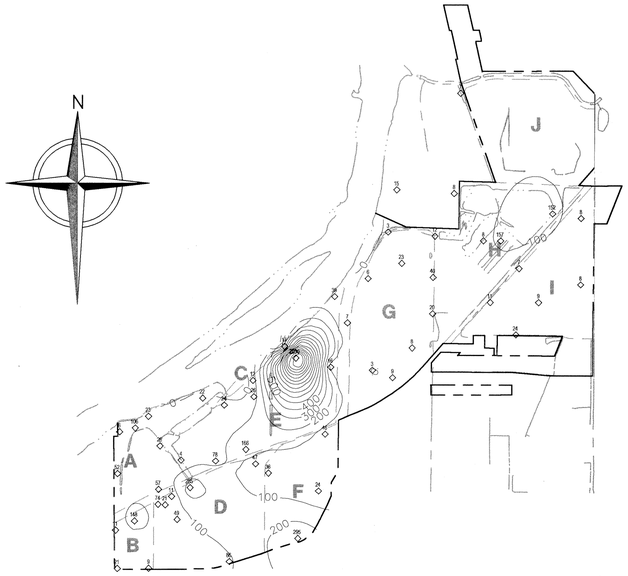
EMCON

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

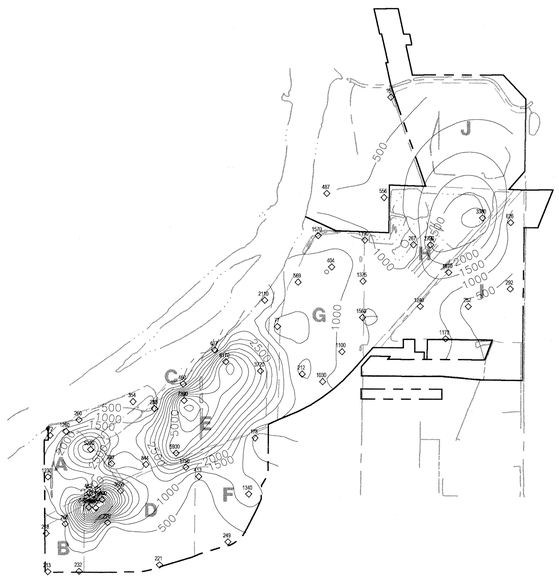
**SOIL INORGANIC DISTRIBUTION ISOPLETHS**

FIGURE NO.
**2-16**
PROJECT NO.
84068-063.009

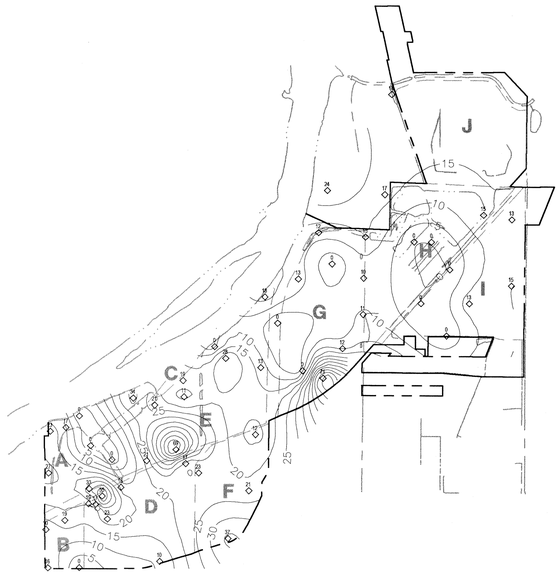

1" 1/2" 0"
IMAGE Files: <No Images>
XREF Files: Hyprmet01.dwg
N:\DWG\GAGAUNAW.84068A\1.0\99\Hyprmet01.dwg Thu, 13/Apr/00 04:29pm JBattisti
Address Project: N:\GDS\VPSO\<none> Linestyle: 1 Lscale: 0.5 Plotscale: 1



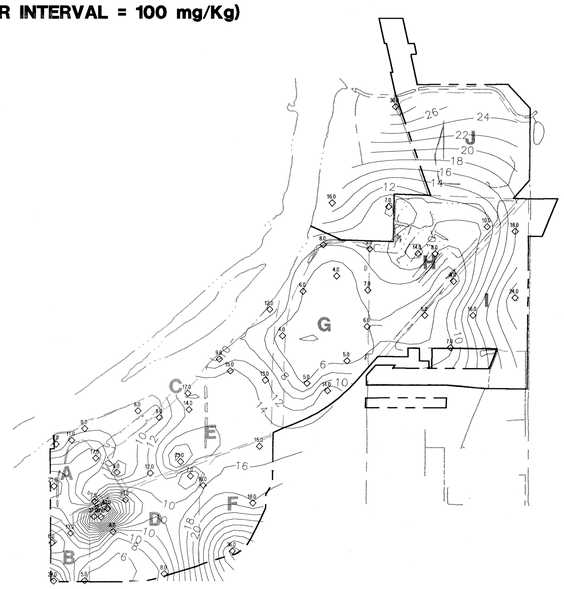

**TOTAL LEAD**
**(CONTOUR INTERVAL = 100 mg/Kg)**



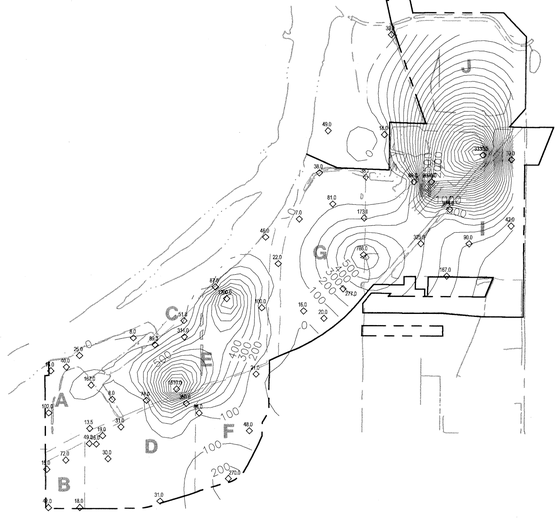

**TOTAL MANGANESE**
**(CONTOUR INTERVAL = 500 mg/Kg)**




**TOTAL NICKEL**
**(CONTOUR INTERVAL = 5 mg/Kg)**




**TOTAL VANADIUM**
**(CONTOUR INTERVAL = 2 mg/Kg)**




**TOTAL ZINC**
**(CONTOUR INTERVAL = 100 mg/Kg)**

NOTE:
SAMPLE DEPTHS RANGE FROM 0 TO 3 FEET BGS.
ALL UNITS IN mg/Kg.

LEGEND

| | |
|---|---|
| 13.5 | CONSTITUENT CONCENTRATION |
| ◇ | PHASE 1B RFI MONITORING WELL LOCATION |
| 200 | ISOCONCENTRATION LINE |
| — — — | APPROXIMATE PROPOERTY BOUNDARY |

0 1200 2400
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC CHK BY
DES BY WKS APP BY

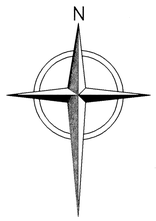
EMCON

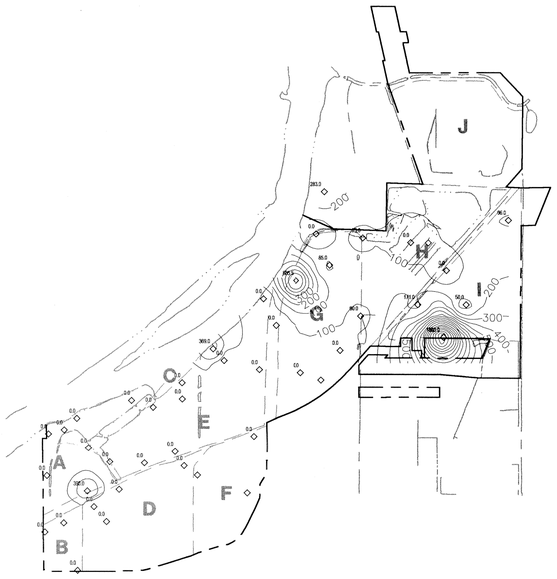
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**SOIL INORGANIC DISTRIBUTION ISOPLETHS**

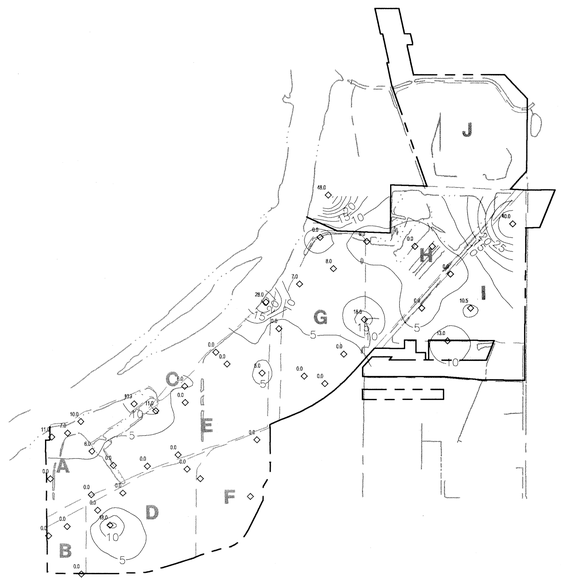
FIGURE NO. **2-17**
PROJECT NO. 84068-063.009

IMAGE Files: <No Images>
XREF Files: Nopnds01.dwg
N:\Dwg\GMSAGINAW\84068063\Dgn\ngmds02.dwg Fri, 14/Apr/00 10:37am Jbobbel
Scale: Model: 1:1 Sheet: 1:1 Plotted:
1" 1/2" 0" 1"

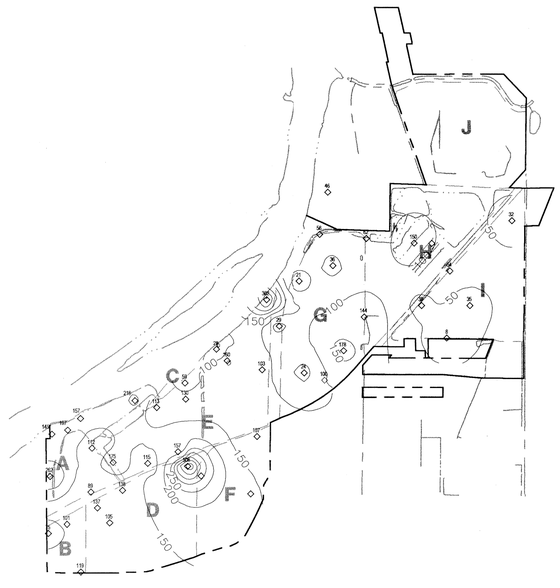


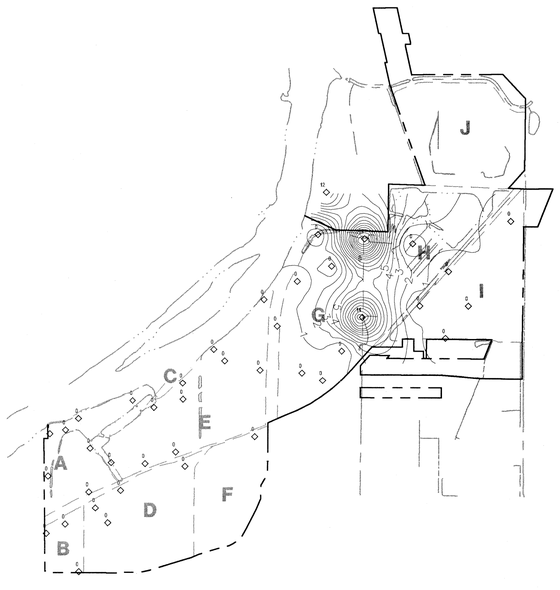

**DISSOLVED ALUMINUM**
**(CONTOUR INTERVAL = 100 ug/L)**




**DISSOLVED ARSENIC**
**(CONTOUR INTERVAL = 5 ug/L)**




**DISSOLVED BARIUM**
**(CONTOUR INTERVAL = 50 ug/L)**




**DISSOLVED COPPER**
**(CONTOUR INTERVAL = 1 ug/L)**

LEGEND

| | |
|---|---|
| 12 | CONSTITUENT CONCENTRATION |
| ◇ | PHASE 1A RFI MONITORING WELL LOCATION |
| 15 | ISOCONCENTRATION LINE |
| — — — | APPROXIMATE PROPERTY BOUNDARY |

NOTE:
ALL UNITS IN ug/L.

0 1200 2400
SCALE IN FEET

| REV. | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY WKS
CHK BY
APP BY

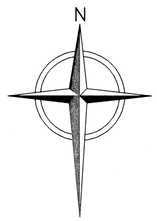
EMCON

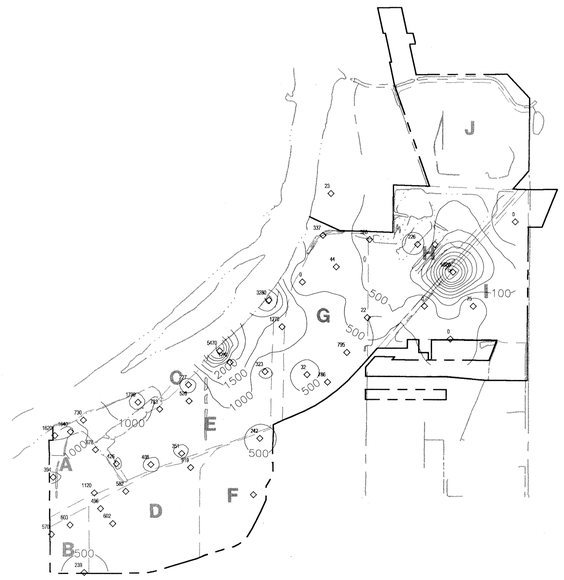
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**UPPER WATER-BEARING ZONE**
**GROUNDWATER INORGANIC DISTRIBUTION ISOPLETHS**

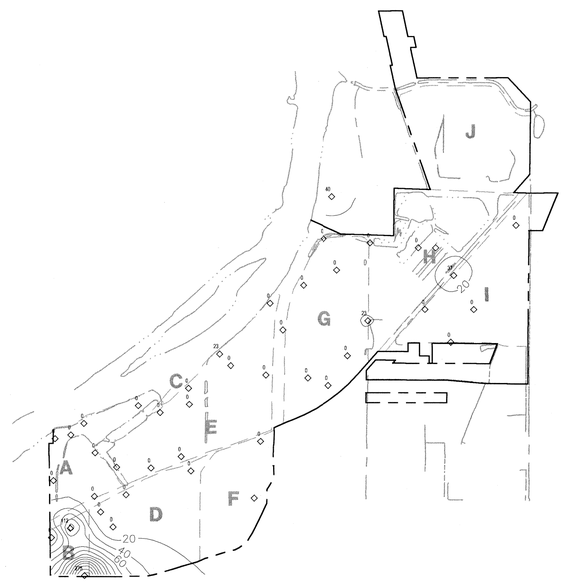
FIGURE NO.
**2-18**
PROJECT NO.
84068-063.009

1" 1/2" 0" 1"
MXREF Files: <No Images>
XREF Files: hsgmsb01.dwg
N:\DWG\GMSAGNAW\SFGSB&S\2001\Hsgmsp401.dwg Fri, 14/Apr/00 12:59pm jbstrakel
Sortbreak Project: N:\2001\PROJ\<none> Dimscale: 1 Uscale: 0.5 Paltscale: 1

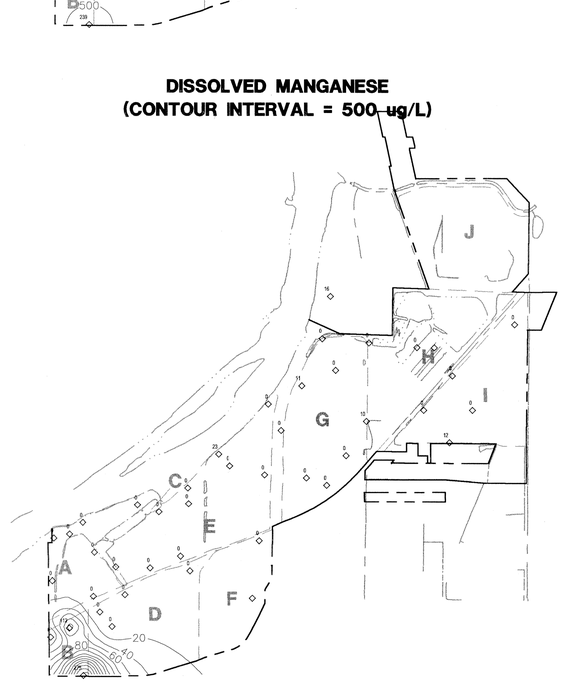


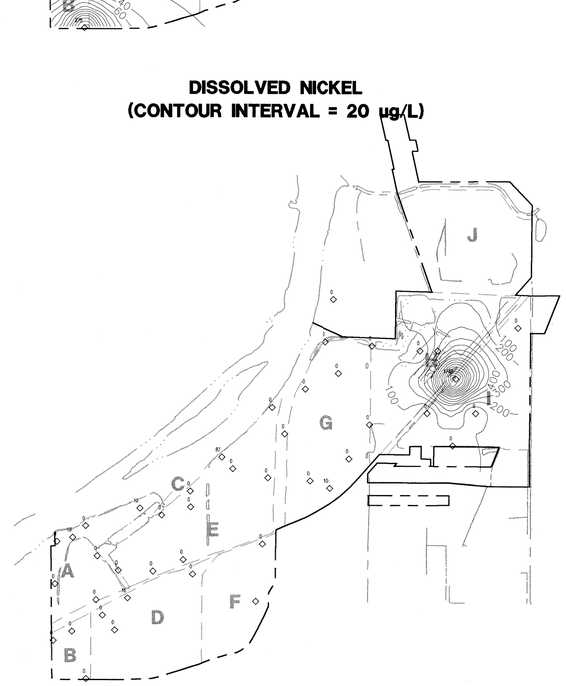

**DISSOLVED MANGANESE**
**(CONTOUR INTERVAL = 500 ug/L)**




**DISSOLVED NICKEL**
**(CONTOUR INTERVAL = 20 ug/L)**




**DISSOLVED VANADIUM**
**(CONTOUR INTERVAL = 20 ug/L)**




**DISSOLVED ZINC**
**(CONTOUR INTERVAL = 100 ug/L)**

NOTE:
ALL UNITS IN ug/L.

LEGEND

| | |
|---|---|
| 12 | CONSTITUENT CONCENTRATION |
| ◇ | PHASE 1A RFI MONITORING WELL LOCATION |
| 100 | ISOCONCENTRATION LINE |
| — — — | APPROXIMATE BOUNDARY |

0 1200 2400
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY WKS
CHK BY
APP BY

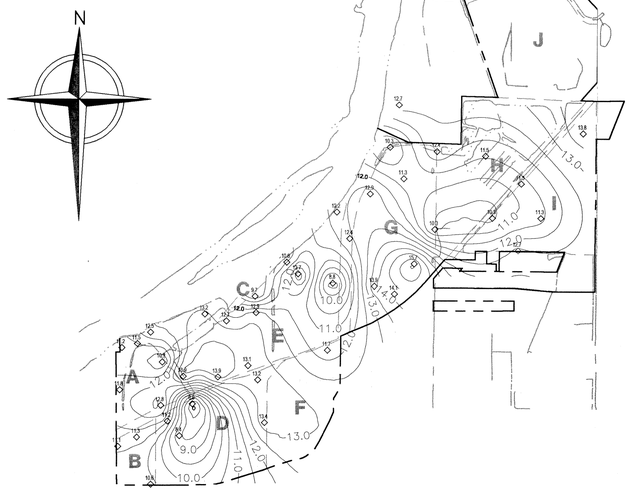
EMCON

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

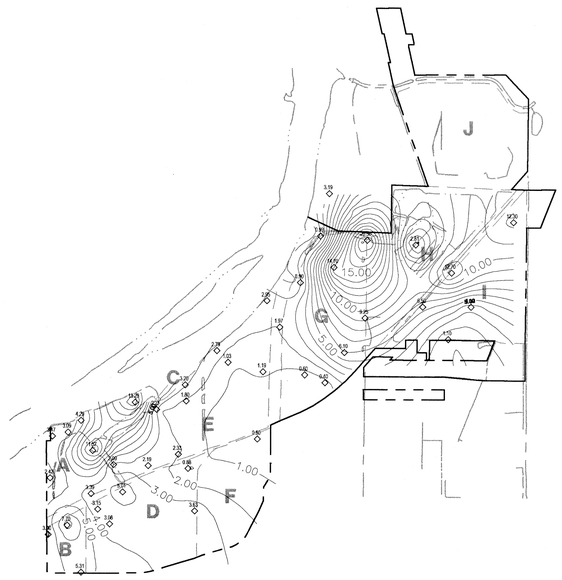
**UPPER WATER-BEARING ZONE**
**GROUNDWATER INORGANIC DISTRIBUTION ISOPLETHS**

FIGURE NO. **2-19**
PROJECT NO. 84068-063.009

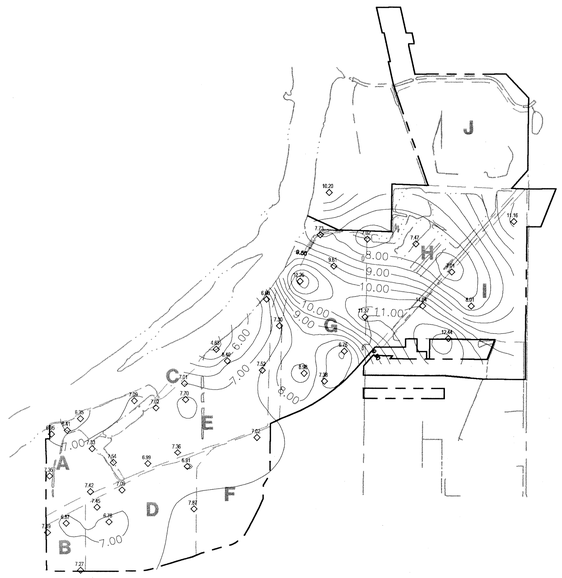
1" 1/2" 0" 1"
IMAGE Files: <No Images>
XREF Files: hsgmisb01.dwg
Saved: Thursday, 14/Apr/00 - 02:58pm, jbaldiel
Software Version: AUTOCAD 14 (LMS TECH)
Project Path: N:\SAGW\PROJ\<current>
Drawing: L:\Model\2-19.dwg



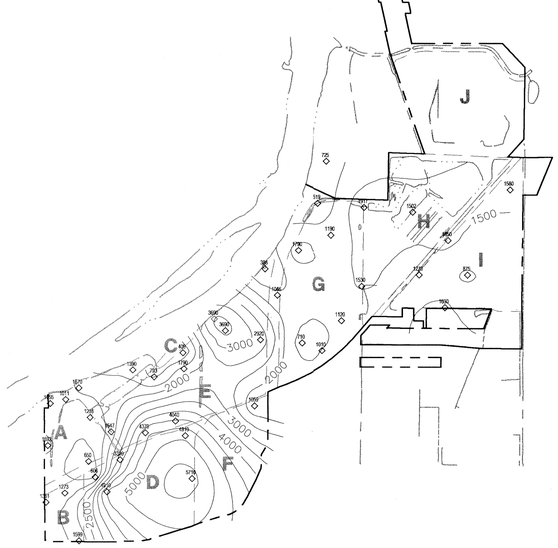

**TEMPERATURE**
**(CONTOUR INTERVAL = 0.5° C)**



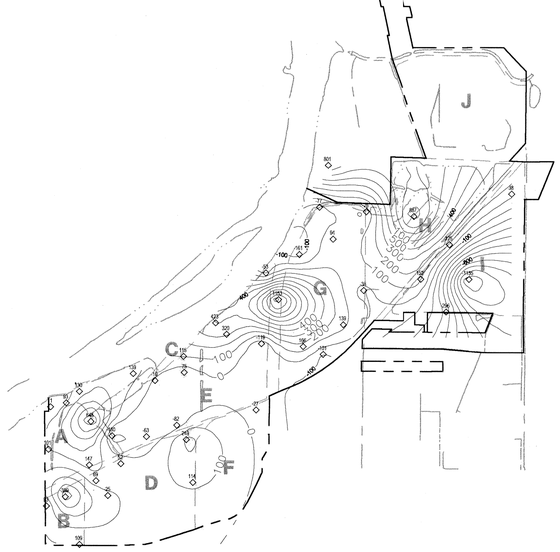

**DISSOLVED OXYGEN**
**(CONTOUR INTERVAL = 1.0%)**




**pH**
**(CONTOUR INTERVAL = 0.50 s.u.)**




**SPECIFIC CONDUCTIVITY**
**(CONTOUR INTERVAL = 500 umho/cm)**




**OXIDATION-REDUCTION POTENTIAL**
**(CONTOUR INTERVAL = 100 eV)**

NOTE:
ALL FIELD PARAMETERS WERE MEASURED AT THE TIME OF SAMPLE COLLECTION DURING NOVEMBER AND DECEMBER 1998.

LEGEND

114 — FIELD PARAMETER CONCENTRATION

◇ — PHASE 1A RFI MONITORING WELL LOCATION

100 — ISOCONCENTRATION LINE

— — — — APPROXIMATE PROPERTY BOUNDARY

0 1200 2400
SCALE IN FEET

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY WKS
CHK BY
APP BY

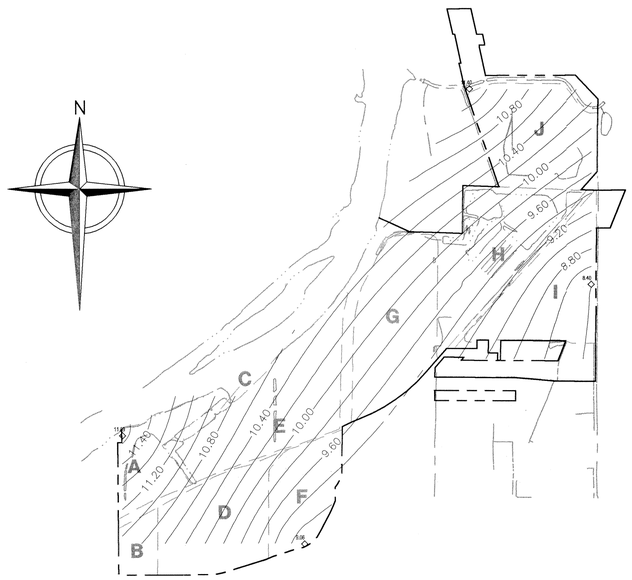
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

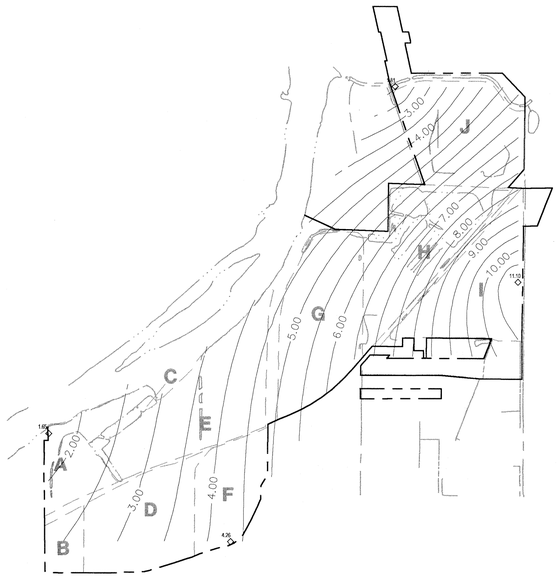
**UPPER WATER-BEARING ZONE**
**GENERAL CHEMISTRY DISTRIBUTION ISOPLETHS**

FIGURE NO. **2-20**
PROJECT NO. 84068-063.009

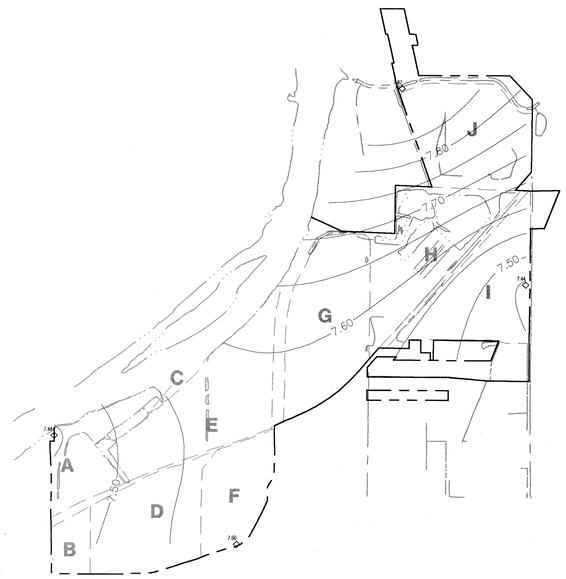
1" 1/2" 0" 1"
N:\Jobs\Gm\Saginaw\84068063\Dgn\
Software Project: N:\SOSW\PROJ\common
IMAGE Files: <No Images>
XREF Files: Nsgmap01.dwg
Nsgmap02.dwg Fri, 14 Apr 00 - 8:35am Patricia
Drawings: 1 Sheets: 01 Patricia



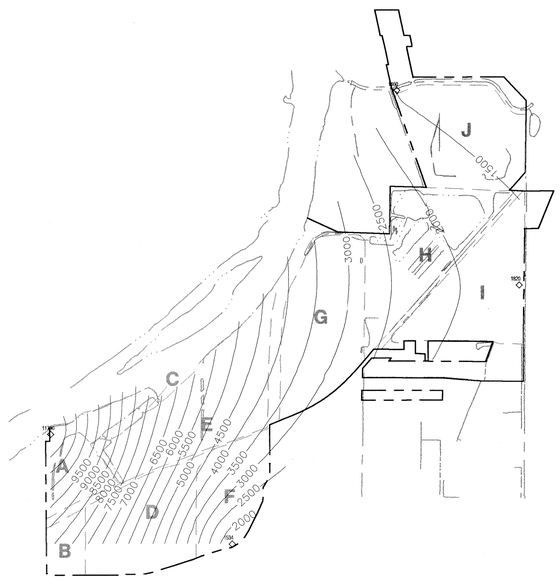

**TEMPERATURE**
**(CONTOUR INTERVAL = 0.20° C)**



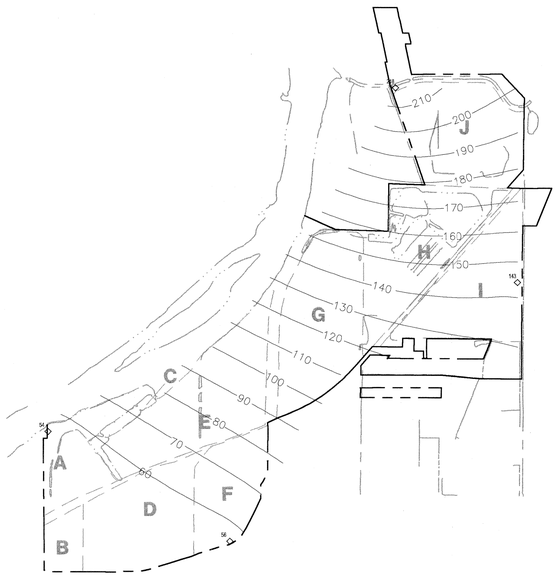

**DISSOLVED OXYGEN**
**(CONTOUR INTERVAL = 0.50%)**




**pH**
**(CONTOUR INTERVAL = 0.05 s.u.)**




**SPECIFIC CONDUCTIVITY**
**(CONTOUR INTERVAL = 500 umho/cm)**




**OXIDATION-REDUCTION POTENTIAL**
**(CONTOUR INTERVAL = 10 eV)**

LEGEND

54 — FIELD PARAMETER CONCENTRATION

◇ — PHASE 1B RFI MONITORING WELL LOCATION

150 — ISOCONCENTRATION LINE

— — — APPROXIMATE PROPERTY BOUNDARY

0 1200 2400
SCALE IN FEET

NOTE:
ALL FIELD PARAMETERS WERE MEASURED AT THE TIME OF SAMPLE COLLECTION DURING NOVEMBER AND DECEMBER 1998.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 6/4/99
DWN BY AMC
DES BY BKS
CHK BY
APP BY

emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**SUBGLACIAL SAND/BEDROCK AQUIFER**
**GENERAL CHEMISTRY DISTRIBUTION ISOPLETHS**

FIGURE NO. **2-21**
PROJECT NO. 84068-063.009


1" 1/2" 0" 1"
N:\DWG\DRAGONAW\84068\83\GW01\Hydrochem.dwg 10:53am Jharbel
Softdesk Project: N:\SSDATA\PROJ\<none> Dimscale: 1 Ltscale: 0.5 Plotscale: 1
XREF Files: Hydrochem1.dwg
IMAGE Files: <No Images>

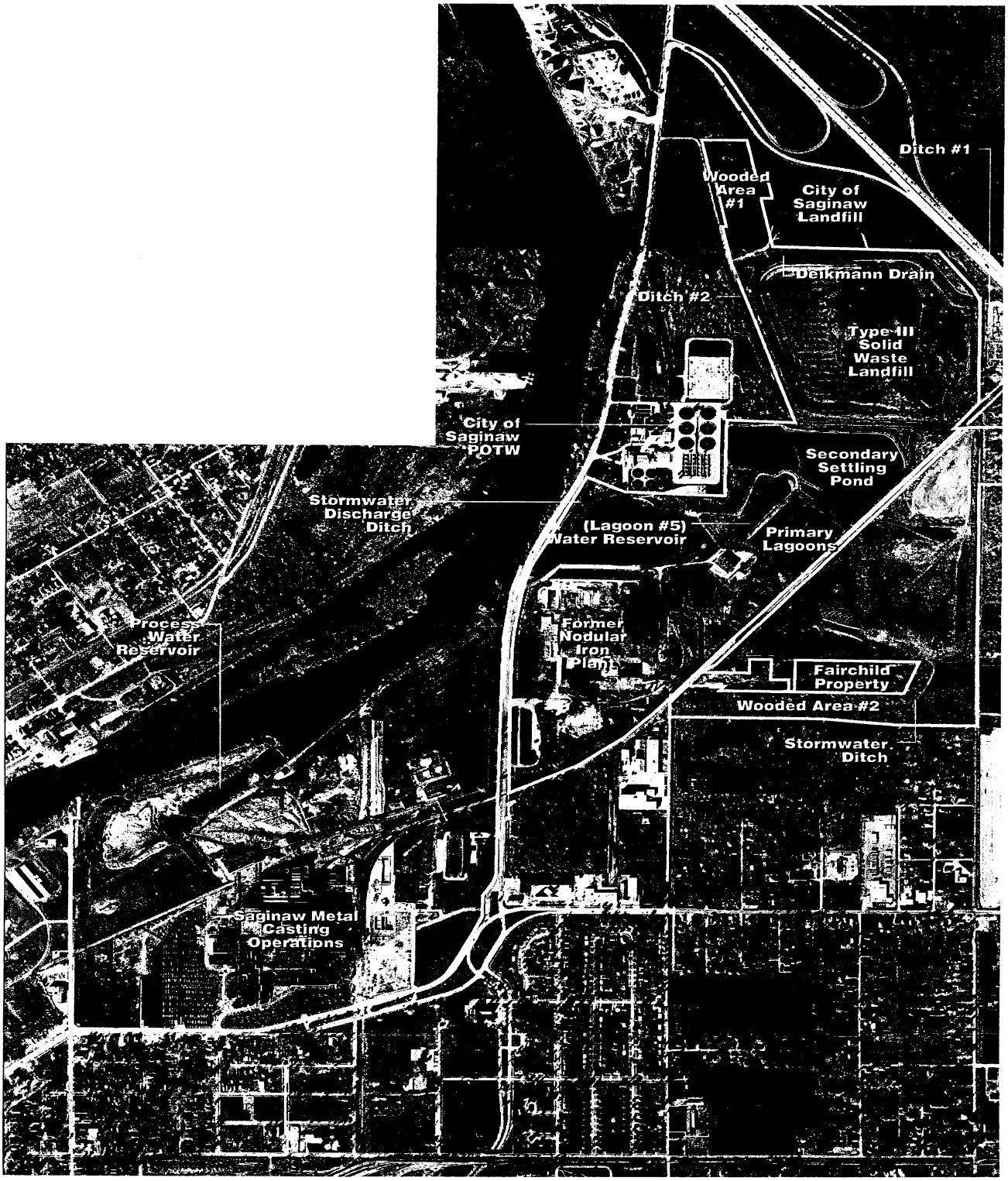



Figure 4-1. Areas surveyed during the ecological reconnaissance.

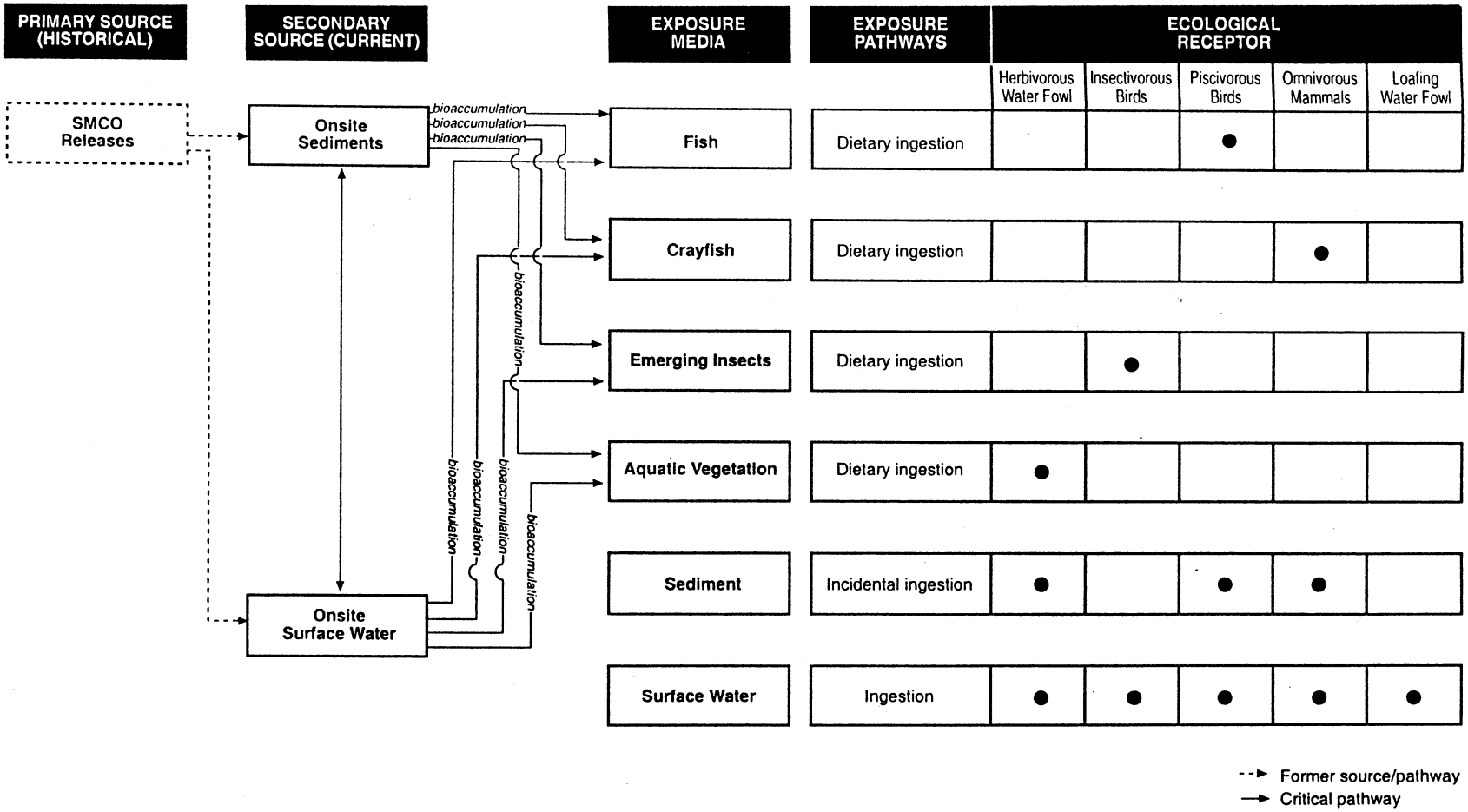
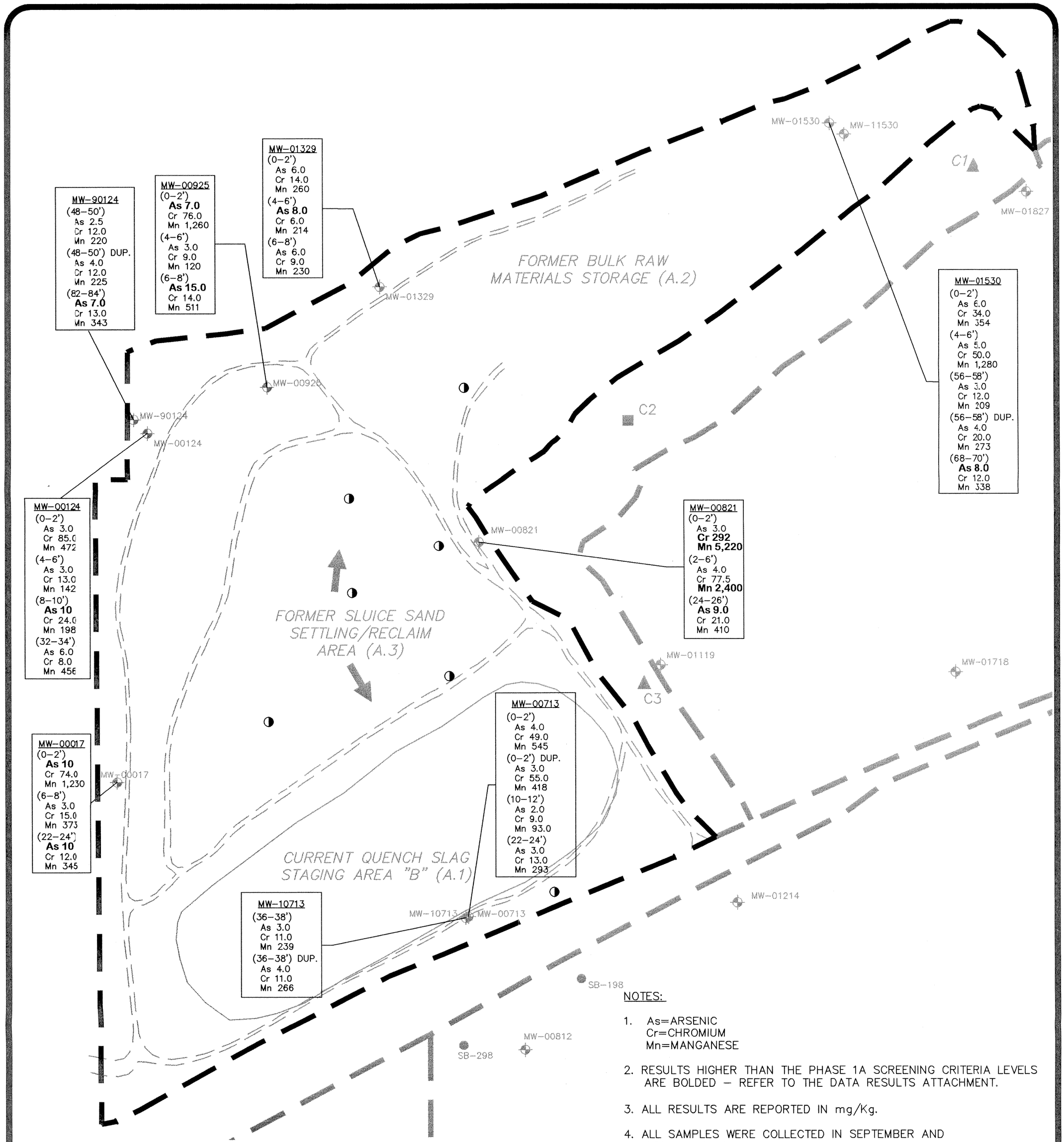



Figure 4-2. Conceptual model for critical ecological exposure pathways.




NOTES:

1. As=ARSENIC
   Cr=CHROMIUM
   Mn=MANGANESE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING CRITERIA LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/Kg.
4. ALL SAMPLES WERE COLLECTED IN SEPTEMBER AND OCTOBER 1998.

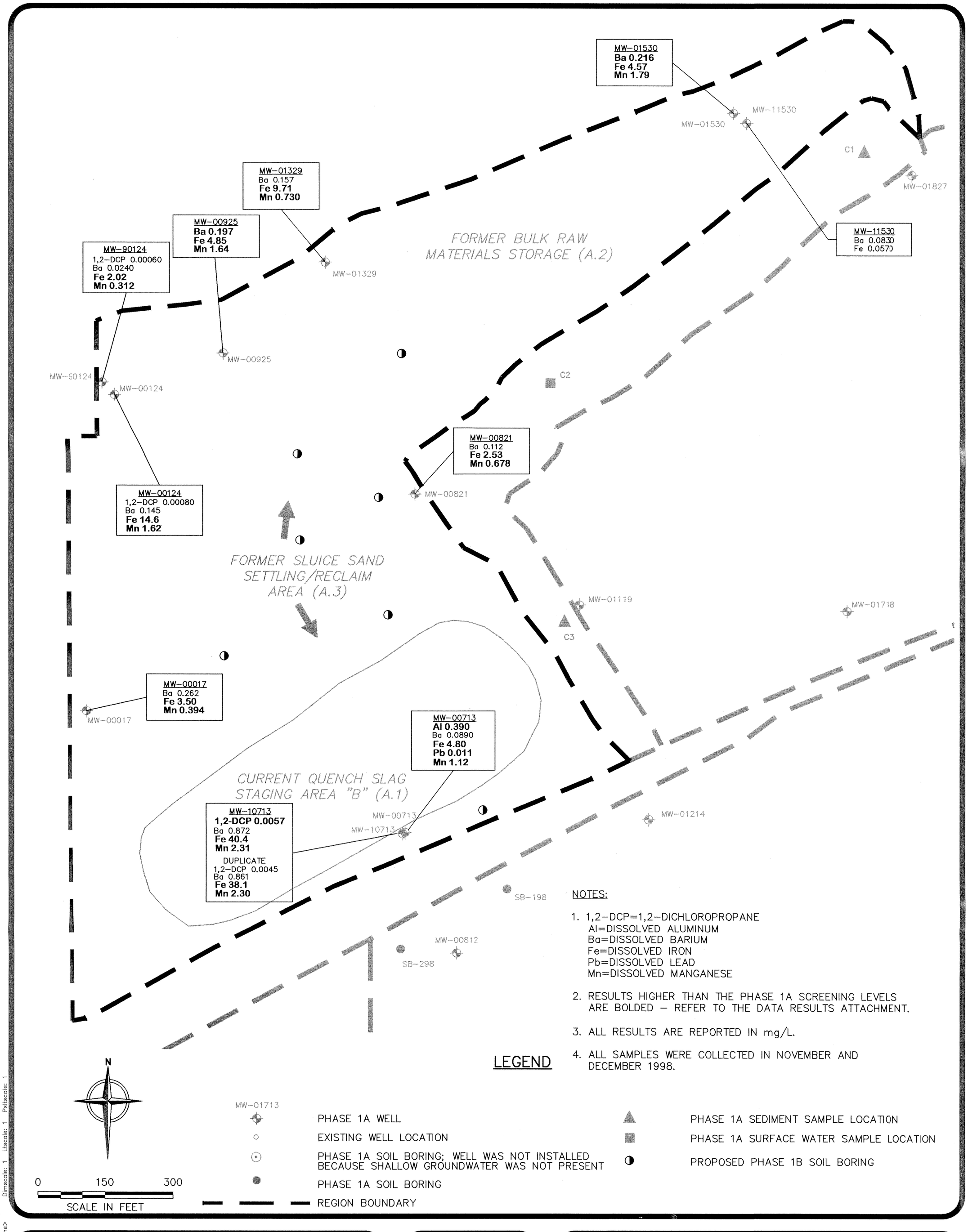
LEGEND

EMCON

DATE 11/29/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-1a
# INVESTIGATIVE UNIT A
## SOIL PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS


IMAGE Files: <No Images>
XREF Files: <No Xrefs>
N:\DWG\GMSAGINAW\84068063\009\Nagms-01.dwg Mon, 17/Apr/00 02:07pm jbatzkiel
Dimscale: 1 Ltscale: 1 Psltscale: 1
Softdesk Project: N:\SDSK\PROJ\<none>




NOTES:

1. 1,2-DCP=1,2-DICHLOROPROPANE
   Al=DISSOLVED ALUMINUM
   Ba=DISSOLVED BARIUM
   Fe=DISSOLVED IRON
   Pb=DISSOLVED LEAD
   Mn=DISSOLVED MANGANESE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998.

LEGEND

MW-01713 PHASE 1A WELL

EXISTING WELL LOCATION

PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT

PHASE 1A SOIL BORING

REGION BOUNDARY

PHASE 1A SEDIMENT SAMPLE LOCATION

PHASE 1A SURFACE WATER SAMPLE LOCATION

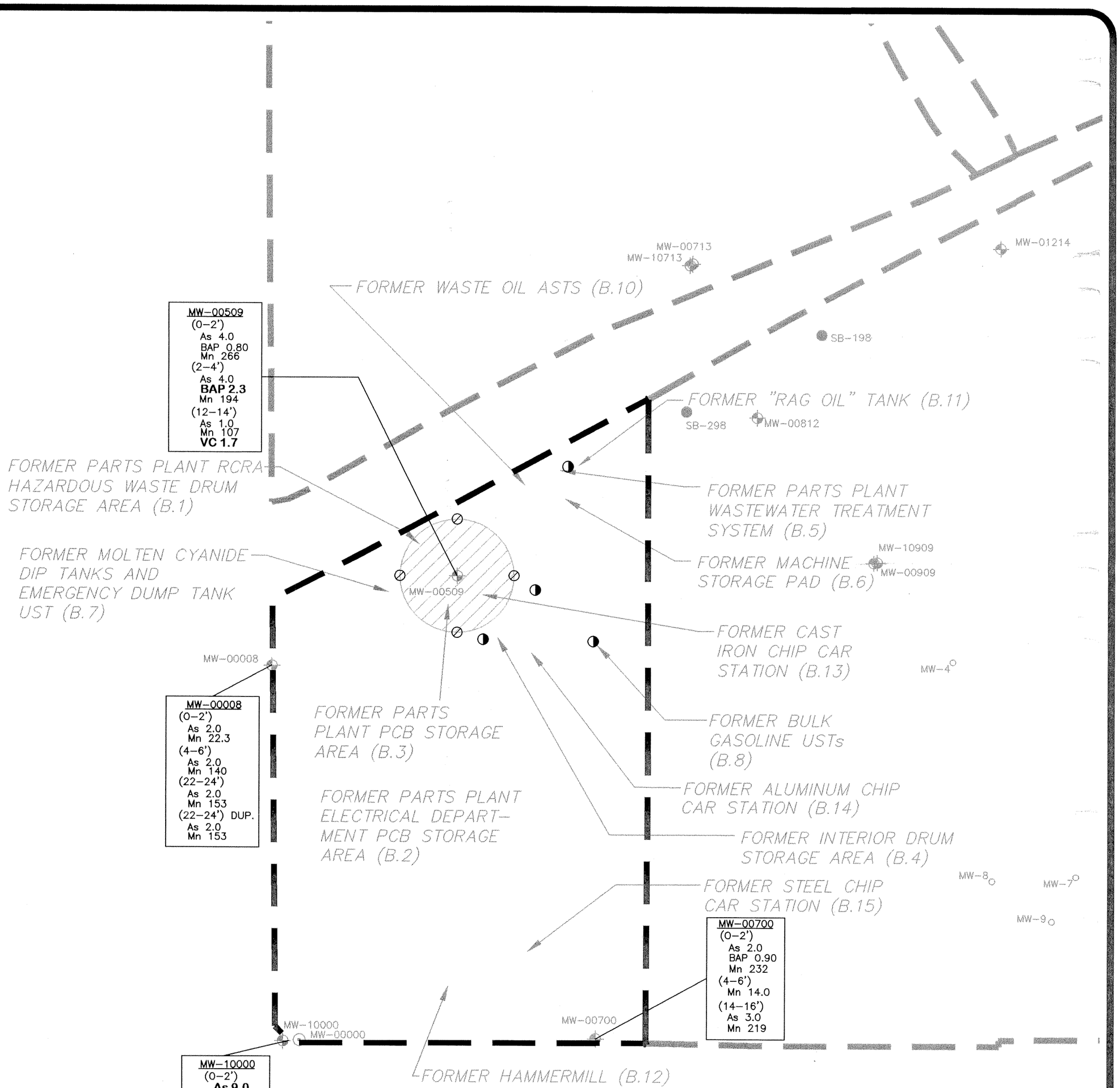
PROPOSED PHASE 1B SOIL BORING

EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-1b
# INVESTIGATIVE UNIT A
## GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\84068063\009\Nagms-1b.dwg Mon, 17/Apr/00 02:24pm jbatzkiel
Softdesk Project: N:\SDSK\PROJ\<none>
Dimscale: 1 Ltscale: 1 Psltscale: 1




NOTES:

1. As=ARSENIC
   BAP=BENZO(A)PYRENE
   Mn=MANGANESE
   VC=VINYL CHLORIDE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/Kg.
4. ALL SAMPLES WERE COLLECTED IN SEPTEMBER AND OCTOBER 1998.

## LEGEND

N

0 150 300

SCALE IN FEET

MW-01713 — PHASE 1A WELL

EXISTING WELL LOCATION

PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT

PHASE 1A SOIL BORING

REGION BOUNDARY

APPROXIMATE AREA OF DIRECT-PUSH SCREENING INVESTIGATION

PHASE 1A SEDIMENT SAMPLE LOCATION

PHASE 1A SURFACE WATER SAMPLE LOCATION

PROPOSED PHASE 1B SOIL BORING

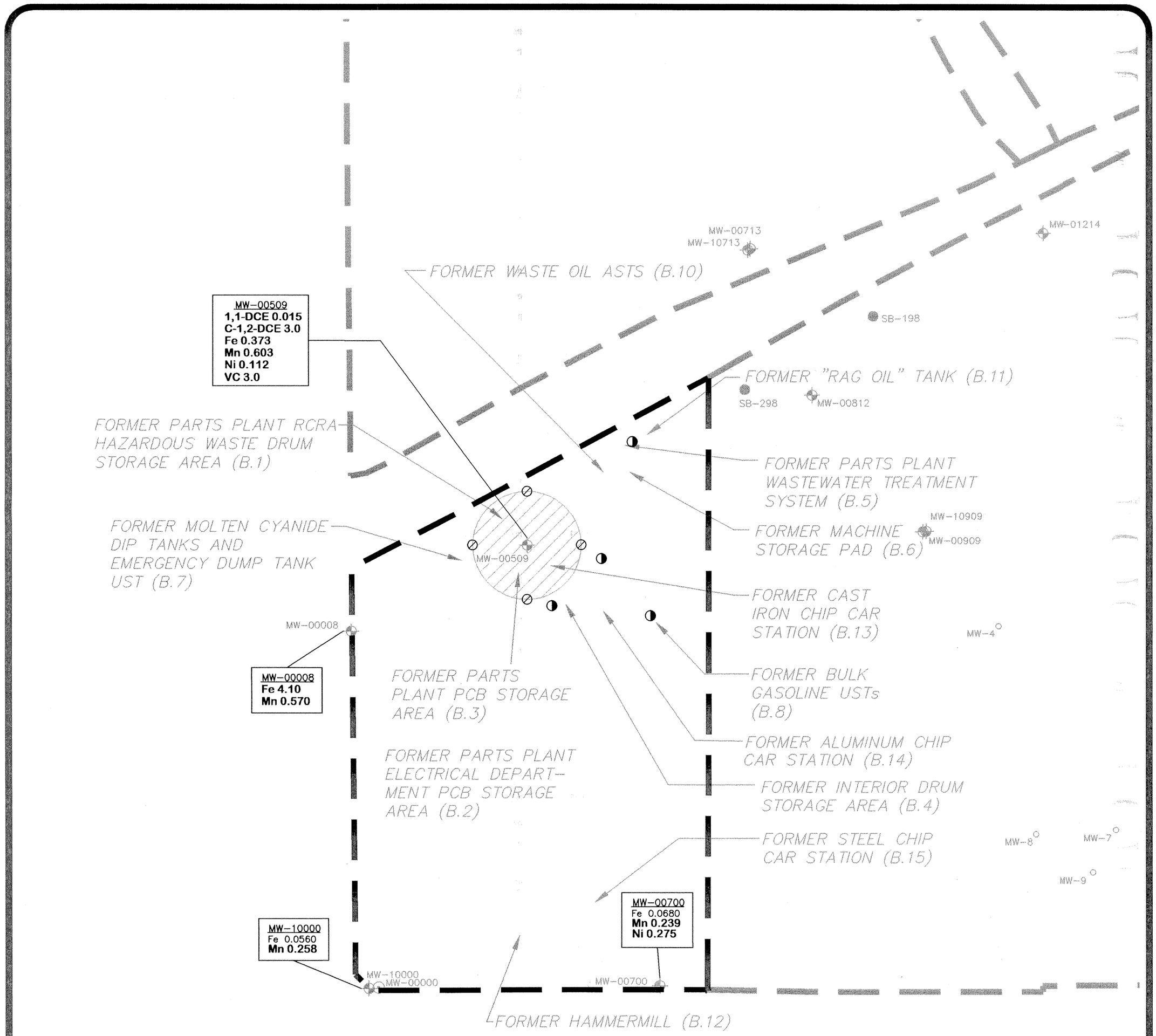
PROPOSED DIRECT-PUSH SAMPLE LOCATION

EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-2a
# INVESTIGATIVE UNIT B
## SOIL PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\84068063\009\Nagms-02.dwg Mon, 17/Apr/00 02:36pm jbatzkiel
Softdesk Project: N:\SDSK\PROJ\<none> Dimscale: 1 Ltscale: 1 Paltscale: 1




NOTES:

1. 1,1-DCE=1,1-DICHLOROETHENE
   C-1,2-DCE=CIS-1,2-DICHLOROETHENE
   Fe=DISSOLVED IRON
   Mn=DISSOLVED MANGANESE
   Ni=DISSOLVED NICKEL
   VC=VINYL CHLORIDE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998.

## LEGEND

N

0 150 300

SCALE IN FEET

MW-01713 — PHASE 1A WELL

EXISTING WELL LOCATION

PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT

PHASE 1A SOIL BORING

REGION BOUNDARY

APPROXIMATE AREA OF DIRECT-PUSH SCREENING INVESTIGATION

PHASE 1A SEDIMENT SAMPLE LOCATION

PHASE 1A SURFACE WATER SAMPLE LOCATION

PROPOSED PHASE 1B SOIL BORING

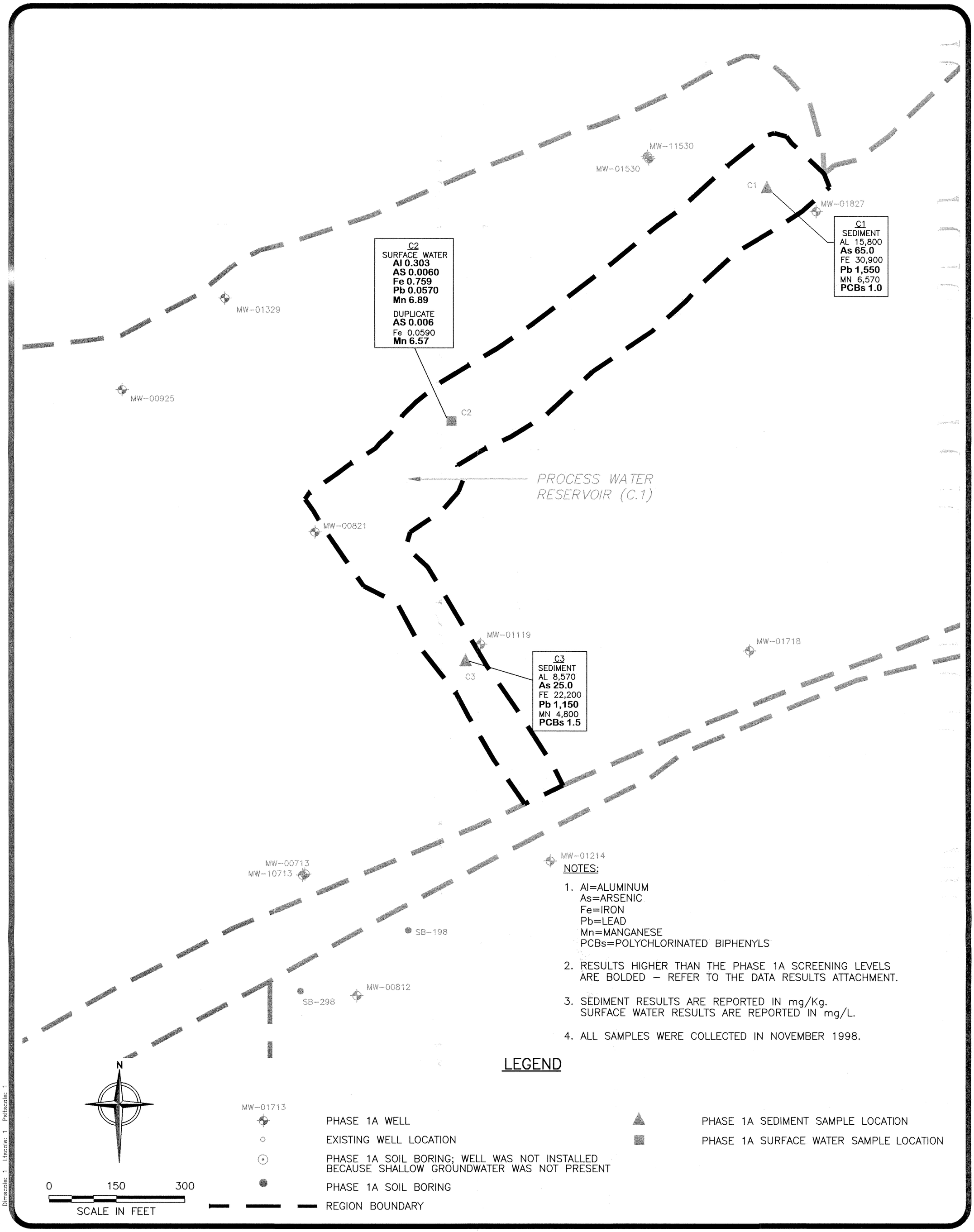
PROPOSED DIRECT-PUSH SAMPLE LOCATION

EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-2b
# INVESTIGATIVE UNIT B
# GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\84068063\009\Nagms-2b.dwg Mon, 17/Apr/00 02:37pm jbatzkiel
Softdesk Project: N:\SDSK\PROJ\<none>
Dimscale: 1 Ltscale: 1 Psltscale: 1




NOTES:

1. Al=ALUMINUM
   As=ARSENIC
   Fe=IRON
   Pb=LEAD
   Mn=MANGANESE
   PCBs=POLYCHLORINATED BIPHENYLS

2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.

3. SEDIMENT RESULTS ARE REPORTED IN mg/Kg.
   SURFACE WATER RESULTS ARE REPORTED IN mg/L.

4. ALL SAMPLES WERE COLLECTED IN NOVEMBER 1998.

## LEGEND

- PHASE 1A WELL
- EXISTING WELL LOCATION
- PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT
- PHASE 1A SOIL BORING
- REGION BOUNDARY
- PHASE 1A SEDIMENT SAMPLE LOCATION
- PHASE 1A SURFACE WATER SAMPLE LOCATION

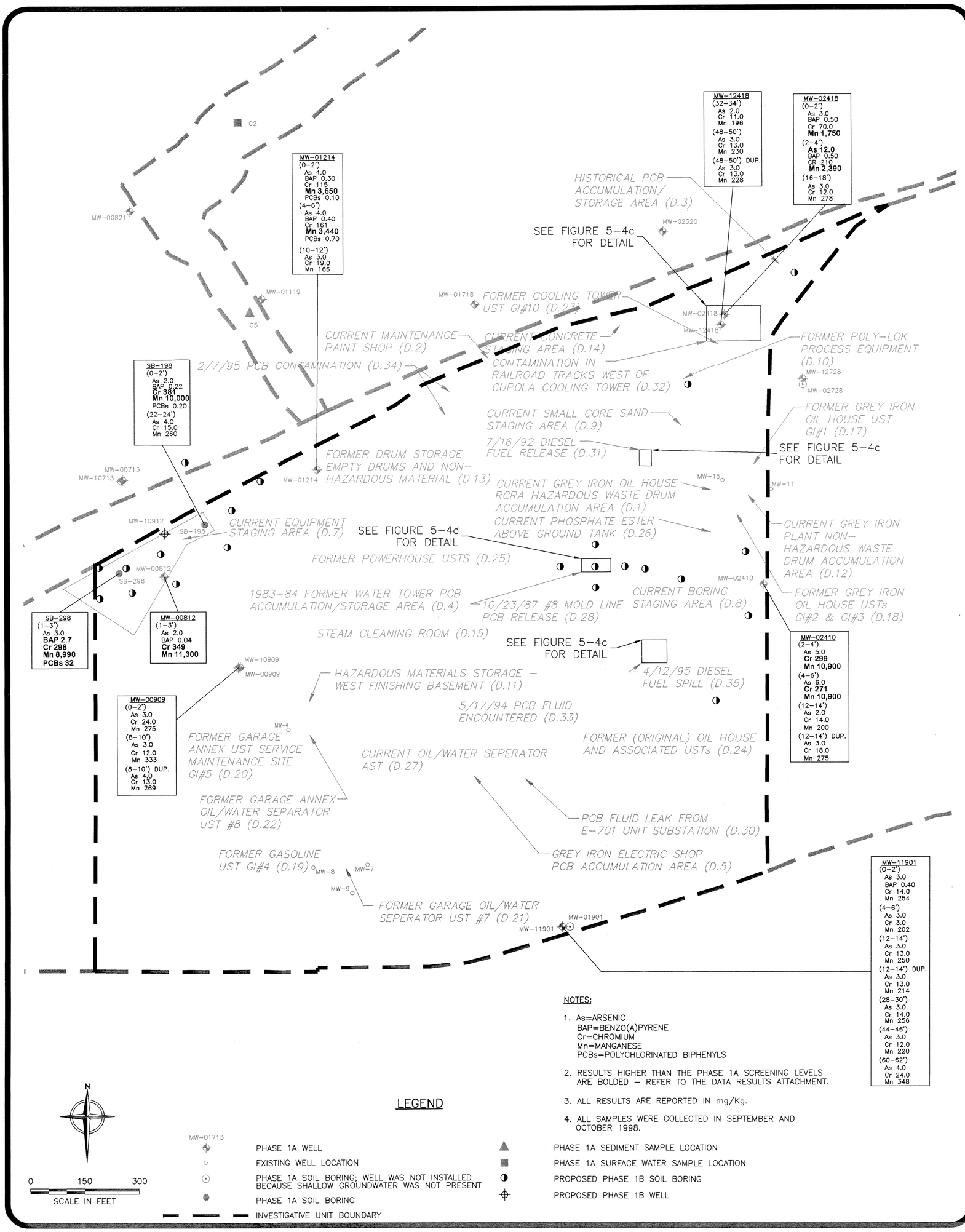
EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-3
INVESTIGATIVE UNIT C

SEDIMENT AND SURFACE WATER
PHASE 1A SCREENING RESULTS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\84068063\009\Nagms-03.dwg Mon, 17/Apr/00 02:39pm jbatzkiel
Softdesk Project: N:\SDSK\PROJ\<none> Dimscale: 1 Ltscale: 1 Psltscale: 1

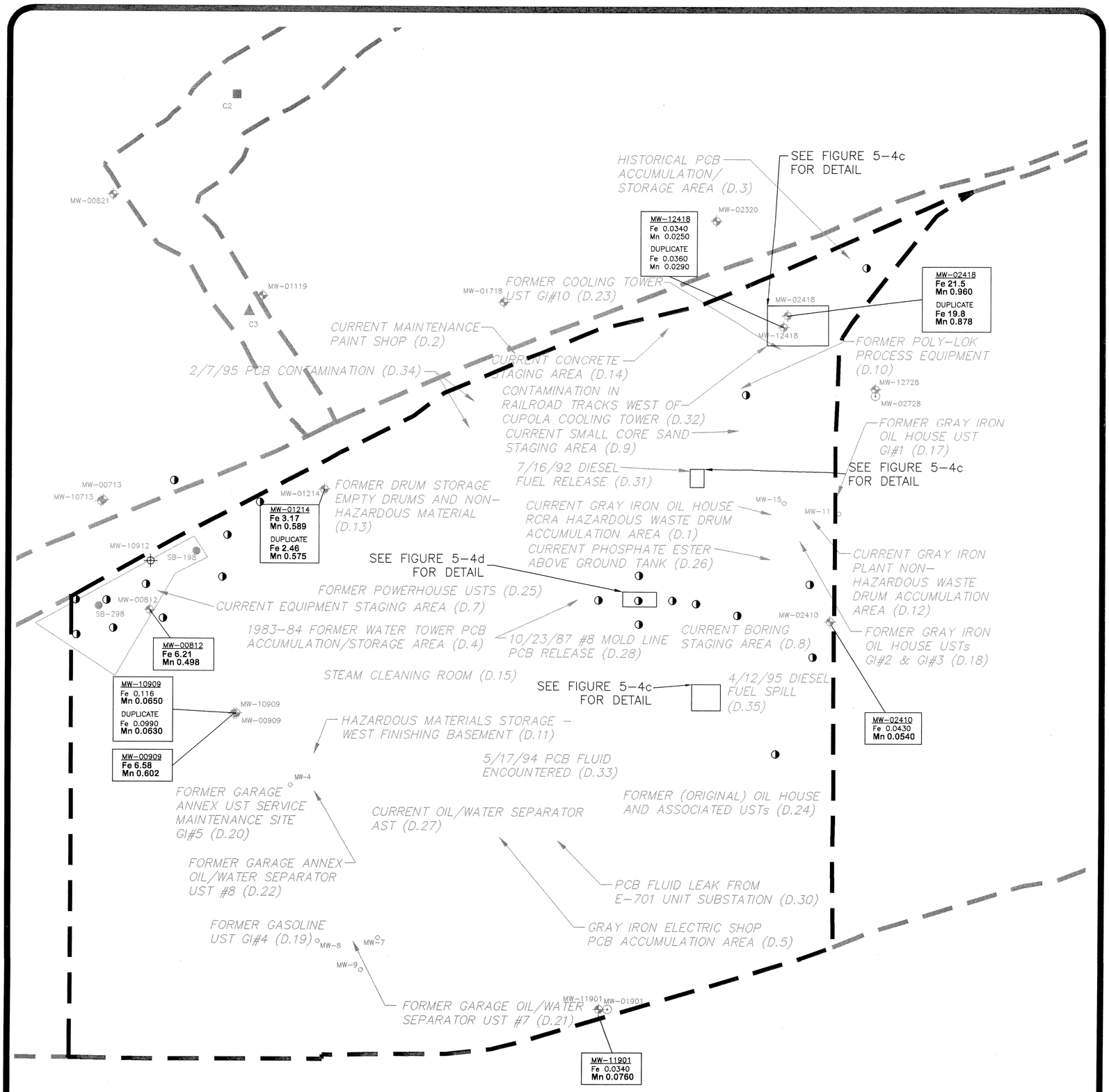



EMCON

DATE 11/29/99
DWN. TSS
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-4a
## INVESTIGATIVE UNIT D
## SOIL PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GM&GNW\84068063\009\Nogms-04.dwg Wed, 19/Apr/00 12:56pm tskidmore
Softdesk Project: N:\SDSK\PROJ\803078 Dimscale: 1 Ltscale: 1 Paltscale: 1




NOTES:

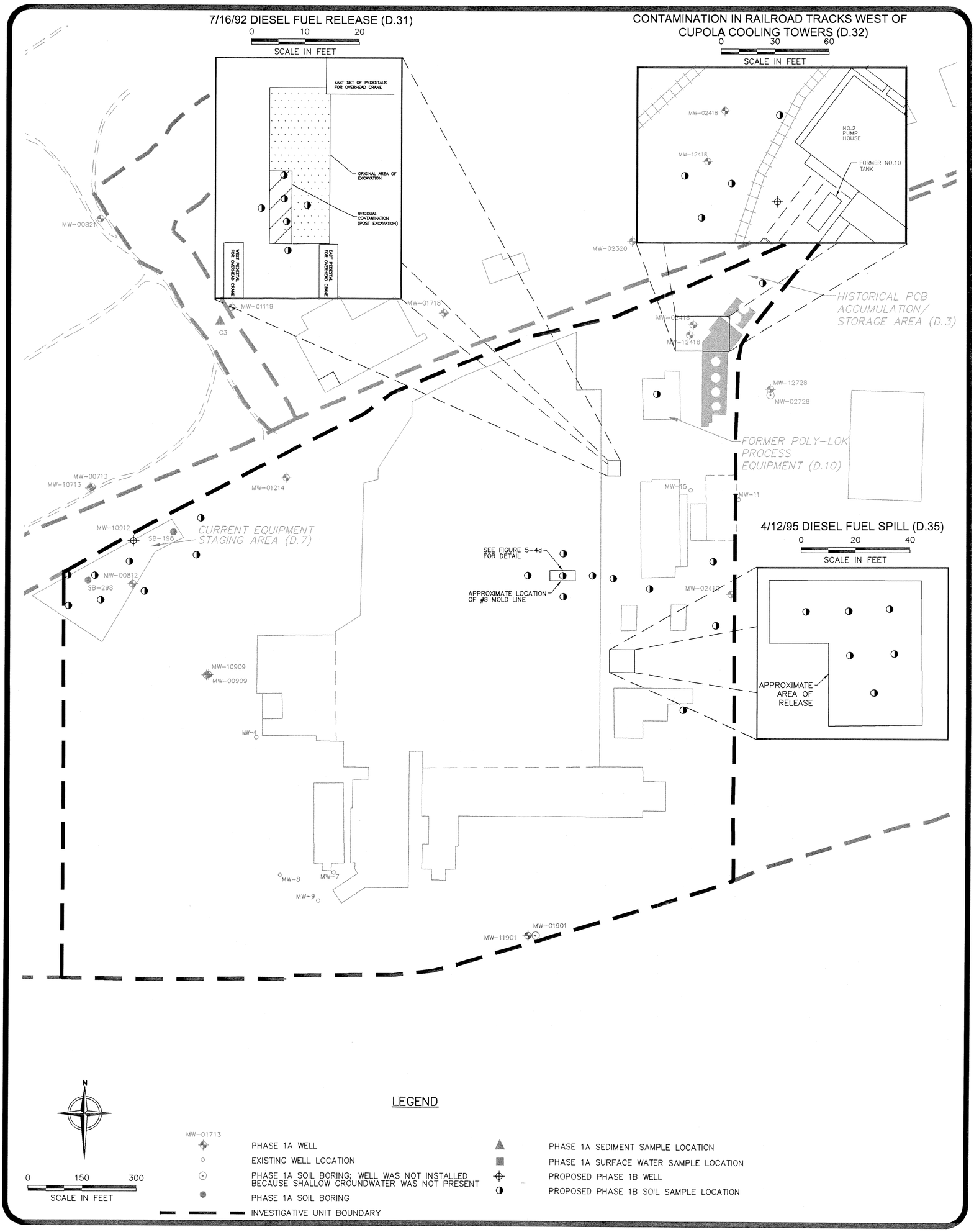
1. Fe=DISSOLVED IRON
   Mn=DISSOLVED MANGANESE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998.

EMCON

DATE 11/29/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-4b
## INVESTIGATIVE UNIT D
## GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_x3.dwg
N:\DWG\GMSAGINAW\84068063\009\Nagms-14.dwg Tue, 18/Apr/00 08:51:am tskidmore
Dimscale: 1 Lscale: 1 Psltscale: 1
Softdesk Project: N:\SDSK\PROJ\<none>



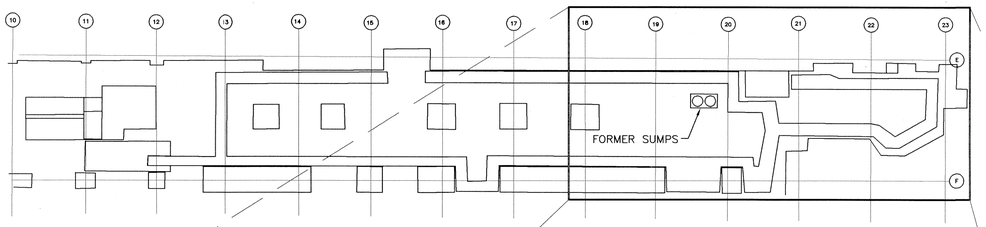

EMCON

DATE 10/20/99
DWN. TSS
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-4c
# INVESTIGATIVE UNIT D

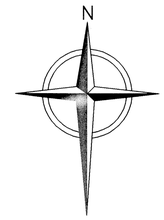
## PROPOSED SAMPLING LOCATION DETAILS

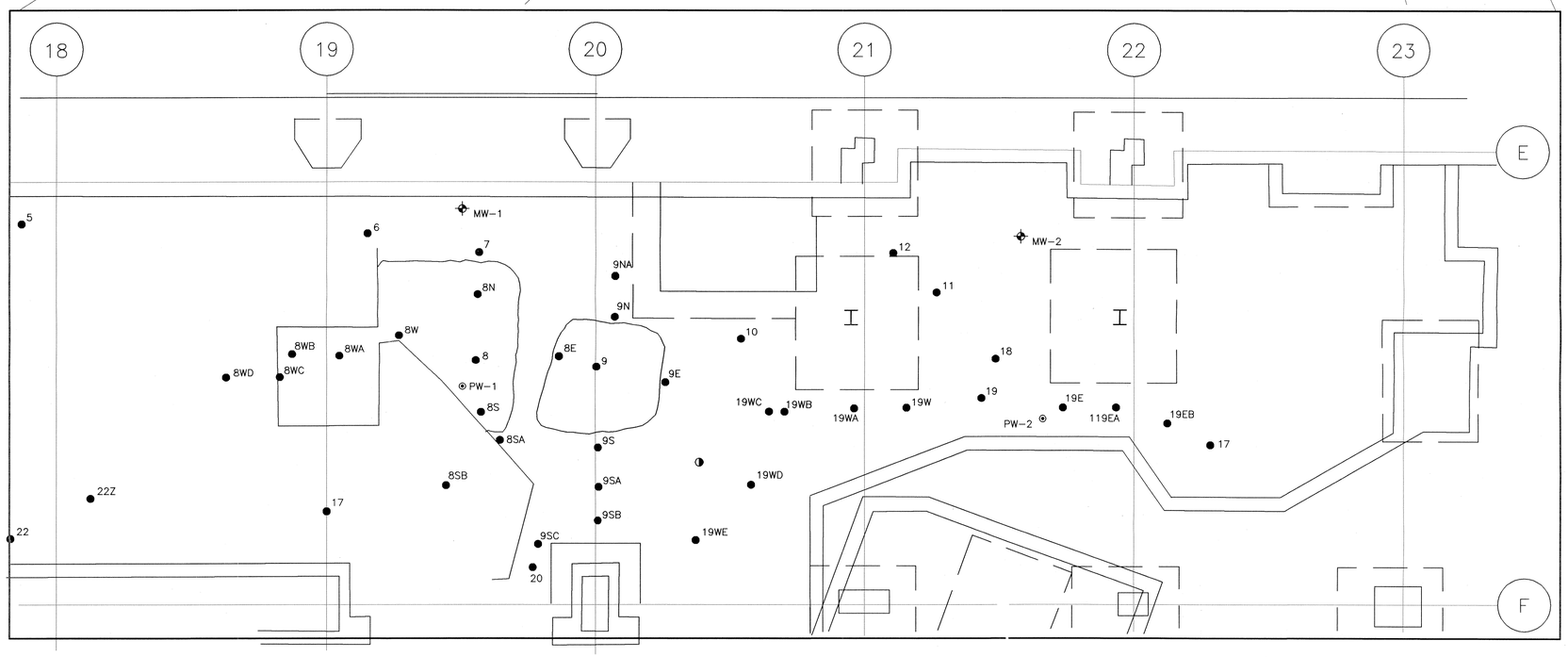
IMAGE Files: Smco.tif
XREF Files: <Obj Xrefs>
N:\DWG\GMSIGNM\84068D63\DGN\Norms-2Aug.dwt 10/20/00 01:14pm tskidmore
Softdesk Project: N:\SDSK\PROJ\863078 Dimscale: 1 Lscale: 1 Psltscale: 1




## #8 MOLD LINE

0 20 40
SCALE IN FEET




## AREA OF CONCENTRATION

0 5 10
SCALE IN FEET

LEGEND

- EXISTING SOIL BORING
- EXISTING PURGE WELL
- EXISTING MONITORING WELL
- PROPOSED PHASE 1B SOIL BORING
- (F) COLUMN

NOTES:

1. SEE EMCON, DECEMBER 1999, RCRA FACILITY INVESTIGATION (RFI) REPORT AND PHASE 1B WORKPLAN, GENERAL MOTORS CORPORATION, SAGINAW, MICHIGAN, VOLUME I, TABLE 5-11 FOR ANALYTICAL RESULTS
   INFORMATION PROVIDED FROM RMT "FIGURE 1, BASEMENT AREA SAMPLE LOCATIONS", DRAWING #1073.15
2. BASEMAP PROVIDED BY RMT, INC.

| REV | DATE | DESCRIPTION | DWN BY | DES BY | CHK BY | APP BY |
|---|---|---|---|---|---|---|
| | | | | | | |

DATE OF ISSUE 11/30/99
DWN BY TSS CHK BY
DES BY DLR APP BY

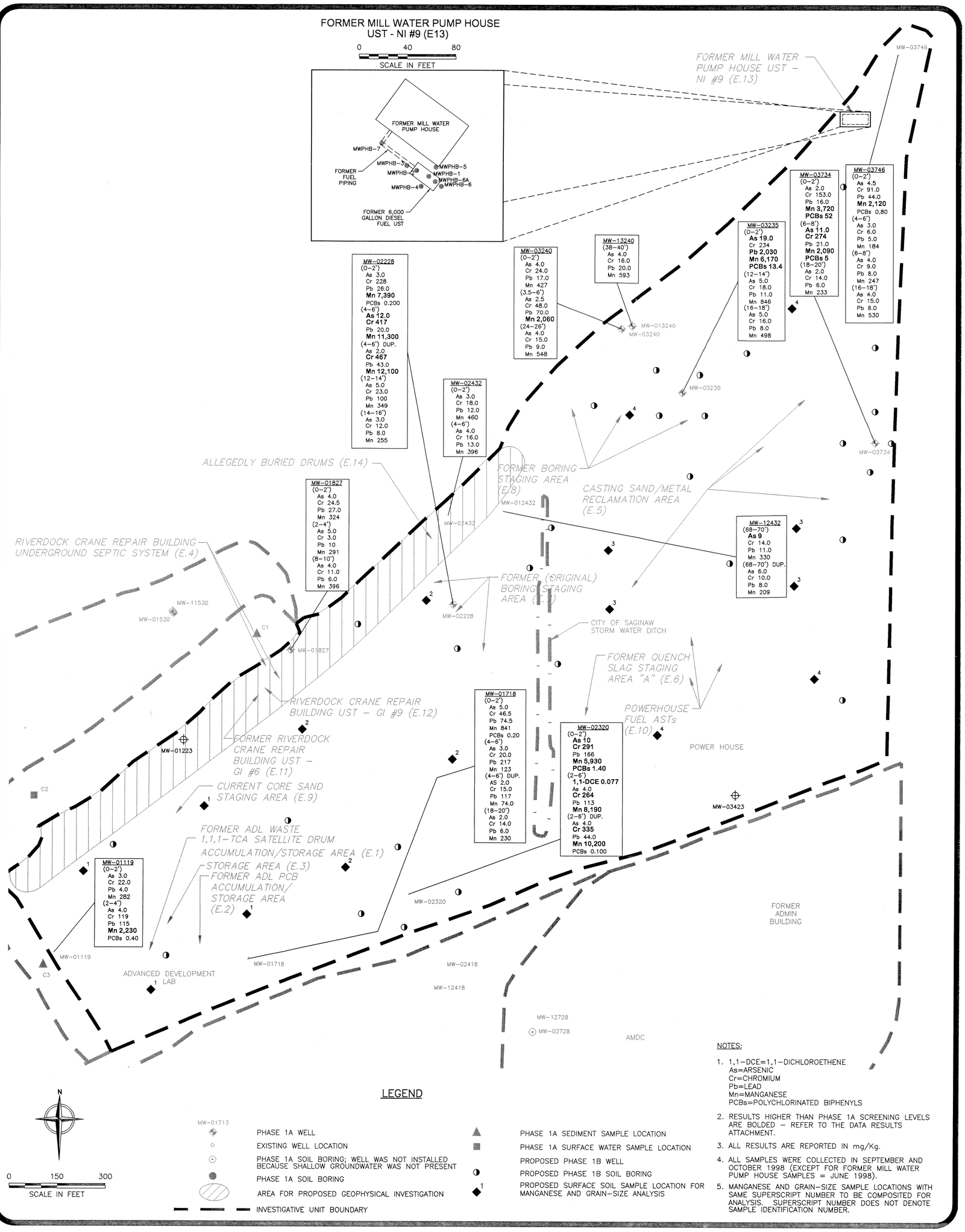
emcon

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN

**#8 MOLD LINE PREVIOUS SAMPLE LOCATIONS AND PHASE 1B PROPOSED SAMPLING LOCATION**

FIGURE NO. **5-4d**
PROJECT NO. 84068-063.009

IMAGE Files: <Xs Images>
XREF Files: Nov-cont.dwg
N:\DWG\GMSAGINAW\84068063\VOL1\dgn\m01.dwg Rel: 16/Apr/99 03:31pm tekilmore
Softdesk Project: N:\S95SA\PROJ\J063078 Dimscale: 0 Uscale: 1 Paltscale: 1
1" 1/2" 0" 1"




NOTES:

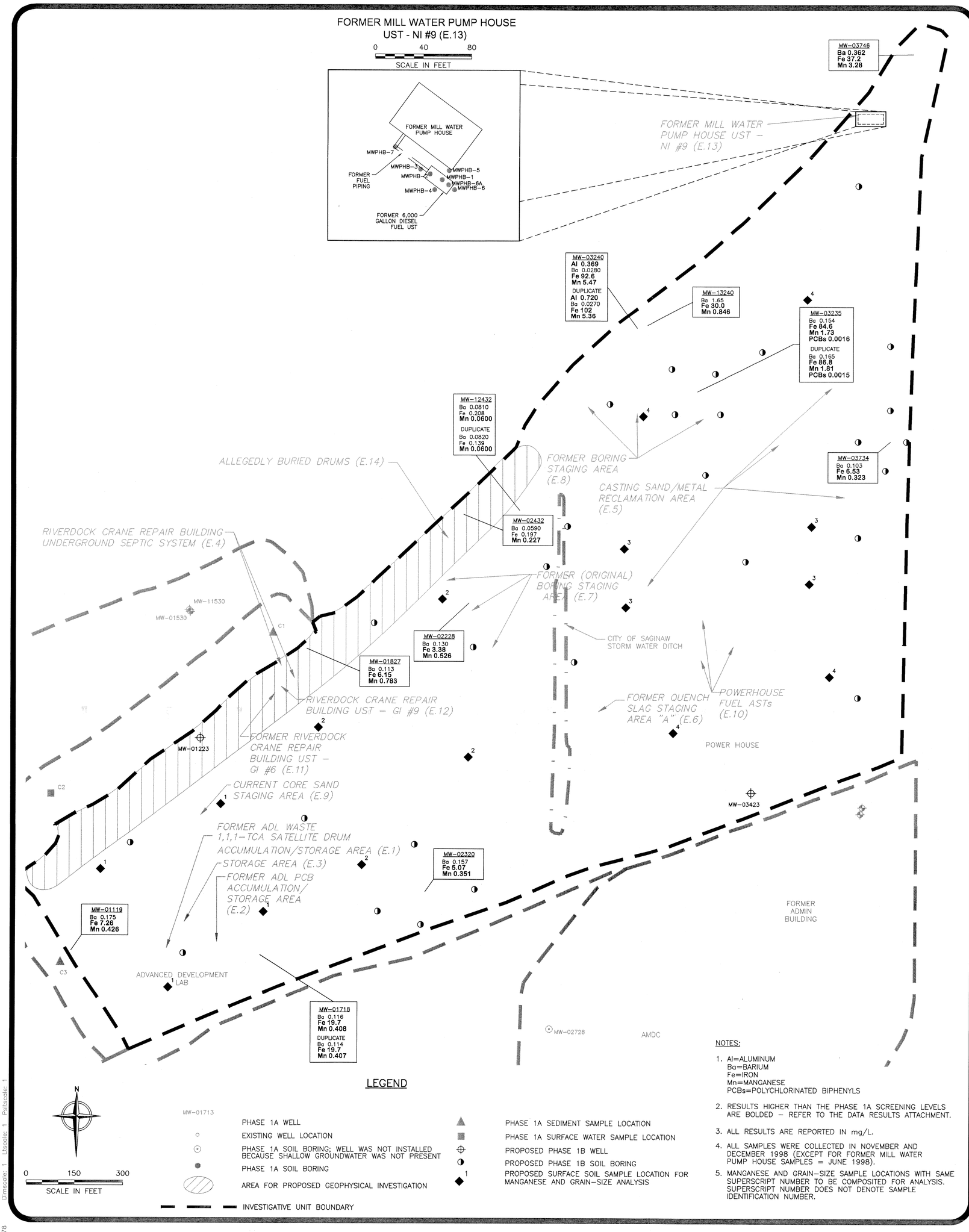
1. 1,1-DCE=1,1-DICHLOROETHENE
   As=ARSENIC
   Cr=CHROMIUM
   Pb=LEAD
   Mn=MANGANESE
   PCBs=POLYCHLORINATED BIPHENYLS
2. RESULTS HIGHER THAN PHASE 1A SCREENING LEVELS ARE BOLDED - REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/Kg.
4. ALL SAMPLES WERE COLLECTED IN SEPTEMBER AND OCTOBER 1998 (EXCEPT FOR FORMER MILL WATER PUMP HOUSE SAMPLES = JUNE 1998).
5. MANGANESE AND GRAIN-SIZE SAMPLE LOCATIONS WITH SAME SUPERSCRIPT NUMBER TO BE COMPOSITED FOR ANALYSIS. SUPERSCRIPT NUMBER DOES NOT DENOTE SAMPLE IDENTIFICATION NUMBER.

EMCON

DATE 3/30/00
DWN. JCB
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-5a
## INVESTIGATIVE UNIT E
## SOIL PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Grn_v3.dwg Wed, 19/Apr/00 01:17pm tskidmore
Dimscale: 0 Ltscale: 1 Plotscale: 1
N:\DWG\GMSAGINAW\84068063\009\Nagms-05.dwg
Software Project: AUTOCAD VRO3 083078




EMCON

DATE 3/30/00
DWN. JCB
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-5b
# INVESTIGATIVE UNIT E
# GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Grn_3.dwg Wed, 19/Apr/00 01:41pm tskidmore
Dimscale= 1 Linscale= 1 Plotscale= 1
N:\DWG\GM54GNAW\84068063\009\Nagms-15.dwg
Software: Project: AUTOCAD (R14) 053078

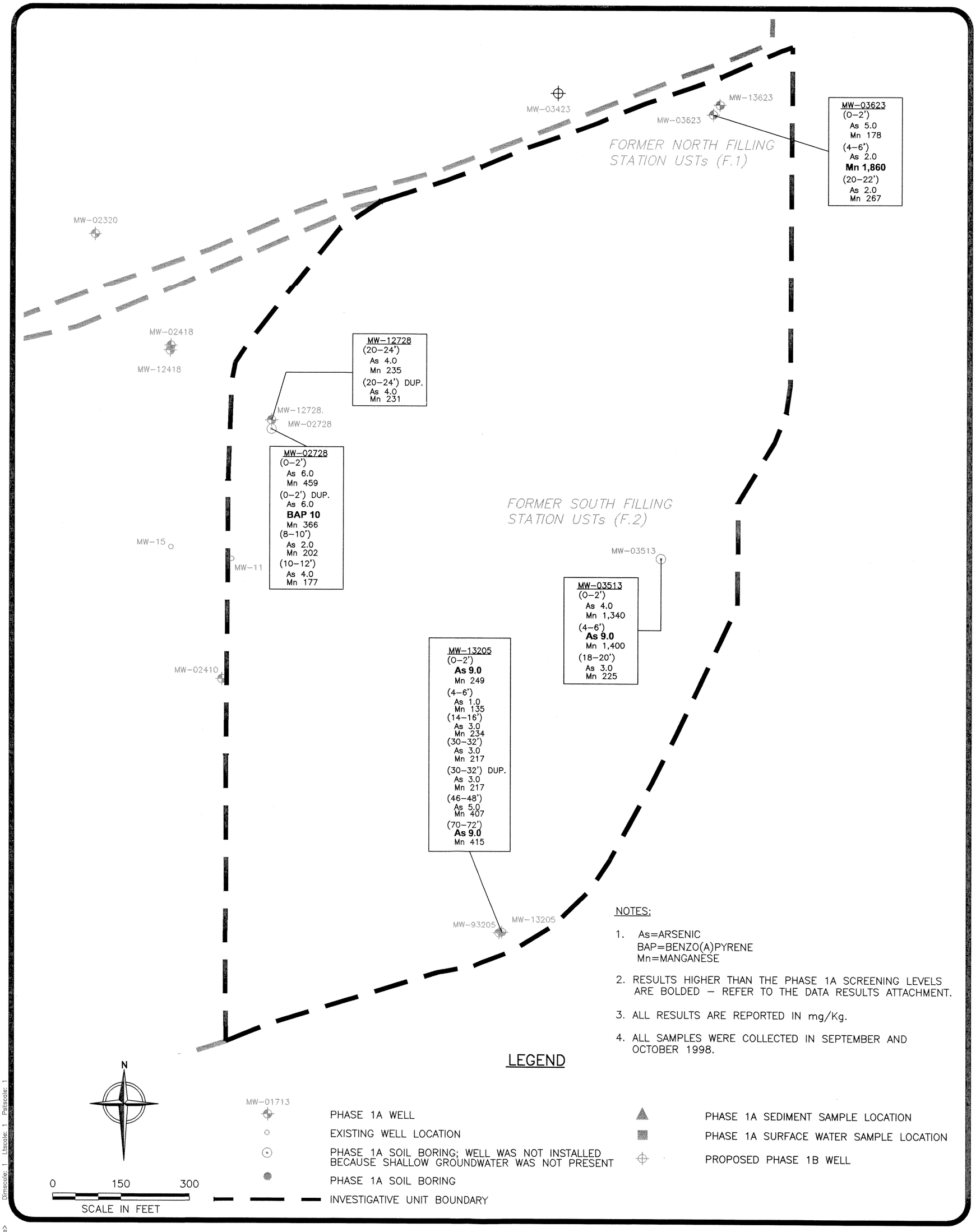



IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg Tue, 18/Apr/00 09:49am tskidmore
N:\DWG\GMSAGINAW\84068063\009\Nagms-06.dwg Dimscale: 1 Ltscale: 1 Pelscale: 1
Softdesk Project: N:\SDSK\PROJ\<none>

EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-6a
INVESTIGATIVE UNIT F

SOIL PHASE 1A
SCREENING RESULTS

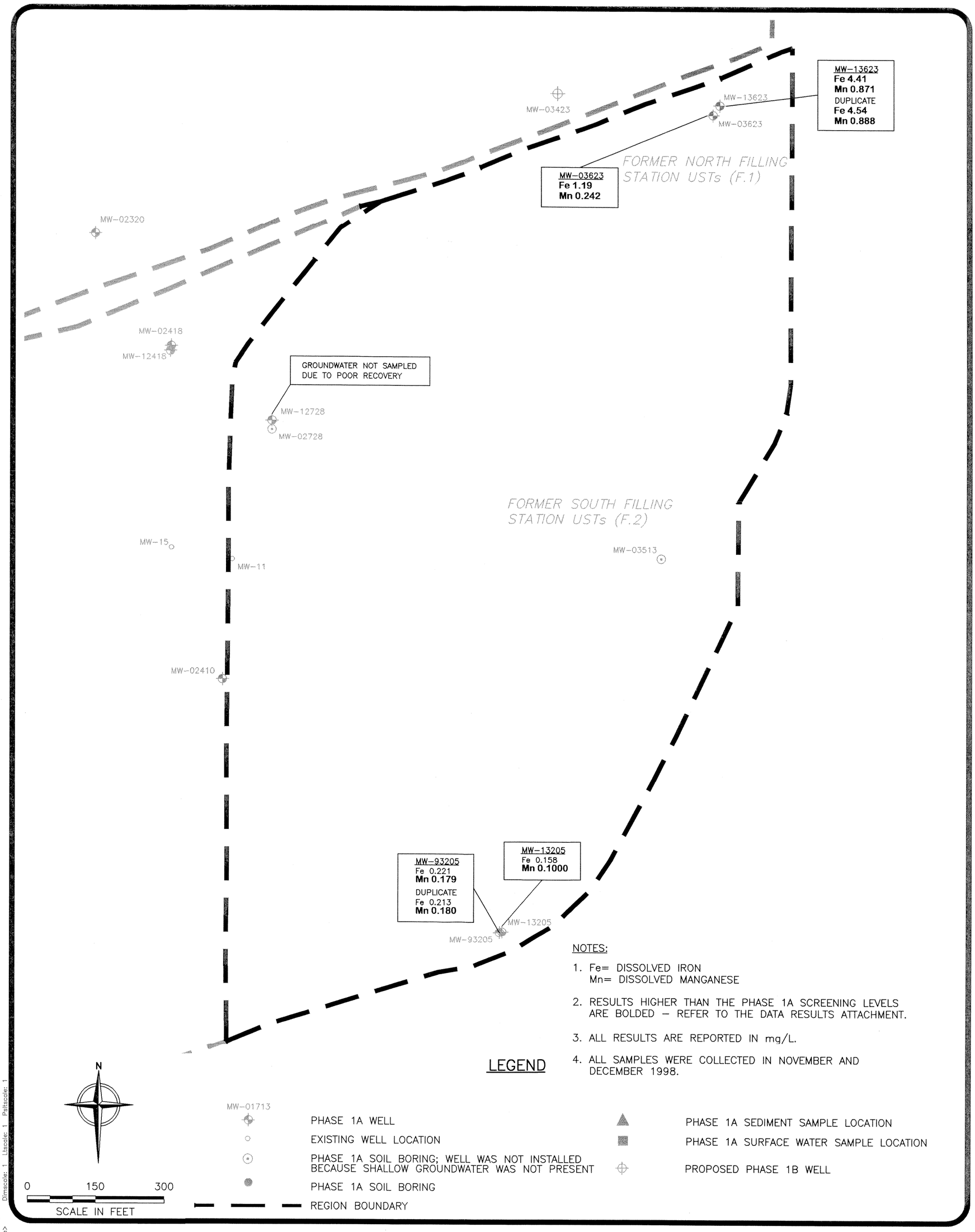



IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
Dimscale: 1 Ltscale: 1 Psltscale: 1
N:\DWG\GMSAGINAW\84068063\009\Nagms-16.dwg Mon, 17/Apr/00 04:04pm tskidmore
Softdesk Project: N:\SDSK\PROJ\<none>

emcon

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-6b
INVESTIGATIVE UNIT F

GROUNDWATER PHASE 1A SCREENING RESULTS

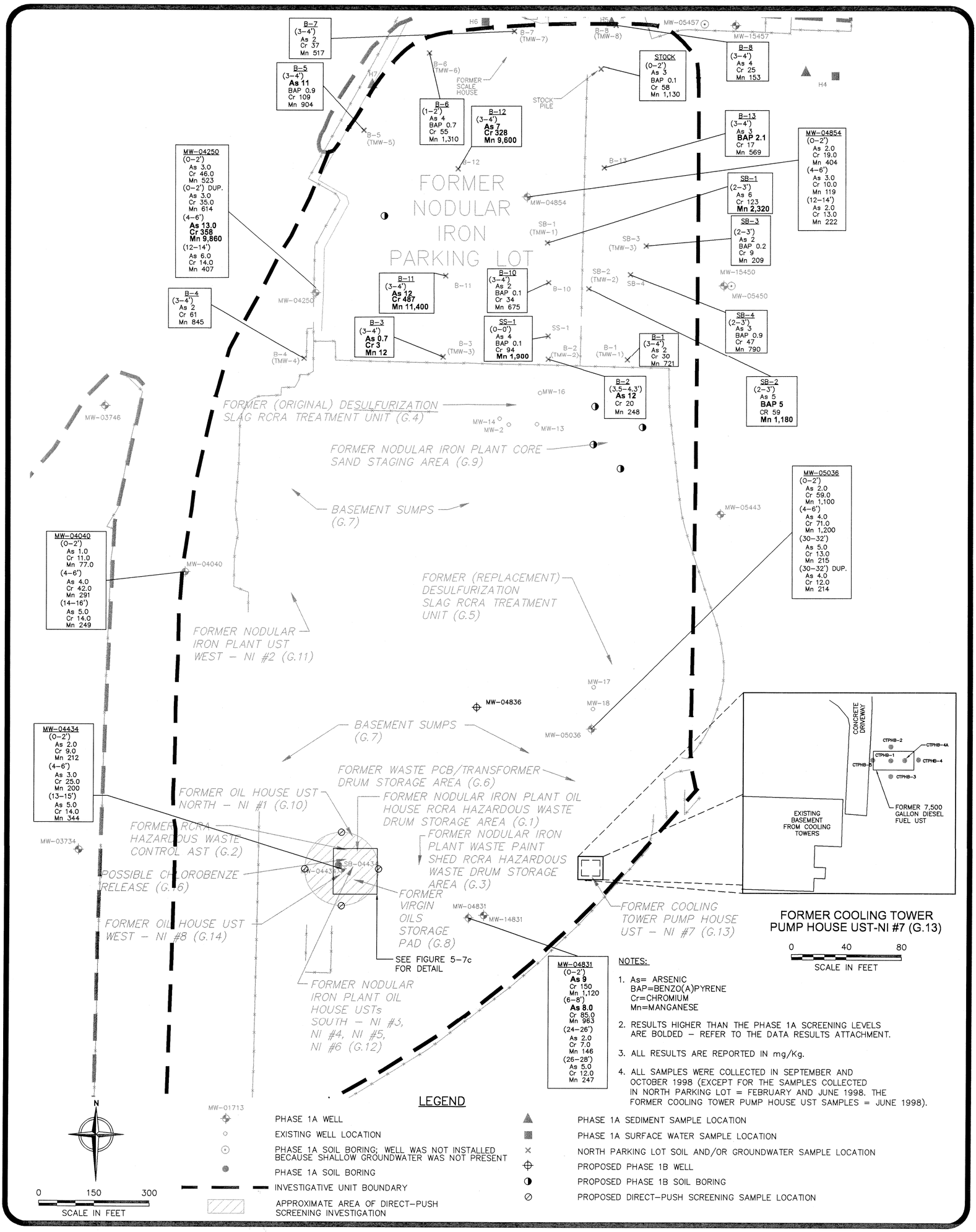
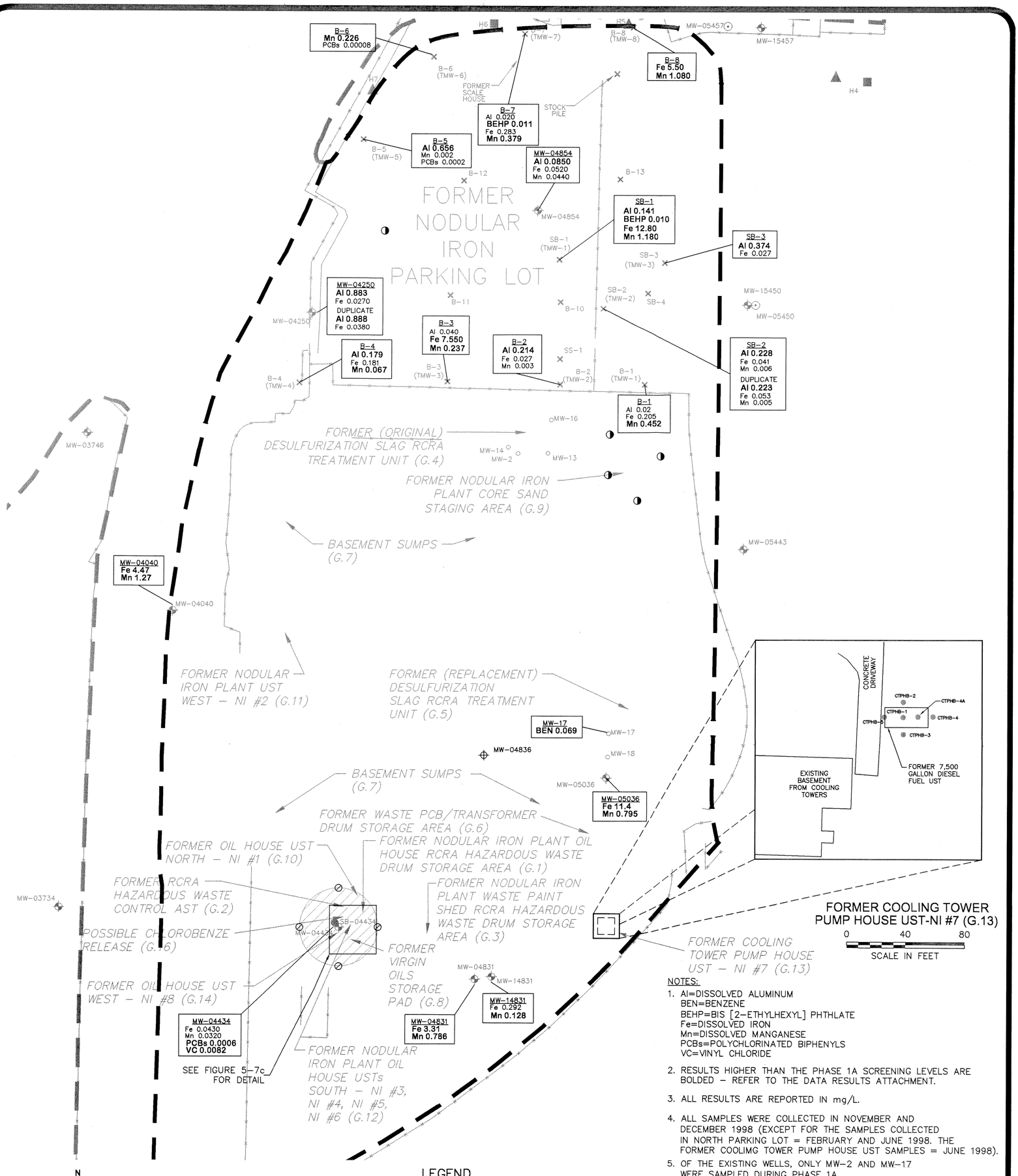



IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\CMSAGNWM\84068063\009\Nagms-07.dwg Wed, 19/Apr/00 09:07am jbatzkiel
Softdesk Project: N:\SDSK\PROJ\<none> Dimscale: 1 Ltscale: 1 Paltscale: 1

EMCON

DATE 3/28/00
DWN. JCB
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-7a
INVESTIGATIVE UNIT G
SOIL PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS




NOTES:

1. Al=DISSOLVED ALUMINUM
   BEN=BENZENE
   BEHP=BIS [2-ETHYLHEXYL] PHTHLATE
   Fe=DISSOLVED IRON
   Mn=DISSOLVED MANGANESE
   PCBs=POLYCHLORINATED BIPHENYLS
   VC=VINYL CHLORIDE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED - REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998 (EXCEPT FOR THE SAMPLES COLLECTED IN NORTH PARKING LOT = FEBRUARY AND JUNE 1998. THE FORMER COOLIMG TOWER PUMP HOUSE UST SAMPLES = JUNE 1998).
5. OF THE EXISTING WELLS, ONLY MW-2 AND MW-17 WERE SAMPLED DURING PHASE 1A.

LEGEND

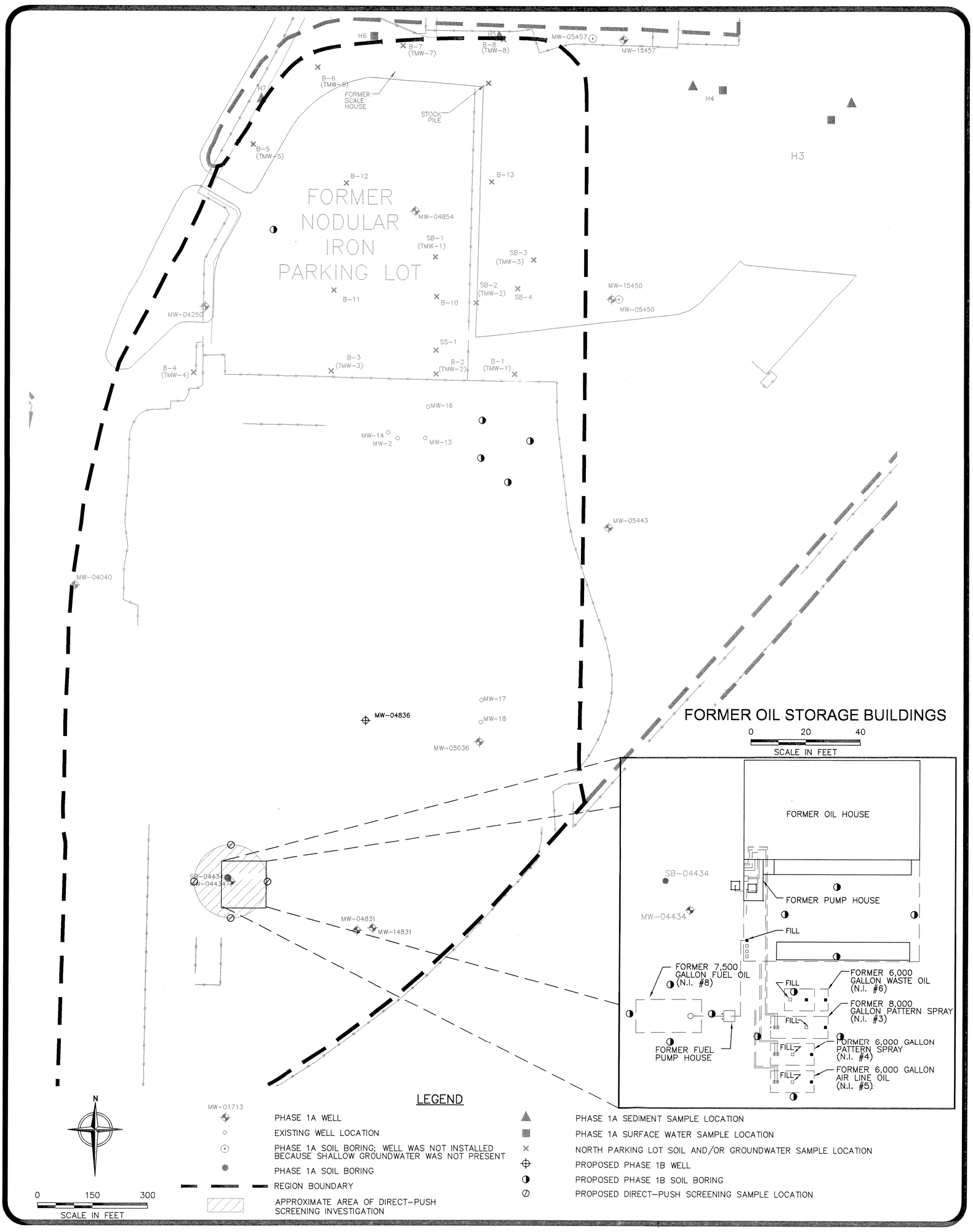
- MW-01713 — PHASE 1A WELL
- EXISTING WELL LOCATION
- PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT
- PHASE 1A SOIL BORING
- INVESTIGATIVE UNIT BOUNDARY
- APPROXIMATE AREA OF DIRECT-PUSH SCREENING INVESTIGATION
- PHASE 1A SEDIMENT SAMPLE LOCATION
- PHASE 1A SURFACE WATER SAMPLE LOCATION
- NORTH PARKING LOT SOIL AND/OR GROUNDWATER SAMPLE LOCATION
- PROPOSED PHASE 1B WELL
- PROPOSED PHASE 1B SOIL BORING
- PROPOSED DIRECT-PUSH SCREENING SAMPLE LOCATION

EMCON

DATE 3/28/00
DWN. JCB
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-7b
# INVESTIGATIVE UNIT G
## GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\B4068063\059\Ncgms-17.dwg Wed, 19/Apr/00 02:56pm tskidmore
Softdesk Project: N:\SDSK\PROJ\B63078 Dimscale: 1 Ltscale: 1 Psltscale: 1



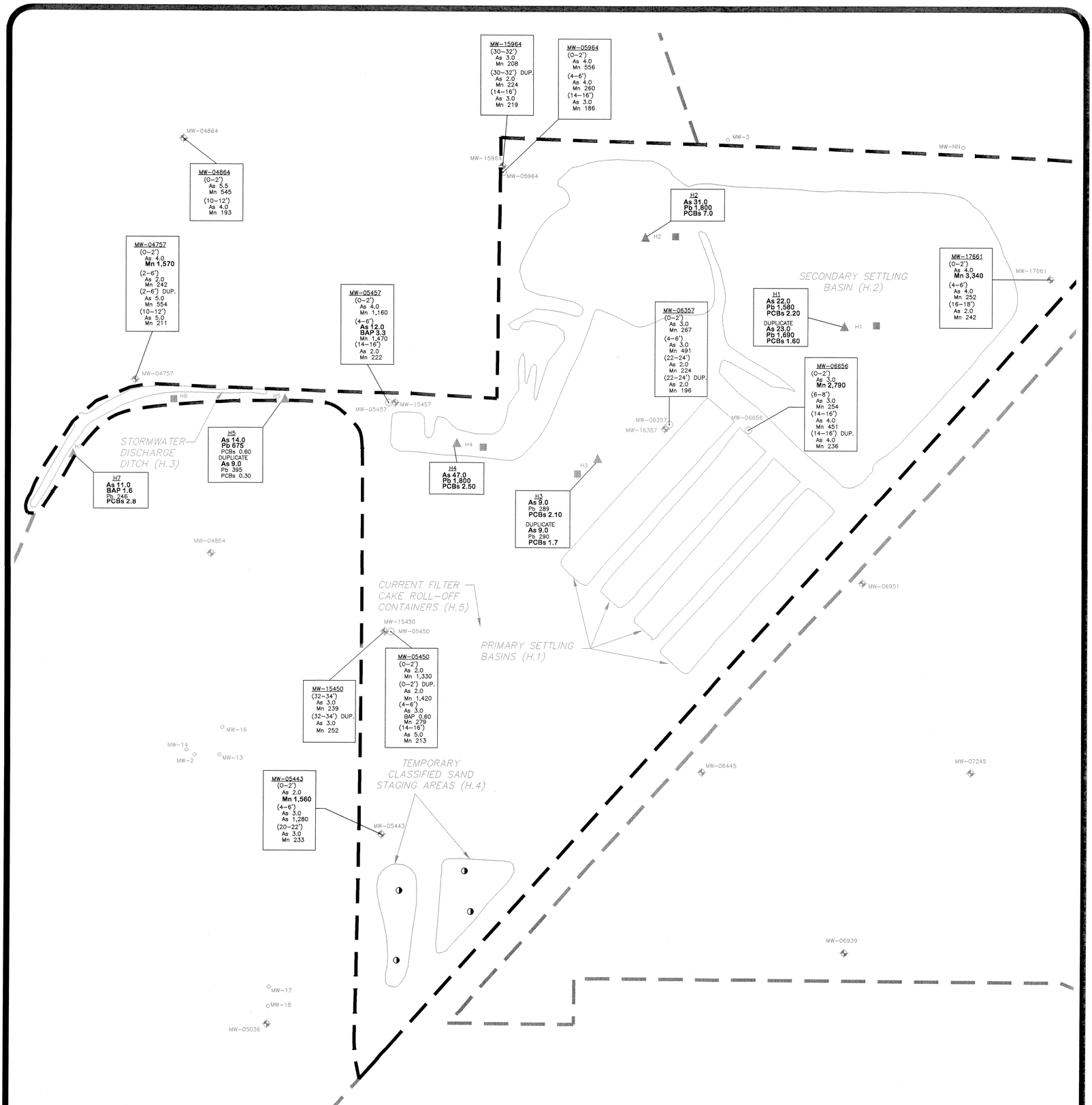

EMCON

DATE 11/29/99
DWN. TSS
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-7c
INVESTIGATIVE UNIT G

PROPOSED SAMPLING LOCATION DETAILS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\OMGATRAN\84068063\003\Mapms-25.dwg Wed, 19/Apr/00 04:21pm taldmore
Softdesk Project: N:\SOFT\PROJ\85357.8 Dimscale: 1 Llscale: 1 Plotscale: 1

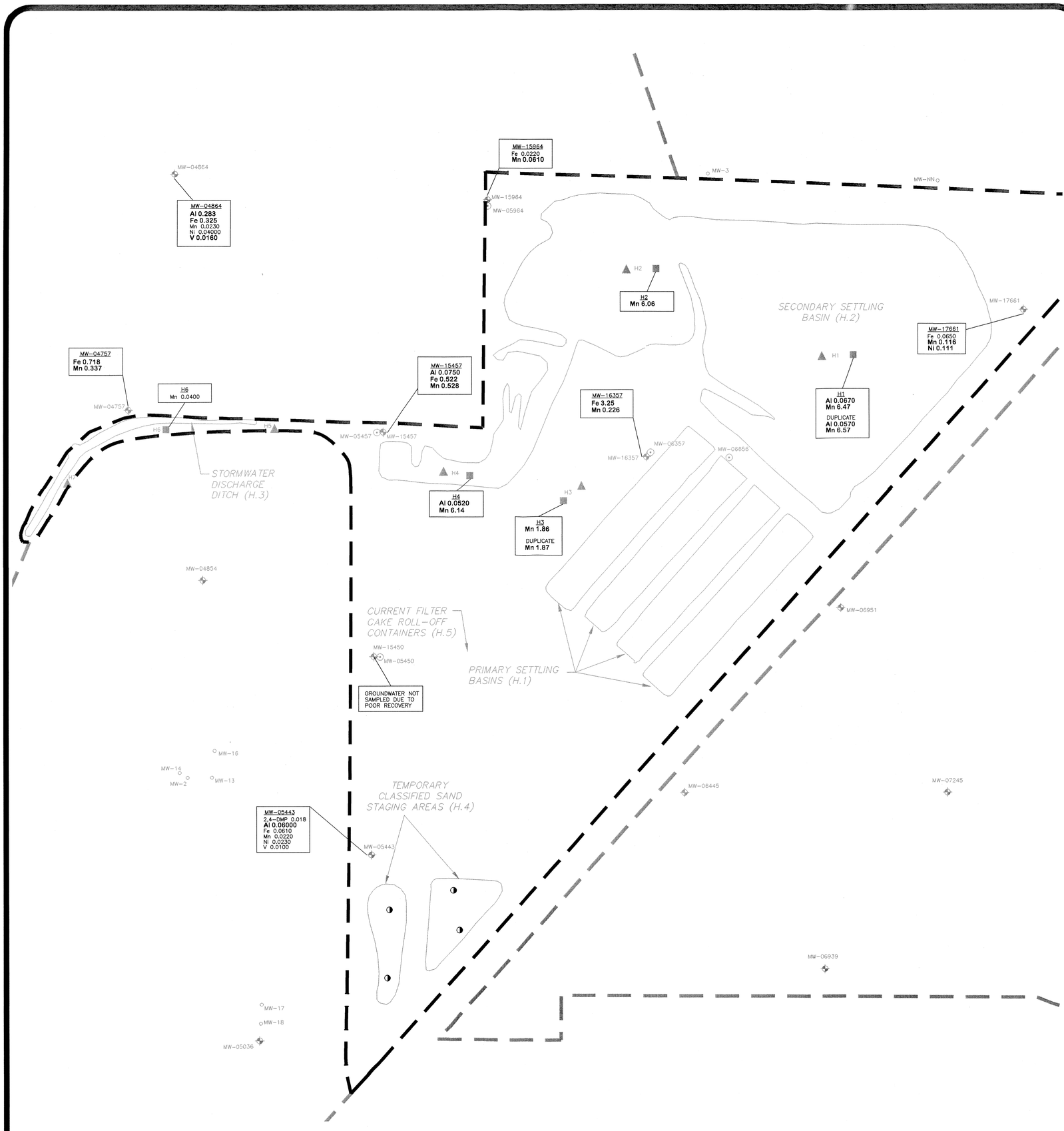



EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-8a
## INVESTIGATIVE UNIT H
## SOIL AND SEDIMENT PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS


IMAGE Files: <No Images>
XREF Files: Gm_x3.dwg
N:\DWG\GMSAGNAW\84068063\009\Vbgms-08.dwg Mon, 17/Apr/00 04:17pm tskidmore
Softdesk Project: N:\SDSK\PROJ\<name> Dimscale: 1 Ltscale: 1 Paltscale: 1




LEGEND

- PHASE 1A WELL
- EXISTING WELL LOCATION
- PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT
- PHASE 1A SOIL BORING
- INVESTIGATIVE UNIT BOUNDARY
- PHASE 1A SEDIMENT SAMPLE LOCATION
- PHASE 1A SURFACE WATER SAMPLE LOCATION
- PROPOSED PHASE 1B SOIL BORING

N

0 150 300

SCALE IN FEET

NOTES:

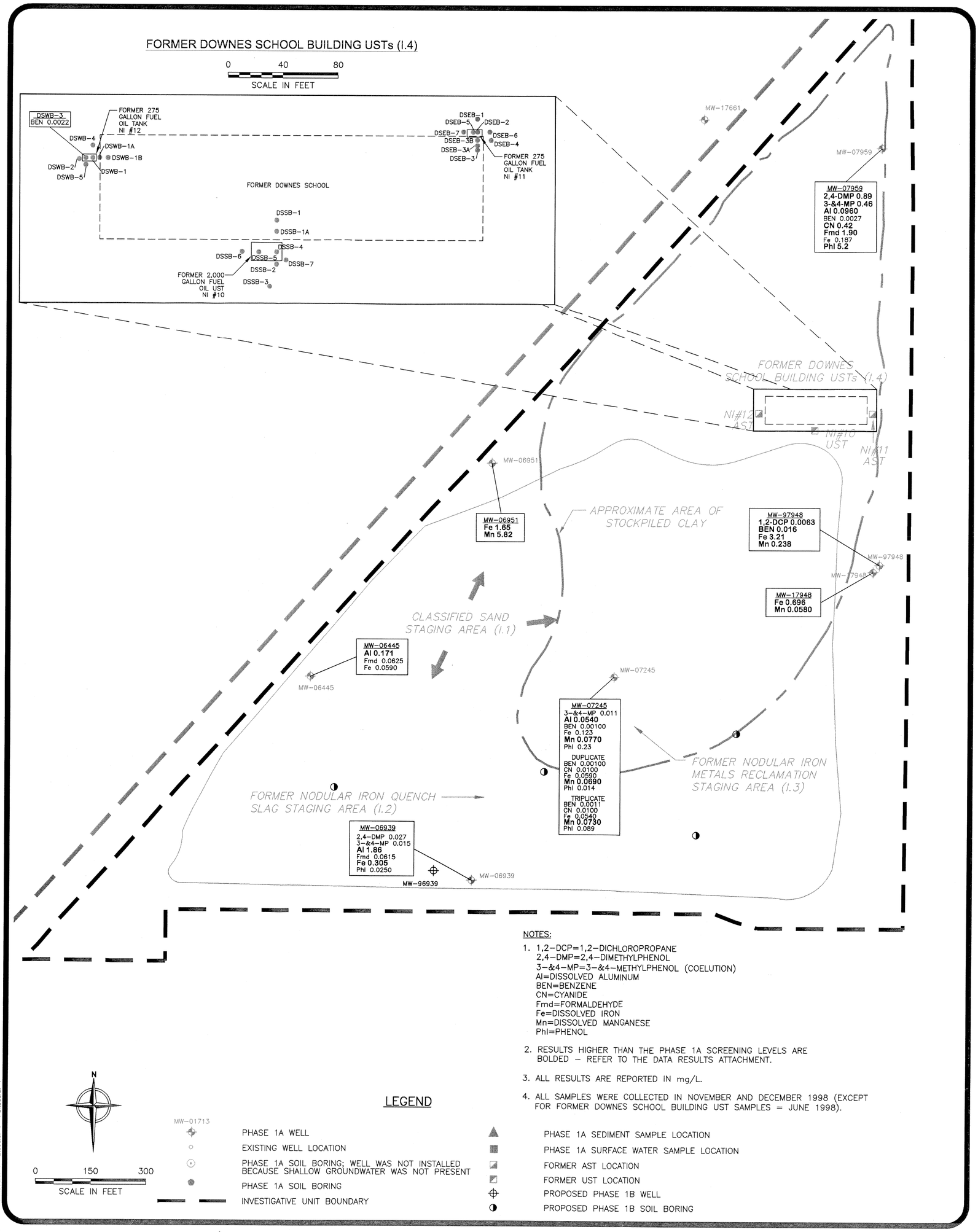
1. AL=DISSOLVED ALUMINUM
   Fe=DISSOLVED IRON
   Mn=DISSOLVED MANGANESE
   Ni=DISSOLVED NICKEL
   V=DISSOLVED VANADIUM
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998.

EMCON

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-8b
# INVESTIGATIVE UNIT H
## GROUNDWATER AND SURFACE WATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGNAW\84068063\009\Nagms-18.dwg Tue, 18/Apr/00 11:36am tskidmore
Softdesk Project: N:\SDSK\PROJ\<none>
Dimscale: 1 Ltscale: 1 Plotscale: 1




NOTES:

1. 1,2-DCP=1,2-DICHLOROPROPANE
   2,4-DMP=2,4-DIMETHYLPHENOL
   3-&4-MP=3-&4-METHYLPHENOL (COELUTION)
   Al=DISSOLVED ALUMINUM
   BEN=BENZENE
   CN=CYANIDE
   Fmd=FORMALDEHYDE
   Fe=DISSOLVED IRON
   Mn=DISSOLVED MANGANESE
   Phl=PHENOL
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN NOVEMBER AND DECEMBER 1998 (EXCEPT FOR FORMER DOWNES SCHOOL BUILDING UST SAMPLES = JUNE 1998).




LEGEND

MW-01713 PHASE 1A WELL

EXISTING WELL LOCATION

PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT

PHASE 1A SOIL BORING

INVESTIGATIVE UNIT BOUNDARY

PHASE 1A SEDIMENT SAMPLE LOCATION

PHASE 1A SURFACE WATER SAMPLE LOCATION

FORMER AST LOCATION

FORMER UST LOCATION

PROPOSED PHASE 1B WELL

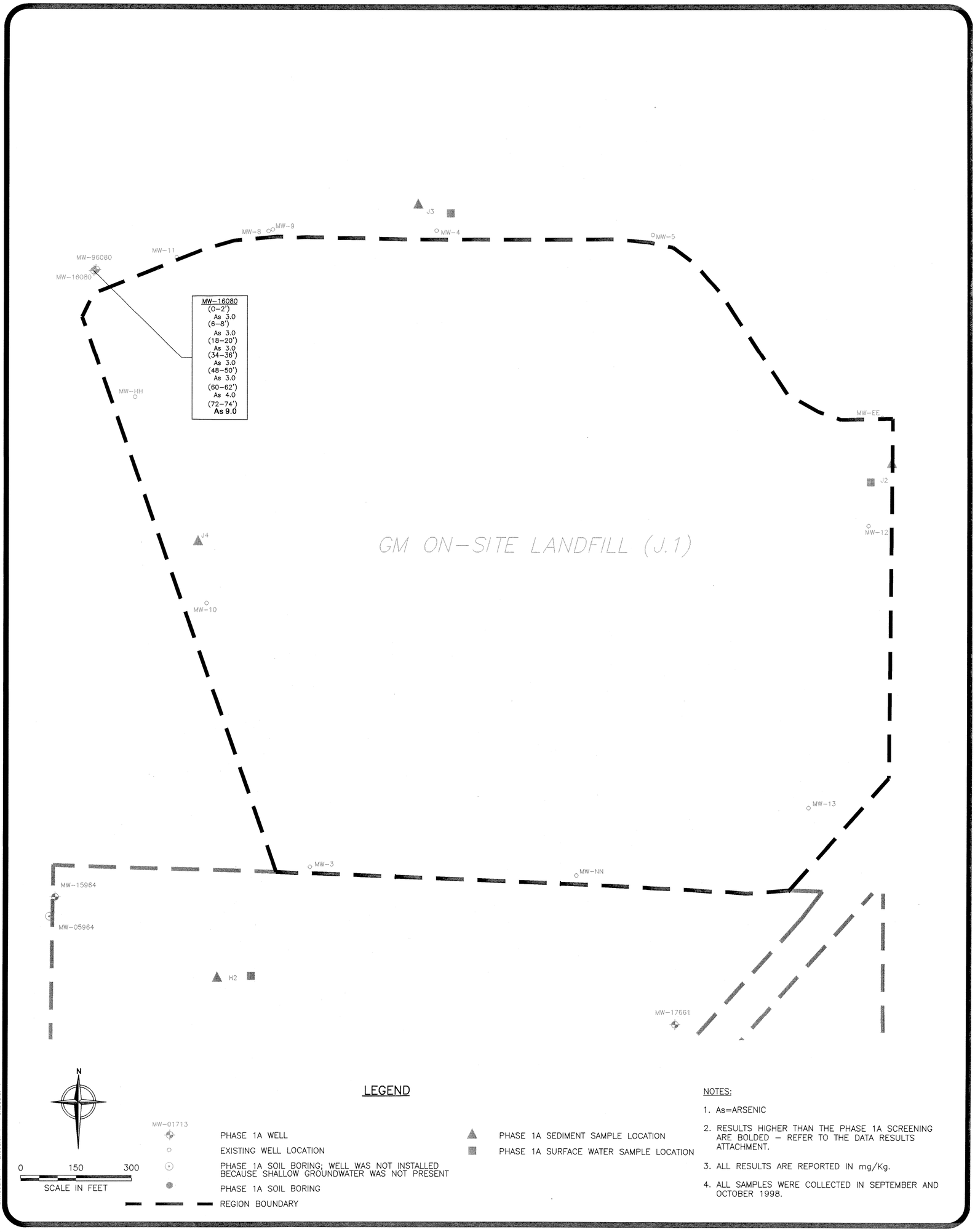
PROPOSED PHASE 1B SOIL BORING

EMCON

DATE 3/28/00
DWN. JCB
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

# FIGURE 5-9b
## INVESTIGATIVE UNIT I
## GROUNDWATER PHASE 1A SCREENING RESULTS AND PHASE 1B PROPOSED SAMPLING LOCATIONS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg Nsgms-19.dwg Wed, 19/Apr/00 03:37pm taskdmore
Dimscale: 1 Ltscale: 1 Plotscale: 1
Softdesk Project: N:\SDSK\PROJ\63078
N:\DWG\GMSAGNAW\84068063\009\



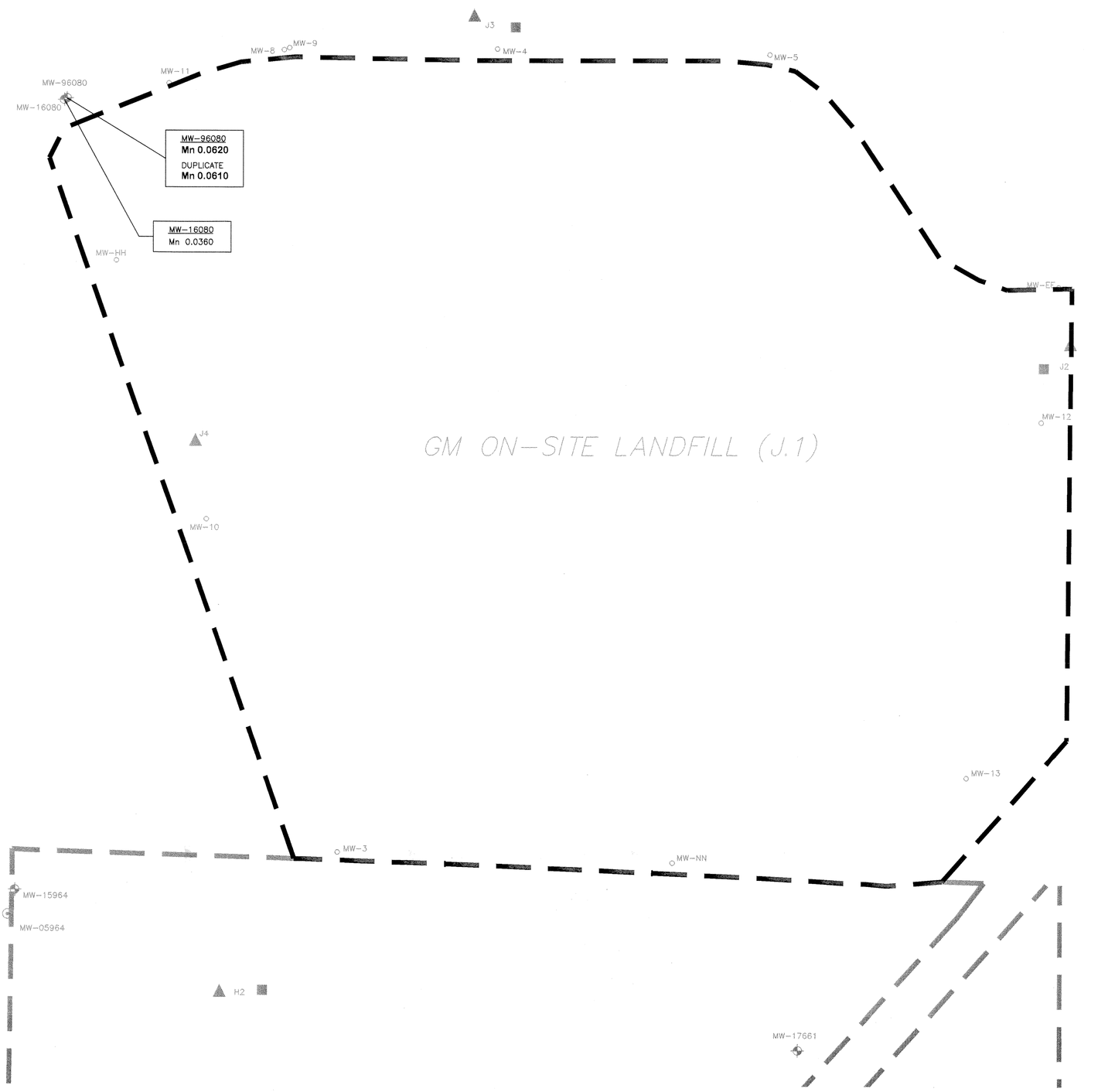

emcon

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-10a
INVESTIGATIVE UNIT J

SOIL PHASE 1A
SCREENING RESULTS

IMAGE Files: <No Images>
XREF Files: <No Xrefs>
N:\DWG\GMSAGINAW\84068063\009\Nagms-10.dwg Tue, 18/Apr/00 10:36am tskidmore
Dimscale: 1 Ltscale: 1 Psltscale: 1
Softdesk Project: N:\SDSK\PROJ\<none>




NOTES:

1. Mn=DISSOLVED MANGANESE
2. RESULTS HIGHER THAN THE PHASE 1A SCREENING LEVELS ARE BOLDED – REFER TO THE DATA RESULTS ATTACHMENT.
3. ALL RESULTS ARE REPORTED IN mg/L.
4. ALL SAMPLES WERE COLLECTED IN SEPTEMBER AND OCTOBER 1998.

N

0 150 300

SCALE IN FEET

LEGEND

MW-01713 PHASE 1A WELL

EXISTING WELL LOCATION

PHASE 1A SOIL BORING; WELL WAS NOT INSTALLED BECAUSE SHALLOW GROUNDWATER WAS NOT PRESENT

PHASE 1A SOIL BORING

INVESTIGATIVE UNIT BOUNDARY

PHASE 1A SEDIMENT SAMPLE LOCATION

PHASE 1A SURFACE WATER SAMPLE LOCATION

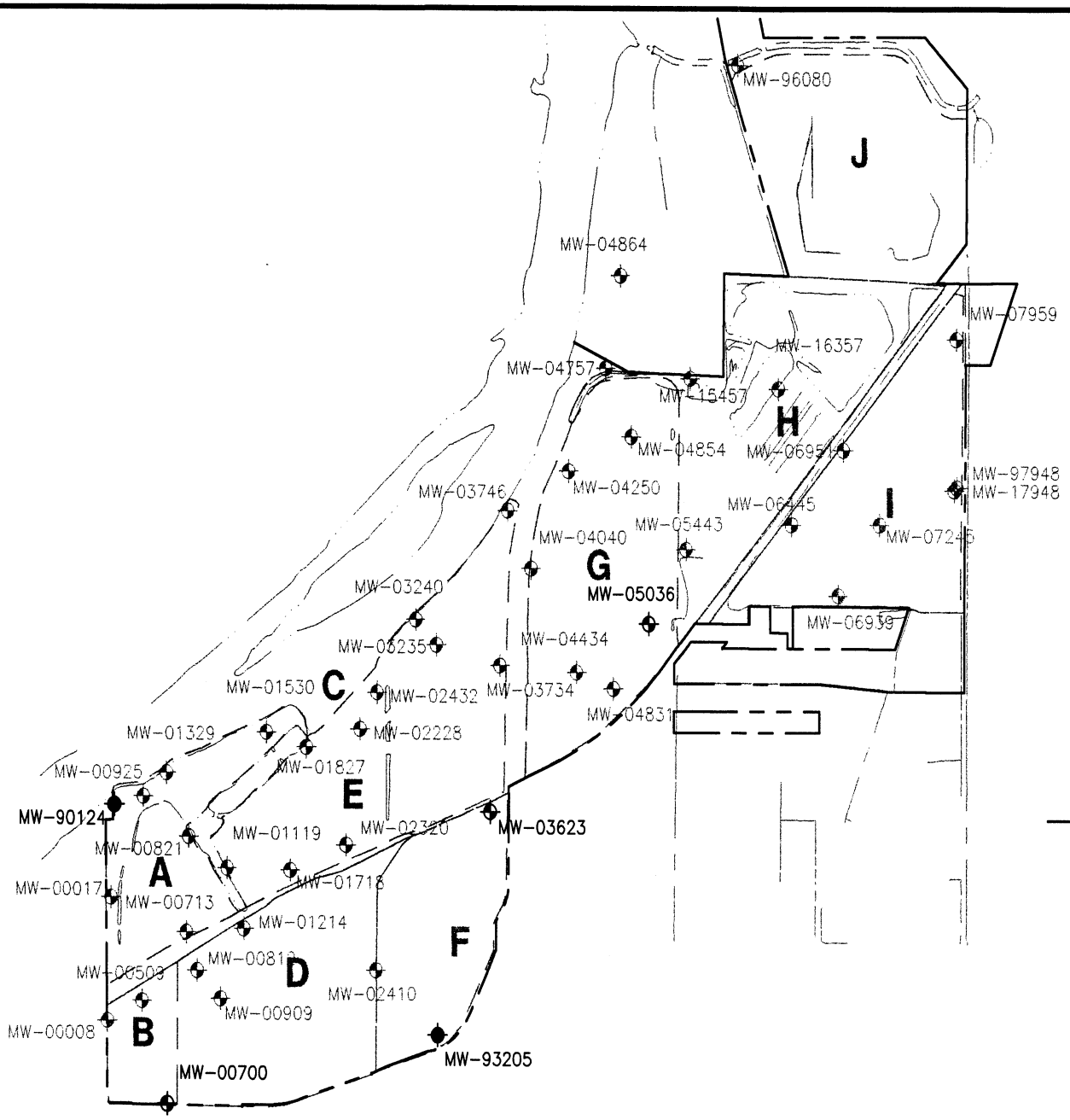
emcon

DATE 6/4/99
DWN. AMC
APPR. BKS
REVIS.
PROJECT NO.
84068-063.009

FIGURE 5-10b
INVESTIGATIVE UNIT J

GROUNDWATER PHASE 1A SCREENING RESULTS

IMAGE Files: <No Images>
XREF Files: Gm_v3.dwg
N:\DWG\GMSAGINAW\84068063\009\tsgms-20.dwg Tue, 18/Apr/00 11:04am tskidmore
Softtask Project: N:\SDSK\PROJ\<none>
Dimscale: 1 Ltscale: 1 Psltscale: 1




N

## LEGEND

| | |
|---|---|
| MW-02432 | PHASE IA RFI SOIL BORING/ MONITORING WELL LOCATION |
| MW-00700 | UPPER SATURATED ZONE BACKGROUND GROUNDWATER QUALITY WELL |
| MW-93205 | SUBGLACIAL SAND/BEDROCK AQUIFER BACKGROUND GROUNDWATER QUALITY WELL |
| | APPROXIMATE PROPERTY BOUNDARY |

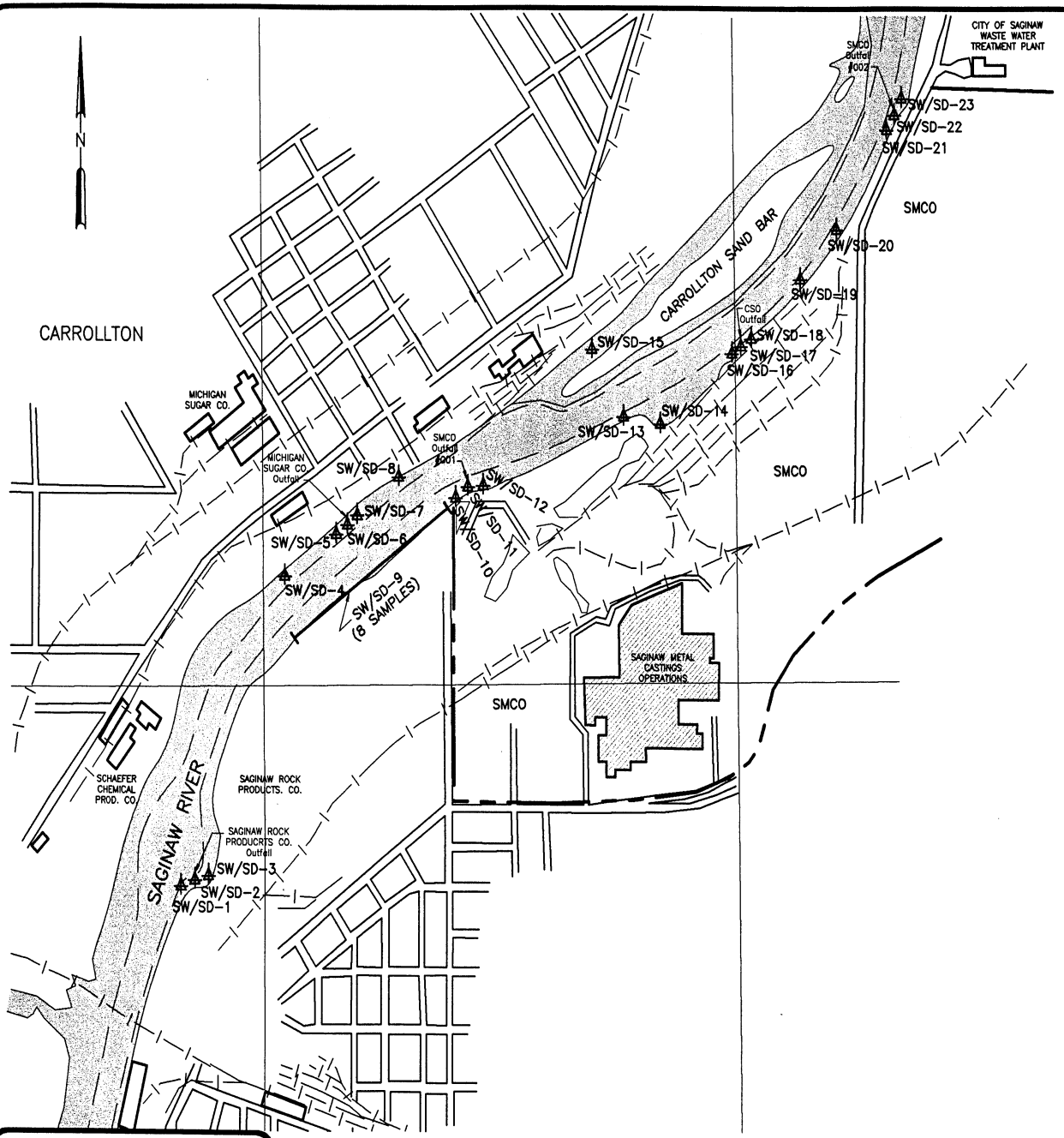
EMCON

0 1000 2000
SCALE IN FEET

DATE 11/29/99
DWN TSS
APP BKS
REV
PROJECT NO. 795283

**FIGURE 5-11**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW MICHIGAN
**MONITORING WELLS FOR BACKGROUND GROUNDWATER QUALITY**

IMAGE Files: SMCO.tif
XREF Files: <No Xrefs>
N:\DWG\GMSAGINAW\84068063\009\Nagmge30.DWG Tue, 18/Apr/00 02:58pm tskidmore
Softdesk Project: N:\SDSK\PROJ\84068063 Dimscale: 1 Ltscale: 0.5 Paltscale: 1
1" 1" 0" 1/2" 1"




## LEGEND:

- SW/SD-23 — PROPOSED SAMPLE STATION
- NAVIGATIONAL CHANNEL
- SITE BOUNDARY

0 600 1200

SCALE IN FEET
APPROXIMATE

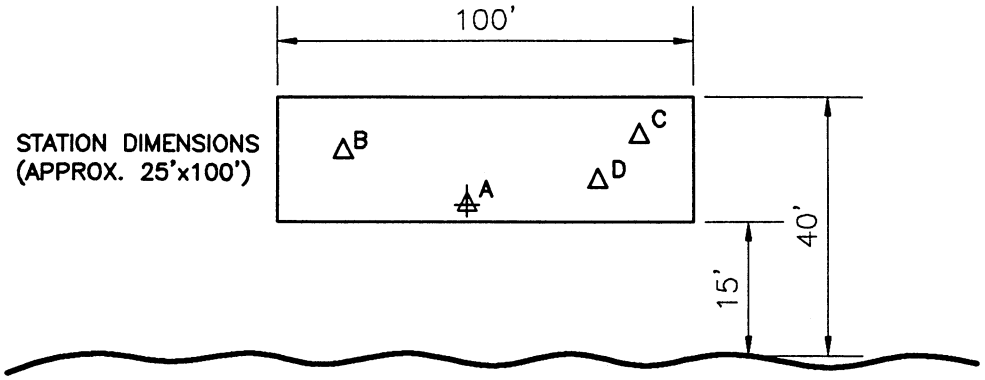
SOURCE:

MAP ADAPTED FROM NOAA SAGINAW RIVER NAVIGATIONAL CHART DATED 1998

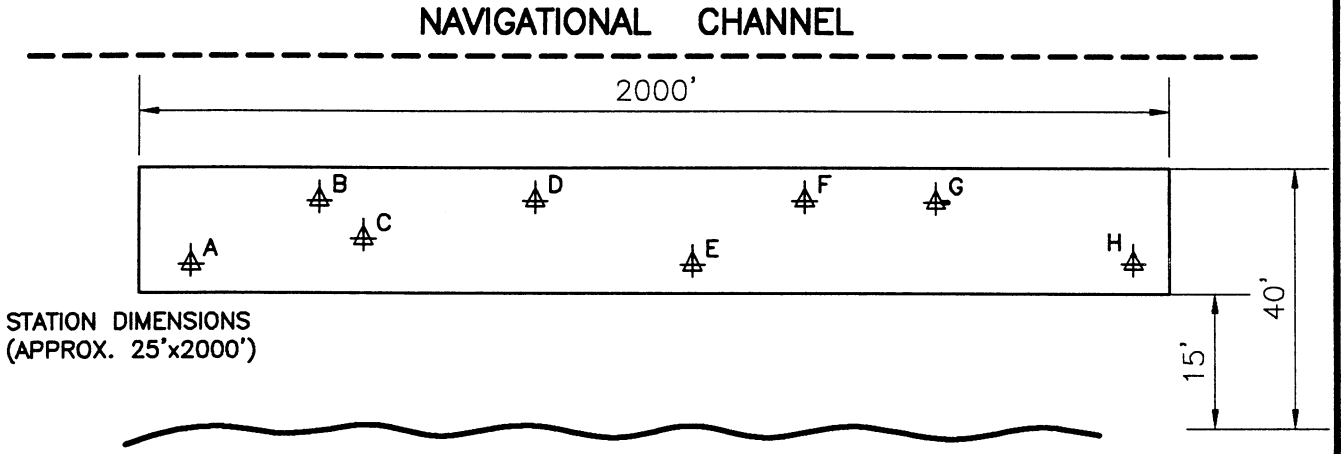
DATE 12/99
DWN AK
APP TS
REV
PROJECT NO. 795283

**FIGURE 5-12**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN
**PROPOSED**
**SAGINAW RIVER SAMPLE LOCATIONS**

IMAGE Files: <No Images>
XREF Files: magmbd02.dwg 11x17.dwg magmb-01
N:\DWG\GMSAGINAW\84068063\009\magmF-01.dwg Wed, 19/Apr/00 09:19am tskidmore
Softdesk Project: N:\SDSK\PROJ\<none> Dimscale: 1 Ltscale: 1 Psltscale: 1
1" 1" 1" 1/2" 0"




**TYPICAL SAMPLE STATION**




**BACKGROUND STATION SW/SD-9**

**LEGEND:**

$\Delta^F$ SURFACE WATER AND SEDIMENT SAMPLE

$\Delta^B$ SEDIMENT SAMPLE LOCATION WITHIN STATION

NOT TO SCALE

emcon

| | |
|---|---|
| DATE | 4/2000 |
| DWN | AK |
| APP | RMK |
| REV | |
| PROJECT NO. | 795283 |

**FIGURE 5-13**
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS
SAGINAW, MICHIGAN
**SCHEMATIC OF**
**RIVER SAMPLING STATIONS**

IMAGE Files: <No Images>
XREF Files: magmbd01.dwg 8X11P.dwg
N:\DWG\GMSAGINAW\795283\mahwah\magmF-03.dwg Wed, 12/Apr/00 12:47pm pvillano
Softdesk Project: N:\SDSK\PROJ\795277 Dimscale: 1 Ltscale: 0.5 Psltscale: 1
1" 1/2" 0" 1"

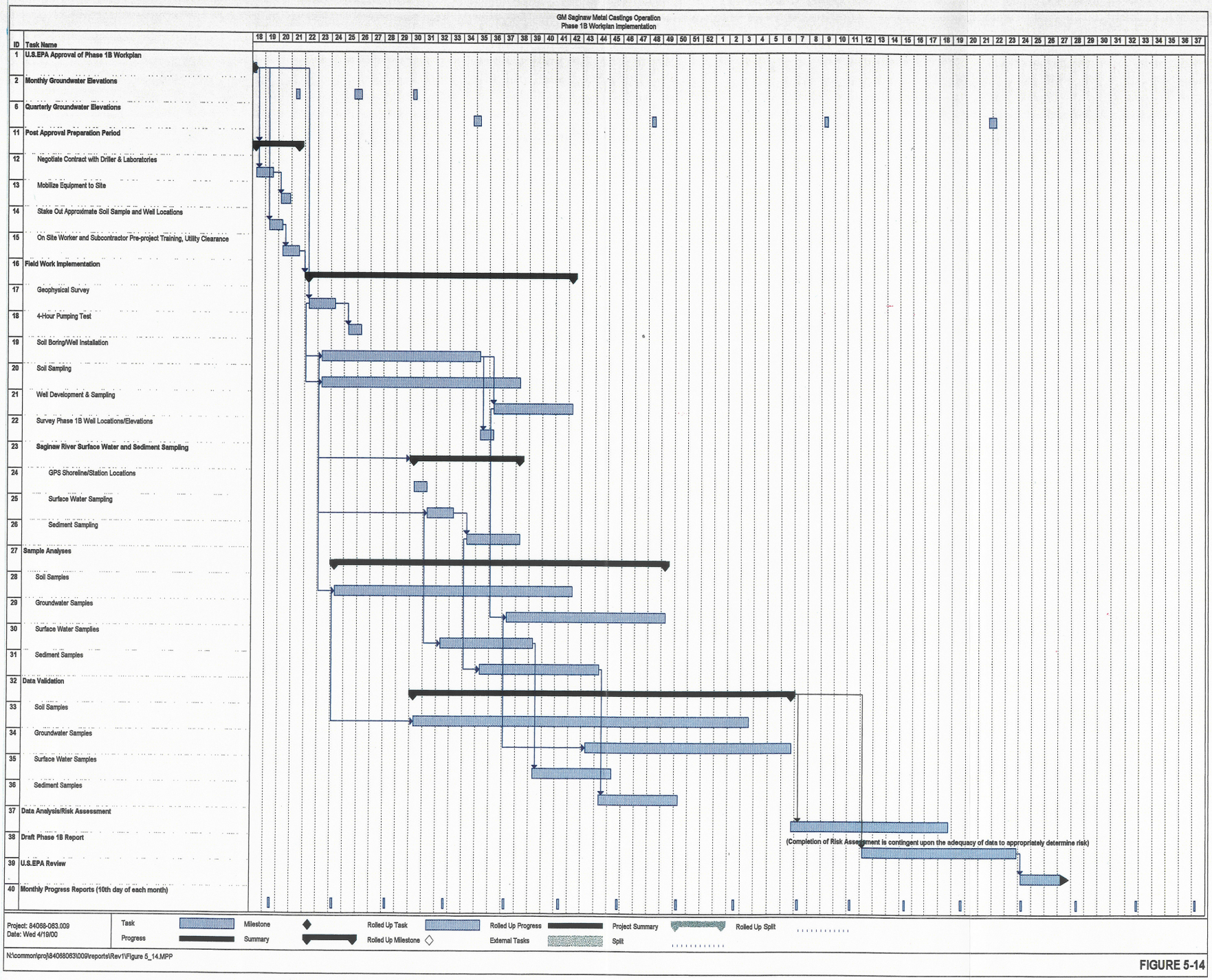

GM Saginaw Metal Castings Operation
Phase 1B Workplan Implementation
ID
Task Name
1 U.S.EPA Approval of Phase 1B Workplan
2 Monthly Groundwater Elevations
6 Quarterly Groundwater Elevations
11 Post Approval Preparation Period
12 Negotiate Contract with Driller & Laboratories
13 Mobilize Equipment to Site
14 Stake Out Approximate Soil Sample and Well Locations
15 On Site Worker and Subcontractor Pre-project Training, Utility Clearance
16 Field Work Implementation
17 Geophysical Survey
18 4-Hour Pumping Test
19 Soil Boring/Well Installation
20 Soil Sampling
21 Well Development & Sampling
22 Survey Phase 1B Well Locations/Elevations
23 Saginaw River Surface Water and Sediment Sampling
24 GPS Shoreline/Station Locations
25 Surface Water Sampling
26 Sediment Sampling
27 Sample Analyses
28 Soil Samples
29 Groundwater Samples
30 Surface Water Samples
31 Sediment Samples
32 Data Validation
33 Soil Samples
34 Groundwater Samples
35 Surface Water Samples
36 Sediment Samples
37 Data Analysis/Risk Assessment
38 Draft Phase 1B Report
39 U.S.EPA Review
40 Monthly Progress Reports (10th day of each month)
(Completion of Risk Assessment is contingent upon the adequacy of data to appropriately determine risk)
Project: 84068-063.009
Date: Wed 4/19/00
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split
N:\common\proj\84068063\009\reports\Rev1\Figure 5_14.MPP

FIGURE 5-14

**Table 2-1**
**Summary of Monitoring Wells Installed**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Well Installed (Yes/No) | Well Objective | Objective Met (Yes/No) | Comments |
|---|---|---|---|---|
| **Upper Water-Bearing Zone Wells** | | | | |
| MW-00000 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-00008 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00017 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00124 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00509 | Yes | Monitor perched groundwater if present | Yes | Moved 180 feet south-southeast of proposed location |
| MW-00700 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00713 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00812* | Yes | Monitor perched groundwater if present | Yes | Added at EPA's request to characterize groundwater in Scrap Equipment Storage Area (a.k.a. the Boneyard, AOI D.7) |
| MW-00821 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00909 | Yes | Monitor perched groundwater if present | Yes | |
| MW-00925 | Yes | Monitor perched groundwater if present | Yes | Moved 430 feet southwest of proposed location |
| MW-01901 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-01119 | Yes | Monitor perched groundwater if present | Yes | |
| MW-01214 | Yes | Monitor perched groundwater if present | Yes | |
| MW-01329 | Yes | Monitor perched groundwater if present | Yes | Moved 840 feet west-southwest of proposed location |
| MW-01530* | Yes | Monitor perched groundwater if present | Yes | Replacement for well MW-01329 |
| MW-01718 | Yes | Monitor perched groundwater if present | Yes | |
| MW-01827 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02228 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02320 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02410 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02418 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02432 | Yes | Monitor perched groundwater if present | Yes | |
| MW-02728 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-03205 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-03235 | Yes | Monitor perched groundwater if present | Yes | |
| MW-03240 | Yes | Monitor perched groundwater if present | Yes | |
| MW-03513 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-03623 | Yes | Monitor perched groundwater if present | Yes | |
| MW-03734 | Yes | Monitor perched groundwater if present | Yes | |

**Table 2-1**
**Summary of Monitoring Wells Installed**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Well Installed (Yes/No) | Well Objective | Objective Met (Yes/No) | Comments |
|---|---|---|---|---|
| **Upper Water-Bearing Zone Wells (continued)** | | | | |
| MW-03746 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04040 | Yes | Monitor perched groundwater if present | Yes | Moved 240 feet north of proposed location |
| MW-04250 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04434 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04757 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04831 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04854 | Yes | Monitor perched groundwater if present | Yes | |
| MW-04864 | Yes | Monitor perched groundwater if present | Yes | |
| MW-05036* | Yes | Monitor perched groundwater if present | Yes | Added at EPA's request to characterize groundwater near Former PCB Storage Area (AOI G.6) |
| MW-05443 | Yes | Monitor perched groundwater if present | Yes | |
| MW-05450 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-05457 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-15457* | Yes | Monitor first-encountered water-bearing zone | Yes | Replacement of well MW-05457, where shallow groundwater was not present |
| MW-05964 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-06080 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-06357 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-16357* | Yes | Monitor first-encountered water-bearing zone | Yes | Replacement of well MW-06357, where shallow groundwater was not present |
| MW-06445 | Yes | Monitor perched groundwater if present | Yes | |
| MW-06656 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-06939 | Yes | Monitor perched groundwater if present | Yes | |
| MW-06951 | Yes | Monitor perched groundwater if present | Yes | |
| MW-07245 | Yes | Monitor perched groundwater if present | Yes | |
| MW-07661 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-07948 | No | Monitor perched groundwater if present | Yes | Shallow groundwater not present |
| MW-07959 | Yes | Monitor perched groundwater if present | Yes | |

**Table 2-1**
**Summary of Monitoring Wells Installed**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Well Installed (Yes/No) | Well Objective | Objective Met (Yes/No) | Comments |
|---|---|---|---|---|
| **Confining Layer Wells** | | | | |
| MW-10000 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-10713 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-10909 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-11329 | No | Monitor intermediate zone if saturated | N/A** | Replaced with well MW-11530 |
| MW-11530* | Yes | Monitor intermediate zone if saturated | Yes | Replacement for well MW-11329 |
| MW-12418 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-12728* | Yes | Monitor first-encountered water-bearing zone | Yes | Replacement for well MW-02728, where shallow groundwater was not present |
| MW-13240 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-13623 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-14831 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-15450 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-15964* | Yes | Monitor first-encountered water-bearing zone | Yes | Replacement for well MW-05964, where shallow groundwater was not present |
| MW-16080 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-17661 | Yes | Monitor intermediate zone if saturated | Yes | |
| MW-17948 | Yes | Monitor intermediate zone if saturated | Yes | |
| **Deep Subglacial Sand/Bedrock Wells** | | | | |
| MW-11901 | Yes | Monitor intermediate zone if saturated | Yes | Groundwater not present in intermediate zone; well installed in deep zone. |
| MW-12432 | Yes | Monitor intermediate zone if saturated | Yes | Groundwater not present in intermediate zone; well installed in deep zone. Well moved 270 feet northeast of proposed location. |
| MW-13205 | Yes | Monitor intermediate zone if saturated | Yes | Groundwater not present in intermediate zone; well installed in deep zone. |
| MW-90124 | Yes | Monitor bedrock aquifer | Yes | |
| MW-93205 | Yes | Monitor bedrock aquifer | Yes | |
| MW-96080 | Yes | Monitor bedrock aquifer | Yes | |
| MW-97948 | Yes | Monitor bedrock aquifer | Yes | |

**Notes:**
Some wells were relocated because of access constraints, utility lines, or site activities such as construction.
* Well not proposed in RFI Workplan, but added after Phase 1A field activities began.
** Well MW-11329 was not installed but was replaced with well MW-11530, which did meet its objective.

# Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area A
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-00017 | B00006 | 0 | 2 | X | | | | |
| | B00008 | 6 | 8 | X | | | | |
| | B00009 | 22 | 24 | X | | | | |
| MW-00124 | B10001 | 0 | 2 | X | | | | |
| | B10002 | 4 | 6 | X | | | | |
| | B10003 | 8 | 10 | X | | | | |
| | B10004 | 32 | 34 | X | | | | |
| MW-90124 | B00145 | 48 | 50 | X | | | | |
| | B00146* | 48 | 50 | X | | | | |
| | B00147 | 82 | 84 | X | | | | |
| MW-00713 | B00010 | 0 | 2 | X | | | | |
| | B00011* | 0 | 2 | X | | | | |
| | B00012 | 10 | 12 | X | | | | |
| | B00013 | 22 | 24 | X | | | | |
| MW-10713 | B10013-T | 28 | 30 | | | | X | X |
| | B10063 | 36 | 38 | X | | | | |
| | B10064* | 36 | 38 | X | | | | |
| | B10014-T | 44 | 46 | | | | | X |
| MW-00821 | B10029 | 0 | 2 | X | | | | |
| | B10030** | 2 | 6 | X | | | | |
| | B10031 | 24 | 26 | X | | | | |
| MW-00925 | B10008 | 0 | 2 | X | | | | |
| | B10009 | 4 | 6 | X | | | | |
| | B10010 | 6 | 8 | X | | | | |
| MW-01329 | B10005 | 0 | 2 | X | | | | |
| | B10006 | 4 | 6 | X | | | | |
| | B10007 | 6 | 8 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area A
## (continued)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-01530 | B00110 | 0 | 2 | X | | X | | |
| | B00111 | 4 | 6 | X | | | | |
| MW-11530 | B00033-T | 4 | 6 | | | | | X |
| | B00034-T | 12 | 14 | | | | | X |
| | B00035-T | 18 | 20 | | | | | X |
| | B10065 | 56 | 58 | X | | | | |
| | B10066* | 56 | 58 | X | | | | |
| | B10015-T | 58 | 60 | | | | X | X |
| | B10067 | 68 | 70 | X | | | | |
| | B10016-T | 70 | 72 | | | | X | X |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area B
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-10000 | B00095 | 0 | 2 | X | | | | |
| | B00096 | 6 | 8 | X | | X | | |
| | B00004-T | 14 | 16 | | | | X | X |
| | B00097 | 18 | 20 | X | | | | |
| | B00098 | 32 | 34 | X | | | | |
| | B00006-T | 46 | 48 | | | | X | X |
| | B00099 | 48 | 50 | X | | | | |
| | B00009-T | 62 | 64 | | | | X | X |
| MW-00008 | B00088 | 0 | 2 | X | | | | |
| | B00089 | 4 | 6 | X | | | | |
| | B00090 | 22 | 24 | X | | | | |
| | B00091* | 22 | 24 | X | | | | |
| MW-00509 | B00092 | 0 | 2 | X | | | | |
| | B00093** | 2 | 4 | X | | | | |
| | B00094 | 12 | 14 | X | | | | |
| MW-00700 | B00018 | 0 | 2 | X | | | | |
| | B00019 | 4 | 6 | X | | | | |
| | B00020 | 14 | 16 | X | | | | |
| MW-00812 | B00142 | 1 | 3 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area C
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| **As Investigative Unit C only contains the Process Water Reservoir, no soil samples were collected** | | | | | | | | |

Notes:

* Duplicate Sample.

** Split sample collected for EPA.

*** Duplicate Sample and Split sample collected for EPA.

TKN = Total Kjeldahl Nitrogen.

VOCs = Volatile Organic Compounds.

SVOCS = Semivolatile Organic Compounds.

PCBs = Polychlorinated Biphenyls.

TOC = Total Organic Carbon.

CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area D
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-00909 | B00133 | 0 | 2 | X | | X | | |
| | B00030-T | 2 | 4 | | | | | X |
| | B00134 | 8 | 10 | X | | | | |
| | B00135* | 8 | 10 | X | | | | |
| MW-10909 | B00036-T | 16 | 18 | | | | X | X |
| MW-11901 | B00123 | 0 | 2 | X | | | | |
| | B00124 | 4 | 6 | X | | X | | |
| | B00125 | 12 | 14 | X | | | | |
| | B00126* | 12 | 14 | X | | | | |
| | B00023-T | 16 | 18 | | | | | X |
| | B00127 | 28 | 30 | X | | | | |
| | B00024-T | 32 | 34 | | | | X | X |
| | B00128 | 44 | 46 | X | | | | |
| | B00025-T | 48 | 50 | | | | | X |
| | B00129 | 60 | 62 | X | | | | |
| | B00026-T | 64 | 66 | | | | X | X |
| MW-01214 | B00105 | 0 | 2 | X | | | | |
| | B00106 | 4 | 6 | X | | | | |
| | B00107 | 10 | 12 | X | | | | |
| MW-02410 | B00108 | 2 | 4 | X | | | | |
| | B00109 | 4 | 6 | X | | | | |
| | B00114 | 12 | 14 | X | | | | |
| | B00115* | 12 | 14 | X | | | | |
| MW-02418 | B00074 | 0 | 2 | X | | | | |
| | B00075** | 2 | 4 | X | | | | |
| | B00076 | 16 | 18 | X | | X | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area D
## (continued)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-12418 | B00112 | 4 | 6 | | | X | | |
| | B00020-T | 4 | 6 | | | | | X |
| | B00031-T | 30 | 32 | | | | X | X |
| | B00136 | 32 | 34 | X | | | | |
| | B00032-T | 46 | 48 | | | | | X |
| | B00137 | 48 | 50 | X | | | | |
| | B00138* | 48 | 50 | X | | | | |
| SB-198 | B00139 | 0 | 2 | X | | | | |
| | B00140 | 22 | 24 | X | | | | |
| SB-298 | B00141 | 1 | 3 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area E
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-01119 | B10011 | 0 | 2 | X | | | | |
| | B10012 | 2 | 4 | X (except VOCs) | | | | |
| | B10032 | 2 | 4 | X (VOCs only) | | | | |
| MW-01718 | B00077 | 0 | 2 | X | | | | |
| | B00078 | 4 | 6 | X | | | | |
| | B00079* | 4 | 6 | X | | | | |
| | B00080 | 18 | 20 | X | | X | | |
| MW-01827 | B10016 | 0 | 2 | X | | | | |
| | B10017 | 2 | 4 | X | | | | |
| | B10018 | 8 | 10 | X | | | | |
| MW-02228 | B10021 | 0 | 2 | X | | | | |
| | B10022 | 4 | 6 | X | | | | |
| | B10023* | 4 | 6 | X | | | | |
| | B10024 | 12 | 14 | X | | | | |
| | B10025 | 14 | 16 | X | | | | |
| MW-02320 | B10013 | 0 | 2 | X | | | | |
| | B10014 | 2 | 6 | X | | | | |
| | B10015* | 2 | 6 | X | | | | |
| MW-02432 | B10019 | 0 | 2 | X | | | | |
| | B10020 | 4 | 6 | X | | | | |
| MW-12432 | B10007-T | 2 | 4 | | | | | X |
| | B00143 | 68 | 70 | X | | | | |
| | B00144* | 68 | 70 | X | | | | |
| MW-03235 | B00081** | 0 | 2 | X | | X | | |
| | B00082 | 12 | 14 | X | | | | |
| | B00083 | 16 | 18 | X | | X | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area E
## (continued)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-03240 | B10026 | 0 | 2 | X | | | | |
| | B10027** | 3.5 | 6 | X | | | | |
| | B10028 | 24 | 26 | X | | | | |
| MW-13240 | B00007-T | 2 | 4 | | | | | X |
| | B00008-T | 14 | 16 | | | | X | X |
| | B00021-T | 26 | 28 | | | | X | X |
| | B00113 | 38 | 40 | X | | | | |
| | B00022-T | 42 | 44 | | | | X | X |
| MW-03734 | B00071 | 0 | 2 | X | | | | |
| | B00072 | 6 | 8 | X | | | | |
| | B00073 | 18 | 20 | X | | | | |
| MW-03746 | B00014 | 0 | 2 | X | | | | |
| | B00015 | 4 | 6 | X | | | | |
| | B00016 | 6 | 8 | X | | | | |
| | B00017 | 16 | 18 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area F
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-02728 | B00067 | 0 | 2 | X | | | | |
| | B00068* | 0 | 2 | X | | | | |
| | B00069 | 8 | 10 | X | | | | |
| | B00070 | 10 | 12 | X | | | | |
| MW-12728 | B10061 | 20 | 24 | X | | | | |
| | B10062* | 20 | 24 | X | | | | |
| | B10012-T | 26 | 28 | | | | X | X |
| MW-13205 | B00116 | 0 | 2 | X | | | | |
| | B00117 | 4 | 6 | X | | | | |
| | B00118 | 14 | 16 | X | | | | |
| | B00119 | 30 | 32 | X | | X | | |
| | B00120* | 30 | 32 | X | | | | |
| | B00121 | 46 | 48 | X | | | | |
| | B00122 | 70 | 72 | X | | | | |
| MW-93205 | B20001-T | 10 | 12 | | | | | X |
| | B20002-T | 26 | 28 | | | | | X |
| | B20003-T | 42 | 44 | | | | | X |
| | B20004-T | 58 | 60 | | | | X | X |
| | B20005-T | 74 | 76 | | | | X | X |
| MW-03513 | B00038 | 0 | 2 | X | | | | |
| | B00039** | 4 | 6 | X | | | | |
| | B00040 | 18 | 20 | X | | | | |
| MW-03623 | B00028 | 0 | 2 | X | | | | |
| | B00029 | 4 | 6 | X | | | | |
| | B00030 | 20 | 22 | X | | | | |
| MW-13623 | B00010-T | 2 | 4 | | | | | X |
| | B00011-T | 6 | 8 | | | | X | X |
| | B00012-T | 14 | 16 | | | | X | X |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area G
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-04040 | B00045 | 0 | 2 | X | | | | |
| | B00046** | 4 | 6 | X | | | | |
| | B00047 | 14 | 16 | X | | | | |
| MW-04250 | B00021 | 0 | 2 | X | | | | |
| | B00022* | 0 | 2 | X | | | | |
| | B00023 | 4 | 6 | X | | | | |
| | B00024 | 12 | 14 | X | | | | |
| MW-04434 | B00001 | 0 | 2 | X | | X (TOC only) | | |
| SB-04434 | B00025 | 0 | 2 | X | | | | |
| | B00026 | 4 | 6 | X | | | | |
| | B00027 | 13 | 15 | X | | | | |
| MW-04831 | B00002 | 0 | 2 | X | | X (TOC only) | | |
| | B00003 | 6 | 8 | X | | X (TOC only) | | |
| | B00004 | 24 | 26 | X | | X (TOC only) | | |
| | B00005 | 26 | 28 | X | | X (TOC only) | | |
| MW-14831 | B00019-T | 36 | 38 | | | | X | X |
| MW-04854 | B00048 | 0 | 2 | X | | | | |
| | B00049 | 4 | 6 | X | | | | |
| | B00050 | 12 | 14 | X | | | | |
| MW-05036 | B00148 | 0 | 2 | X | | | | |
| | B00149 | 4 | 6 | X | | | | |
| | B00150 | 30 | 32 | X | | | | |
| | B00151* | 30 | 32 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area H
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample Location | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-04757 | B10036 | 0 | 2 | X | | | | |
| | B10037 | 2 | 6 | X | | | | |
| | B10038* | 2 | 6 | X | | | | |
| | B10039 | 10 | 12 | X | | | | |
| MW-04864 | B00152 | 0 | 2 | X | | | | |
| | B00153 | 10 | 12 | X | | | | |
| MW-05443 | B00035 | 0 | 2 | X | | | | |
| | B00036 | 4 | 6 | X | | | | |
| | B00037 | 20 | 22 | X | | | | |
| MW-05450 | B00031 | 0 | 2 | X | | | | |
| | B00032* | 0 | 2 | X | | | | |
| | B00033 | 4 | 6 | X | | | | |
| | B00034 | 14 | 16 | X | | | | |
| MW-15450 | B00016-T | 14 | 16 | | | | | X |
| | B00017-T | 30 | 32 | | | | | X |
| | B00103 | 32 | 34 | X | | | | |
| | B00104* | 32 | 34 | X | | | | |
| | B00018-T | 46 | 48 | | | | X | X |
| MW-05457 | B00058 | 0 | 2 | X | | | | |
| | B00059 | 4 | 6 | X | | | | |
| | B00060 | 14 | 16 | X | | | | |
| MW-15457 | B00027-T | 2 | 4 | | | | | X |
| MW-05964 | B00051 | 0 | 2 | X | | | | |
| | B00052 | 4 | 6 | X | | | | |
| | B00053 | 14 | 16 | X | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area H
## (continued)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-15964 | B00028-T | 28 | 30 | | | | X | X |
| | B00130 | 30 | 32 | X | | | | |
| | B00131* | 30 | 32 | X | | | | |
| | B00029-T | 46 | 48 | | | | X | X |
| | B00132 | 48 | 50 | X | | | | |
| MW-06357 | B00041 | 0 | 2 | X | | | | |
| | B00042 | 4 | 6 | X | | | | |
| | B00043 | 22 | 24 | X | | | | |
| | B00044*** | 22 | 24 | X | | | | |
| MW-16357 | B00037-T | 14 | 16 | | | | X | X |
| MW-06656 | B00054 | 0 | 2 | X | | | | |
| | B00055 | 6 | 8 | X | | | | |
| | B00056 | 14 | 16 | X | | | | |
| | B00057* | 14 | 16 | X | | | | |
| MW-17661 | B00100 | 0 | 2 | X | | X | | |
| | B00013-T | 0 | 2 | | | | | X |
| | B00101 | 4 | 6 | X (except metals) | | | | |
| | B00014-T | 14 | 16 | | | | X | X |
| | B00102 | 16 | 18 | X (except metals) | | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area I
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-06445 | B00061 | 0 | 2 | X | X | | | |
| | B00062 | 6 | 8 | X | X | | | |
| | B00063 | 8 | 10 | X | X | | | |
| MW-06939 | B10033 | 0 | 2 | X | X | | | |
| | B10034 | 2 | 4 | X | X | | | |
| | B10035 | 6 | 8 | X | X | | | |
| MW-06951 | B00064 | 0 | 2 | X | X | | | |
| | B00065 | 4 | 6 | X | X | | | |
| | B00066 | 8 | 10 | X | X | | | |
| MW-07245 | B10046 | 0 | 2 | X | X | | | |
| | B10047 | 4 | 6 | X | X | | | |
| | B10048** | 6 | 12 | X | X | | | |
| | B10049 | 26 | 30 | X | X | | | |
| | B10050 | 46 | 48 | X | X | | | |
| MW-17948 | B10056 | 52 | 54 | X | X | | | |
| | B10057 | 66 | 68 | X | X | | | |
| | B10008-T | 80 | 82 | | | | | X |
| MW-97948 | B10051 | 0 | 2 | X | X | | | |
| | B10052 | 4 | 10 | X | X | | | |
| | B10001-T | 10 | 12 | | | | X | X |
| | B10053 | 22 | 24 | X | X | | | |
| | B10054* | 22 | 24 | X | X | | | |
| | B10002-T | 24 | 26 | | | | X | X |
| | B10055 | 36 | 38 | X | X | | | |
| | B10003-T | 38 | 40 | | | | X | X |
| | B10005-T | 68 | 70 | | | | X | X |
| | B10006-T | 74 | 76 | | | | | X |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area I
## (continued)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-07959 | B10040 | 0 | 2 | X | X | | | |
| | B10041 | 4 | 6 | X | X | | | |
| | B10042 | 6 | 10 | X | X | | | |
| | B10043* | 6 | 10 | X | X | | | |
| | B10044 | 10 | 12 | X | X | | | |
| | B10045 | 32 | 34 | X | X | | | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-2
## Soil Sample Designations, Depths, and Analyses Performed
## Area J
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Sample Interval | | Summary of Chemical and Physical Analyses Performed | | | | |
|---|---|---|---|---|---|---|---|---|
| Well | Sample ID | Top Depth (feet) | Bottom Depth (feet) | Total Metals, TKN, VOCs, SVOCs, PCBs, Cyanide, Sulfide | Formal-dehyde | TOC, CEC | Permeability, Wet and Dry Density, Specific Gravity | Grain Size Distribution, Moisture Content |
| MW-16080 | B00084 | 0 | 2 | X | | | | |
| | B00085 | 4 | 6 | X | | | | |
| | B00001-T | 16 | 18 | | | | X | X |
| | B00086 | 18 | 20 | X | | | | |
| | B00002-T | 32 | 34 | | | | X | X |
| | B00087** | 34 | 36 | X | | | | |
| | B00003-T | 48 | 50 | | | | X | X |
| MW-96080 | B10058 | 48 | 50 | X | | | | |
| | B10059 | 60 | 62 | X | | | | |
| | B10060 | 72 | 74 | X | | | | |
| | B10010-T | 74 | 76 | | | | | X |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
*** Duplicate Sample and Split sample collected for EPA.
TKN = Total Kjeldahl Nitrogen.
VOCs = Volatile Organic Compounds.
SVOCS = Semivolatile Organic Compounds.
PCBs = Polychlorinated Biphenyls.
TOC = Total Organic Carbon.
CEC = Cation Exchange Capacity.

## Table 2-3
## Summary of Monitoring Well Construction Details
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Total Boring Depth (feet bgs) | Total Well Depth (feet bgs) | Bottom Depth of Steel Outer Casing (feet bgs) | Screen Length (feet) | Screened Interval (feet bgs) | Top of Casing Elevation (feet MSL) | Casing Stick-up (feet) | Ground Elevation (feet MSL) |
|---|---|---|---|---|---|---|---|---|
| **Upper Water-Bearing Zone Wells** | | | | | | | | |
| MW-00000 | 28 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-00008 | 24 | 13.52 | NR | 4.73 | 8.45 to 13.18 | 592.01 | 2.48 | 589.5 |
| MW-00017 | 24 | 16.99 | NR | 9.68 | 6.97 to 16.65 | 592.39 | 2.50 | 589.9 |
| MW-00124 | 34 | 18.25 | NR | 9.72 | 8.11 to 17.83 | 591.91 | 2.00 | 589.9 |
| MW-00509 | 14 | 10.00 | NR | 4.73 | 4.93 to 9.66 | 590.48 | 2.49 | 588.0 |
| MW-00700 | 16 | 9.45 | NR | 4.79 | 4.61 to 9.40 | 591.53 | 2.50 | 589.0 |
| MW-00713 | 24 | 16.00 | NR | 4.79 | 10.87 to 15.66 | 599.04 | 2.52 | 596.5 |
| MW-00812 | 8 | 8.14 | NR | 4.69 | 3.11 to 7.80 | 591.90 | 2.53 | 589.4 |
| MW-00821 | 26 | 14.35 | NR | 9.79 | 4.22 to 14.01 | 592.82 | 2.05 | 590.8 |
| MW-00909 | 10 | 7.45 | NR | 4.59 | 2.52 to 7.11 | 589.79 | -0.47 | 590.3 |
| MW-00925 | 14 | 11.00 | NR | 4.75 | 6.02 to 10.77 | 590.95 | 1.91 | 589.0 |
| MW-01901 | Shallow groundwater was not present in MW-11901; therefore, a shallow well was not installed. | | | | | | | |
| MW-01119 | 10 | 9.03 | NR | 4.75 | 4.06 to 8.81 | 590.50 | 2.05 | 588.5 |
| MW-01214 | 12 | 10.00 | NR | 4.73 | 4.93 to 9.66 | 590.23 | -0.52 | 590.8 |
| MW-01329 | 18 | 18.00 | NR | 9.87 | 7.88 to 17.75 | 590.56 | 2.00 | 588.6 |
| MW-01530 | 22 | 15.52 | NR | 9.67 | 5.51 to 15.18 | 591.69 | 2.53 | 589.2 |
| MW-01718 | 20 | 16.04 | NR | 9.68 | 6.02 to 15.70 | 593.21 | 2.45 | 590.8 |
| MW-01827 | 10 | 8.21 | NR | 4.77 | 3.03 to 7.80 | 591.04 | 2.00 | 589.0 |
| MW-02228 | 18 | 10.14 | NR | 4.76 | 5.04 to 9.80 | 591.21 | 1.94 | 589.3 |
| MW-02320 | 12 | 9.04 | NR | 4.78 | 4.02 to 8.80 | 592.92 | 2.00 | 590.9 |
| MW-02410 | 14 | 11.02 | NR | 4.79 | 6.19 to 10.98 | 590.34 | -0.53 | 590.9 |
| MW-02418 | 18 | 16.00 | NR | 9.79 | 6.17 to 15.96 | 593.53 | 2.50 | 591.0 |
| MW-02432 | 9 | 7.91 | NR | 4.75 | 2.91 to 7.66 | 590.57 | 1.13 | 589.4 |
| MW-02728 | 12 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-03205 | Shallow groundwater was not present in MW-13205; therefore, a shallow well was not installed. | | | | | | | |
| MW-03235 | 18 | 13.54 | NR | 9.68 | 3.52 to 13.20 | 588.95 | 2.48 | 586.5 |
| MW-03240 | 26 | 16.32 | NR | 9.80 | 6.16 to 15.96 | 591.65 | 2.69 | 589.0 |
| MW-03513 | 20 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-03623 | 22 | 14.96 | NR | 9.79 | 5.13 to 14.92 | 592.49 | 2.48 | 590.0 |
| MW-03734 | 20 | 16.20 | NR | 9.70 | 6.16 to 15.86 | 593.37 | 2.80 | 590.6 |
| MW-03746 | 18 | 11.96 | NR | 4.79 | 6.94 to 11.73 | 589.96 | 2.52 | 587.4 |
| MW-04040 | 16 | 11.01 | NR | 4.61 | 6.07 to 10.68 | 591.32 | 2.49 | 588.8 |
| MW-04250 | 14 | 10.00 | NR | 4.59 | 5.37 to 9.96 | 587.57 | 2.45 | 585.1 |
| MW-04434 | 16 | 9.73 | NR | 4.76 | 4.38 to 9.14 | 589.81 | 2.54 | 587.3 |
| MW-04757 | 12 | 9.50 | NR | 4.75 | 4.41 to 9.16 | 588.43 | 2.00 | 586.4 |
| MW-04831 | 28 | 16.32 | NR | 9.74 | 6.24 to 15.98 | 591.36 | 2.10 | 589.3 |
| MW-04854 | 14 | 8.40 | NR | 4.79 | 3.38 to 8.17 | 588.72 | 2.10 | 586.6 |
| MW-04864 | 12 | 9.98 | NR | 4.69 | 4.95 to 9.64 | 590.48 | 2.92 | 587.6 |
| MW-05036 | 32 | 16.02 | NR | 9.74 | 5.94 to 15.68 | 591.95 | 2.40 | 589.6 |
| MW-05443 | 22 | 16.27 | NR | 9.79 | 6.44 to 16.23 | 592.92 | 2.20 | 590.7 |
| MW-05450 | 18 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-05457 | 16 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-15457 | 18 | 10.02 | NR | 4.59 | 5.09 to 9.68 | 592.18 | 2.46 | 589.7 |

**Table 2-3**
**Summary of Monitoring Well Construction Details**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Total Boring Depth (feet bgs) | Total Well Depth (feet bgs) | Bottom Depth of Steel Outer Casing (feet bgs) | Screen Length (feet) | Screened Interval (feet bgs) | Top of Casing Elevation (feet MSL) | Casing Stick-up (feet) | Ground Elevation (feet MSL) |
|---|---|---|---|---|---|---|---|---|
| **Upper Water-Bearing Zone Wells (continued)** | | | | | | | | |
| MW-05964 | 16 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-06080 | Shallow groundwater was not present in MW-16080; therefore, a shallow well was not installed. | | | | | | | |
| MW-06357 | 24 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-16357 | 28 | 25.98 | NR | 4.69 | 20.95 to 25.64 | 600.13 | 2.51 | 597.6 |
| MW-06445 | 10 | 8.25 | NR | 4.79 | 3.04 to 7.83 | 590.82 | 1.95 | 588.9 |
| MW-06656 | 16 | Shallow groundwater not encountered in boring; no well installed. | | | | | | |
| MW-06939 | 8 | 7.00 | NR | 4.75 | 1.91 to 6.66 | 591.22 | 2.25 | 589.0 |
| MW-06951 | 10 | 8.92 | NR | 4.79 | 3.71 to 8.50 | 591.11 | 2.23 | 588.9 |
| MW-07245 | 48 | 46.08 | NR | 9.76 | 35.98 to 45.74 | 630.54 | 2.00 | 628.5 |
| MW-07661 | Shallow groundwater was not present in MW-17661; therefore, a shallow well was not installed. | | | | | | | |
| MW-07948 | Shallow groundwater was not present in MW-17948; therefore, a shallow well was not installed. | | | | | | | |
| MW-07959 | 34 | 21.98 | NR | 9.69 | 11.95 to 21.64 | 597.14 | 2.00 | 595.1 |
| TMW-1* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-2* | 11.5 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-3* | 12 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-4* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-5* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-6* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-7* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| TMW-8* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | NA | NA |
| SB-1-TMW-1* | 8 | 8.00 | NR | 2.00 | 6.00 to 8.00 | NA | 2.00 | NA |
| SB-2-TMW-2* | 9 | 9.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| SB-3-TMW-3* | 9 | 9.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| CTPHB-1/TMW-1* | 14 | 14.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| CTPHB-2/TMW-2* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| CTPHB-3/TMW-3* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| CTPHB-4/TMW-4* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| CTPHB-5/TMW-5* | 8 | 8.00 | NR | 5.00 | 3.00 to 8.00 | NA | 2.00 | NA |
| MWPHB-1/TMW-1* | 10 | 10.00 | NR | 5.00 | 5.00 to 10.00 | NA | 0.00 | NA |
| MWPHB-3/TMW-3* | 12 | 12.00 | NR | 5.00 | 5.00 to 10.00 | NA | 0.00 | NA |
| MWPHB-4/TMW-4* | 12 | 12.00 | NR | 5.00 | 5.00 to 10.00 | NA | 0.00 | NA |
| MWPHB-5/TMW-5* | 12 | 12.00 | NR | 5.00 | 5.00 to 10.00 | NA | 0.00 | NA |
| MWPHB-6/TMW-6* | 10 | 10.00 | NR | 5.00 | 5.00 to 10.00 | NA | 0.00 | NA |
| MWPHB-7/TMW-7* | 12 | 12.00 | NR | 5.00 | 4.00 to 9.00 | NA | 1.00 | NA |
| **Confining Layer Wells** | | | | | | | | |
| MW-10000 | 66 | 63.56 | NR | 9.78 | 53.74 to 63.52 | 591.90 | 2.47 | 589.4 |
| MW-10713 | 48 | 47.83 | 22 | 9.80 | 37.52 to 47.32 | 598.26 | 2.00 | 596.3 |
| MW-10909 | 26 | 26.00 | 9.9 | 9.74 | 15.92 to 25.66 | 589.85 | -0.35 | 590.2 |
| MW-11329 | Well was not installed due to the proximity of well MW-11530. | | | | | | | |
| MW-11530 | 76 | 73.50 | 58 | 9.80 | 63.36 to 73.16 | 591.39 | 2.00 | 589.4 |
| MW-12418 | 53 | 50.04 | 18 | 9.59 | 40.11 to 49.70 | 593.07 | 2.47 | 590.6 |
| MW-12728 | 36 | 35.00 | NR | 9.80 | 24.69 to 34.49 | 589.52 | 2.17 | 587.4 |
| MW-13240 | 60 | 55.50 | 26.2 | 9.69 | 45.46 to 55.15 | 591.54 | 2.50 | 589.0 |
| MW-13623 | 26 | 25.97 | 17 | 4.73 | 20.90 to 25.63 | 592.05 | 2.54 | 589.5 |

**Table 2-3**
**Summary of Monitoring Well Construction Details**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | Total Boring Depth (feet bgs) | Total Well Depth (feet bgs) | Bottom Depth of Steel Outer Casing (feet bgs) | Screen Length (feet) | Screened Interval (feet bgs) | Top of Casing Elevation (feet MSL) | Casing Stick-up (feet) | Ground Elevation (feet MSL) |
|---|---|---|---|---|---|---|---|---|
| **Confining Layer Wells (continued)** | | | | | | | | |
| MW-14831 | 38 | 38.03 | 28.8 | 4.72 | 33.27 to 37.99 | 591.31 | 2.46 | 588.9 |
| MW-15450 | 54 | 53.04 | NR | 4.60 | 48.10 to 52.70 | 597.18 | 2.45 | 594.7 |
| MW-15964 | 68 | 67.50 | NR | 9.69 | 57.47 to 67.16 | 591.76 | 2.30 | 589.5 |
| MW-16080 | 51 | 50.00 | NR | 9.79 | 40.17 to 49.96 | 586.12 | 2.50 | 583.6 |
| MW-17661 | 24 | 24.01 | NR | 4.59 | 19.08 to 23.67 | 593.41 | 2.54 | 590.9 |
| MW-17948 | 83.5 | 83.31 | NR | 9.78 | 73.19 to 82.97 | 590.05 | 2.04 | 588.0 |
| **Deep Subglacial Sand/Bedrock Wells** | | | | | | | | |
| MW-11901 | 87 | 83.99 | NR | 9.79 | 74.16 to 83.95 | 589.64 | -0.48 | 590.1 |
| MW-12432 | 93.5 | 93.48 | 60 | 9.74 | 83.40 to 93.14 | 591.33 | 2.42 | 588.9 |
| MW-13205 | 92 | 90.10 | NR | 9.79 | 80.27 to 90.06 | 590.10 | 2.39 | 587.7 |
| MW-90124 | 120 | 120.00 | NR | 4.69 | 114.97 to 119.66 | 592.37 | 2.51 | 589.9 |
| MW-93205 | 112.5 | 112.35 | NR | 4.70 | 111.50 to 116.20 | 589.98 | 1.90 | 588.1 |
| MW-96080 | 96 | 93.38 | NR | 4.73 | 88.31 to 93.04 | 586.38 | 1.75 | 584.6 |
| MW-97948 | 114 | 113.92 | NR | 4.73 | 108.85 to 113.58 | 589.74 | 2.63 | 587.1 |

**Notes:**
bgs = below ground surface.
MSL = Mean sea level, surveyed using North American Vertical Datum 1988.
NA = Not available.
NR = Not required. Outer casing was not required for shallow or deep wells, or for confining layer wells in which the upper water-bearing zone was not encountered.
* = Temporary monitoring well, abandoned.

## Table 2-4
## Groundwater Field Parameters Measurements
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | pH (std. units) | Specific Conductivity (umhos/cm) | Temperature (°C) | Dissolved Oxygen (%) | Redox Potential (eV) |
|---|---|---|---|---|---|
| **Shallow Wells** | | | | | |
| MW-06939 | 12.44 | 1630 | 12.70 | 1.10 | -296 |
| MW-04250 | 12.25 | 1790 | 12.95 | 0.90 | -161 |
| MW-05443 | 11.37 | 1530 | 10.33 | 9.25 | -38 |
| MW-07959 | 11.16 | 1580 | 13.80 | 12.30 | 38 |
| MW-06445 | 11.04 | 1270 | 10.30 | 6.50 | 152 |
| MW-04864 | 10.20 | 725 | 12.72 | 3.19 | 801 |
| MW-04854 | 9.61 | 1190 | 11.30 | 14.70 | 94 |
| MW-04434 | 8.98 | 710 | 13.90 | 0.60 | 166 |
| MW-07245 | 8.01 | 875 | 11.28 | 3.10 | -1135 |
| MW-02410 | 7.87 | 5710 | 13.39 | 3.63 | 114 |
| MW-04757 | 7.73 | 519 | 10.28 | 0.99 | -77 |
| MW-02228 | 7.70 | 1790 | 12.94 | 1.80 | -75 |
| MW-01119 | 7.54 | 1647 | 13.94 | 2.09 | -160 |
| MW-03734 | 7.52 | 2920 | 8.78 | 1.19 | -119 |
| MW-16357 | 7.47 | 1502 | 11.50 | 2.81 | 887 |
| MW-00812 | 7.45 | 606 | 11.22 | 3.15 | 69 |
| MW-00713 | 7.42 | 650 | 12.78 | 3.39 | 147 |
| MW-04831 | 7.38 | 1010 | 14.10 | 0.40 | -101 |
| MW-02320 | 7.36 | 4040 | 13.06 | 2.33 | -82 |
| MW-00017 | 7.35 | 1692 | 11.78 | 2.42 | 101 |
| MW-00821 | 7.33 | 1218 | 10.28 | 11.57 | 645 |
| MW-04040 | 7.30 | 1046 | 12.39 | 1.97 | 1153 |
| MW-00700 | 7.27 | 1599 | 10.61 | 5.31 | 109 |
| MW-00008 | 7.19 | 1361 | 11.06 | 3.90 | 93 |
| MW-01214 | 7.09 | 3320 | 6.89 | 5.01 | 52 |
| MW-01530 | 7.09 | 1390 | 13.20 | 13.20 | 139 |
| MW-01827 | 7.02 | 793 | 12.67 | 2.21 | -16 |
| MW-03623 | 7.02 | 1059 | 11.67 | 0.60 | -27 |
| MW-15457 | 7.02 | 1917 | 12.39 | 20.50 | -26 |
| MW-02432 | 7.01 | 405 | 9.72 | 3.20 | 115 |
| MW-06951 | 7.01 | 1650 | 11.25 | 12.70 | 125 |
| MW-01718 | 6.99 | 4370 | 13.89 | 2.19 | -63 |
| MW-00124 | 6.95 | 1055 | 11.17 | 3.47 | 11 |
| MW-02418 | 6.91 | 4910 | 13.22 | 0.88 | 249 |
| MW-00509 | 6.87 | 1273 | 11.28 | 7.70 | -389 |
| MW-00909 | 6.78 | 4910 | 8.39 | 3.08 | -25 |
| MW-05036 | 6.76 | 1120 | 15.70 | 6.10 | 139 |
| MW-03746 | 6.60 | 388 | 12.22 | 2.95 | -53 |
| MW-00925 | 6.41 | 1011 | 11.50 | 3.09 | 93 |
| MW-03235 | 6.40 | 3690 | 13.67 | 1.03 | 320 |
| MW-01329 | 6.35 | 1670 | 12.50 | 4.29 | 130 |
| MW-03240 | 4.63 | 3690 | 10.56 | 2.79 | 423 |

## Table 2-4
## Groundwater Field Parameters Measurements
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well Number | pH (std. units) | Specific Conductivity (umhos/cm) | Temperature (°C) | Dissolved Oxygen (%) | Redox Potential (eV) |
|---|---|---|---|---|---|
| **Intermediate Wells** | | | | | |
| MW-10000 | 8.33 | 1896 | 10.56 | 4.14 | 130 |
| MW-10713 | 6.64 | 4180 | 9.61 | 3.11 | 43 |
| MW-10909 | 6.92 | 1910 | 8.00 | 5.86 | 62 |
| MW-11530 | 9.28 | 2920 | 14.67 | 5.18 | 171 |
| MW-12418 | 8.18 | 1110 | 9.44 | 4.28 | 158 |
| MW-12728 | 7.50 | 1344 | 11.72 | 6.60 | -37 |
| MW-13240 | 6.64 | 5510 | 11.70 | 10.40 | -41 |
| MW-13623 | 6.72 | 1338 | 10.44 | 6.24 | 94 |
| MW-14831 | 7.76 | 948 | 10.90 | 5.05 | -34 |
| MW-15450 | 8.51 | 1278 | 7.89 | 12.92 | -335 |
| MW-15964 | 7.90 | 1160 | 11.20 | 73.80 | 227 |
| MW-16080 | 7.49 | 1449 | 9.56 | 9.64 | 807 |
| MW-17661 | 7.41 | 1400 | 13.00 | 47.20 | 157 |
| **Deep Wells** | | | | | |
| MW-11901 | 8.41 | 1115 | 9.94 | 2.89 | 123 |
| MW-12432 | 8.40 | 2210 | 12.33 | 1.99 | 9 |
| MW-13205 | 7.71 | 1380 | 12.06 | 1.29 | 113 |
| MW-17948 | 8.59 | 2280 | 9.10 | 22.50 | 113 |
| MW-90124 | 7.44 | 11,790 | 11.89 | 1.65 | 54 |
| MW-93205 | 7.60 | 1534 | 9.06 | 4.26 | 56 |
| MW-96080 | 7.97 | 1460 | 11.40 | 1.81 | 218 |
| MW-97948 | 7.44 | 1820 | 8.40 | 11.10 | 143 |

**Notes:**
std. units = standard units.
umhos/cm = micromhos per centimeter.
°C = degrees Celsius.
eV = electron volts.

**Table 2-5**
**Surface Water Field Parameter Measurements**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Area/ Location | pH (std. units) | Conductivity (umhos/cm) | Temperature (°C) | Dissolved Oxygen (%) | Redox Potential (eV) |
|---|---|---|---|---|---|
| C2 | 7.01 | 2230 | 11.2 | -- | 131 |
| H1 | 7.16 | 1780 | 10.5 | -- | 178 |
| H2 | 7.09 | 1740 | 10 | -- | NA |
| H3 | 7.02 | 2240 | 5.7 | -- | 96 |
| H4 | 7.14 | 1730 | 10 | -- | 120 |
| H6 | 7.99 | 580 | 7.7 | -- | NA |
| J1 | 7.86 | 820 | 6.3 | -- | 196 |
| J2 | 7.39 | 1630 | 7.8 | -- | 196 |
| J3 | 8.95 | 800 | 7.0 | -- | 165 |
| J5 | 8.65 | 990 | 6.5 | -- | 194 |

**Notes:**

-- = Dissolved oxygen results were erroneous due to equipment failure; therefore dissolved oxygen results are not reported.

std. units = standard units.

umhos/cm = micromhos per centimeter.

°C = degrees Celsius.

eV = electron volts.

**Table 2-6**
**Summary of Vertical and Horizontal Permeability Testing Results**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Region | Unit[1] | Material Description | USCS Class. | Boring\Well | Vertical Permeameter Results | | | Horizontal Slug Test Results | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sample Interval | | Permeability | Screen Interval | | Average Permeability |
| | | | | | Top | Bottom | (cm/s) | Top | Bottom | (cm/s) |
| A | A | Found. Sd | sm | MW-00017 | --- | --- | --- | 7.31 | 16.99 | 8.9E-02 |
| A | A | Fluvial Sd | sm | MW-00124 | --- | --- | --- | 8.11 | 17.83 | 7.1E-01 |
| A | A | Found. Sd | sp | MW-00713 | --- | --- | --- | 11.21 | 16.00 | 8.7E-02 |
| A | A | Found. Sd | sm | MW-00821 | --- | --- | --- | 5.17 | 14.96 | 3.7E-01 |
| A | A | Fluvial Sd | sp | MW-00925 | --- | --- | --- | 6.02 | 10.77 | 3.8E-01 |
| A | A | Fluvial Sd | sm | MW-01329 | --- | --- | --- | 7.88 | 17.75 | 3.4E-01 |
| A | A | Found. Sd/Fluvial Sd/Marsh Silt | sp | MW-01530 | --- | --- | --- | 5.51 | 15.18 | 9.4E-02 |
| B | A | Fluvial Sd/Marsh Silt | sm | MW-00008 | --- | --- | --- | 8.45 | 13.18 | 2.0E-02 |
| B | A | Found. Sd/Fluvial Sd | sp | MW-00509 | --- | --- | --- | 4.93 | 9.66 | 8.8E-03 |
| B | A | Fluvial Sd/Glac. Clay | sp | MW-00700 | --- | --- | --- | 4.61 | 9.40 | 3.0E-03 |
| D | A | Found. Sd | sp | MW-00812 | --- | --- | --- | 3.11 | 7.80 | 2.4E-01 |
| D | A | Found. Sd | SP-SM | MW-00909 | --- | --- | --- | 2.52 | 7.11 | 1.7E-02 |
| D | A | Found. Sd/Marsh Silt | sp | MW-01214 | --- | --- | --- | 4.93 | 9.66 | 2.2E-01 |
| D | A | Found. Sd/Glac. Clay | sp | MW-02410 | --- | --- | --- | 6.19 | 10.98 | 1.2E-03 |
| D | A | Found. Sd/Marsh Clay/Marsh Silt | sp | MW-02418 | --- | --- | --- | 6.17 | 15.96 | 4.3E-01 |
| E | A | Found. Sd | sp | MW-01119 | --- | --- | --- | 4.06 | 8.81 | 3.6E-01 |
| E | A | Found. Sd/Marsh Clay/Marsh Silt | sp | MW-01718 | --- | --- | --- | 6.02 | 15.70 | 4.7E-02 |
| E | A | Found. Sd/Fluvial Sand | sp | MW-01827 | --- | --- | --- | 3.03 | 7.80 | 5.8E-01 |
| E | A | Found. Sd | sm | MW-02228 | --- | --- | --- | 5.04 | 9.80 | 4.0E-01 |
| E | A | Found. Sd | sm | MW-02320 | --- | --- | --- | 4.02 | 8.80 | 4.4E-01 |
| E | A | Found. Sd | SP-SM | MW-02432 | --- | --- | --- | 2.91 | 7.66 | 1.5E+00 |
| E | A | Found. Sd/Marsh Silt | sm | MW-03235 | --- | --- | --- | 3.52 | 13.20 | 1.7E-02 |
| E | A | Found. Sd/Fluvial Sd | SP | MW-03240 | --- | --- | --- | 6.16 | 15.96 | 2.7E-01 |
| E | A | Found. Sd | sp | MW-03734 | --- | --- | --- | 6.16 | 15.86 | --- |
| E | A | Found. Sd | sp-sm | MW-03746 | --- | --- | --- | 6.94 | 11.73 | 8.4E-02 |
| F | A | Marsh Silt/Marsh Clay | sm-ml | MW-03623 | --- | --- | --- | 5.13 | 14.92 | 6.4E-04 |
| F | A | Marsh Silt/Marsh Clay | CL | MW-13623 | 6 | 8 | 8.4E-08 | NA | NA | --- |
| F | A | Found. Sd/Silt | MH | MW-13623 | 14 | 16 | 1.4E-06 | NA | NA | --- |
| G | A | Found. Sd | sp | MW-04040 | --- | --- | --- | 6.07 | 10.68 | 5.1E-01 |
| G | A | Found. Sd | sp | MW-04250 | --- | --- | --- | 5.37 | 9.96 | 1.6E-02 |
| G | A | Found. Sd | sp | MW-04434 | --- | --- | --- | 4.38 | 9.14 | 1.5E-02 |
| G | A | Found. Sd | sp-sm | MW-04831 | --- | --- | --- | 6.24 | 15.98 | 3.4E-03 |
| G | A | Found. Sd | sp | MW-04854 | --- | --- | --- | 3.38 | 8.17 | 4.0E-03 |
| G | A | Found. Sd | sp | MW-05036 | --- | --- | --- | 5.94 | 15.68 | 1.1E-01 |
| H | A | Found. Sd | sm | MW-04757 | --- | --- | --- | 4.41 | 9.16 | 1.6E-01 |
| H | A | Fill Clay/Fluvial Silt | ml | MW-04864 | --- | --- | --- | 4.95 | 9.64 | 7.5E-01 |
| H | A | Found. Sd/Fluvial Sd/ Marsh Silt/Marsh Cl | sm | MW-05443 | --- | --- | --- | 6.44 | 16.23 | 4.8E-04 |
| H | A | Found. Sd/Marsh Clay | sp | MW-15457 | --- | --- | --- | 5.09 | 9.68 | 2.3E-02 |
| H | A | Clay Fill (above the Upper Water-Bearing Z | CL | MW-16357 | 14 | 16 | 1.2E-07 | NA | NA | --- |
| H | A | Marsh Silt | ml | MW-16357 | --- | --- | --- | 20.95 | 25.64 | 1.2E-03 |
| I | A | Found. Sd/Glac. Clay | sp | MW-06445 | --- | --- | --- | 3.04 | 7.83 | 4.1E-03 |
| I | A | Found. Sd | sm | MW-06939 | --- | --- | --- | 1.91 | 6.66 | 7.7E-02 |
| I | A | Found. Sd/Marsh Clay | sp | MW-06951 | --- | --- | --- | 3.71 | 8.50 | 2.0E-02 |
| I | A | Found. Sd | sm | MW-07245 | --- | --- | --- | 35.98 | 45.74 | 2.5E-01 |
| I | A | Found. Sd | sm | MW-07959 | --- | --- | --- | 11.95 | 21.64 | 1.9E-01 |

**Table 2-6**
**Summary of Vertical and Horizontal Permeability Testing Results**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Region | Unit[1] | Material Description | USCS Class. | Boring\Well | Vertical Permeameter Results | | | Horizontal Slug Test Results | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sample Interval | | Permeability | Screen Interval | | Average Permeability |
| | | | | | Top | Bottom | (cm/s) | Top | Bottom | (cm/s) |
| A | B | Glac. Clay | CL | MW-11530 | 58 | 60 | 9.6E-08 | 63.36 | 73.16 | **3.5E-06** |
| A | B | Glac. Clay | CL | MW-11530 | 70 | 72 | 3.9E-08 | NA | NA | --- |
| B | B | Glac. Clay | CL | MW-10000 | 14 | 16 | 7.2E-08 | NA | NA | --- |
| B | B | Glac. Clay | CL | MW-10000 | 46 | 48 | 3.2E-08 | 53.74 | 63.52 | **1.8E-05** |
| B | B | Glac. Clay | CL | MW-10000 | 62 | 64 | 6.4E-08 | NA | NA | --- |
| D | B | Marsh Clay/Fluvial Sd | SP-SM | MW-10713 | --- | --- | --- | 37.52 | 47.32 | **8.0E-03** |
| D | B | Glac. Clay | CL | MW-10713 | 28 | 30 | 2.2E-07 | NA | NA | --- |
| D | B | Glac. Clay | CL | MW-10909 | 16 | 18 | 7.5E-08 | 15.92 | 25.66 | **1.9E-04** |
| D | B | Glac. Clay | CL | MW-11901 | 32 | 34 | 1.9E-08 | NA | NA | --- |
| D | B | Glac. Clay | CL | MW-11901 | 64 | 66 | 3.4E-08 | NA | NA | --- |
| D | B | Glac. Clay | cl | MW-12418 | 30 | 32 | 3.7E-08 | 40.11 | 49.70 | **1.3E-06** |
| E | B | Glac. Clay | CL | MW-13240 | 24 | 26 | 7.5E-08 | NA | NA | --- |
| E | B | Glac. Clay | CL | MW-13240 | 26 | 28 | 6.8E-08 | NA | NA | --- |
| E | B | Glac. Silt | MH | MW-13240 | 42 | 44 | 9.7E-08 | NA | NA | --- |
| E | B | Fluvial Sd | sp | MW-13240 | --- | --- | --- | 45.46 | 55.15 | **9.6E-04** |
| F | B | Glac. Clay | CL | MW-12728 | 26 | 28 | 3.4E-08 | 24.69 | 34.49 | **1.7E-06** |
| F | B | Glac. Silt | cl | MW-13623 | --- | --- | --- | 20.90 | 25.63 | **1.3E-04** |
| F | B | Glac. Clay | CL | MW-93205 | 58 | 60 | 3.5E-08 | NA | NA | --- |
| F | B | Glac. Clay | CL | MW-93205 | 74 | 76 | 2.1E-08 | NA | NA | --- |
| G | B | Glac. Clay | CL | MW-14831 | 36 | 38 | 2.7E-08 | 33.27 | 37.99 | **1.7E-04** |
| H | B | Glac. Clay | CL | MW-15450 | 46 | 48 | 4.3E-08 | 48.10 | 52.70 | **8.3E-07** |
| H | B | Glac. Clay | CL | MW-15964 | 28 | 30 | 2.5E-08 | NA | NA | --- |
| H | B | Glac. Clay | CL | MW-15964 | 46 | 48 | 4.0E-08 | 57.47 | 67.16 | **3.4E-07** |
| H | B | Glac. Clay | CL | MW-17661 | 14 | 16 | 8.3E-08 | 19.08 | 23.67 | **4.3E-03** |
| I | B | Glac. Clay | NA | MW-17948 | --- | --- | --- | 73.19 | 82.97 | **2.8E-04** |
| I | B | Glac. Clay | CL | MW-97948 | 10 | 12 | 1.8E-08 | NA | NA | --- |
| I | B | Glac. Clay | CL | MW-97948 | 24 | 26 | 3.8E-08 | NA | NA | --- |
| I | B | Glac. Clay | CL | MW-97948 | 38 | 40 | 3.4E-08 | NA | NA | --- |
| I | B | Glac. Clay | CL | MW-97948 | 68 | 70 | 5.9E-08 | NA | NA | --- |
| J | B | Glac. Clay | CL | MW-16080 | 16 | 18 | 2.0E-08 | NA | NA | --- |
| J | B | Glac. Clay | CL | MW-16080 | 32 | 34 | 5.1E-08 | 40.17 | 49.96 | **1.8E-06** |
| J | B | Glac. Clay | CL | MW-16080 | 48 | 50 | 4.4E-08 | NA | NA | --- |
| A | C | Comp. Bdrk | NA | MW-90124 | --- | --- | --- | 114.97 | 119.66 | **2.1E-03** |
| D | C | Subglac. Sd | sp | MW-11901 | --- | --- | --- | 74.16 | 83.95 | **1.3E-05** |
| E | C | Weath. Bdrk | sp | MW-12432 | --- | --- | --- | 83.40 | 93.14 | **4.2E-04** |
| F | C | Subglac. Sd | sp | MW-13205 | --- | --- | --- | 80.27 | 90.06 | **5.0E-04** |
| F | C | Comp. Bdrk | NA | MW-93205 | --- | --- | --- | 111.50 | 116.20 | **7.3E-03** |
| I | C | Comp. Bdrk | NA | MW-97948 | --- | --- | --- | 108.85 | 113.58 | **5.3E-03** |
| J | C | Comp. Bdrk | NA | MW-96080 | --- | --- | --- | 88.31 | 93.04 | **3.1E-03** |

**Table 2-6**
**Summary of Vertical and Horizontal Permeability Testing Results**
Saginaw Metal Casting Operations
Saginaw, Michigan

**Summary of Results**

| | | Average Vertical Permeability (cm/s) | | Average Horizontal Permeability (cm/s) | |
|---|---|---|---|---|---|
| **Unit A** | | *Result* | *# of tests* | *Result* | *# of tests* |
| | **Foundry Sand** | --- | *0* | **2.1E-01** | *32* |
| | **Fluvial Sand** | --- | *0* | **2.7E-01** | *9* |
| | **Silt/Clay** | **7.3E-07** | *3* | **1.2E-01** | *4* |
| | **Overall** | **7.3E-07** | *3* | **2.2E-01** | *41*[3] |
| **Unit B** | | *Result* | *# of tests* | *Result* | *# of tests* |
| | **Clay** | **5.2E-08** | *27* | **4.5E-04** | *11* |
| | **Fluvial Sand** | --- | | **4.5E-03** | *2* |
| | **Silt** | **9.7E-08** | *1* | **1.3E-04** | *1* |
| | **Overall** | **5.4E-08** | *27* | **1.0E-03** | *14* |
| **Unit C** | | *Result* | *# of tests* | *Result* | *# of tests* |
| | **Subglacial Sand** | --- | *0* | **2.6E-04** | *2* |
| | **Weathered Bedrock** | --- | *0* | **3.6E-04** | *1* |
| | **Competent Bedrock** | --- | *0* | **4.5E-03** | *4* |
| | **Overall** | --- | *0* | **2.8E-03** | *7* |

Notes:
[1] = Units are hydrostratigraphic units as described in the text and as outlined above.
[2] = Permeability value not used in summaries.
[3] = Some values of permeability were used more than once for the determination of the listed averages (i.e., where the permeability was measured across more than one depositional unit).
--- = No test completed.
NA = Not applicable.
USCS Classifications are expressed in upper case where determined in the laboratory; lower case refers to a field description.
For wells screened across more than one type of geologic material, the primary water-bearing material(s) is/are underlined.

## Table 2-7
## Groundwater Sample Designations and Analyses Performed
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Summary of Chemical Analysis Performed | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total and Dissolved Metals | Total Kjeldahl Nitrogen (TKN) | Volatile Organic Compounds (VOCs) | Semivolatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Sulfide | Formal-dehyde |
| **Area A** | | | | | | | | | |
| MW-00017 | M10007 | X | X | X | X | X | X | X | |
| MW-00124 | M10038 | X | X | X | X | X | X | X | |
| MW-90124 | M30046 | X | X | X | X | X | X | X | |
| MW-00713 | M10008 | X | X | X | X | X | X | X | |
| MW-10713 | M30036 | X | X | X | X | X | X | X | |
| | M30037* | X | X | X | X | X | X | X | |
| MW-00821 | M00002** | X | X | X | X | X | X | X | |
| MW-00925 | M10041 | X | X | X | X | X | X | X | |
| MW-01329 | M10043 | X | X | X | X | X | X | X | |
| MW-01530 | M10044 | X | X | X | X | X | X | X | |
| MW-11530 | M10034 | X | X | X | X | X | X | X | |
| **Area B** | | | | | | | | | |
| MW-10000 | M30035 | X | X | X | X | X | X | X | |
| MW-00008 | M10037 | X | X | X | X | X | X | X | |
| MW-00509 | M10002** | X | X | X | X | X | X | X | |
| MW-00700 | M10039 | X | X | X | X | X | X | X | |
| MW-00812 | M10040 | X | X | X | X | X | X | X | |

## Table 2-7
## Groundwater Sample Designations and Analyses Performed
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Summary of Chemical Analysis Performed | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total and Dissolved Metals | Total Kjeldahl Nitrogen (TKN) | Volatile Organic Compounds (VOCs) | Semivolatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Sulfide | Formal-dehyde |
| **Area D** | | | | | | | | | |
| MW-00909 | M30042 | X | X | X | X | X | X | X | |
| MW-10909 | M10053 | X | X | X | X | X | X | X | |
| | M10053-Q* | X | X | X | X | X | X | X | |
| MW-11901 | M30043 | X | X | X | X | X | X | X | |
| MW-01214 | M30044 | X | X | X | X | X | X | X | |
| | M30045* | X | X | X | X | X | X | X | |
| MW-02410 | M10054 | X | X | X | X | X | X | X | |
| MW-02418 | M00003** | X | X | X | X | X | X | X | |
| | M00004* | X | X | X | X | X | X | X | |
| MW-12418 | M10051 | X | X | X | X | X | X | X | |
| | M10052* | X | X | X | X | X | X | X | |
| **Area E** | | | | | | | | | |
| MW-01119 | M10042 | X | X | X | X | X | X | X | |
| MW-01718 | M10045 | X | X | X | X | X | X | X | |
| | M10046* | X | X | X | X | X | X | X | |
| MW-01827 | M10047 | X | X | X | X | X | X | X | |
| MW-02228 | M10048 | X | X | X | X | X | X | X | |
| MW-02320 | M10049 | X | X | X | X | X | X | X | |
| MW-02432 | M10050 | X | X | X | X | X | X | X | |
| MW-12432 | M10035 | X | X | X | X | X | X | X | |
| | M10036* | X | X | X | X | X | X | X | |
| MW-03235 | M00006** | X | X | X | X | X | X | X | |
| | M00007* | X | X | X | X | X | X | X | |
| MW-03240 | M00005** | X | X | X | X | X | X | X | |
| | M00005-Q* | X | X | X | X | X | X | X | |

**Table 2-7**
**Groundwater Sample Designations and Analyses Performed**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Summary of Chemical Analysis Performed | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total and Dissolved Metals | Total Kjeldahl Nitrogen (TKN) | Volatile Organic Compounds (VOCs) | Semivolatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Sulfide | Formal-dehyde |
| **Area E (continued)** | | | | | | | | | |
| MW-13240 | M10055 | X | X | X | X | X | X | X | |
| MW-03746 | M30033 | X | X | X | X | X | X | X | |
| **Area F** | | | | | | | | | |
| MW-13205 | M00008 | X | X | X | X | X | X | X | |
| MW-93205 | M30040 | X | X | X | X | X | X | X | |
| | M30041* | X | X | X | X | X | X | X | |
| MW-03623 | M00009 | X | X | X | X | X | X | X | |
| MW-13623 | M00010 | X | X | X | X | X | X | X | |
| | M00011* | X | X | X | X | X | X | X | |
| **Area G** | | | | | | | | | |
| MW-04040 | M10004** | X | X | X | X | X | X | X | |
| MW-04250 | M30029 | X | X | X | X | X | X | X | |
| | M30030* | X | X | X | X | X | X | X | |
| MW-04434 | M30032 | X | X | X | X | X | X | X | |
| MW-04831 | M30023 | X | X | X | X | X | X | X | |
| MW-14831 | M10032 | X | X | X | X | X | X | X | |
| MW-04854 | M30031 | X | X | X | X | X | X | X | |
| MW-05036 | M30024 | X | X | X | X | X | X | X | |

**Table 2-7**
**Groundwater Sample Designations and Analyses Performed**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Well | Sample ID | Summary of Chemical Analysis Performed | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total and Dissolved Metals | Total Kjeldahl Nitrogen (TKN) | Volatile Organic Compounds (VOCs) | Semivolatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Sulfide | Formal-dehyde |
| **Area H** | | | | | | | | | |
| MW-04757 | M20001 | X | X | X | X | X | X | X | |
| MW-04864 | M20003 | X | X | X | X | X | X | X | |
| MW-05443 | M20004 | X | X | X | X | X | X | X | |
| MW-15457 | M20002 | X | X | X | X | X | X | X | |
| MW-15964 | M30019 | X | X | X | X | X | X | X | |
| MW-16357 | M10003** | X | X | X | X | X | X | X | |
| MW-17661 | M30022 | | X | | | | X | X | |
| MW-17661 | M30047 | X | X | X | X | X | X | X | |
| **Area I** | | | | | | | | | |
| MW-06445 | M30026 | X | X | X | X | X | X | X | X |
| MW-06939 | M30027 | X | X | X | X | X | X | X | X |
| MW-06951 | M30025 | X | X | X | X | X | X | X | X |
| MW-07245 | M10005** | X | X | X | X | X | X | X | X |
| | M10005-Q* | X | X | X | X | X | X | X | X |
| | M10006* | X | X | X | X | X | X | X | X |
| MW-17948 | M30039 | X | X | X | X | X | X | X | X |
| MW-97948 | M30038 | X | X | X | X | X | X | X | X |
| MW-07959 | M30028 | X | X | X | X | X | X | X | |
| **Area J** | | | | | | | | | |
| MW-16080 | M10001** | X | X | X | X | X | X | X | |
| MW-96080 | M30017 | X | X | X | X | X | X | X | |
| | M30018* | X | X | X | X | X | X | X | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.

## Table 2-8
## Surface Water Sample Designations and Analyses Performed
Saginaw Metal Casting Operations
Saginaw, Michigan

| | | Summary of Chemical Analysis Performed | |
|---|---|---|---|
| Location | Sample ID | Total and Dissolved Metals | Polychlorinated Biphenyls (PCBs) |
| C2 | W00018 | X | X |
| | W00019* | X | X |
| H1 | W00003 | X | X |
| | W00004* | X | X |
| H2 | W00005 | X | X |
| H3 | W00001 | X | X |
| | W00002* | X | X |
| H4 | W00006 | X | X |
| H6 | W00013** | X | X |
| J1 | W00011 | X | X |
| | W00012* | X | X |
| J2 | W00010 | X | X |
| J3 | W00007 | X | X |
| J4 | | NS | NS |
| J5 | W00008 | X | X |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.
NS = Not sampled. Sample location was dry.

**Table 2-9**
**Soil Descriptions and Grain Size Distributions**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Laboratory Report Number | Well ID | Sample ID | Sample Depth Top (feet) | Sample Depth Bottom (feet) | Soil Type (ASTM) | Material Description | Grain Size Distribution Clay (%) | Silt (%) | Sand (%) | Gravel (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Fill Material:** | | | | | | | | | | |
| 5851 | MW-00909 | B00030-T | 2 | 4 | SP-SM | Poorly graded sand with silt | 6.8* | | 87.3 | 5.9 |
| 5851 | MW-11530 | B00033-T | 4 | 6 | SM | Silty sand with gravel | 18.7* | | 47.1 | 34.2 |
| 5851 | MW-12418 | B00020-T | 4 | 6 | -- | -- | 24.8* | | 71.9 | 3.3 |
| 5822 | MW-12432 | B10007-T | 2 | 4 | SP-SM | Poorly graded sand with silt | 9.3* | | 87.2 | 3.5 |
| 5992 | MW-13623 | B00010-T | 2 | 4 | SM | Silty Sand | 18.9* | | 73.1 | 8.0 |
| 5822 | MW-13623 | B00011-T | 6 | 8 | CL | Sandy lean clay | 31.8 | 32.2 | 33.6 | 2.4 |
| 5851 | MW-15457 | B00027-T | 2 | 4 | SM | Silty sand | 12.7* | | 84.9 | 2.4 |
| 5851/5885 | MW-16357 | B00037-T | 14 | 16 | CL | Sandy lean clay | 36.0 | 33.0 | 27.6 | 3.4 |
| 5822 | MW-17661 | B00013-T | 0 | 2 | SM | Silty sand | 5.2 | 24.9 | 68.3 | 1.6 |
| **Fluvial & Marsh Deposits:** | | | | | | | | | | |
| Fluvial Deposits | | | | | | | | | | |
| 5851 | MW-10713 | B10014-T | 44 | 46 | SP-SM | Poorly graded sand with silt | 5.1* | | 94.9 | 0.0 |
| 5851 | MW-11530 | B00035-T | 18 | 20 | SM | Silty sand | 23.8* | | 75.8 | 0.4 |
| 5992 | MW-13240 | B00007-T | 14 | 16 | SP | Poorly graded sand | 3.0* | | 94.0 | 3.0 |
| Marsh Deposits | | | | | | | | | | |
| 5851/5871 | MW-10713 | B10013-T | 28 | 30 | CL | Lean clay | 25.9 | 70.0 | 4.1 | 0.0 |
| 5851 | MW-11530 | B00034-T | 12 | 14 | SM | -- | 81.9* | | 18.1 | 0.0 |
| 5807 | MW-13240 | B00008-T | 24 | 26 | CL | Lean clay | 29.0 | 67.6 | 3.4 | 0.0 |
| 5851/5871 | MW-13240 | B00021-T | 26 | 28 | CL | Lean clay | 38.5 | 60.7 | 0.8 | 0.0 |
| 5851/5871 | MW-13240 | B00022-T | 42 | 44 | MH | Elastic silt with sand | 23.2 | 59.2 | 17.6 | 0.0 |
| 5822 | MW-13623 | B00012-T | 14 | 16 | MH | Elastic silt with sand | 17.6 | 64.2 | 18.1 | 0.1 |

**Table 2-9**
**Soil Descriptions and Grain Size Distributions**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Laboratory Report Number | Well ID | Sample ID | Sample Depth Top (feet) | Sample Depth Bottom (feet) | Soil Type (ASTM) | Material Description | Grain Size Distribution Clay (%) | Silt (%) | Sand (%) | Gravel (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Glaciolacustrine Sediments:** | | | | | | | | | | |
| 5807 | MW-10000 | B00004-T | 14 | 16 | CL | Sandy lean clay | 33.3 | 28.4 | 33.3 | 5.0 |
| 5807 | MW-10000 | B00006-T | 46 | 48 | CL | Sandy lean clay | 36.5 | 31.6 | 30.2 | 1.7 |
| 5807 | MW-10000 | B00009-T | 62 | 64 | CL | Lean clay | 47.5 | 47.3 | 4.9 | 0.3 |
| 5851/5871 | MW-10909 | B00036-T | 16 | 18 | CL | Lean clay with sand | 39.9 | 36.5 | 22.6 | 1.0 |
| 5851/5885 | MW-11530 | B10015-T | 58 | 60 | CL | Lean clay with sand | 32.6 | 42.3 | 18.1 | 7.0 |
| 5851/5885 | MW-11530 | B10016-T | 70 | 72 | CL | Sandy lean clay | 26.5 | 38.8 | 30.6 | 4.1 |
| 5885 | MW-11901 | B00023-T | 16 | 18 | -- | Lean clay with sand (visual) | 38.8 | 36.1 | 23.8 | 1.3 |
| 5851/5885 | MW-11901 | B00024-T | 32 | 34 | CL | Lean clay with sand | 38.6 | 34.0 | 25.1 | 2.3 |
| 5885 | MW-11901 | B00025-T | 48 | 50 | -- | Lean clay with sand (visual) | 38.9 | 31.4 | 28.4 | 1.3 |
| 5851/5871 | MW-11901 | B00026-T | 64 | 66 | CL | Lean clay | 77.2 | 19.5 | 3.2 | 0.1 |
| 5851/5885 | MW-12418 | B00031-T | 30 | 32 | -- | Lean clay with sand (visual) | 38.3 | 32.4 | 27.1 | 2.2 |
| 5885 | MW-12418 | B00032-T | 46 | 48 | -- | Lean clay with sand (visual) | 36.2 | 35.1 | 24.9 | 3.8 |
| 5851/5885 | MW-12728 | B10012-T | 26 | 28 | CL | Lean clay with sand | 37.7 | 32.6 | 27.3 | 2.4 |
| 5885 | MW-93205 | B20001-T | 10 | 12 | -- | Lean clay with sand (visual) | 37.0 | 35.5 | 26.6 | 0.9 |
| 5885 | MW-93205 | B20002-T | 26 | 28 | -- | Lean clay with sand (visual) | 36.8 | 32.0 | 26.3 | 4.9 |
| 5885 | MW-93205 | B20003-T | 42 | 44 | -- | Lean clay with sand (visual) | 37.1 | 44.2 | 15.8 | 2.9 |
| 5851/5885 | MW-93205 | B20004-T | 58 | 60 | CL | Lean clay | 77.7 | 21.2 | 1.1 | 0.0 |
| 5851/5871 | MW-93205 | B20005-T | 74 | 76 | CL | Sandy lean clay | 26.9 | 41.1 | 28.5 | 3.5 |
| 5851/5871 | MW-14831 | B00019-T | 36 | 38 | CL | Lean clay with sand | 39.7 | 32.5 | 22.0 | 5.8 |
| 5885 | MW-15450 | B00016-T | 14 | 16 | -- | Lean clay with sand (visual) | 37.2 | 31.0 | 30.1 | 1.7 |
| 5885 | MW-15450 | B00017-T | 30 | 32 | -- | Lean clay with sand (visual) | 37.2 | 45.0 | 12.3 | 5.5 |
| 5822 | MW-15450 | B00018-T | 46 | 48 | CL | Sandy lean clay | 35.7 | 33.7 | 28.0 | 2.6 |

**Table 2-9**
**Soil Descriptions and Grain Size Distributions**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Laboratory Report Number | Well ID | Sample ID | Sample Depth Top (feet) | Sample Depth Bottom (feet) | Soil Type (ASTM) | Material Description | Grain Size Distribution Clay (%) | Silt (%) | Sand (%) | Gravel (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Glaciolacustrine Sediments (continued):** | | | | | | | | | | |
| 5851/5885 | MW-15964 | B00028-T | 28 | 30 | CL | Lean clay with sand | 39.6 | 32.8 | 24.0 | 3.6 |
| 5851/5871 | MW-15964 | B00029-T | 46 | 48 | CL | Lean clay with sand | 37.4 | 33.2 | 28.1 | 1.3 |
| 5793 | MW-16080 | B00001-T | 16 | 18 | CL | Sandy lean clay | 34.8 | 29.5 | 33.7 | 2.0 |
| 5793 | MW-16080 | B00002-T | 32 | 34 | CL | Sandy lean clay | 38.8 | 28.9 | 27.1 | 5.2 |
| 5793 | MW-16080 | B00003-T | 48 | 50 | CL | Sandy lean clay | 25.3 | 26.7 | 40.2 | 7.8 |
| 5822 | MW-17661 | B00014-T | 14 | 16 | CL | Sandy lean clay | 33.5 | 33.1 | 32.1 | 1.3 |
| 5793 | MW-97948 | B10001-T | 10 | 12 | CL | Sandy lean clay | 37.5 | 33.9 | 27.1 | 1.5 |
| 5793 | MW-97948 | B10002-T | 24 | 26 | CL | Sandy lean clay | 32.9 | 25.5 | 39.9 | 1.7 |
| 5793 | MW-97948 | B10003-T | 38 | 40 | CL | Sandy lean clay | 34.9 | 28.1 | 35.0 | 2.0 |
| 5807 | MW-97948 | B10005-T | 68 | 70 | CL | Lean clay with sand | 52.8 | 32.1 | 14.2 | 0.9 |
| 5992 | MW-97948 | B10006-T | 74 | 76 | CL-ML | Sandy silty clay | 21.4 | 35.2 | 37.0 | 6.4 |
| **Subglacial Deposits:** | | | | | | | | | | |
| 5851 | MW-17948 | B10008-T | 80 | 82 | -- | -- | 41.6* | | 53.8 | 4.6 |

**Notes:**
Soil was classified based on American Society of Testing and Materials (ASTM) D2487: Standard Test Method for Classification of Soils for Engineering Purposes.
-- = Not Reported. Atterberg Limits were not determined because the soil was not plastic or there was insufficient sample volume. Therefore an ASTM soil type could not be assigned.
* Percentage of silt and clay.

# Table 2-10
## Summary of Physical Analytical Results
Saginaw Metal Casting Operations
Saginaw, Michigan

| Laboratory Report Number | Well ID | Sample ID | Sample Depth Top (feet) | Sample Depth Bottom (feet) | Soil Type[1] (USCS) | Permeability (cm/s) | Dry Density (pcf) | Dry Density g/cm$^3$ | Porosity (%) | Specific Gravity g/cm$^3$ | Moisture Content (Perm[2]) (%) | Moisture Content (Sieve[3]) (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5851 | MW-00909 | B00030-T | 2 | 4 | SP-SM | -- | -- | -- | -- | -- | -- | 9.5 |
| 5807 | MW-10000 | B00004-T | 14 | 16 | CL | 7.23E-08 | 124.61 | 1.99 | 27.8 | 2.76 | 13.76 | -- |
| 5807 | MW-10000 | B00006-T | 46 | 48 | CL | 3.22E-08 | 125.42 | 2.01 | 27.0 | 2.75 | 13.54 | -- |
| 5807 | MW-10000 | B00009-T | 62 | 64 | CL | 6.36E-08 | 98.78 | 1.58 | 43.1 | 2.78 | 27.67 | -- |
| 5851/5871 | MW-10713 | B10013-T | 28 | 30 | CL | 2.20E-07 | 91.66 | 1.47 | 46.0 | 2.71 | 33.55 | 33.5 |
| 5851 | MW-10713 | B10014-T | 44 | 46 | SP-SM | -- | -- | -- | -- | -- | -- | 18.4 |
| 5851/5871 | MW-10909 | B00036-T | 16 | 18 | CL | 7.50E-08 | 123.65 | 1.98 | 28.0 | 2.75 | 14.63 | 15.3 |
| 5851 | MW-11530 | B00033-T | 4 | 6 | SM | -- | -- | -- | -- | -- | -- | 7.8 |
| 5851 | MW-11530 | B00034-T | 12 | 14 | SM | -- | -- | -- | -- | -- | -- | 38.7 |
| 5851 | MW-11530 | B00035-T | 18 | 20 | SM | -- | -- | -- | -- | -- | -- | 30.9 |
| 5851/5885 | MW-11530 | B10015-T | 58 | 60 | CL | 9.63E-08 | 127.10 | 2.03 | 26.7 | 2.78 | 13.66 | 14.1 |
| 5851/5885 | MW-11530 | B10016-T | 70 | 72 | CL | 3.90E-08 | 126.06 | 2.02 | 27.3 | 2.78 | 15.37 | 16.2 |
| 5885 | MW-11901 | B00023-T | 16 | 18 | -- | -- | -- | -- | -- | -- | -- | 13.5 |
| 5851/5885 | MW-11901 | B00024-T | 32 | 34 | CL | 1.94E-08 | 121.35 | 1.94 | 29.9 | 2.77 | 15.21 | 15.4 |
| 5885 | MW-11901 | B00025-T | 48 | 50 | -- | -- | -- | -- | -- | -- | -- | 16.0 |
| 5851/5871 | MW-11901 | B00026-T | 64 | 66 | CL | 3.42E-08 | 88.54 | 1.42 | 49.3 | 2.79 | 35.83 | 35.4 |
| 5851 | MW-12418 | B00020-T | 4 | 6 | -- | -- | -- | -- | -- | -- | -- | 11.9 |
| 5851/5885 | MW-12418 | B00031-T | 30 | 32 | -- | 3.67E-08 | 123.15 | 1.97 | 28.0 | 2.74 | 14.53 | 14.5 |
| 5885 | MW-12418 | B00032-T | 46 | 48 | -- | -- | -- | -- | -- | -- | -- | 16.0 |
| 5822 | MW-12432 | B10007-T | 2 | 4 | SP-SM | -- | -- | -- | -- | -- | -- | 1.9 |
| 5851/5885 | MW-12728 | B10012-T | 26 | 28 | CL | 3.40E-08 | 122.82 | 1.97 | 28.7 | 2.75 | 14.59 | 15.1 |
| 5992 | MW-13240 | B00007-T | 14 | 16 | SP | -- | -- | -- | -- | -- | -- | 19.5 |
| 5807 | MW-13240 | B00008-T | 24 | 26 | CL | 7.54E-08 | 81.51 | 1.30 | 50.5 | 2.63 | 40.25 | -- |
| 5851/5871 | MW-13240 | B00021-T | 26 | 28 | CL | 6.78E-08 | 74.20 | 1.19 | 56.9 | 2.75 | 47.01 | 49.5 |
| 5851/5871 | MW-13240 | B00022-T | 42 | 44 | MH | 9.71E-08 | 62.28 | 1.00 | 60.6 | 2.53 | 57.53 | 70.6 |
| 5992 | MW-13623 | B00010-T | 2 | 4 | SM | -- | -- | -- | -- | -- | -- | 7.9 |
| 5822 | MW-13623 | B00011-T | 6 | 8 | CL | 8.41E-08 | 113.41 | 1.81 | 32.0 | 2.67 | 18.12 | 16.2 |
| 5822 | MW-13623 | B00012-T | 14 | 16 | MH | 1.37E-06 | 65.63 | 1.05 | 59.0 | 2.56 | 56.23 | 38.9 |
| 5851/5871 | MW-14831 | B00019-T | 36 | 38 | CL | 2.69E-08 | 119.64 | 1.91 | 30.8 | 2.76 | 15.34 | 15.5 |
| 5885 | MW-15450 | B00016-T | 14 | 16 | -- | -- | -- | -- | -- | -- | -- | 11.6 |
| 5885 | MW-15450 | B00017-T | 30 | 32 | -- | -- | -- | -- | -- | -- | -- | 11.5 |
| 5822 | MW-15450 | B00018-T | 46 | 48 | CL | 4.29E-08 | 122.11 | 1.95 | 27.4 | 2.69 | 14.68 | 13.4 |
| 5851 | MW-15457 | B00027-T | 2 | 4 | SM | -- | -- | -- | -- | -- | -- | 11.5 |
| 5851/5885 | MW-15964 | B00028-T | 28 | 30 | CL | 2.50E-08 | 122.69 | 1.96 | 29.1 | 2.77 | 15.04 | 15.7 |

# Table 2-10
## Summary of Physical Analytical Results
Saginaw Metal Casting Operations
Saginaw, Michigan

| Laboratory Report Number | Well ID | Sample ID | Sample Depth Top (feet) | Sample Depth Bottom (feet) | Soil Type[1] (USCS) | Permeability (cm/s) | Dry Density (pcf) | Dry Density g/cm$^3$ | Porosity (%) | Specific Gravity g/cm$^3$ | Moisture Content (Perm[2]) (%) | Moisture Content (Sieve[3]) (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5851/5871 | MW-15964 | B00029-T | 46 | 48 | CL | 4.02E-08 | 120.73 | 1.93 | 29.9 | 2.75 | 15.96 | 15.4 |
| 5793 | MW-16080 | B00001-T | 16 | 18 | CL | 2.04E-08 | 126.41 | 2.02 | 26.6 | 2.76 | 12.94 | 14.1 |
| 5793 | MW-16080 | B00002-T | 32 | 34 | CL | 5.13E-08 | 118.20 | 1.89 | 31.1 | 2.74 | 15.20 | 16.9 |
| 5793 | MW-16080 | B00003-T | 48 | 50 | CL | 4.35E-08 | 128.61 | 2.06 | 25.1 | 2.75 | 11.44 | 11.5 |
| 5851/5885 | MW-16357 | B00037-T | 14 | 16 | CL | 1.21E-07 | 130.58 | 2.09 | 24.6 | 2.77 | 10.14 | 11.2 |
| 5822 | MW-17661 | B00013-T | 0 | 2 | SM | -- | -- | -- | -- | -- | -- | 4.8 |
| 5822 | MW-17661 | B00014-T | 14 | 16 | CL | 8.30E-08 | 125.09 | 2.00 | 25.3 | 2.68 | 11.86 | 11.7 |
| 5851 | MW-17948 | B10008-T | 80 | 82 | -- | -- | -- | -- | -- | -- | -- | 13.6 |
| 5885 | MW-93205 | B20001-T | 10 | 12 | -- | -- | -- | -- | -- | -- | -- | 12.9 |
| 5885 | MW-93205 | B20002-T | 26 | 28 | -- | -- | -- | -- | -- | -- | -- | 15.1 |
| 5885 | MW-93205 | B20003-T | 42 | 44 | -- | -- | -- | -- | -- | -- | -- | 16.1 |
| 5851/5885 | MW-93205 | B20004-T | 58 | 60 | CL | 3.48E-08 | 82.92 | 1.33 | 52.1 | 2.77 | 40.30 | 35.2 |
| 5851/5871 | MW-93205 | B20005-T | 74 | 76 | CL | 2.06E-08 | 133.47 | 2.14 | 23.0 | 2.77 | 9.07 | 8.6 |
| 5992 | MW-96080 | B10010-T | 74 | 76 | SM | -- | -- | -- | -- | -- | -- | 7.9 |
| 5793 | MW-97948 | B10001-T | 10 | 12 | CL | 1.83E-08 | 126.85 | 2.03 | 25.5 | 2.73 | 10.65 | 0.9 |
| 5793 | MW-97948 | B10002-T | 24 | 26 | CL | 3.80E-08 | 121.52 | 1.94 | 28.1 | 2.71 | 14.61 | 27.5 |
| 5793 | MW-97948 | B10003-T | 38 | 40 | CL | 3.42E-08 | 123.48 | 1.98 | 27.5 | 2.73 | 14.00 | 14.2 |
| 5807 | MW-97948 | B10005-T | 68 | 70 | CL | 5.92E-08 | 85.82 | 1.37 | 50.2 | 2.76 | 36.54 | -- |
| 5992 | MW-97948 | B10006-T | 74 | 76 | CL-ML | -- | -- | -- | -- | -- | -- | 10.7 |

**Notes:**

[1] Atterberg Limits were not determined for some samples because the soil was not plastic or there was insufficient sample volume. Therefore, soil types could not be assigned for all samples.

[2] Moisture content as determined by permeability testing.

[3] Moisture content as determined from sieve analysis.

-- = Not Required.

cm/s = Centimeters per second.

g/cm$^3$ = Grams per cubic centimeter.

pcf = Pounds per cubic foot.

USCS = Unified Soil Classification System.

## Table 2-11
## Sediment Sample Designations and Analyses Performed
Saginaw Metal Casting Operations
Saginaw, Michigan

| Location | Sample ID | Summary of Chemical Analysis Performed | | | | |
|---|---|---|---|---|---|---|
| | | Total Metals | Polychlorinated Biphenyls (PCBs) | Acid Volatile Sulfide/ Simultaneously Extractable Metals (AVS/SEM) | Total Organic Carbon (TOC) | Semivolatile Organic Compounds (SVOCs) |
| C1 | S00014** | X | X | X | X | |
| C3 | S00015 | X | X | X | X | |
| H1 | S00003 | X | X | X | X | |
| | S00004* | X | X | X | X | |
| H2 | S00005 | X | X | X | X | |
| H3 | S00001 | X | X | X | X | |
| | S00002* | X | X | X | X | |
| H4 | S00006 | X | X | X | X | |
| H5 | S00016 | X | X | X | X | X |
| | S00017* | X | X | X | X | X |
| H7 | S00020 | X | X | X | X | |
| J1 | S00011 | X | X | X | X | |
| | S00012* | X | X | X | X | |
| J2 | S00010 | X | X | X | X | |
| J3 | S00007 | X | X | X | X | X |
| J4 | S00009 | X | X | X | X | |
| J5 | S00008 | X | X | X | X | |

Notes:
* Duplicate Sample.
** Split sample collected for EPA.

**Table 2-12**
**Surface Water Measurements and Elevations**
Saginaw Metal Casting Operations
Saginaw, Michigan

| | Easting | Northing | Date | Elevation (msl) | General Location |
|---|---|---|---|---|---|
| Staff Gauge #1 | 716276.83 | 13244650 | 3/24/99 | 580.64 msl | In the Saginaw River. |
| Staff Gauge #2 | 715775.60 | 13247360 | 3/24/99 | 590.87 msl | In the secondary settling pond. |
| #3 | 715410.85 | 13246970 | 3/24/99 | 596.0 msl | Measured in the easternmost primary settling pond south of the secondary settling pond. |
| #4 | 715501.84 | 13246870 | 3/24/99 | 596.0 msl | Measured in the primary settling pond immediately west of #3. |
| #5 | 715783.63 | 13246590 | 3/24/99 | 590.5 msl | Measured in the lagoon located west of the primary settling ponds. |
| #6 | 715552.08 | 13244680 | 3/24/99 | 581.3 msl | Measured near the drain located in the ditch in investigation unit H. |
| #7 | 712778.24 | 13241980 | 3/24/99 | 585.0 msl | Measured in the lagoon north of MW-01827. |

| | 3/23/99 | | | | 3/24/99 | | | | 3/25/99 | | | | | 3/30/99 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 11:15 | 15:05 | 10:45 | 14:55 | 8:30 | 12:41 | 13:00 | 16:00 | | 17:10 | | 8:30 | 17:00 | 14:15 | 14:30 |
| Staff Gauge #1 | 578.44 | 578.24 | NM | NM | 578.64 | 579.07 | NM | NM | 578.91 | 578.59 | NM | NM | NM | NM | 581.32 |
| Staff Gauge #2 | NM | NM | 588.62 | 588.61 | NM | NM | 588.58 | 588.58 | NM | NM | 588.72 | 589.26 | 589.26 | 591.69 | NM |
| #3 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| #4 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| #5 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| #6 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| #7 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |

**Notes:**
All elevations are referenced to mean sea level (msl).
All elevations are surveyed using North American Vertical Datum 1988.
NM = not measured.

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit A: Miscellaneous Sluice Sand and Bulk Storage Area** | | | | | | |
| Description: Investigation Unit A encompasses a 37-acre area that is primarily comprised of a grassy field; formerly it included a large quench slag stockpile and two settling ponds from which water was discharged to the Saginaw River via Outfall 001. The ponds have since been filled-in. | | | | | | |
| A.1: Former Quench Slag Staging Area "B"; A.2: Former Bulk Raw Materials Storage; A.3: Former Sluice Sand Settling/Reclaim Area | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | A portion of Investigation Unit A is currently leased for asphalt operations. The entire unit is unpaved. In addition, the unit is partially fenced and, therefore, may be accessed by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit B: Former Parts Plant** | | | | | | |
| Description: Investigation Unit B encompasses a 14-acre area comprised of a vacant lot, the site of the former Parts Plant which was demolished in 1985. | | | | | | |
| B.1: Former RCRA Hazardous Waste Drum Storage Area (Clean closed)<br>B.2: Former Electric Department PCB Storage Area<br>B.3: Former PCB Storage Area<br>B.4: Former Interior Drum Storage Area<br>B.5: Former Wastewater Treatment System<br>B.6: Former Machine Storage Pad<br>B.7: Former Cyanide Dip Tanks and Emergency Dump Tank UST<br>B.8: Former Bulk Gasoline USTs<br>B.9: Former Coolant Systems<br>B.10: Former Waste Oil ASTs<br>B.11: Former "Rag Oil" Tank<br>B.12: Former Hammer Mill (Swagger)<br>B.13: Former Cast Iron Chip Car Station<br>B.14: Former aluminum Chip Car Station<br>B.15: Former Steel Chip Car Station | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | Construction trailers are currently located on Investigation Unit B for implementation of modernization plans. Although the perimeter of this unit is currently fenced, the gate is not locked, which allows access to the unit by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit C: Process Water Reservoir** | | | | | | |
| Description: Investigation Unit C encompasses a 6-acre area consisting solely of the 266,000 $ft^2$ Process Water Reservoir. This reservoir is approximately 15-20 ft deep with steep banks. | | | | | | |
| C.1: Process Water Reservoir | Maintenance Workers | ingestion and dermal contact | surface water | yes | yes | This portion of the facility is still in operation. Potential worker exposure occurs while in a boat out in the reservoir during semi-annual application of algaecide. The depth of water and steep nature of the banks precludes contact with sediment. Investigation Unit C is currently unfenced and, therefore, may be accessed by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Furthermore, this unit is surrounded by land used for industrial purposes and is integral to continued GM operation. Consequently, the us of the area for future residential purposes is unlikely. |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | | ingestion and dermal contact | sediment | no | no | |
| | Residents | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |
| | Trespassers | ingestion and dermal contact | surface water | yes | yes | |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | | ingestion and dermal contact | sediment | no | no | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit D: Grey Iron Plant** | | | | | | |
| Descriptions: Investigation Unit D encompasses a 60-acre area, which includes the 1.8 million $ft^2$ Grey Iron Plant built in 1918, currently undergoing its fifth modernization. | | | | | | |
| D.1: Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area (Clean closed)<br>D.2-D.6: Accumulation/Storage Areas<br>D.7-D.10: Equipment/Boring/Sand Staging Area<br>D.11-D.13: Non-Hazardous Waste Drum/Hazardous Materials Storage<br>D.14: Concrete Staging Area<br>D.15: Steam Cleaning Room<br>D.16: Air Scrubber Systems<br>D.17-D.18: UST<br>D.19-D.23: UST (Tanks removed - Closure approved by MDEQ)<br>D.24-D.25: UST<br>D.26-D.27: AST<br>D.28-D.35: Releases/Leaks/Contamination | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | This portion of the facility is still in operation. In addition to plant activities, construction trailers ar located within this unit to facilitate implementation of modernization plans. The majority of the Grey Iron Plant area is paved or is covered by buildings. Exposures to soil coul occur in unpaved or unmaintaine areas. The perimeter of Investigation Unit D is mostly fenced, while the remaining area on the northern side is protected from trespassers by continuous security.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Furthermore, GM plans to continue plant operation as evidenced by a recent large capital investment. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit E: Riverdock Area** | | | | | | |
| Description: Investigation Unit E encompasses an 84-acre area, which includes the former Riverdock buildings (demolished), recyclable materials staging areas, the Powerhouse, and the Advanced Development Lab. The Powerhouse has three ASTs, two of which are certified closed, and one 300,000 gallon empty AST. The Riverdock contained a 1,000-gallon septic tank. | | | | | | |
| E.1: Former ADL Waste 1,1,1-TCA Satellite Drum Accumulation/Storage Area<br>E.2: Former ADL PCB Accumulation/Storage Area<br>E.3: Current ADL Drum Accumulation/Storage Area<br>E.4: Riverdock Crane Repair Building Underground Septic System (Removed Feb '99)<br>E.5: Current Casting Sand/Metal Reclamation Area<br>E.6: Former Quench Slag Staging Area "A"<br>E.7: Former (Original) Boring Staging Area<br>E.8: Former Boring Staging Area<br>E.9: Current Core Sand Staging Area<br>E.10: Powerhouse Fuel Oil ASTs<br>E.11: Former Riverdock Crane Repair Building UST (G.I. #6, Clean closed)<br>E.12: Riverdock Crane Repair Building UST (G.I. #9)<br>E.13: Former Mill Water Pump House UST (N.I. #9, MDEQ closure report pending)<br>E.14: Allegedly Buried Drums | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | This portion of the facility is still in operation. This area is currently partially fenced and, therefore, may be accessed by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Furthermore, this unit is integral to continued GM operation. Consequently, the us of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit F: Advanced Materials Development Center (AMDC) and Administrative Building** | | | | | | |
| Description: Investigation Unit F encompasses a 41-acre area, which includes the former administrative building (demolished in 1998), a 48,000 $ft^2$ Advanced Materials Development Center building (AMDC) constructed in 1965 as a warehouse and renovated in 1988 for its current use, and two former filling stations with a total of seven USTs, the removal of which is undocumented. | | | | | | |
| F.1: Former North Filling Station USTs<br>F.2: Former South Filling Station USTs | Routine Workers | ingestion and dermal contact | surface soil | no | no | Industrial activity in Investigation Unit F is limited to the parking lot and the AMDC. The remaining area is unpaved. In particular, the area of the two former filling stations is covered by grass. Any contamination resulting from the USTs would be deep below ground surface. Potential direct exposure would only be encountered through excavation or maintenance activities. The location of the two former USTs is currently partially fenced and, therefore, may be accessed by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor in air from subsurface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor in air from subsurface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from subsurface soil | yes | yes | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit G: Former Nodular Iron Plant** | | | | | | |
| Description: Investigation Unit G encompasses a 67-acre area, which includes the north parking lot and the former Nodular Iron Plant that was operated from 1966 to its closing in 1987; the plant has been dismantled. Hazardous waste activities were conducted outside of the plant on the south and east sides; a former calcium carbide desulfurization unit was operated on the north side from 1979 to 1981. | | | | | | |
| G.1: Former Oil House RCRA Hazardous Waste Drum Storage Area (Closure report submittal to MDEQ pending)<br>G.2: Former RCRA Hazardous Waste Control Tank (AST) (MDEQ reviewing closure report)<br>G.3: Former Waste Paint Shed RCRA Hazardous Waste Drum Storage Unit (MDEQ reviewing closure report)<br>G.4: Former (Original) Desulfurization Slag RCRA Treatment Unit, "Weathering Slab" (MDEQ reviewing closure report)<br>G.5: Former (Replacement) Desulfurization Slag RCRA Treatment Unit (MDEQ reviewing closure report)<br>G.6: Former Waste PCB Transformer/Drum Storage Area<br>G.7: Basement Sumps (4)<br>G.8: Former Virgin Oils Storage Pad<br>G.9: Former Core Sand Staging Area<br>G.10: Former Oil House UST North (N.I. #1, Tank removed 1988)<br>G.11: Former Gasoline UST West (N.I. #2, Tank removed 1988)<br>G.12: Former Oil House USTs South (N.I. #3, N.I. #4, N.I. #5, N.I. #6)<br>G.13: Former Cooling Tower Pump House UST (N.I. #7, MDEQ closure report pending)<br>G.14: Former Oil House UST West (N.I. #8)<br>G.15: Elevator Hydraulic Leaks<br>G.16: 01/26/89 Possible Chlorobenzene Release | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | Currently, only the north parking lot is still in use; the former Nodular Iron Plant has been dismantled, and the desulfurization pad and surrounding soil was removed per an MDNR approved closure plan. The perimeter of GM's portion of Investigation Unit G is currently fenced. However, the north parking lot, which was sold for commercial land use, is partially fenced and, therefore, may be accessed by trespassers.<br><br>According to the City of Saginaw Master Plan and Future Land Use Plan Map, this area is zoned for industrial use. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit H: Stormwater Discharge Ditch and Wastewater Treatment System** | | | | | | |
| Description: Investigation Unit H encompasses a 75-acre area, which includes the wastewater treatment system and a discharge ditch. The WWTP consists of four primary and one large secondary settling basin. The primary lagoons have been in operation since the construction of the WWTP in 1976. Prior to this time, the secondary settling basin was the primary settling basin for approximately ten years. Effluent from the lagoons was discharged via the drainage ditch to a permitted outlet to the Saginaw River. This outlet has been plugged and the discharge ditch currently receives only stormwater. Discharge from the lagoons is presently recycled for use in the Grey Iron Plant. | | | | | | |
| H.1: Primary Settling Basins<br>H.2: Secondary Settling Basin<br>H.3: Stormwater Discharge Ditch<br>H.4: Temporary Classified Sand Staging Areas<br>H.5: Current Filter Cake Roll-Off Container(s) | Routine Workers | ingestion and dermal contact | surface soil | yes | yes | This portion of the facility is still in operation. The perimeter of Investigation Unit H is currently fenced to prevent trespassing. The former NPDES permit for Outfall 002 (MI 0001139, the ditch) has been withdrawn, and the outlet to the Saginaw River has been plugged (RFI Workplan, Volume 1, pg. 1: 3-12).<br><br>According to the Buena Vista Charter Township Community Development Plan, this area is zoned for industrial use (pg. 66). Furthermore, this unit is integral to continued GM operation. Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | | ingestion and dermal contact | sediment | no | no | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | | ingestion and dermal contact | surface water | yes | yes | |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | | ingestion and dermal contact | sediment | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit H: Stormwater Discharge Ditch and Wastewater Treatment System** | | | | | | |
| | Trespassers | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit I: Classified Sand Staging Area** | | | | | | |
| Description: Investigation Unit I encompasses a 67-acre area, which includes a classified sand staging area (1983 - present), a former quench slag staging area (1965 - 1987), a former metals reclamation staging area (1965 - 1987), and three former Downes school building USTs (1956 - 1988 when the building was demolished). | | | | | | |
| I.1: Classified Sand Staging Area<br>I.2: Former Nodular Iron Quench Slag Staging Area<br>I.3: Former Nodular Iron Metals Reclamation Staging Area<br>I.4 Former Downes School Building USTs (N.I. #10, N.I. #11, N.I. #12, MDEQ closure report pending) | Routine Workers | ingestion and dermal contact | surface soil | no | yes | This portion of the facility is still in operation. Potentially impacted soil is covered by piles of soil and/or classified sand and, therefore, not available for exposure. This area is currently partially fenced and, therefore, may be accessed by trespassers. During removal of UST #12 a petroleum odor was detected. Consequently, 5 $yd^3$ of additional soil was removed for disposal (DOCC, Volume 1, pg. 14-3).<br><br>According to the Buena Vista Charter Township Community Development Plan, this area is zoned for industrial use (pg. 66). Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | Occasional Excavation/Maintenance Workers | ingestion and dermal contact | surface and subsurface soil | no | yes | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | yes | yes | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | Trespassers | ingestion and dermal contact | surface soil | no | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit J: On-Site Landfill** | | | | | | |
| Description: Investigation Unit J encompasses a 71-acre area, which includes a 60-acre MDEQ-licensed Type III landfill (industrial monofill) that has been in operation since circa 1978, and which has a leachate collection system and ground water monitoring system. The Gage (Deikmann) drain also runs along the northern boundary of this Investigation Unit. | | | | | | |
| J.1: MDEQ-licensed Type III Landfill | Routine Workers | ingestion and dermal contact | surface soil | no | no | This portion of the facility is still in operation. "Phases I and II (on the east side...) have been completed and are currently idle (but classified as active). Phase III (on the west side) is currently operational" (DOCC, Volume 1, pg. 15-1). Quarterly ground water monitoring has been conducted since 1980 (RFI Workplan, Volume 1, pg. 1: 3-14). This area is currently partially fenced and, therefore, may be accessed by trespassers.<br><br>Workers in this unit are subject to a separate HASP.<br><br>According to the Buena Vista Charter Township Community Development Plan, this area is zoned for industrial use (pg. 66). Consequently, the use of the area for future residential purposes is unlikely. |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |
| | Maintenance Workers | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from disturbed surface and subsurface soil | no | no | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |
| | Residents | ingestion and dermal contact | surface soil | no | no | |
| | | inhalation | vapor and particulates in air from surface soil | no | no | |
| | | ingestion and dermal contact | surface water | no | no | |
| | | inhalation | vapor in air from surface water | no | no | |
| | | ingestion and dermal contact | sediment | no | no | |

Table 2-13
Scenarios for Potential Human Exposure
GMC Saginaw Metal Casting Operations - Saginaw, Michigan

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **On-Facility** | | | | | | |
| **Investigation Unit J: On-Site Landfill** | | | | | | |
| | Trespassers | ingestion and dermal contact | surface soil | yes | yes | |
| | | inhalation | vapor and particulates in air from surface soil | yes | yes | |
| | | ingestion and dermal contact | surface water | yes | yes | |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | | ingestion and dermal contact | sediment | yes | yes | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **Off-Facility** | | | | | | |
| Surrounding Land Areas | Residents | inhalation | vapor and particulates in air from surface soil | yes | yes | Surrounding land also includes commercial and industrial use, but potential exposures to worker population would be lower than those for the residential population. |
| | | | vapor and particulates in air from disturbance of subsurface soil | yes | yes | |
| | | | vapor in air from surface water | yes | yes | |
| Saginaw River | Recreational Boaters | ingestion and dermal contact | surface water | yes | yes | No surface water or fish samples will be collected from the Saginaw River. The potential impact by ground water on exposure media is evaluated. Potential exposures may occur through recreational activity in the river including fishing and boating. The City of Saginaw intends to further encourage the use of the Saginaw River for recreational purposes (City of Saginaw Master Plan, pg. IV-8). A fish consumption advisory recommends that certain species of fish be consumed in a limited quantity (white bass), particularly for pregnant women, and that certain species of fish (carp and catfish) be avoided altogether (City of Saginaw Master Plan, pg II-3; 1988 Michigan Fish Advisory). It is expected that the shallow ground water discharges into the Saginaw River (RFI Phase 1B Work Plan, Sec. 2.4). |
| | | inhalation | vapor in air from surface water | yes | yes | |
| | Fishermen | ingestion | fish | yes | yes | |
| | | ingestion and dermal contact | surface water | yes | yes | |
| | | inhalation | vapor in air from surface water | yes | yes | |

**Table 2-13**
**Scenarios for Potential Human Exposure**
**GMC Saginaw Metal Casting Operations - Saginaw, Michigan**

| Exposure Area & Exposure Point(s) | Receptor Population | Exposure Route | Exposure Medium | Possible Currently | Possible in Future | Comments |
|---|---|---|---|---|---|---|
| **Off-Facility** | | | | | | |
| Drinking water well in the uppermost aquifer at a location allowable under MDEQ and MDPH regulations. MDEQ regulations (325.10801 through 325.10833) and MDPH regulations (325.1601 through 325.1676) apply to wells used to supply groundwater for a public water supply and a private water supply, respectively. The regulations include provisions for a minimum well casing depth of 25 ft below ground surface (325.10818, 325.1632), location of any well outside an area subject to flooding (325.10816, 325.1625) and beyond the specified isolation distances from contamination sources (325.10808 and 325.10812, 325.1622). | Residents | ingestion, dermal contact and inhalation | ground water | no | yes | Since 1948, the City of Saginaw (which also supplies the township of Buena Vista) has obtained its drinking water supply from the Whitestone Point area in Lake Huron (City of Saginaw Master Plan, pg. II-77). The abundant supply of water from Lake Huron and the lack of adequate aquifers almost eliminates the use of ground water wells in the area. Officials in the City of Saginaw were unaware of any ground water drinking wells. In Buena Vista, a limited number of private wells reportedly do exist (Buena Vista Community Development Plan, pg. 12). A well search of the area revealed domestic and commercial supply wells that are screened at depths ranging from 93 to 147 ft, located within 1-mile of the GM property. Based on the hydrogeologic conceptual model developed for this site, the existing wells do not appear to be directly downgradient of the Facility. |

# TABLE 3-1
## COMPLETENESS OF PHASE IA SAMPLE COLLECTION AND ANALYSIS BY INVESTIGATION UNIT

| Unit ID/ Name | Sample Matrix | Lab Parameters [ab] | Planned Investigative Samples | Actual Investigative Samples | Percent Completeness Investigative Samples |
|---|---|---|---|---|---|
| | | | No. | No. | No. |
| A Sluice Sand Staging Area | Soil | Total metals | 15 | 26 | 173% |
| | | Total Kjeldahl nitrogen (TKN) | 15 | 26 | 173% |
| | | Volatile organic compounds (VOCs) | 15 | 26 | 173% |
| | | Semivolatile organic compounds (SVOCs) | 15 | 26 | 173% |
| | | Polychlorinated biphenyls (PCBs) | 15 | 26 | 173% |
| | | Cyanide and sulfide | 15 | 26 | 173% |
| | | Total organic carbon (TOC) | 0 | 26 | NP |
| | Ground-water | Total and dissolved metals | 9 | 10 | 111% |
| | | Total Kjeldahl nitrogen (TKN) | 9 | 10 | 111% |
| | | Volatile organic compounds (VOCs) | 9 | 10 | 111% |
| | | Semivolatile organic compounds (SVOCs) | 9 | 10 | 111% |
| | | Polychlorinated biphenyls (PCBs) | 9 | 10 | 111% |
| | | Cyanide and sulfide | 9 | 10 | 111% |
| B. Former Parts Plant | Soil | Total metals | 9 | 14 | 156% |
| | | Total Kjeldahl nitrogen (TKN) | 9 | 14 | 156% |
| | | Volatile organic compounds (VOCs) | 9 | 14 | 156% |
| | | Semivolatile organic compounds (SVOCs) | 9 | 14 | 156% |
| | | Polychlorinated biphenyls (PCBs) | 9 | 14 | 156% |
| | | Cyanide and sulfide | 9 | 14 | 156% |
| | | Total organic carbon (TOC) | 0 | 14 | NP |
| | Ground-water | Total and dissolved metals | 5 | 4 | 80% |
| | | Total Kjeldahl nitrogen (TKN) | 5 | 4 | 80% |
| | | Volatile organic compounds (VOCs) | 5 | 4 | 80% |
| | | Semivolatile organic compounds (SVOCs) | 5 | 4 | 80% |
| | | Polychlorinated biphenyls (PCBs) | 5 | 4 | 80% |
| | | Cyanide and sulfide | 5 | 4 | 80% |
| C Recycle Water Reservoir | Surface Water | Total and dissolved metals | 1 | 1 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 1 | 1 | 100% |
| | Sediment | Total metals | 2 | 2 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 2 | 2 | 100% |
| | | AVS/SEM | 2 | 2 | 100% |
| | | Total organic carbon (TOC) | 2 | 2 | 100% |

## TABLE 3-1
## COMPLETENESS OF PHASE IA SAMPLE COLLECTION AND ANALYSIS BY INVESTIGATION UNIT

| Unit ID/ Name | Sample Matrix | Lab Parameters [ab] | Planned Investigative Samples | Actual Investigative Samples | Percent Completeness Investigative Samples |
|---|---|---|---|---|---|
| | | | No. | No. | No. |
| D Grey Iron Plant | Soil | Total metals | 13 | 23 | 177% |
| | | Total Kjeldahl nitrogen (TKN) | 13 | 23 | 177% |
| | | Volatile organic compounds (VOCs) | 13 | 23 | 177% |
| | | Semivolatile organic compounds (SVOCs) | 13 | 23 | 177% |
| | | Polychlorinated biphenyls (PCBs) | 13 | 23 | 177% |
| | | Cyanide and sulfide | 13 | 23 | 177% |
| | | Total organic carbon (TOC) | 0 | 23 | NP |
| | Ground-water | Total and dissolved metals | 8 | 8 | 100% |
| | | Total Kjeldahl nitrogen (TKN) | 8 | 8 | 100% |
| | | Volatile organic compounds (VOCs) | 8 | 8 | 100% |
| | | Semivolatile organic compounds (SVOCs) | 8 | 8 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 8 | 8 | 100% |
| | | Cyanide and sulfide | 8 | 8 | 100% |
| E. Riverdock Area | Soil | Total metals | 22 | 12 | 55% |
| | | Total Kjeldahl nitrogen (TKN) | 22 | 33 | 150% |
| | | Volatile organic compounds (VOCs) | 22 | 40 | 182% |
| | | Semivolatile organic compounds (SVOCs) | 22 | 39 | 177% |
| | | Polychlorinated biphenyls (PCBs) | 22 | 33 | 150% |
| | | Cyanide and sulfide | 22 | 33 | 150% |
| | | Total organic carbon (TOC) | 0 | 39 | NP |
| | Ground-water | Total and dissolved metals | 12 | 12 | 100% |
| | | Total Kjeldahl nitrogen (TKN) | 12 | 14 | 117% |
| | | Volatile organic compounds (VOCs) | 12 | 18 | 150% |
| | | Semivolatile organic compounds (SVOCs) | 12 | 18 | 150% |
| | | Polychlorinated biphenyls (PCBs) | 12 | 12 | 100% |
| | | Cyanide and sulfide | 12 | 15 | 125% |
| F. AMDC and Administration Building | Soil | Total metals | 14 | 16 | 114% |
| | | Total Kjeldahl nitrogen (TKN) | 14 | 16 | 114% |
| | | Volatile organic compounds (VOCs) | 14 | 16 | 114% |
| | | Semivolatile organic compounds (SVOCs) | 14 | 16 | 114% |
| | | Polychlorinated biphenyls (PCBs) | 14 | 16 | 114% |
| | | Cyanide and sulfide | 14 | 16 | 114% |
| | | Total organic carbon (TOC) | 0 | 16 | NP |
| | Ground-water | Total and dissolved metals | 7 | 4 | 57% |
| | | Total Kjeldahl nitrogen (TKN) | 7 | 4 | 57% |
| | | Volatile organic compounds (VOCs) | 7 | 4 | 57% |
| | | Semivolatile organic compounds (SVOCs) | 7 | 4 | 57% |
| | | Polychlorinated biphenyls (PCBs) | 7 | 4 | 57% |
| | | Cyanide and sulfide | 7 | 4 | 57% |

# TABLE 3-1
## COMPLETENESS OF PHASE IA SAMPLE COLLECTION AND ANALYSIS BY INVESTIGATION UNIT

| Unit ID/ Name | Sample Matrix | Lab Parameters [ab] | Planned Investigative Samples | Actual Investigative Samples | Percent Completeness Investigative Samples |
|---|---|---|---|---|---|
| | | | No. | No. | No. |
| G Former Nodular Iron Plant | Soil | Total metals | 11 | 37 | 336% |
| | | Total Kjeldahl nitrogen (TKN) | 11 | 24 | 218% |
| | | Volatile organic compounds (VOCs) | 11 | 38 | 345% |
| | | Semivolatile organic compounds (SVOCs) | 11 | 43 | 391% |
| | | Polychlorinated biphenyls (PCBs) | 11 | 37 | 336% |
| | | Cyanide and sulfide | 11 | 21 | 191% |
| | | Total organic carbon (TOC) | 0 | 43 | NP |
| | Ground-water | Total and dissolved metals | 8 | 20 | 250% |
| | | Total Kjeldahl nitrogen (TKN) | 8 | 20 | 250% |
| | | Volatile organic compounds (VOCs) | 8 | 22 | 275% |
| | | Semivolatile organic compounds (SVOCs) | 8 | 25 | 313% |
| | | Polychlorinated biphenyls (PCBs) | 8 | 20 | 250% |
| | | Cyanide and sulfide | 8 | 15 | 188% |
| H Wastewater Treatment System | Soil | Total metals | 20 | 29 | 145% |
| | | Total Kjeldahl nitrogen (TKN) | 20 | 29 | 145% |
| | | Volatile organic compounds (VOCs) | 20 | 29 | 145% |
| | | Semivolatile organic compounds (SVOCs) | 20 | 29 | 145% |
| | | Polychlorinated biphenyls (PCBs) | 20 | 29 | 145% |
| | | Cyanide and sulfide | 20 | 29 | 145% |
| | | Total organic carbon (TOC) | 0 | 29 | NP |
| | Ground-water | Total and dissolved metals | 11 | 7 | 64% |
| | | Total Kjeldahl nitrogen (TKN) | 11 | 8 | 73% |
| | | Volatile organic compounds (VOCs) | 11 | 7 | 64% |
| | | Semivolatile organic compounds (SVOCs) | 11 | 7 | 64% |
| | | Polychlorinated biphenyls (PCBs) | 11 | 7 | 64% |
| | | Cyanide and sulfide | 11 | 8 | 73% |
| | Surface Water | Total and dissolved metals | 5 | 5 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 5 | 5 | 100% |
| | Sediment | Total metals | 6 | 6 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 6 | 6 | 100% |
| | | AVS/SEM | 6 | 6 | 100% |
| | | Total organic carbon (TOC) | 6 | 6 | 100% |
| | | Semivolatile organic compounds (SVOCs) | 2 | 2 | 100% |

# TABLE 3-1
## COMPLETENESS OF PHASE IA SAMPLE COLLECTION AND ANALYSIS BY INVESTIGATION UNIT

| Unit ID/ Name | Sample Matrix | Lab Parameters [ab] | Planned Investigative Samples | Actual Investigative Samples | Percent Completeness Investigative Samples |
|---|---|---|---|---|---|
| | | | No. | No. | No. |
| I. Classified Sand Staging Area | Soil | Total metals | 17 | 25 | 147% |
| | | Total Kjeldahl nitrogen (TKN) | 17 | 25 | 147% |
| | | Volatile organic compounds (VOCs) | 17 | 47 | 276% |
| | | Semivolatile organic compounds (SVOCs) | 17 | 47 | 276% |
| | | Polychlorinated biphenyls (PCBs) | 17 | 25 | 147% |
| | | Cyanide and sulfide | 17 | 25 | 147% |
| | | Total organic carbon (TOC) | 0 | 47 | NP |
| | | Formaldehyde | 17 | 25 | 147% |
| | Ground-water | Total and dissolved metals | 8 | 7 | 88% |
| | | Total Kjeldahl nitrogen (TKN) | 8 | 7 | 88% |
| | | Volatile organic compounds (VOCs) | 8 | 10 | 125% |
| | | Semivolatile organic compounds (SVOCs) | 8 | 10 | 125% |
| | | Polychlorinated biphenyls (PCBs) | 8 | 7 | 88% |
| | | Cyanide and sulfide | 8 | 7 | 88% |
| | | Formaldehyde | 8 | 7 | 88% |
| J. On-site Landfill | Soil | Total metals | 7 | 7 | 100% |
| | | Total Kjeldahl nitrogen (TKN) | 7 | 7 | 100% |
| | | Volatile organic compounds (VOCs) | 7 | 7 | 100% |
| | | Semivolatile organic compounds (SVOCs) | 7 | 7 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 7 | 7 | 100% |
| | | Cyanide and sulfide | 7 | 7 | 100% |
| | | Total organic carbon (TOC) | 0 | 7 | NP |
| | Ground-water | Total and dissolved metals | 3 | 2 | 67% |
| | | Total Kjeldahl nitrogen (TKN) | 3 | 2 | 67% |
| | | Volatile organic compounds (VOCs) | 3 | 2 | 67% |
| | | Semivolatile organic compounds (SVOCs) | 3 | 2 | 67% |
| | | Polychlorinated biphenyls (PCBs) | 3 | 2 | 67% |
| | | Cyanide and sulfide | 3 | 2 | 67% |
| | Surface Water | Total and dissolved metals | 5 | 4 | 80% |
| | | Polychlorinated biphenyls (PCBs) | 5 | 4 | 80% |
| | Sediment | Total metals | 5 | 5 | 100% |
| | | Polychlorinated biphenyls (PCBs) | 5 | 5 | 100% |
| | | AVS/SEM | 5 | 5 | 100% |
| | | Total organic carbon (TOC) | 5 | 5 | 100% |

NOTES:

[a]Samples for laboratory analysis will be collected separately from the field screen samples.

[b]Lists of specific compounds and methods are shown in Tables 3A - 3F. These lists include the 40 CFR 264 Appendix IX for metals, VOCs, SVOCs, PCBs, cyanide, and sulfide, as discussed in **Section 1.2.2.**

NP - Phase 1A scope did not include collection of these samples.

## TABLE 3-2
## LABORATORY COMPLETENESS

| Investigation/ Sample Matrix | Analysis | Completeness Ratio[a] | Percent Completeness |
|---|---|---|---|
| RFI/Groundwater | VOCs | 4,214/4,712 | 89 |
| | SVOCs | 8,260/8,284 | 100 |
| | PCBs | 532/532 | 100 |
| | Formaldehyde | 9/9 | 100 |
| | Metals | 3,192/3,192 | 100 |
| | Conventional parameters | 228/228 | 100 |
| Surface Water | PCBs | 98/98 | 100 |
| | Metals | 588/588 | 100 |
| Soil | VOCs | 11,693/13,454 | 87 |
| | SVOCs | 23,464/23,544 | 100 |
| | PCBs | 1,512/1,512 | 100 |
| | Formaldehyde | 27/27 | 100 |
| | Conventional parameters | 868/876 | 99 |
| Sediment | SVOCs | 327/327 | 100 |
| | PCBs | 119/119 | 100 |
| | Metals | 469/469 | 100 |
| | AVS; Conventional parameters | 51/51 | 100 |
| UST/ Groundwater | SVOCs | 2,052/2,071 | 99 |
| | PCBs | 14/14 | 100 |
| | Conventional parameters | 6/6 | 100 |
| | Metals | 40/40 | 100 |
| Soil | SVOCs | 3,671/3,706 | 99 |
| North Parking Lot/ Groundwater | VOCs | 472/480 | 98 |
| | SVOCs | 1,288/1,308 | 98 |
| | PCBs | 84/84 | 100 |
| | Metals | 336/336 | 100 |
| | Ammonia (as nitrogen) | 12/12 | 100 |
| Soil | VOCs | 780/780 | 100 |
| | SVOCs | 1,936/1,962 | 99 |
| | PCBs | 126/126 | 100 |
| | Metals | 378/378 | 100 |
| | Conventional parameters | 23/23 | 100 |

**Notes:**

[a] Completeness ratio equals the total number of valid data points (excludes rejected data points) divided by the total number of data points reported.

AVS - Acid Volatile Sulfide
PCBs - Polychlorinated Biphenyl Compounds
SVOCs - Semivolatile Organic Compounds
VOCs - Volatile Organic Compounds

## Table 4-1

## Phase 1A Screening Levels for Soil and Sediment[a]

| Chemical | Chemical Abstract Service Number | Residential Direct Contact Criteria[b] | Industrial and Commercial II (Direct Contact)[b] | Residential Finite VSIC for 5 Meter Source Thickness[b] | Industrial Finite VSIC for 5 Meter Source Thickness[b] | Residential Particulate Soil Inhalation Criteria[b] | Industrial Particulate Soil Inhalation Criteria[b] | Residential Soil Volatilization to Indoor Air Inhalation Criteria[b] | Industrial Soil Volatilization to Indoor Air Inhalation Criteria[b] |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles** | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | 630206 | 99 | 950 | 65 | 210 | 420,000 | 530,000 | 12 | 65 |
| 1,1,1-Trichloroethane | 71556 | 460 | 460 | 14000 | 15000 | 67,000,000 | 29,000,000 | 250 | 460 |
| 1,1,2,2-Tetrachloroethane | 79345 | 13 | 120 | 10 | 34 | 54,000 | 68,000 | 4.3 | 23 |
| 1,1,2-Trichloroethane | 79005 | 45 | 440 | 18 | 57 | 190,000 | 250,000 | 4.6 | 24 |
| 1,1-Dichloroethane | 75343 | 790 | 790 | 95000 | 97000 | 540,000,000 | 240,000,000 | 790 | 790 |
| 1,1-Dichloroethylene | 75354 | 99 | 580 | 5.3 | 15 | 62,000 | 78,000 | 0.062 | 0.33 |
| 1,2-Dichlorobenzene | 95501 | 210 | 210 | 39000 | 46000 | 100,000,000 | 44,000,000 | 210 | 210 |
| 1,2-Dichloroethane | 107062 | 28 | 270 | 11 | 33 | 120,000 | 150,000 | 2.1 | 11 |
| 1,2-Dichloropropane | 78875 | 38 | 360 | 50 | 51 | 270,000 | 120,000 | 4.0 | 7.4 |
| 1,3-Dichlorobenzene | 541731 | 200 | 200 | | | | | | |
| 1,3-Dichloropropene | 542756 | 14 | 140 | 5.2 | 15 | 60,000 | 75,000 | 0.079 | 0.42 |
| 1,4-Dichlorobenzene | 106467 | 110 | 1,000 | 77 | 260 | 450,000 | 570,000 | 19 | 100 |
| 2-Butanone (MEK) | 78933 | 27,000 | 27,000 | 29,000 | 35,000 | 67,000,000 | 29,000,000 | 27,000 | 27,000 |
| 2-Hexanone | 591786 | 2,500 | 2,500 | | | 2,700,000 | 1,200,000 | 990 | 1,800 |
| 4-Methyl-2-pentanone (MIBK) | 108101 | 2,700 | 2,700 | 45,000 | 53,000 | 140,000,000 | 60,000,000 | 2,700 | 2,700 |
| Acetone | 67641 | 11,000 | 74,000 | 130,000 | 160,000 | 390,000,000 | 170,000,000 | 110,000 | 110,000 |
| Acetonitrile | 75058 | 2,100 | 14,000 | 9,200 | 11,000 | 23,000,000 | 10,000,000 | 22,000 | 22,000 |
| Acrolein | 107028 | 1,800 | 12,000 | 0.31 | 0.37 | 1,300 | 590 | 0.41 | 0.76 |
| Acrylonitrile | 107131 | 4.7 | 46 | 5.1 | 17 | 46,000 | 58,000 | 6.6 | 35 |
| Benzene | 71432 | 88 | 400 | 34 | 99 | 380,000 | 470,000 | 1.6 | 8.4 |
| Bromodichloromethane | 75274 | 41 | 400 | 9.7 | 31 | 84,000 | 110,000 | 1.2 | 6.4 |
| Bromoform | 75252 | 320 | 870 | 900 | 3,100 | 2,800,000 | 3,600,000 | 150 | 770 |
| Bromomethane | 74839 | 150 | 1,000 | 57 | 57 | 330,000 | 150,000 | 0.86 | 1.6 |
| Carbon disulfide | 75150 | 280 | 280 | 7,900 | 8,000 | 47,000,000 | 21,000,000 | 76 | 140 |
| Carbon tetrachloride | 56235 | 20 | 190 | 12 | 34 | 130,000 | 170,000 | 0.19 | 0.99 |
| Chlorobenzene | 108907 | 260 | 260 | 990 | 1100 | 4,700,000 | 2,100,000 | 120 | 220 |
| Chloroethane | 75003 | 670 | 970 | 120,000 | 120,000 | 670,000,000 | 290,000,000 | 970 | 970 |
| Chloroform | 67663 | 420 | 1,500 | 120 | 340 | 1,300,000 | 1,600,000 | 7.2 | 38 |
| Chloromethane | 74873 | 200 | 1,100 | 410 | 1,200 | 4,900,000 | 6,100,000 | 2.3 | 12 |
| cis-1,2-Dichloroethylene | 156592 | 640 | 640 | 96,000 | 98,000 | 530,000,000 | 230,000,000 | 640 | 640 |
| Dibromochloromethane | 124481 | 31 | 300 | 24 | 80 | 130,000 | 160,000 | 3.9 | 21 |
| Dibromochloropropane | 96128 | 0.30 | 2.1 | | | | | | |
| Dibromomethane | 74953 | 2,000 | 2,000 | | | | | | |
| Dichlorodifluoromethane | 75718 | 1,000 | 1,000 | 550,000 | 550,000 | 3,300,000,000 | 1,500,000,000 | 900 | 1,000 |
| Ethylbenzene | 100414 | 140 | 140 | 14,000 | 14,000 | 67,000,000 | 29,000,000 | 140 | 140 |
| Ethylene dibromide | 106934 | 0.030 | 0.29 | 1.7 | 5.8 | 14,000 | 18,000 | 0.67 | 3.6 |
| Methylene chloride | 75092 | 340 | 2300 | 590 | 1,700 | 6,600,000 | 8,300,000 | 45 | 240 |
| Naphthalene | 91203 | 15,000 | 160,000 | 49,000 | 59,000 | 33,000,000 | 15,000,000 | 42,000 | 77,000 |
| Styrene | 100425 | 85 | 520 | 940 | 3,200 | 5,300,000 | 6,600,000 | 240 | 520 |
| Tetrachloroethylene | 127184 | 50 | 88 | 480 | 1,400 | 5,400,000 | 6,800,000 | 11 | 60 |

## Table 4-1

## Phase 1A Screening Levels for Soil and Sediment[a]

| Chemical | Chemical Abstract Service Number | Residential Direct Contact Criteria[b] | Industrial and Commercial II (Direct Contact)[b] | Residential Finite VSIC for 5 Meter Source Thickness[b] | Industrial Finite VSIC for 5 Meter Source Thickness[b] | Residential Particulate Soil Inhalation Criteria[b] | Industrial Particulate Soil Inhalation Criteria[b] | Residential Soil Volatilization to Indoor Air Inhalation Criteria[b] | Industrial Soil Volatilization to Indoor Air Inhalation Criteria[b] |
|---|---|---|---|---|---|---|---|---|---|
| Toluene | 108883 | 250 | 250 | 30,000 | 36,000 | 27,000,000 | 12,000,000 | 250 | 250 |
| trans-1,2-Dichloroethylene | 156605 | 1,400 | 1,400 | 94,000 | 96,000 | 530,000,000 | 230,000,000 | 1,400 | 1,400 |
| Trichloroethylene | 79016 | 160 | 500 | 150 | 440 | 1,800,000 | 2,300,000 | 7.0 | 37 |
| Trichlorofluoromethane | 75694 | 560 | 560 | 120,000,000 | 140,000,000 | 3,800,000,000 | 1,700,000,000 | 560 | 560 |
| Vinyl acetate | 108054 | 2,400 | 2,400 | 2,600 | 2,700 | 13,000,000 | 5,900,000 | 790 | 1,500 |
| Vinyl chloride | 75014 | 1.2 | 11 | 3.1 | 9.0 | 37,000 | 47,000 | 0.028 | 0.15 |
| meta & para Xylenes[c] | 13677761 2 | 150 | 150 | 61,000 | 65,000 | 290,000,000 | 130,000,000 | 150 | 150 |
| ortho-Xylene[c] | 95476 | 150 | 150 | 61,000 | 65,000 | 290,000,000 | 130,000,000 | 150 | 150 |
| **SVOCs** | | | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | 95943 | 140,000 | 1,000,000 | | | | | | |
| 1,2,4-Trichlorobenzene | 120821 | 1,100 | 1,100 | 28,000 | 34,000 | 25,000,000 | 11,000,000 | 1,100 | 1,100 |
| 2,4,5-Trichlorophenol | 95954 | 42,000 | 450,000 | | | 23,000,000 | 10,000,000 | | |
| 2,4,6-Trichlorophenol | 88062 | 900 | 14,000 | | | 1,000,000 | 1,300,000 | | |
| 2,4-Dichlorophenol | 120832 | 4,200 | 10,000 | | | 5,100,000 | 2,300,000 | | |
| 2,4-Dimethylphenol | 105679 | 21,000 | 230,000 | | | 4,700,000 | 2,100,000 | | |
| 2,4-Dinitrotoluene | 121142 | 15 | 220 | | | 16,000 | 20,000 | | |
| 2-Chlorophenol | 95578 | 680 | 4,600 | | | | | | |
| 2-Methyl-4,6-dinitrophenol | 534521 | 150 | 1,600 | | | | | | |
| 2-Methylnaphthalene | 91576 | 15,000 | 160,000 | | | | | | |
| 2-Nitrophenol | 88755 | 1,200 | 13,000 | | | | | | |
| 3,3'-Dichlorobenzidine | 91941 | 5.7 | 55 | | | 6,500 | 8,200 | | |
| 3-and 4-Methylphenol Coelution[d] | 65794964 | 2,100 | 23,000 | | | | | | |
| 4-Chloro-3-methylphenol | 59507 | 2,200 | 15,000 | | | | | | |
| 4-Methylphenol | 106445 | 2,100 | 23,000 | | | | | | |
| Acenaphthene | 83329 | 76,000 | 810,000 | 81,000 | 97,000 | 14,000,000 | 6,200,000 | 190,000 | 350,000 |
| Acenaphthylene | 208968 | 1,500 | 16,000 | 2,200 | 2,700 | 2,300,000 | 1,000,000 | 1,600 | 3,000 |
| Anthracene | 120127 | 420,000 | 1,000,000 | 1,400,000 | 1,600,000 | 67,000,000 | 29,000,000 | 1,000,000 | 1,000,000 |
| Benzo(a)anthracene | 56553 | 14 | 210 | | | | | | |
| Benzo(a)pyrene | 50328 | 1.4 | 21 | | | 1,500 | 1,900 | | |
| Benzo(b)fluoranthene | 205992 | 14 | 210 | | | | | | |
| Benzo(g,h,i)perylene | 191242 | 1,500 | 16,000 | | | 800,000 | 350,000 | | |
| Benzo(k)fluoranthene | 207089 | 140 | 2,100 | | | | | | |
| Benzoic acid | 65850 | 1,000,000 | 1,000,000 | | | | | | |
| Benzyl alcohol | 100516 | 5,800 | 5,800 | | | 330,000,000 | 150,000,000 | | |
| beta-Chloronaphthalene | 91587 | 27,000 | 190,000 | | | | | | |
| bis(2-Chloroethyl)ether | 111444 | 2.3 | 23 | 3.8 | 13 | 9,400 | 12,000 | 8.3 | 44 |
| bis(2-Ethylhexyl)phthalate | 117817 | 700 | 10,000 | | | 700,000 | 890,000 | | |
| Butyl benzyl phthalate | 85687 | 310 | 310 | | | 47,000,000 | 21,000,000 | | |
| Caprolactam | 105602 | 340,000 | 1,000,000 | | | 670,000 | 290,000 | | |
| Carbazole | 86748 | 130 | 1,200 | | | | | | |
| Chrysene | 218019 | 1,400 | 21,000 | | | | | | |

## Table 4-1

## Phase 1A Screening Levels for Soil and Sediment[a]

| Chemical | Chemical Abstract Service Number | Residential Direct Contact Criteria[b] | Industrial and Commercial II (Direct Contact)[b] | Residential Finite VSIC for 5 Meter Source Thickness[b] | Industrial Finite VSIC for 5 Meter Source Thickness[b] | Residential Particulate Soil Inhalation Criteria[b] | Industrial Particulate Soil Inhalation Criteria[b] | Residential Soil Volatilization to Indoor Air Inhalation Criteria[b] | Industrial Soil Volatilization to Indoor Air Inhalation Criteria[b] |
|---|---|---|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | 53703 | 1.4 | 21 | | | | | | |
| Dibenzofuran | 132649 | | | | | | | | |
| Diethyl phthalate | 84662 | 740 | 740 | | | 3,300,000 | 1,500,000 | | |
| Diethylene glycol monobutyl ether | 112345 | 5,100 | 54,000 | | | 1,300,000 | 590,000 | | |
| Dimethyl phthalate | 131113 | 790 | 790 | | | 3,300,000 | 1,500,000 | | |
| Di-n-butyl phthalate | 84742 | 760 | 760 | | | 3,300,000 | 1,500,000 | | |
| Di-n-octyl phthalate | 117840 | 7,600 | 81,000 | | | | | | |
| Dinoseb | 88857 | 140 | 140 | | | | | | |
| Fluoranthene | 206440 | 51,000 | 540,000 | 740,000 | 880,000 | 9,300,000 | 4,100,000 | 1,000,000 | 1,000,000 |
| Fluorene | 86737 | 51,000 | 540,000 | 130,000 | 150,000 | 9,300,000 | 4,100,000 | 580,000 | 1,000,000 |
| Hexachlorobenzene (C-66) | 118741 | 6.2 | 94 | 16 | 56 | 6,800 | 8,500 | 41 | 220 |
| Hexachlorobutadiene (C-46) | 87683 | 130 | 350 | 130 | 460 | 140,000 | 180,000 | 130 | 350 |
| Hexachlorocyclopentadiene (C-56) | 77474 | 81 | 81 | | | | | | |
| Hexachloroethane | 67721 | 180 | 1,800 | 1,200 | 1,400 | 230,000 | 100,000 | 190 | 370 |
| Indeno(1,2,3-cd)pyrene | 193395 | 14 | 210 | | | | | | |
| Isophorone | 78591 | 2,400 | 2,400 | | | 19,000,000 | 8,200,000 | | |
| Methyl parathion | 298000 | 110 | 1,100 | | | | | | |
| Nitrobenzene | 98953 | 51 | 340 | 3,900 | 4,600 | 3,300,000 | 1,500,000 | 490 | 490 |
| n-Nitroso-di-n-propylamine | 621647 | 0.37 | 3.5 | | | 1,600 | 2,000 | | |
| N-Nitrosodiphenylamine | 86306 | 520 | 5,100 | | | | | | |
| Pentachlorobenzene | 608935 | 190 | 190 | | | | | | |
| Pentachloronitrobenzene | 82688 | 3,200 | 34,000 | 230 | 280 | 330,000 | 150,000 | 120 | 220 |
| Pentachlorophenol | 87865 | 8.1 | 63 | | | 100,000 | 130,000 | | |
| Phenanthrene | 85018 | 1,500 | 16,000 | 620 | 720 | 130,000 | 59,000 | 15,000 | 28,000 |
| Phenol | 108952 | 12,000 | 12,000 | | | 40,000,000 | 18,000,000 | | |
| Pyrene | 129000 | 32,000 | 340,000 | 650,000 | 770,000 | 6,700,000 | 2,900,000 | 1,000,000 | 1,000,000 |
| **PCBs[e]** | | | | | | | | | |
| Aroclor® 1016 | 12674112 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1221 | 11104282 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1232 | 11141165 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1242 | 53469219 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1248 | 12672296 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1254 | 11097691 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Aroclor® 1260 | 11096825 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| Total PCBs | 1336363 | 1.2 | 9.9 | 7,900 | 28,000 | 5,200 | 6,500 | 3,000 | 16,000 |
| **Formaldehyde** | | | | | | | | | |
| Formaldehyde | 50000 | 20,000 | 60,000 | 23 | 69 | 240,000 | 300,000 | 12 | 65 |

## Table 4-1

## Phase 1A Screening Levels for Soil and Sediment[a]

| Chemical | Chemical Abstract Service Number | Residential Direct Contact Criteria[b] | Industrial and Commercial II (Direct Contact)[b] | Residential Finite VSIC for 5 Meter Source Thickness[b] | Industrial Finite VSIC for 5 Meter Source Thickness[b] | Residential Particulate Soil Inhalation Criteria[b] | Industrial Particulate Soil Inhalation Criteria[b] | Residential Soil Volatilization to Indoor Air Inhalation Criteria[b] | Industrial Soil Volatilization to Indoor Air Inhalation Criteria[b] |
|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | |
| Aluminum | 7429905 | 42,000 | 300,000 | | | | | | |
| Antimony | 7440360 | 150 | 1,600 | | | 330,000 | 150,000 | | |
| Arsenic | 7440382 | 6.6 | 100 | | | 720 | 910 | | |
| Barium | 7440393 | 30,000 | 320,000 | | | 330,000 | 150,000 | | |
| Beryllium | 7440417 | 2,100 | 23,000 | | | 1,300 | 1,600 | | |
| Cadmium | 7440439 | 210 | 2,300 | | | 1,700 | 2,200 | | |
| Chromium[f] | 7440473 | 2,000 | 22,000 | | | 260 | 330 | | |
| Cobalt | 7440484 | 2,100 | 23,000 | | | 13,000 | 5,900 | | |
| Copper | 7440508 | 16,000 | 170,000 | | | 130,000 | 59,000 | | |
| Iron | 7439896 | | | | | | | | |
| Lead | 7439921 | 400 | 900 | | | 100,000 | 44,000 | | |
| Manganese | 7439965 | 20,000 | 210,000 | | | 3,300 | 1,500 | | |
| Mercury (Inorganic) | 7439976 | 130 | 1,400 | | | | | | |
| Nickel | 7440020 | 32,000 | 340,000 | | | 13,000 | 16,000 | | |
| Selenium | 7782492 | 2,100 | 23,000 | | | 130,000 | 59,000 | | |
| Silver | 7440224 | 2,000 | 21,000 | | | 6,700 | 2,900 | | |
| Thallium | 7440280 | 28 | 300 | | | | | | |
| Vanadium | 7440622 | 3,700 | 39,000 | | | | | | |
| Zinc | 7440666 | 140,000 | 1,000,000 | | | | | | |
| **Conventionals** | | | | | | | | | |
| Cyanide | 57125 | 250 | 250 | | | 250 | 250 | | |

All screening levels are in mg/kg, dry weight. Soil data were compared to all creening levels. Sediment data were compared to only direct contact screening evels.

[b] Phase 1A Screening Levels obtained from Michigan Part 201 Generic Cleanup Criteria.

[c] Each xylene isomer, and total xylenes, were compared to the total xylene screening level.

[d] 3-and 4-Methylphenol Coelution was compared to the 4-methylphenol screening level.

[e] Each Aroclor mixture, and the sum of detected Aroclors, were compared to the total PCB screening level.

[f] Total chromium was compared to the hexavalent chromium screening level.

## Table 4-2

## Phase 1A Screening Levels for Groundwater and Surface Water[a]

| Chemical | Chemical Abstract Service Number | Residential & Commercial I Drinking Water Criteria[b] | Industrial & Commercial II, III & IV Drinking Water Criteria[b] | Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Groundwater Surface Water Interface Criteria[b] |
|---|---|---|---|---|---|---|
| **Volatiles** | | | | | | |
| 1,1,1,2-Tetrachloroethane | 630206 | 0.033 | 0.13 | 15 | 96 | |
| 1,1,1-Trichloroethane | 71556 | 0.20 | 0.20 | 660 | 1,300 | 0.20 |
| 1,1,2,2-Tetrachloroethane | 79345 | 0.0043 | 0.017 | 12 | 77 | 0.078 |
| 1,1,2-Trichloroethane | 79005 | 0.0050 | 0.0050 | 17 | 110 | 0.33 |
| 1,1-Dichloroethane | 75343 | 0.88 | 2.5 | 5,100 | 5,100 | |
| 1,1-Dichloroethylene | 75354 | 0.0070 | 0.0070 | 0.20 | 1.3 | 0.065 |
| 1,2-Dichlorobenzene | 95501 | 0.60 | 0.60 | 160 | 160 | 0.016 |
| 1,2-Dichloroethane | 107062 | 0.0050 | 0.0050 | 9.6 | 59 | 0.36 |
| 1,2-Dichloropropane | 78875 | 0.0050 | 0.0050 | 16 | 36 | 0.29 |
| 1,3-Dichlorobenzene | 541731 | 0.60 | 0.60 | | | 0.038 |
| 1,3-Dichloropropene | 542756 | 0.0047 | 0.019 | 0.30 | 2.0 | |
| 1,4-Dichlorobenzene | 106467 | 0.075 | 0.075 | 16 | 74 | 0.013 |
| 2-Butanone (MEK) | 78933 | 13 | 38 | 240,000 | 240,000 | 2.2 |
| 2-Hexanone | 591786 | 1.0 | 2.9 | 4,200 | 8,800 | |
| 4-Methyl-2-pentanone (MIBK) | 108101 | 1.8 | 5.2 | 20,000 | 20,000 | |
| Acetone | 67641 | 0.73 | 2.1 | 1,000,000 | 1,000,000 | 1.7 |
| Acetonitrile | 75058 | 0.14 | 0.40 | 140,000 | 200,000 | |
| Acrolein | 107028 | 0.12 | 0.33 | 2.1 | 4.2 | |
| Acrylonitrile | 107131 | 0.0016 | 0.0064 | 34 | 190 | 0.0049 |
| Benzene | 71432 | 0.0050 | 0.0050 | 5.6 | 36 | 0.20 |
| Bromodichloromethane | 75274 | 0.10 | 0.10 | 4.8 | 38 | |
| Bromoform | 75252 | 0.10 | 0.10 | 480 | 3,100 | |
| Bromomethane | 74839 | 0.010 | 0.029 | 4.0 | 9.0 | 0.035 |
| Carbon disulfide | 75150 | 0.80 | 2.3 | 250 | 550 | |
| Carbon tetrachloride | 56235 | 0.0050 | 0.0050 | 0.37 | 2.4 | 0.045 |
| Chlorobenzene | 108907 | 0.10 | 0.10 | 210 | 470 | 0.047 |
| Chloroethane | 75003 | 0.22 | 0.91 | 5,700 | 5,700 | |
| Chloroform | 67663 | 0.10 | 0.10 | 28 | 180 | 0.17 |
| Chloromethane | 74873 | 0.066 | 0.27 | 8.6 | 52 | |
| cis-1,2-Dichloroethylene | 156592 | 0.070 | 0.070 | 3,500 | 3,500 | |
| Dibromochloromethane | 124481 | 0.10 | 0.10 | 15 | 110 | |
| Dibromochloropropane | 96128 | 0.00020 | 0.00020 | | | |
| Dibromomethane | 74953 | 0.080 | 0.23 | | | |
| Dichlorodifluoromethane | 75718 | 1.7 | 4.8 | 220 | 300 | |
| Ethylbenzene | 100414 | 0.074 | 0.074 | 170 | 170 | 0.018 |
| Ethylene dibromide | 106934 | 0.000050 | 0.000050 | 2.4 | 15 | |
| Methylene chloride | 75092 | 0.0050 | 0.0050 | 220 | 1,400 | 0.94 |
| Naphthalene | 91203 | 0.26 | 0.75 | 31 | 31 | 0.013 |
| Styrene | 100425 | 0.10 | 0.10 | 160 | 310 | 0.08 |
| Tetrachloroethylene | 127184 | 0.0050 | 0.0050 | 25 | 170 | 0.045 |
| Toluene | 108883 | 0.79 | 0.79 | 530 | 530 | 0.14 |

## Table 4-2

## Phase 1A Screening Levels for Groundwater and Surface Water[a]

| Chemical | Chemical Abstract Service Number | Residential & Commercial I Drinking Water Criteria[b] | Industrial & Commercial II, III & IV Drinking Water Criteria[b] | Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Groundwater Surface Water Interface Criteria[b] |
|---|---|---|---|---|---|---|
| trans-1,2-Dichloroethylene | 156605 | 0.10 | 0.10 | 6,300 | 6,300 | |
| Trichloroethylene | 79016 | 0.0050 | 0.0050 | 15 | 97 | 0.20 |
| Trichlorofluoromethane | 75694 | 2.6 | 7.3 | 1,100 | 1,100 | |
| Vinyl acetate | 108054 | 0.64 | 1.8 | 4,100 | 8,900 | |
| Vinyl chloride | 75014 | 0.0020 | 0.0020 | 0.11 | 0.69 | 0.015 |
| meta & para Xylenes[c] | 136777612 | 0.28 | 0.28 | 190 | 190 | 0.035 |
| ortho-Xylene[c] | 95476 | 0.28 | 0.28 | 190 | 190 | 0.035 |
| **SVOCs** | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | 95943 | 1.3 | 1.3 | | | |
| 1,2,4-Trichlorobenzene | 120821 | 0.070 | 0.070 | 300 | 300 | 0.030 |
| 2,4,5-Trichlorophenol | 95954 | 0.73 | 2.1 | | | |
| 2,4,6-Trichlorophenol | 88062 | 0.077 | 0.32 | | | 0.0050 |
| 2,4-Dichlorophenol | 120832 | 0.073 | 0.21 | | | 0.019 |
| 2,4-Dimethylphenol | 105679 | 0.37 | 1.0 | | | 0.012 |
| 2,4-Dinitrotoluene | 121142 | 0.0050 | 0.0051 | | | |
| 2-Chlorophenol | 95578 | 0.045 | 0.13 | | | 0.022 |
| 2-Methyl-4,6-dinitrophenol | 534521 | 0.020 | 0.020 | | | |
| 2-Methylnaphthalene | 91576 | 0.26 | 0.75 | | | |
| 2-Nitrophenol | 88755 | 0.020 | 0.058 | | | |
| 3,3'-Dichlorobenzidine | 91941 | 0.0019 | 0.0077 | | | 0.00030 |
| 3-and 4-Methylphenol Coelution[d] | 65794964 | 0.037 | 0.10 | | | |
| 4-Chloro-3-methylphenol | 59507 | 0.15 | 0.42 | | | |
| 4-Methylphenol | 106445 | 0.037 | 0.10 | | | |
| Acenaphthene | 83329 | 1.3 | 3.8 | 4.2 | 4.2 | 0.019 |
| Acenaphthylene | 208968 | 0.026 | 0.075 | 3.9 | 3.9 | |
| Anthracene | 120127 | 0.043 | 0.043 | 0.043 | 0.043 | |
| Benzo(a)anthracene | 56553 | 0.0050 | 0.0050 | | | |
| Benzo(a)pyrene | 50328 | 0.0050 | 0.0050 | | | |
| Benzo(b)fluoranthene | 205992 | 0.0050 | 0.0050 | | | |
| Benzo(g,h,i)perylene | 191242 | 0.0050 | 0.0050 | | | |
| Benzo(k)fluoranthene | 207089 | 0.0050 | 0.0050 | | | |
| Benzoic acid | 65850 | 32 | 92 | | | |
| Benzyl alcohol | 100516 | 10 | 29 | | | |
| beta-Chloronaphthalene | 91587 | 1.8 | 5.2 | | | |
| bis(2-Chloroethyl)ether | 111444 | 0.0050 | 0.0050 | 38 | 210 | |
| bis(2-Ethylhexyl)phthalate | 117817 | 0.0060 | 0.0060 | | | 0.032 |
| Butyl benzyl phthalate | 85687 | 1.2 | 2.7 | | | |
| Caprolactam | 105602 | 5.8 | 17 | | | |
| Carbazole | 86748 | 0.043 | 0.17 | | | |
| Chrysene | 218019 | 0.0050 | 0.0050 | | | |
| Dibenzo(a,h)anthracene | 53703 | 0.0050 | 0.0050 | | | |
| Dibenzofuran | 132649 | | | | | |

## Table 4-2

## Phase 1A Screening Levels for Groundwater and Surface Water[a]

| Chemical | Chemical Abstract Service Number | Residential & Commercial I Drinking Water Criteria[b] | Industrial & Commercial II, III & IV Drinking Water Criteria[b] | Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Groundwater Surface Water Interface Criteria[b] |
|---|---|---|---|---|---|---|
| Diethyl phthalate | 84662 | 5.5 | 16 | | | |
| Diethylene glycol monobutyl ether | 112345 | 0.088 | 0.25 | | | |
| Dimethyl phthalate | 131113 | 73 | 210 | | | |
| Di-n-butyl phthalate | 84742 | 0.88 | 2.5 | | | 0.0097 |
| Di-n-octyl phthalate | 117840 | 0.13 | 0.38 | | | |
| Dinoseb | 88857 | 0.0070 | 0.0070 | | | |
| Fluoranthene | 206440 | 0.21 | 0.21 | 0.21 | 0.21 | |
| Fluorene | 86737 | 0.88 | 2.0 | 2.0 | 2.0 | 0.012 |
| Hexachlorobenzene (C-66) | 118741 | 0.0010 | 0.0010 | 0.44 | 3.0 | |
| Hexachlorobutadiene (C-46) | 87683 | 0.011 | 0.045 | 1.6 | 3.2 | |
| Hexachlorocyclopentadiene (C-56) | 77474 | 0.050 | 0.05 | | | |
| Hexachloroethane | 67721 | 0.061 | 0.25 | 27 | 50 | 0.0067 |
| Indeno(1,2,3-cd)pyrene | 193395 | 0.0050 | 0.0050 | | | |
| Isophorone | 78591 | 0.90 | 3.7 | | | |
| Methyl parathion | 298000 | 0.0018 | 0.0052 | | | |
| Nitrobenzene | 98953 | 0.0050 | 0.0096 | 2100 | 2100 | |
| n-Nitroso-di-n-propylamine | 621647 | 0.0050 | 0.0050 | | | |
| N-Nitrosodiphenylamine | 86306 | 0.17 | 0.71 | | | |
| Pentachlorobenzene | 608935 | 0.0061 | 0.017 | | | |
| Pentachloronitrobenzene | 82688 | 0.032 | 0.032 | 0.032 | 0.032 | |
| Pentachlorophenol | 87865 | 0.0010 | 0.0010 | | | |
| Phenanthrene | 85018 | 0.026 | 0.075 | 1.0 | 1.0 | 0.0050 |
| Phenol | 108952 | 4.4 | 13 | | | 0.21 |
| Pyrene | 129000 | 0.14 | 0.14 | 0.14 | 0.14 | |
| **PCBs[e]** | | | | | | |
| Aroclor® 1016 | 12674112 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1221 | 11104282 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1232 | 11141165 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1242 | 53469219 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1248 | 12672296 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1254 | 11097691 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Aroclor® 1260 | 11096825 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| Total PCBs | 1336363 | 0.0005 | 0.0005 | 0.045 | 0.045 | 0.0002 |
| **Formaldehyde** | | | | | | |
| Formaldehyde | 50000 | 1.3 | 3.8 | 63 | 360 | 0.12 |
| **Metals[f]** | | | | | | |
| Aluminum | 7429905 | 0.050 | 0.050 | | | |
| Antimony | 7440360 | 0.0060 | 0.0060 | | | |
| Arsenic | 7440382 | 0.050 | 0.050 | | | 0.15 |
| Barium | 7440393 | 2.0 | 2.0 | | | 0.19 |

## Table 4-2

## Phase 1A Screening Levels for Groundwater and Surface Water[a]

| Chemical | Chemical Abstract Service Number | Residential & Commercial I Drinking Water Criteria[b] | Industrial & Commercial II, III & IV Drinking Water Criteria[b] | Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria[b] | Groundwater Surface Water Interface Criteria[b] |
|---|---|---|---|---|---|---|
| Beryllium | 7440417 | 0.0040 | 0.0040 | | | |
| Cadmium | 7440439 | 0.0050 | 0.0050 | | | |
| Chromium[g] | 7440473 | 0.10 | 0.10 | | | 0.011 |
| Cobalt | 7440484 | 0.050 | 0.10 | | | 0.10 |
| Copper | 7440508 | 1.0 | 1.0 | | | |
| Iron | 7439896 | 0.30 | 0.30 | | | |
| Lead | 7439921 | 0.0040 | 0.0040 | | | |
| Manganese | 7439965 | 0.050 | 0.050 | | | |
| Mercury (Inorganic) | 7439976 | 0.0020 | 0.0020 | | | 0.00020 |
| Nickel | 7440020 | 0.10 | 0.10 | | | |
| Selenium | 7782492 | 0.050 | 0.050 | | | 0.0050 |
| Silver | 7440224 | 0.034 | 0.098 | | | 0.00020 |
| Thallium | 7440280 | 0.0020 | 0.0020 | | | 0.0037 |
| Vanadium | 7440622 | 0.064 | 0.18 | | | 0.012 |
| Zinc | 7440666 | 2.4 | 5.0 | | | |
| **Conventionals** | | | | | | |
| Cyanide | 57125 | 0.20 | 0.20 | | | 0.020 |

All screening levels are in mg/L. Groundwater data were compared to all screening evels. Surface water data were compared to only drinking water screening levels.

[b] Phase 1A Screening Levels obtained from Michigan Part 201 Generic Cleanup Criteria.

[c] Each xylene isomer, and total xylenes, were compared to the total xylene screening level.

[d] 3-and 4-Methylphenol Coelution was compared to the 4-methylphenol screening level.

[e] Each Aroclor mixture, and the sum of detected Aroclors, were compared to the total PCB screening level.

[f] Dissolved concentrations for all metals were compared to the screening levels.

[g] Total chromium was compared to the hexavalent chromium screening level.

## Table 4-3
## Summary of Detection Frequencies for Phase 1A Soil Analytes with No Screening Levels

| Medium | Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum | Mean | Maximum | Concentration units |
|---|---|---|---|---|---|---|---|---|---|---|
| Soil | A | Semivolatiles | Dibenzofuran | 132-64-9 | 31 | 2 | 0.3 | 0.3 | 0.3 | mg/kg |
| Soil | A | Conventionals | Cation exchange capacity | | 31 | 1 | 10.3 | 10.3 | 10.3 | MEC |
| Soil | A | Conventionals | Sulfides | 18496-25-8 | 31 | 22 | 0 | 120 | 1850 | mg/kg |
| Soil | A | Conventionals | Total Kjeldahl nitrogen | | 31 | 29 | 140 | 760 | 2550 | mg/kg |
| Soil | A | Conventionals | Total organic carbon | | 31 | 1 | 8300 | 8300 | 8300 | mg/kg |
| Soil | A | Conventionals | Total solids (dry wt. as % of wet wt.) | | 31 | 30 | 569000 | 848000 | 980000 | mg/kg |
| Soil | A | Metals | Calcium | 7440-70-2 | 31 | 30 | 1000 | 48000 | 120000 | mg/kg |
| Soil | A | Metals | Iron | 7439-89-6 | 31 | 30 | 5500 | 17400 | 56700 | mg/kg |
| Soil | A | Metals | Tin | 7440-31-5 | 31 | 2 | 10 | 13 | 16 | mg/kg |
| Soil | B | Conventionals | Cation exchange capacity | | 16 | 1 | 7.2 | 7.2 | 7.2 | MEC |
| Soil | B | Conventionals | Sulfides | 18496-25-8 | 16 | 7 | 4 | 13.4 | 29.1 | mg/kg |
| Soil | B | Conventionals | Total Kjeldahl nitrogen | | 16 | 15 | 120 | 430 | 1020 | mg/kg |
| Soil | B | Conventionals | Total organic carbon | | 16 | 1 | 14000 | 14000 | 14000 | mg/kg |
| Soil | B | Conventionals | Total solids (dry wt. as % of wet wt.) | | 16 | 15 | 765000 | 883000 | 976000 | mg/kg |
| Soil | B | Metals | Calcium | 7440-70-2 | 16 | 15 | 1200 | 49900 | 97200 | mg/kg |
| Soil | B | Metals | Iron | 7439-89-6 | 16 | 15 | 1200 | 8900 | 13400 | mg/kg |
| Soil | B | Metals | Tin | 7440-31-5 | 16 | 2 | 14 | 23 | 32 | mg/kg |
| Soil | D | Conventionals | Cation exchange capacity | | 28 | 4 | 5 | 8.3 | 12.3 | MEC |
| Soil | D | Conventionals | Sulfides | 18496-25-8 | 28 | 18 | 0 | 410 | 3000 | mg/kg |
| Soil | D | Conventionals | Total Kjeldahl nitrogen | | 28 | 27 | 139 | 252 | 408 | mg/kg |
| Soil | D | Conventionals | Total organic carbon | | 28 | 4 | 4000 | 16000 | 48000 | mg/kg |
| Soil | D | Conventionals | Total solids (dry wt. as % of wet wt.) | | 28 | 28 | 789000 | 889000 | 972000 | mg/kg |
| Soil | D | Metals | Calcium | 7440-70-2 | 28 | 27 | 3000 | 91000 | 220000 | mg/kg |
| Soil | D | Metals | Iron | 7439-89-6 | 28 | 27 | 6600 | 19600 | 76300 | mg/kg |
| Soil | D | Metals | Tin | 7440-31-5 | 28 | 2 | 21 | 31.5 | 42 | mg/kg |
| Soil | E | Semivolatiles | Dibenzofuran | 132-64-9 | 45 | 1 | 0.6 | 0.6 | 0.6 | mg/kg |
| Soil | E | Conventionals | Cation exchange capacity | | 45 | 3 | 6.8 | 13.2 | 19.1 | MEC |
| Soil | E | Conventionals | Sulfides | 18496-25-8 | 45 | 32 | 0 | 360 | 2530 | mg/kg |
| Soil | E | Conventionals | Total Kjeldahl nitrogen | | 45 | 37 | 40 | 870 | 6050 | mg/kg |
| Soil | E | Conventionals | Total organic carbon | | 45 | 3 | 14000 | 153000 | 429000 | mg/kg |
| Soil | E | Conventionals | Total solids (dry wt. as % of wet wt.) | | 45 | 6 | 78 | 86.1 | 92.3 | % |
| Soil | E | Conventionals | Total solids (dry wt. as % of wet wt.) | | 45 | 35 | 592000 | 862000 | 977000 | mg/kg |
| Soil | E | Metals | Calcium | 7440-70-2 | 39 | 37 | 1000 | 67000 | 176000 | mg/kg |
| Soil | E | Metals | Iron | 7439-89-6 | 39 | 37 | 5700 | 20600 | 95600 | mg/kg |
| Soil | E | Metals | Tin | 7440-31-5 | 39 | 4 | 14 | 22.2 | 39 | mg/kg |
| Soil | F | Semivolatiles | Dibenzofuran | 132-64-9 | 20 | 1 | 0.6 | 0.6 | 0.6 | mg/kg |
| Soil | F | Conventionals | Cation exchange capacity | | 20 | 1 | 7 | 7 | 7 | MEC |
| Soil | F | Conventionals | Sulfides | 18496-25-8 | 20 | 9 | 1 | 60 | 307 | mg/kg |
| Soil | F | Conventionals | Total Kjeldahl nitrogen | | 20 | 19 | 100 | 370 | 1560 | mg/kg |
| Soil | F | Conventionals | Total organic carbon | | 20 | 1 | 40000 | 40000 | 40000 | mg/kg |
| Soil | F | Conventionals | Total solids (dry wt. as % of wet wt.) | | 20 | 19 | 715000 | 878000 | 946000 | mg/kg |
| Soil | F | Metals | Calcium | 7440-70-2 | 20 | 19 | 6800 | 63800 | 92900 | mg/kg |

**Table 4-3**
**Summary of Detection Frequencies for Phase 1A Soil Analytes with No Screening Levels**

| Medium | Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum | Mean | Maximum | Concentration units |
|---|---|---|---|---|---|---|---|---|---|---|
| Soil | F | Metals | Iron | 7439-89-6 | 20 | 19 | 7400 | 17400 | 52800 | mg/kg |
| Soil | F | Metals | Tin | 7440-31-5 | 20 | 2 | 16 | 20.5 | 25 | mg/kg |
| Soil | G | Semivolatiles | Acetophenone | 98-86-2 | 46 | 1 | 0.65 | 0.65 | 0.65 | mg/kg |
| Soil | G | Semivolatiles | Dibenzofuran | 132-64-9 | 46 | 1 | 0.6 | 0.6 | 0.6 | mg/kg |
| Soil | G | Conventionals | Ammonia-nitrogen | | 46 | 4 | 0.3 | 2.4 | 6.8 | mg/kg |
| Soil | G | Conventionals | Sulfides | 18496-25-8 | 46 | 18 | 0 | 150 | 1440 | mg/kg |
| Soil | G | Conventionals | Total Kjeldahl nitrogen | | 46 | 21 | 40 | 290 | 1170 | mg/kg |
| Soil | G | Conventionals | Total solids (dry wt. as % of wet wt.) | | 46 | 24 | 64.5 | 83.8 | 93.1 | % |
| Soil | G | Conventionals | Total solids (dry wt. as % of wet wt.) | | 46 | 21 | 699000 | 872000 | 975000 | mg/kg |
| Soil | G | Metals | Calcium | 7440-70-2 | 40 | 39 | 1000 | 45000 | 181000 | mg/kg |
| Soil | G | Metals | Iron | 7439-89-6 | 40 | 39 | 2000 | 26000 | 107000 | mg/kg |
| Soil | G | Metals | Tin | 7440-31-5 | 40 | 1 | 12 | 12 | 12 | mg/kg |
| Soil | H | Conventionals | Cation exchange capacity | | 36 | 1 | 14 | 14 | 14 | MEC |
| Soil | H | Conventionals | Sulfides | 18496-25-8 | 36 | 23 | 0 | 137 | 791 | mg/kg |
| Soil | H | Conventionals | Total Kjeldahl nitrogen | | 36 | 35 | 80 | 510 | 4410 | mg/kg |
| Soil | H | Conventionals | Total organic carbon | | 36 | 1 | 42000 | 42000 | 42000 | mg/kg |
| Soil | H | Conventionals | Total solids (dry wt. as % of wet wt.) | | 36 | 35 | 575000 | 893000 | 963000 | mg/kg |
| Soil | H | Metals | Calcium | 7440-70-2 | 36 | 35 | 5000 | 64000 | 100000 | mg/kg |
| Soil | H | Metals | Iron | 7439-89-6 | 36 | 35 | 6000 | 15200 | 44400 | mg/kg |
| Soil | H | Metals | Tin | 7440-31-5 | 36 | 2 | 11.5 | 13.7 | 16 | mg/kg |
| Soil | I | Semivolatiles | Dibenzofuran | 132-64-9 | 50 | 2 | 1.1 | 1.2 | 1.4 | mg/kg |
| Soil | I | Conventionals | Sulfides | 18496-25-8 | 50 | 14 | 1 | 51 | 324 | mg/kg |
| Soil | I | Conventionals | Total Kjeldahl nitrogen | | 50 | 27 | 100 | 520 | 2330 | mg/kg |
| Soil | I | Conventionals | Total solids (dry wt. as % of wet wt.) | | 50 | 22 | 62.8 | 82.7 | 91 | % |
| Soil | I | Conventionals | Total solids (dry wt. as % of wet wt.) | | 50 | 27 | 719000 | 876000 | 969000 | mg/kg |
| Soil | I | Metals | Calcium | 7440-70-2 | 28 | 27 | 6000 | 61000 | 117000 | mg/kg |
| Soil | I | Metals | Iron | 7439-89-6 | 28 | 27 | 8500 | 15800 | 36400 | mg/kg |
| Soil | I | Metals | Tin | 7440-31-5 | 28 | 2 | 18 | 33 | 48 | mg/kg |
| Soil | J | Conventionals | Sulfides | 18496-25-8 | 8 | 2 | 0.7 | 4.3 | 8 | mg/kg |
| Soil | J | Conventionals | Total Kjeldahl nitrogen | | 8 | 7 | 169 | 437 | 955 | mg/kg |
| Soil | J | Conventionals | Total solids (dry wt. as % of wet wt.) | | 8 | 7 | 728000 | 816000 | 867000 | mg/kg |
| Soil | J | Metals | Calcium | 7440-70-2 | 8 | 7 | 18000 | 64000 | 102000 | mg/kg |
| Soil | J | Metals | Iron | 7439-89-6 | 8 | 7 | 11700 | 16600 | 25500 | mg/kg |
| Groundwater | A | Conventionals | Sulfides | 18496-25-8 | 11 | 6 | 0.1 | 1.8 | 9.4 | mg/L |
| Groundwater | A | Conventionals | Total Kjeldahl nitrogen | | 11 | 11 | 1 | 8 | 20 | mg/L |
| Groundwater | A | Metals | Calcium | 7440-70-2 | 11 | 11 | 122 | 229 | 580 | mg/L |
| Groundwater | B | Conventionals | Total Kjeldahl nitrogen | | 4 | 4 | 2.8 | 5.7 | 9.9 | mg/L |
| Groundwater | B | Metals | Calcium | 7440-70-2 | 4 | 4 | 120 | 154 | 181 | mg/L |
| Groundwater | D | Conventionals | Sulfides | 18496-25-8 | 12 | 6 | 0.1 | 6.4 | 25.5 | mg/L |
| Groundwater | D | Conventionals | Total Kjeldahl nitrogen | | 12 | 10 | 0.8 | 6.8 | 15.6 | mg/L |
| Groundwater | D | Metals | Calcium | 7440-70-2 | 12 | 12 | 89 | 146 | 310 | mg/L |
| Groundwater | E | Conventionals | Sulfides | 18496-25-8 | 16 | 9 | 0.1 | 0.8 | 1.6 | mg/L |

## Table 4-3
## Summary of Detection Frequencies for Phase 1A Soil Analytes with No Screening Levels

| Medium | Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum | Mean | Maximum | Concentration units |
|---|---|---|---|---|---|---|---|---|---|---|
| Groundwater | E | Conventionals | Total Kjeldahl nitrogen | | 16 | 16 | 2.6 | 16 | 39.2 | mg/L |
| Groundwater | E | Metals | Calcium | 7440-70-2 | 16 | 16 | 73 | 340 | 768 | mg/L |
| Groundwater | F | Conventionals | Sulfides | 18496-25-8 | 6 | 2 | 0.01 | 0.06 | 0.11 | mg/L |
| Groundwater | F | Conventionals | Total Kjeldahl nitrogen | | 6 | 6 | 0.6 | 11.7 | 53.7 | mg/L |
| Groundwater | F | Metals | Calcium | 7440-70-2 | 6 | 6 | 99 | 135 | 190 | mg/L |
| Groundwater | G | Conventionals | Ammonia-nitrogen | | 22 | 12 | 0 | 2.8 | 12.4 | mg/L |
| Groundwater | G | Conventionals | Sulfides | 18496-25-8 | 22 | 7 | 0.1 | 2 | 11 | mg/L |
| Groundwater | G | Conventionals | Total Kjeldahl nitrogen | | 22 | 10 | 3.7 | 18.5 | 49.7 | mg/L |
| Groundwater | G | Metals | Calcium | 7440-70-2 | 22 | 20 | 20 | 73 | 138 | mg/L |
| Groundwater | G | Metals | Tin | 7440-31-5 | 22 | 2 | 0.059 | 0.063 | 0.067 | mg/L |
| Groundwater | H | Conventionals | Sulfides | 18496-25-8 | 7 | 3 | 0.3 | 1.7 | 3.8 | mg/L |
| Groundwater | H | Conventionals | Total Kjeldahl nitrogen | | 7 | 7 | 0.4 | 9.7 | 31.8 | mg/L |
| Groundwater | H | Metals | Calcium | 7440-70-2 | 7 | 7 | 47 | 127 | 232 | mg/L |
| Groundwater | I | Conventionals | Sulfides | 18496-25-8 | 9 | 6 | 0.6 | 1.1 | 2.5 | mg/L |
| Groundwater | I | Conventionals | Total Kjeldahl nitrogen | | 9 | 9 | 1 | 12.9 | 35.6 | mg/L |
| Groundwater | I | Metals | Calcium | 7440-70-2 | 9 | 9 | 24 | 104 | 222 | mg/L |
| Groundwater | I | Metals | Tin | 7440-31-5 | 9 | 1 | 0.227 | 0.227 | 0.227 | mg/L |
| Groundwater | J | Conventionals | Total Kjeldahl nitrogen | | 3 | 3 | 1.3 | 1.8 | 2.2 | mg/L |
| Groundwater | J | Metals | Calcium | 7440-70-2 | 3 | 3 | 93 | 97 | 104 | mg/L |
| Sediment | C | Conventionals | Acid-volatile sulfide | | 2 | 2 | 12700 | 28200 | 43700 | mg/kg |
| Sediment | C | Conventionals | Total organic carbon | | 2 | 2 | 10.4 | 10.6 | 10.8 | % |
| Sediment | C | Conventionals | Total solids (dry wt. as % of wet wt.) | | 2 | 2 | 9.9 | 17.5 | 25.2 | % |
| Sediment | C | Metals | Calcium | 7440-70-2 | 2 | 2 | 28400 | 64100 | 99800 | mg/kg |
| Sediment | C | Metals | Iron | 7439-89-6 | 2 | 2 | 22200 | 26600 | 30900 | mg/kg |
| Sediment | C | Metals | Tin | 7440-31-5 | 2 | 2 | 120 | 122 | 124 | mg/kg |
| Sediment | H | Conventionals | Acid-volatile sulfide | | 9 | 9 | 1000 | 13600 | 28500 | mg/kg |
| Sediment | H | Conventionals | Cation exchange capacity | | 9 | 4 | 123 | 178 | 225 | MEC |
| Sediment | H | Conventionals | Total organic carbon | | 9 | 9 | 5.2 | 10 | 16.3 | % |
| Sediment | H | Conventionals | Total solids (dry wt. as % of wet wt.) | | 9 | 9 | 11.1 | 21.2 | 31 | % |
| Sediment | H | Metals | Calcium | 7440-70-2 | 9 | 9 | 40000 | 86000 | 127000 | mg/kg |
| Sediment | H | Metals | Iron | 7439-89-6 | 9 | 9 | 27700 | 35100 | 46400 | mg/kg |
| Sediment | H | Metals | Tin | 7440-31-5 | 9 | 9 | 17 | 81 | 170 | mg/kg |
| Sediment | J | Conventionals | Acid-volatile sulfide | | 6 | 6 | 2 | 94 | 221 | mg/kg |
| Sediment | J | Conventionals | Cation exchange capacity | | 6 | 5 | 2.5 | 35.4 | 69.1 | MEC |
| Sediment | J | Conventionals | Total organic carbon | | 6 | 6 | 1.2 | 3.1 | 5.4 | % |
| Sediment | J | Conventionals | Total solids (dry wt. as % of wet wt.) | | 6 | 6 | 39.8 | 65.4 | 85.3 | % |
| Sediment | J | Metals | Calcium | 7440-70-2 | 6 | 6 | 33000 | 67000 | 120000 | mg/kg |
| Sediment | J | Metals | Iron | 7439-89-6 | 6 | 6 | 3900 | 10400 | 18200 | mg/kg |
| Surface water | C | Metals | Calcium | 7440-70-2 | 2 | 2 | 167 | 168 | 169 | mg/L |
| Surface water | H | Metals | Calcium | 7440-70-2 | 7 | 7 | 46 | 143 | 167 | mg/L |
| Surface water | J | Metals | Calcium | 7440-70-2 | 5 | 5 | 47.6 | 58 | 89.6 | mg/L |

## Table 4-4
## Summary of Screening Evaluation for Phase 1A Soil Characterization Data

| Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum (mg/kg, dry) | Mean (mg/kg, dry) | Maximum (mg/kg, dry) | Number of measurements higher than screening level | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Residential Direct Contact Criteria | Industrial and Commercial II (Direct Contact) | Residential Finite VSIC for 5 Meter Source Thickness | Industrial Finite VSIC for 5 Meter Source Thickness | Residential Particulate Soil Inhalation Criteria | Industrial Particulate Soil Inhalation Criteria | Residential Soil Volatilization to Indoor Air Inhalation Criteria | Industrial Soil Volatilization to Indoor Air Inhalation Criteria |
| A | Metals | Arsenic | 7440-38-2 | 30 | 30 | 2.0 | 5.0 | 15 | 9 | | | | | | | |
| A | Metals | Chromium | 7440-47-3 | 30 | 30 | 6.0 | 35 | 292 | | | | | 1 | | | |
| A | Metals | Manganese | 7439-96-5 | 30 | 30 | 90 | 630 | 5220 | | | | | 1 | 2 | | |
| B | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 15 | 3 | 0.80 | 1.3 | 2.3 | 1 | | | | | | | |
| B | Metals | Arsenic | 7440-38-2 | 15 | 14 | 1.0 | 3.1 | 9.0 | 1 | | | | | | | |
| B | Volatiles | Vinyl chloride | 75-01-4 | 15 | 1 | 1.7 | 1.7 | 1.7 | 1 | | | | | | 1 | 1 |
| D | PCBs | Aroclor® 1260 | 11096-82-5 | 27 | 2 | 0 | 16 | 32 | 1 | 1 | | | | | | |
| D | PCBs | Polychlorinated biphenyls | 1336-36-3 | 27 | 4 | 0 | 8.0 | 32 | 1 | 1 | | | | | | |
| D | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 27 | 6 | 0.3 | 0.8 | 2.7 | 1 | | | | | | | |
| D | Metals | Arsenic | 7440-38-2 | 28 | 27 | 2.0 | 3.6 | 12 | 1 | | | | | | | |
| D | Metals | Chromium | 7440-47-3 | 28 | 27 | 3.0 | 89 | 381 | | | | | 5 | 2 | | |
| D | Metals | Manganese | 7439-96-5 | 28 | 27 | 200 | 2500 | 11300 | | | | | 7 | 9 | | |
| E | PCBs | Aroclor® 1248 | 12672-29-6 | 37 | 3 | 1.0 | 5.0 | 13 | 1 | 1 | | | | | | |
| E | PCBs | Aroclor® 1254 | 11097-69-1 | 37 | 2 | 0.10 | 2.5 | 5 | 1 | | | | | | | |
| E | PCBs | Aroclor® 1260 | 11096-82-5 | 37 | 7 | 0 | 8.0 | 52 | 1 | 1 | | | | | | |
| E | PCBs | Polychlorinated biphenyls | 1336-36-3 | 37 | 9 | 0 | 8.0 | 52 | 4 | 2 | | | | | | |
| E | Metals | Arsenic | 7440-38-2 | 37 | 37 | 2.0 | 5.0 | 19 | 5 | | | | | | | |
| E | Metals | Chromium | 7440-47-3 | 37 | 37 | 3.0 | 92 | 467 | | | | | 6 | 3 | | |
| E | Metals | Lead | 7439-92-1 | 37 | 37 | 0 | 90 | 2030 | 1 | 1 | | | | | | |
| E | Metals | Manganese | 7439-96-5 | 37 | 37 | 100 | 2300 | 12100 | | | | | 8 | 12 | | |
| E | Volatiles | 1,1-Dichloroethene | 75-35-4 | 46 | 1 | 0.077 | 0.077 | 0.077 | | | | | | | 1 | |
| F | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 19 | 1 | 10 | 10 | 10 | 1 | | | | | | | |
| F | Metals | Arsenic | 7440-38-2 | 19 | 19 | 1.0 | 4.4 | 9.0 | 3 | | | | | | | |
| F | Metals | Manganese | 7439-96-5 | 19 | 19 | 140 | 460 | 1860 | | | | | | 1 | | |
| G | PCBs | Aroclor® 1254 | 11097-69-1 | 39 | 3 | 0.10 | 1.2 | 3.2 | 1 | | | | | | | |
| G | PCBs | Polychlorinated biphenyls | 1336-36-3 | 39 | 6 | 0.10 | 0.8 | 3.2 | 1 | | | | | | | |
| G | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 45 | 6 | 0.30 | 1.7 | 5.5 | 2 | | | | | | | |
| G | Metals | Arsenic | 7440-38-2 | 39 | 38 | 1.0 | 5.0 | 13 | 7 | | | | | | | |
| G | Metals | Chromium | 7440-47-3 | 39 | 39 | 3.0 | 67 | 487 | | | | | 3 | 2 | | |
| G | Metals | Manganese | 7439-96-5 | 39 | 39 | 0 | 1400 | 11400 | | | | | 3 | 6 | | |
| H | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 35 | 2 | 0.60 | 1.9 | 3.3 | 1 | | | | | | | |
| H | Metals | Arsenic | 7440-38-2 | 35 | 35 | 2.0 | 3.5 | 12 | 1 | | | | | | | |
| H | Metals | Manganese | 7439-96-5 | 35 | 35 | 190 | 670 | 3340 | | | | | 1 | 4 | | |
| I | Formaldehyde | Formaldehyde | 50-00-0 | 27 | 15 | 11 | 29 | 69 | | | 6 | | | | 14 | 1 |
| I | Metals | Arsenic | 7440-38-2 | 27 | 27 | 1.0 | 3.0 | 10 | 1 | | | | | | | |
| I | Metals | Manganese | 7439-96-5 | 27 | 27 | 150 | 600 | 3230 | | | | | | 2 | | |
| J | Metals | Arsenic | 7440-38-2 | 7 | 7 | 3.0 | 4.0 | 9.0 | 1 | | | | | | | |

**Table 4-5**
**Summary of Screening Evaluvation for Phase 1A Groundwater Characterization Data**

| Area | Chemical Class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Mnimum (mg/L, dissolved) | Mean (mg/L, dissolved) | Maximm (mg/L, dissolved) | Number of measurements higher than screening level | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Residential & Commercial I Drinking Water Criteria | Industrial & Commercial II, III & IV Drinking Water Criteria | Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria | Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria | Groundwater Surface Water Interface Criteria |
| A | Metals | Aluminum | 7429-90-5 | 11 | 1 | 0.39 | 0.39 | 0.39 | 1 | 1 | | | |
| A | Metals | Barium | 7440-39-3 | 11 | 11 | 0.024 | 0.274 | 0.872 | | | | | 2 |
| A | Metals | Iron | 7439-89-6 | 11 | 11 | 0.10 | 11.4 | 40.4 | 10 | 10 | | | |
| A | Metals | Lead | 7439-92-1 | 11 | 1 | 0.011 | 0.011 | 0.011 | 1 | 1 | | | |
| A | Metals | Manganese | 7439-96-5 | 11 | 10 | 0.31 | 1.29 | 2.31 | 10 | 10 | | | |
| A | Volatile | 1,2-Dichloropropane | 78-87-5 | 11 | 4 | 0.00060 | 0.0029 | 0.0057 | 1 | 1 | | | |
| B | Metals | Iron | 7439-89-6 | 4 | 4 | 0.060 | 1.15 | 4.1 | 2 | 2 | | | |
| B | Metals | Manganese | 7439-96-5 | 4 | 4 | 0.239 | 0.418 | 0.603 | 4 | 4 | | | |
| B | Metals | Nickel | 7440-02-0 | 4 | 2 | 0.112 | 0.194 | 0.275 | 2 | 2 | | | |
| B | Volatile | 1,1-Dichloroethene | 75-35-4 | 4 | 1 | 0.015 | 0.015 | 0.015 | 1 | 1 | | | |
| B | Volatile | cis-1,2-Dichloroethene | 156-59-2 | 4 | 1 | 3.0 | 3.0 | 3.0 | 1 | 1 | | | |
| B | Volatile | Vinyl chloride | 75-01-4 | 4 | 1 | 3.0 | 3.0 | 3.0 | 1 | 1 | 1 | 1 | |
| D | Metals | Iron | 7439-89-6 | 12 | 12 | 0 | 5.0 | 21.5 | 6 | 6 | | | |
| D | Metals | Manganese | 7439-96-5 | 12 | 12 | 0.025 | 0.368 | 0.96 | 10 | 10 | | | |
| E | Metals | Aluminum | 7429-90-5 | 16 | 2 | 0.369 | 0.544 | 0.72 | 2 | 2 | | | |
| E | Metals | Barium | 7440-39-3 | 16 | 16 | 0.030 | 0.22 | 1.65 | | | | | 1 |
| E | Metals | Iron | 7439-89-6 | 16 | 16 | 0 | 31 | 102 | 13 | 13 | | | |
| E | Metals | Manganese | 7439-96-5 | 16 | 16 | 0.060 | 1.38 | 5.47 | 16 | 16 | | | |
| E | PCBs | Aroclor® 1242 | 53469-21-9 | 16 | 2 | 0.0011 | 0.0011 | 0.0012 | 2 | 2 | | | 2 |
| E | PCBs | Aroclor® 1254 | 11097-69-1 | 16 | 2 | 0.00040 | 0.00040 | 0.00040 | | | | | 2 |
| E | PCBs | Polychlorinated biphenyls | 1336-36-3 | 16 | 2 | 0.00150 | 0.00160 | 0.00160 | 2 | 2 | | | 2 |
| F | Metals | Iron | 7439-89-6 | 6 | 6 | 0.16 | 1.79 | 4.54 | 3 | 3 | | | |
| F | Metals | Manganese | 7439-96-5 | 6 | 6 | 0.10 | 0.41 | 0.888 | 6 | 6 | | | |
| G | Metals | Aluminum | 7429-90-5 | 22 | 10 | 0.085 | 0.387 | 0.888 | 10 | 10 | | | |
| G | Metals | Iron | 7439-89-6 | 22 | 18 | 0 | 2.6 | 12.8 | 6 | 6 | | | |
| G | Metals | Manganese | 7439-96-5 | 22 | 15 | 0.010 | 0.45 | 1.27 | 11 | 11 | | | |
| G | Semivolatiles | bis[2-Ethylhexyl]phthalate | 117-81-7 | 28 | 2 | 0.010 | 0.010 | 0.011 | 2 | 2 | | | |
| G | PCBs | Polychlorinated biphenyls | 1336-36-3 | 22 | 1 | 0.00060 | 0.00060 | 0.00060 | 1 | 1 | | | |
| G | Volatile | Benzene | 71-43-2 | 24 | 2 | 0.0010 | 0.035 | 0.069 | 1 | 1 | | | |
| G | Volatile | Vinyl chloride | 75-01-4 | 24 | 1 | 0.0082 | 0.0082 | 0.0082 | 1 | 1 | | | |
| H | Metals | Aluminum | 7429-90-5 | 7 | 3 | 0.060 | 0.139 | 0.283 | 3 | 3 | | | |
| H | Metals | Iron | 7439-89-6 | 7 | 7 | 0.020 | 0.71 | 3.25 | 4 | 4 | | | |
| H | Metals | Manganese | 7439-96-5 | 7 | 7 | 0.022 | 0.188 | 0.528 | 5 | 5 | | | |
| H | Metals | Nickel | 7440-02-0 | 7 | 3 | 0.023 | 0.058 | 0.111 | 1 | 1 | | | |
| H | Metals | Vanadium | 7440-62-2 | 7 | 2 | 0.010 | 0.013 | 0.016 | | | | | 1 |
| I | Metals | Aluminum | 7429-90-5 | 9 | 4 | 0.050 | 0.55 | 1.86 | 4 | 4 | | | |
| I | Metals | Iron | 7439-89-6 | 9 | 9 | 0.050 | 0.70 | 3.21 | 4 | 4 | | | |
| I | Metals | Manganese | 7439-96-5 | 9 | 6 | 0.060 | 1.06 | 5.82 | 6 | 6 | | | |
| I | Semivolatiles | 2,4-Dimethylphenol | 105-67-9 | 13 | 2 | 0.030 | 0.46 | 0.89 | 1 | | | | |
| I | Semivolatiles | 3-and 4-Methylphenol Coelutio | 65794-96-4 | 13 | 3 | 0.010 | 0.16 | 0.46 | 1 | 1 | | | |
| I | Semivolatiles | Phenol | 108-95-2 | 13 | 5 | 0 | 1.1 | 5.2 | 1 | | | | |
| I | Volatile | 1,2-Dichloropropane | 78-87-5 | 13 | 1 | 0.0063 | 0.0063 | 0.0063 | 1 | 1 | | | |
| I | Volatile | Benzene | 71-43-2 | 13 | 6 | 0.0010 | 0.0040 | 0.016 | 1 | 1 | | | |
| J | Metals | Manganese | 7439-96-5 | 3 | 3 | 0.036 | 0.053 | 0.062 | 2 | 2 | | | |

## Table 4-6
## Summary of Screening Evaluation for Phase 1A Sediment Characterization Data

| Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum (mg/kg, dry) | Mean (mg/kg, dry) | Maximum (mg/kg, dry) | Number of measurements higher than screening level | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Residential Direct Contact Criteria | Industrial and Commercial II (Direct Contact) |
| C | PCBs | Polychlorinated biphenyls | 1336-36-3 | 2 | 2 | 1.0 | 1.2 | 1.5 | 1 | |
| C | Metals | Arsenic | 7440-38-2 | 2 | 2 | 25 | 45 | 65 | 2 | |
| C | Metals | Lead | 7439-92-1 | 2 | 2 | 1150 | 1350 | 1550 | 2 | 2 |
| H | PCBs | Aroclor® 1254 | 11097-69-1 | 9 | 7 | 0.40 | 0.80 | 2.2 | 1 | |
| H | PCBs | Polychlorinated biphenyls | 1336-36-3 | 9 | 9 | 0.30 | 2.3 | 7.0 | 7 | |
| H | Semivolatiles | Benzo[a]pyrene | 50-32-8 | 3 | 1 | 1.6 | 1.6 | 1.6 | 1 | |
| H | Metals | Arsenic | 7440-38-2 | 9 | 9 | 9.0 | 19.4 | 47 | 9 | |
| H | Metals | Lead | 7439-92-1 | 9 | 9 | 250 | 970 | 1800 | 5 | 4 |

**Table 4-7**
**Summary of Screening Evaluation for Phase 1A Surface Water Characterization Data**

| Area | Chemical class | Chemical | Chemical Abstracts Service Registry Number | Number of analyses | Number of detects | Minimum (mg/L, dissolved) | Mean (mg/L, dissolved) | Maximum (mg/L, dissolved) | Number of measurements higher than screening level | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Residential & Commercial I Drinking Water Criteria | Industrial & Commercial II, III & IV Drinking Water Criteria |
| C | Metals | Aluminum | 7429-90-5 | 2 | 1 | 0.303 | 0.303 | 0.303 | 1 | 1 |
| C | Metals | Iron | 7439-89-6 | 2 | 2 | 0.059 | 0.409 | 0.759 | 1 | 1 |
| C | Metals | Lead | 7439-92-1 | 2 | 1 | 0.057 | 0.057 | 0.057 | 1 | 1 |
| C | Metals | Manganese | 7439-96-5 | 2 | 2 | 6.57 | 6.73 | 6.89 | 2 | 2 |
| H | Metals | Aluminum | 7429-90-5 | 7 | 3 | 0.052 | 0.0587 | 0.067 | 3 | 3 |
| H | Metals | Manganese | 7439-96-5 | 7 | 7 | 0.040 | 4.14 | 6.57 | 6 | 6 |

## Table 5-1

## Investigative Unit A: Phase 1B Sampling Rationale and AOI Summary
## Miscellaneous Sluice Sand and Bulk Storage Area

Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| A.1 | Current Quench Slag Staging Area "B" | Soil | | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| A.2 | Materials Storage | Soil | | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| A.3 | Former Sluice Sand Settling/Reclaim Area | Soil | X | | X | X | X | X | X |
| | | Groundwater | X | X | X | X | X | X | X |

**Scope of work:**

1 Collect a minimum of four surficial soil samples and complete two soil borings in the Former Sluice Sand Settling/Reclaim Area (A.3) for VOCs, SVOCs, PCBs, formaldehyde and site-specific metals.
2 Resample all Phase 1A monitoring wells and analyze for TCL parameters, site-specific metals, cyanide, and formaldehyde.
3 Analyte Lists can be found on Tables 3a through 3f of Attachment A.

## Table 5-2

## Investigative Unit B: Phase 1B Sampling Rationale and AOI Summary
## Former Parts Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| B.1 | Former Parts Plant RCRA Hazardous Waste Drum Storage Area | Soil | **This Unit has an Approved Closure** | | | | | | |
| | | Groundwater | **This Unit has an Approved Closure** | | | | | | |
| B.2 | Former Parts Plant Electric Department PCB Storage Area | Soil | **No Release to the Environment Documented - Storage in Drums on Concrete** | | | | | | |
| | | Groundwater | **No Release to the Environment Documented - Storage in Drums on Concrete** | | | | | | |
| B.3 | Former Parts Plant PCB Storage Area | Soil | X | | X | X | X | X | X |
| | | Groundwater | X | X | X | X | X | X | X |
| B.4 | Former Interior Drum Storage Area | Soil | X | | X | X | X | X | X |
| | | Groundwater | X | X | X | X | X | X | X |
| B.5 | Former Parts Plant Wastewater Treatment System | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |
| B.6 | Storage Pad Former Machine | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |

## Table 5-2

## Investigative Unit B: Phase 1B Sampling Rationale and AOI Summary
## Former Parts Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| B.7 | Former Molten Cyanide Dip Tanks and Emergency Dump Tank UST | Soil | | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| B.8 | Former Bulk Gasoline USTs | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |
| B.9 | Former Coolant Systems | Soil | No Release to the Environment Documented - Specific Location Unknown | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Specific Location Unknown | | | | | | |
| B.10 | Former Waste Oil ASTs | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |
| B.11 | Former "RAG Oil Tank | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |
| B.12 | Former Hammer Mill (Swagger) | Soil | No Release to the Environment Documented - Inside Building | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Inside Building | | | | | | |

## Table 5-2

## Investigative Unit B: Phase 1B Sampling Rationale and AOI Summary
## Former Parts Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| B.13 | Former Cast Iron Chip Car Station | **Soil** | X | | X | X | X | X | X |
| | | **Groundwater** | X | X | X | X | X | X | X |
| B.14 | Former Aluminum Chip Car Station | **Soil** | X | | X | X | X | X | X |
| | | **Groundwater** | X | X | X | X | X | X | X |
| B.15 | Former Steel Chip Car Station | **Soil** | **No Release to the Environment Documented - On Concrete** | | | | | | |
| | | **Groundwater** | **No Release to the Environment Documented - On Concrete** | | | | | | |

**Scope of work:**

1 Perform soil, soil vapor, and/or groundwater screening to determine source and extent of VOCs detected in Phase 1A well MW-00509 (near B.1 and B.7). Install up to four monitoring wells and sample for VOCs to confirm that the extent of impact has been delineated.

2 Complete four soil borings in the northeast corner of the Investigative Unit. Soil samples will be analyzed for VOCs, SVOCs, site-specific metals, cyanide, PBCs and formaldehyde.

3 Resample all Phase 1A monitoring wells and analyze TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-3

## Investigative Unit C: Phase 1B Sampling Rationale and AOI Summary
## Process Water Reservoir

Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Total and Dissolved Metals | Polychlorinated Biphenyls (PCBs) | AVS/SEM | Total Organic Carbon |
|---|---|---|---|---|---|
| C.1 | Process Water Reservoir | **This AOI does not meet the criteria for requiring additional assessment; therefore, additional activities are not warranted.** | | | |

**Scope of work:**

NO FURTHER ACTION

## Table 5-4

## Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary
### Grey Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| D.1 | Current Grey Iron Oil House RCRA Hazardous Waste Drum Accumulation Area | Soil | **This Unit has an Approved Closure** | | | | | | |
| | | Groundwater | **This Unit has an Approved Closure** | | | | | | |
| D.2 | Current Maintenance Paint Shop | Soil | **No Release to the Environment Documented - Inside Building on Concrete** | | | | | | |
| | | Groundwater | **No Release to the Environment Documented - Inside Building on Concrete** | | | | | | |
| D.3 | Historic PCB Accumulation/Storage Area | Soil | | | | | | X | |
| | | Groundwater | | | | | | | |
| D.4 | 1983 - 1984 Former Water Tower PCB Accumulation/Storage Area | Soil | **No Release to the Environment Documented - Storage in Drums on Concrete** | | | | | | |
| | | Groundwater | **No Release to the Environment Documented - Storage in Drums on Concrete** | | | | | | |
| D.5 | Grey Iron Electric Shop PCB Accumulation Area | Soil | **No Release to the Environment Documented - Inside Building on Concrete** | | | | | | |
| | | Groundwater | **No Release to the Environment Documented - Inside Building on Concrete** | | | | | | |
| D.6 | Floor Sumps | Soil | **No Release to the Environment Documented - Inside Building** | | | | | | |
| | | Groundwater | **No Release to the Environment Documented - Inside Building** | | | | | | |
| D.7 | Current Equipment Staging Area (a.k.a. Boneyard) | Soil | X | | | X | X | X | |
| | | Groundwater | X | X | X | X | X | X | X |
| D.8 | Current Boring Staging Area | Soil | X | | X | | X | X | X |
| | | Groundwater | X | X | X | X | X | X | X |

## Table 5-4

## Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary
## Grey Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| D.9 | Current Small Core Sand Staging Area | Soil | X | | X | | X | X | X |
| | | Groundwater | | | | | | | |
| D.10 | Former Poly-lok Process Equipment | Soil | X | | X | X | X | X | X |
| | | Groundwater | | | | | | | |
| D.11 | Hazardous Materials Storage - West Finishing Basement | Soil | No Release to the Environment Documented - Inside Building on Concrete | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Inside Building on Concrete | | | | | | |
| D.12 | Current Grey Iron Plant Non-Hazardous Waste Drum Storage Area | Soil | No Release to the Environment Documented - Storage in Drums on Concrete | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Storage in Drums on Concrete | | | | | | |
| D.13 | Former Drum Storage - Empty Drums and Non-Hazardous Materials | Soil | | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| D.14 | Current Concrete Staging Area | Soil | No Release to the Environment Documented - Historic Testing of Materials Available | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Historic Testing of Materials Available | | | | | | |
| D.15 | Steam Cleaning Room | Soil | No Release to the Environment Documented - Inside Building on Concrete | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Inside Building on Concrete | | | | | | |
| D.16 | Air Scrubber Systems | Soil | Active Permitted Pollution Control System | | | | | | |
| | | Groundwater | Active Permitted Pollution Control System | | | | | | |

## Table 5-4

### Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary
### Grey Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| D.17 | Former Grey Iron Oil House UST (G.I. #1) | Soil | **Tanks Removed - Final Assessment Report Submitted to MDEQ in October 1996** | | | | | | |
| | | Groundwater | **Tanks Removed - Final Assessment Report Submitted to MDEQ in October 1996** | | | | | | |
| D.18 | Former G.I. Oil House USTs (G.I. #2 and G.I. #3) | Soil | **Tanks Removed - Final Assessment Report Submitted to MI State Police in June 1993** | | | | | | |
| | | Groundwater | **Tanks Removed - Final Assessment Report Submitted to MI State Police in June 1993** | | | | | | |
| D.19 | Former Gasoline UST (G.I. #4) | Soil | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| | | Groundwater | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| D.20 | Former Garage Annex UST Service Maintenance Site (G.I. #5) | Soil | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| | | Groundwater | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| D.21 | Former Garage Oil/Water Separator UST (G.I. #7) | Soil | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| | | Groundwater | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| D.22 | Former Garage Annex Oil/Water Separator UST (G.I. #8) | Soil | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| | | Groundwater | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| D.23 | Former Cooling Tower UST (G.I. #10) | Soil | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| | | Groundwater | **Tanks Removed - Closure Approved by MDEQ** | | | | | | |
| D.24 | Former (Original) Oil House and Associated USTs | Soil | **Historic Location (circa 1936) that is Currently Beneath Existing Plant** | | | | | | |
| | | Groundwater | **Historic Location (circa 1936) that is Currently Beneath Existing Plant** | | | | | | |

## Table 5-4

## Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary
## Grey Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| D.25 | Former Powerhouse USTs | Soil | Historic Location (circa 1936 - 1964) that is Currently Beneath Existing Plant | | | | | | |
| | | Groundwater | Historic Location (circa 1936-1964) that is Currently Beneath Existing Plant | | | | | | |
| D.26 | Current Phosphate Ester Above-Ground Tank | Soil | X | | X | | X | X | X |
| | | Groundwater | | | | | | | |
| D.27 | Current Oil/Water Separator AST | Soil | No Release to the Environment Documented - Operating Double-Wall AST with Containment | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Operating Double-Wall AST with Containment | | | | | | |
| D.28 | 10/23/87 #8 Mold Line PCB Release | Soil | | | | | | X | |
| | | Groundwater | | | | | | | |
| D.29 | 6/17/87 PCB-Containing Transformer Fluid Leaks | Soil | Small Releases of Transformer Oil to Concrete - Remediated | | | | | | |
| | | Groundwater | Small Releases of Transformer Oil to Concrete - Remediated | | | | | | |
| D.30 | PCB Fluid Leak From E-701 Unit Substation | Soil | Small Releases of Transformer Oil to Concrete - Remediated | | | | | | |
| | | Groundwater | Small Releases of Transformer Oil to Concrete - Remediated | | | | | | |
| D.31 | 7/16/92 Diesel Fuel Release | Soil | | | | X | X | X | |
| | | Groundwater | | | | | | | |

Table 5-4

**Investigative Unit D: Phase 1B Sampling Rationale and AOI Summary**
**Grey Iron Plant**
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| D.32 | Contamination in Railroad Tracks West of the Cupola Cooling Tower | Soil | | | | X | X | X | |
| | | Groundwater | X | X | X | X | X | X | X |
| D.33 | 5/17/94 PCB Fluid Encountered | Soil | Inside Operating Plant | | | | | | |
| | | Groundwater | Inside Operating Plant | | | | | | |
| D.34 | 2/7/95 PCB Contamination | Soil | PCB Contaminated Concrete Discovered During Renovation - Remediated via Removal | | | | | | |
| | | Groundwater | PCB Contaminated Concrete Discovered During Renovation - Remediated via Removal | | | | | | |
| D.35 | 4/12/95 Diesel Fuel Spill | Soil | | | | X | X | X | |
| | | Groundwater | | | | | | | |

## Scope of work:

1 Collect ten surficial soil samples within the Current Equipment Staging Area (i.e., the Boneyard, D.7) for TCL SVOCs, PCBs and site-specific metals analysis. One of the surface soil samples will be located in the southeast corner of IU A. Install one intermediate monitoring well and analyze soil samples for TCL VOCs and PCBs, and site-specific metals; groundwater will be analyzed for TCL parameters, site-specific metals, cyanide and formaldehyde.

2 Collect one surficial soil sample at the Historical PCB Accumulation/Storage Area (D.3) for PCBs analysis.

3 Complete six soil borings along the east side of the plant; analyze the samples for site-specific metals, TCL SVOCs and PCBs, cyanide and formaldehyde. One of the samples will be additionally analyzed for VOCs.

4 Collect a minimum of six soil samples at each of the two diesel spill locations (D.31 and D.35). Analyze the samples for VOCs, SVOCs and PCBs as required by the MDEQ.

5 Drill five soil borings near the #8 Mold Line (D.28) to determine the horizontal and vertical extent of PCB impact. Potentially install one MW to determine vertical extent of impacted materials.

6 Drill four borings near the Railroad Tracks West of the Cupola Cooling Towers (D.32); analyze samples for TCL VOCs, SVOCs and PCBs. One monitoring well will be installed.

7 One monitoring well will be installed in the northwest portion of this IU and sampled for VOCs.

8 Resample all Phase 1A monitoring wells and analyze for TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-5

## Investigative Unit E: Phase 1B Sampling Rationale and AOI Summary
## River Dock Area
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| E.1 | Former ADL Waste 1,1,1-TCA Satellite Drum Accumulation/Storage Area | Soil | | | | X | | | |
| | | Groundwater | No Release to the Environment Documented - Storage in Drums Inside Building on Concrete | | | | | | |
| E.2 | Former ADL PCB Accumulation/Storage Area | Soil | No Release to the Environment Documented - Storage in Drums Inside Building on Concrete | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Storage in Drums Inside Building on Concrete | | | | | | |
| E.3 | Current ADL Drum Accumulation/Storage Area | Soil | No Release to the Environment Documented - Storage in Drums Under Roof on Concrete | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Storage in Drums Under Roof on Concrete | | | | | | |
| E.4 | Riverdock Crane Repair Building Underground Septic System | Soil | The Septic Tank was Removed in February 1999 | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| E.5 | Current Casting Sand/Metal Reclamation Area | Soil | X | | | | X | X | |
| | | Groundwater | X | X | X | X | X | X | X |
| E.6 | Former Quench Slag Staging Area "A" | Soil | No Releases to the Environment Documented - Recyclable Material Staged Here with Existing Data | | | | | | |
| | | Groundwater | No Releases to the Environment Documented - Recyclable Material Staged Here with Existing Data | | | | | | |

## Table 5-5

## Investigative Unit E: Phase 1B Sampling Rationale and AOI Summary
## River Dock Area
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| E.7 | Former (Original) Boring Staging Area | Soil | X | | | | | | |
| | | Groundwater | X | X | X | X | X | X | X |
| E.8 | Former Boring Staging Area | Soil | X | | | | X | X | |
| | | Groundwater | X | X | X | X | X | X | X |
| E.9 | Current Core Sand Staging Area | Soil | X | | X | | X | X | |
| | | Groundwater | X | X | X | X | X | X | X |
| E.10 | Powerhouse Fuel Oil ASTs | Soil | No Releases to the Environment Documented - 3 ASTs / 2 Certified Closed, One Empty | | | | | | |
| | | Groundwater | No Releases to the Environment Documented - 3 ASTs / 2 Certified Closed, One Empty | | | | | | |
| E.11 | Former Riverdock Crane Repair Building UST (G.I. #6) | Soil | Tank Removed - Closure Approved by MDEQ | | | | | | |
| | | Groundwater | Tank Removed - Closure Approved by MDEQ | | | | | | |
| E.12 | Riverdock Crane Repair Building UST (G.I. #9) | Soil | Tank Taken Out of Service Circa 1978 - Not Found February 1999 - Excavation Soil Samples all <EQLs | | | | | | |
| | | Groundwater | Tank Taken Out of Service Circa 1978 - Not Found February 1999 - Excavation Soil Samples all <EQLs | | | | | | |

## Table 5-5

## Investigative Unit E: Phase 1B Sampling Rationale and AOI Summary
## River Dock Area
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| E.13 | Former Mill Water Pump House UST (N.I. #9) | **Soil** | **Tank Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending** | | | | | | |
| | | **Groundwater** | **Tank Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending** | | | | | | |
| E.14 | Allegedly Buried Drums | **Soil** | X | | X | X | X | X | X |
| | | **Groundwater** | X | X | X | X | X | X | X |

**Scope of work:**

1 Collect six surficial soil samples in the northern portion for analysis of site-specific metals, SVOCs and PCBs.
2 Composite surficial soil samples from four locations (four samples from each location to be composited) for analysis of manganese and grain-size.
3 Two additional samples will be analyzed for site-specific metals, PCBs and formaldehyde in the former and current sand staging areas.
4 Soil samples will be collected from four Direct-Push borings to determine the extent of 1,1,1-TCA in soil near MW-02320.
5 Soil samples will be collected from three Direct-Push borings near MW-02228 for analysis of site-specific metals.
6 Collect one surficial soil sample at the Former ADL Waste 1,1,1-TCA Satellite Drum Accumulation/Storage Area (E.1) for analysis of VOCs and PCBs.
7 One additional monitoring well (MW-01223) will be installed. Samples will be analyzed for site-specific TCL parameters, site-specific metals, cyanide and formaldehyde.
8 Install one monitoring well (MW-03423) and analyze soil samples for site-specific metals, VOCs, SVOCs and PCBs, analyze groundwater for TCL VOCs, SVOCs and PCBs, site-specific metals, cyanide and formaldehyde.
9 Resample all Phase 1A monitoring wells and analyze TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-6

## Investigative Unit F: Phase 1B Sampling Rationale and AOI Summary
## AMDC Building and Administration Building

Saginaw Metal Casting Operations
Saginaw, Michigan

| **Areas of Interest (AOIs)** | Total Metals | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Total and Dissolved Metals |
|---|---|---|---|---|---|---|
| Former North Filling Station USTs | **No Release to the Environment Documented in Phase 1A** | | | | | |
| Former South Filling Station USTs | **No Release to the Environment Documented in Phase 1A** | | | | | |

**Scope of work:**

NO FURTHER ACTION BEYOND RESAMPLING PHASE 1A WELLS

## Table 5-7

## Investigative Unit G: Phase 1B Sampling Rationale and AOI Summary
## Former Nodular Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Ammonia | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|---|
| G.1 | Former Nodular Iron Plant Oil House RCRA Hazardous Waste Drum Storage Area | Soil | RCRA Closure Field Activities Complete - Report Submittal to MDEQ Pending | | | | | | | |
| | | Groundwater | RCRA Closure Field Activities Complete - Report Submittal to MDEQ Pending | | | | | | | |
| G.2 | Former RCRA Hazardous Waste Control Tank (AST) | Soil | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| | | Groundwater | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| G.3 | Former Nodular Iron Plant Waste Paint Shed RCRA Hazardous Waste Drum Storage Area | Soil | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| | | Groundwater | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| G.4 | Former (Original) Desulfurization Slag RCRA Treatment Unit | Soil | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| | | Groundwater | RCRA Closure Complete - Undergoing MDEQ Review | | | | | | | |
| G.5 | Former (Replacement) Desulfurization Slag RCRA Treatment Unit | Soil | | | | X | Closure Currently Undergoing MDEQ Review | | | |
| | | Groundwater | X | X | | X | Closure Currently Undergoing MDEQ Review | | | |
| G.6 | Former Waste PCB Transformer/Drum Storage Area | Soil | | | | | | | | |
| | | Groundwater | X | X | X | | X | X | X | X |
| G.7 | Basement Sumps (4) | Soil | No Release to the Environment Documented - Inspected During Nodular Iron Demolition Activities | | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Inspected During Nodular Iron Demolition Activities | | | | | | | |

## Table 5-7

## Investigative Unit G: Phase 1B Sampling Rationale and AOI Summary
## Former Nodular Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Ammonia | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|---|
| G.8 | Former Virgin Oils Storage Pad | Soil | X | | | | X | X | X | |
| | | Groundwater | X | X | X | | X | X | X | X |
| G.9 | Former Nodular Iron Plant Core Sand Staging Area | Soil | X | | X | | | | | |
| | | Groundwater | No Release to the Environment Documented - Recyclable Materials Staged Here with Existing Data | | | | | | | |
| G.10 | Former Oil House UST North (N.I. #1) | Soil | Tank Removed 1988 - No Contamination Detected | | | | | | | |
| | | Groundwater | Tank Removed 1988 - No Contamination Detected | | | | | | | |
| G.11 | Former Nodular Iron Plant Gasoline UST West (N.I. #2) | Soil | Tank Removed 1988 - No Contamination Detected | | | | | | | |
| | | Groundwater | Tank Removed 1988 - No Contamination Detected | | | | | | | |
| G.12 | Former Nodular Iron Plant Oil House USTs South (N.I. #3, N.I. #4, N.I. #5 and N.I. #6) | Soil | X | | | | X | X | X | |
| | | Groundwater | X | X | X | | X | X | X | X |
| G.13 | Former Cooling Tower Pump House UST (N.I. #7) | Soil | Tank Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending | | | | | | | |
| | | Groundwater | Tank Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending | | | | | | | |

## Table 5-7

## Investigative Unit G: Phase 1B Sampling Rationale and AOI Summary
## Former Nodular Iron Plant
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Ammonia | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|---|
| G.14 | Former Oil House UST West (N.I. #8) | Soil | X | | | | X | X | X | |
| | | Groundwater | X | X | X | | X | X | X | X |
| G.15 | Elevator Hydraulic Leaks | Soil | No Release to the Environment Documented - Inspected During Nodular Iron Demolition Activities | | | | | | | |
| | | Groundwater | No Release to the Environment Documented - Inspected During Nodular Iron Demolition Activities | | | | | | | |
| G.16 | 1/26/89 Possible Chlorobenzene Release | Soil | | | | | | | | |
| | | Groundwater | X | X | X | | X | X | X | X |

**Scope of work:**

1 Perform soil, soil vapor, and/or groundwater screening to determine source and extent of VOCs in groundwater near Former Oil House USTs (G.13 and and G.14). Install up to four shallow wells and sample for VOCs and PCBs to confirm that the horizontal extent of impact has been delineated.

2 Complete four soil borings at the Former Virgin Oils Storage Pad (G.8) and analyze soil samples for TCL VOCs, SVOCs and PCBs, and the site-specific metals.

3 Complete four soil borings at the Former Nodular Iron Plant Oil House USTs South (G.12) and analyze soil samples for TCL VOCs, SVOCs and PCBs, and the site-specific metals.

4 Complete four soil borings at the Former Oil House UST West (G.14) and analyze soil samples for TCL VOCs, SVOCs and PCBs, and the site-specific metals.

5 Collect soil samples and install one additional monitoring well in the area where slab on grade exists (G.5).

6 Resample the existing "$CaC_2$ Replacement Pad" wells and new well for VOCs, ammonia and site-specific metals analysis (G.5).

7 Collect one soil sample from the Former Nodular Iron Plant North Parking Lot for site-specific metals analysis.

8 Collect soil samples from four borings at the Former Nodular Iron Plant Core Sand Staging Area (G.9) and analyze for site-specific metals and formaldehyde.

9 Resample all Phase 1A monitoring wells and analyze TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-8

## Investigative Unit H: Phase 1B Sampling Rationale and AOI Summary
## Wastewater Treatment System and Stormwater Discharge Ditch

Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| H.1 | Primary Settling Basins | **Soil** | | | | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| H.2 | econdary Settling Basi | **Soil** | | | | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| H.3 | Stormwater Discharge Ditch | **Soil** | | | | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| H.4 | Temporary Classified Sand Staging Areas | **Soil** | X | | X | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| H.5 | Current Filter Cake Roll-Off Container(s) | **Soil** | | | | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |

**Scope of work:**

1 Four soil samples will be collected from four Direct-Push borings within the Temporary Classified Sand Staging Area (H.4) and analyzed for site-specific metals and formaldehyde.

2 Resample all Phase 1A monitoring wells and analyze TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-9

## Investigative Unit I: Phase 1B Sampling Rationale and AOI Summary
## Classified Sand Staging Area
Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Media | Total Metals | Dissolved Metals | Formaldehyde | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide |
|---|---|---|---|---|---|---|---|---|---|
| I.1 | Classified Sand Staging Area | **Soil** | X | | X | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| I.2 | Former Nodular Iron Quench Slag Staging Area | **Soil** | X | | X | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| I.3 | Former Nodular Iron Metals Reclamation Staging Area | **Soil** | X | | X | | | | |
| | | **Groundwater** | X | X | X | X | X | X | X |
| I.4 | Former Downes School Building USTs (N.I. #10, N.I. #11, N.I. #12) | **Soil** | **Tanks Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending** | | | | | | |
| | | **Groundwater** | **Tanks Removed 1988 - Additional Verification Sampling Completed - MDEQ Report Pending** | | | | | | |

**Scope of work:**

1 Resurvey MW-07959 to confirm the direction of ground-water flow. If necessary to confirm flow direction, install one additional monitoring well east of MW-079579 across Outer Drive.

2 Install one bedrock monitoring well (MW-96939) at the southern edge of the IU to assess potential upgradient (off-site) impacts. Sample the well for site-specific TCL parameters, metals, cyanide and formaldehyde.

3 Collect soil samples from four additional borings in the south half of the IU for formaldehyde and site-specific metals analysis. Sample only in areas where surficial clay is absent.

4 Resample all Phase 1A monitoring wells and analyze TCL parameters, site-specific metals, cyanide, and formaldehyde.

## Table 5-10

## Investigative Unit J: Phase 1B Sampling Rationale and AOI Summary
## On-Site Landfill

Saginaw Metal Casting Operations
Saginaw, Michigan

| Areas of Interest (AOIs) | | Total Metals | Volatile Organic Compounds (VOCs) | Semi-Volatile Organic Compounds (SVOCs) | Polychlorinated Biphenyls (PCBs) | Cyanide | Total and Dissolved Metals | AVS/SEM | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|
| J.1 | GM On-Site Landfill | **This AOI does not meet the criteria for requiring additional assessment: No Release to the Environment Detected During Phase 1A** | | | | | | | |

**Scope of work:**

NO FURTHER ACTION. THE LANDFILL IS LICENSED AND REGULATED BY THE MDEQ.

# Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 6 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 1.09 |
| 7 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| 8 | 0 - 6 | 574.0 - 580.0 | excavated |
| | 6 - 7 | 573.0 - 574.0 | 352.2 |
| | 9 - 10 | 570.0 - 571.0 | 292 |
| | 10 - 11 | 569.0 - 570.0 | 515 |
| | 11 - 12 | 568.0 - 569.0 | 309 |
| | 12 - 13 | 567.0 - 568.0 | <1 |
| | 13 - 14 | 566.0 - 567.0 | 18.4 |
| | 14 - 15 | 565.0 - 566.0 | 9.7 |
| | 15 - 16 | 564.0 - 565.0 | 1.2 |
| | 16 - 17 | 563.0 - 564.0 | <1 |
| | 17 - 18 | 562.0 - 563.0 | <1 |
| 8E | 0 - 5.5 | 574.5 - 580.0 | excavated |
| | 5.5 - 6.5 | 573.5 - 574.5 | 46 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 33 |
| | 7.5 - 8.5 | 571.5 - 572.5 | <1 |
| | 8.5 - 9.5 | 570.5 - 571.5 | <1 |
| 8N | 0 - 6 | 574.0 - 580.0 | excavated |
| | 6 - 7 | 573.0 - 574.0 | 113 |
| | 7 - 8 | 572.0 - 573.0 | 156 |
| | 8 - 9 | 571.0 - 572.0 | 13.4 |
| | 9 - 10 | 570.0 - 571.0 | 2.1 |
| | 10 - 11 | 569.0 - 570.0 | <1 |
| 8S | 0 - 6 | 574.0 - 580.0 | excavated |
| | 6 - 7 | 573.0 - 574.0 | 110 |
| | 7 - 8 | 572.0 - 573.0 | 98 |
| | 8 - 9 | 571.0 - 572.0 | 200 |
| | 9 - 10 | 570.0 - 571.0 | 120 |
| | 10 - 11 | 569.0 - 570.0 | 63 |
| | 11 - 12 | 568.0 - 569.0 | 140 |
| | 12 - 13 | 567.0 - 568.0 | 110 |
| | 13 - 14 | 566.0 - 567.0 | 50 |
| | 14 - 15 | 565.0 - 566.0 | 2.3 |
| | 15 - 16 | 564.0 - 565.0 | <1 |
| | 16 - 17 | 563.0 - 564.0 | <1 |

## Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 8SA | 0 - 1.5 | 578.5 - 580.0 | excavated |
| | 1.5 - 2.5 | 577.5 - 578.5 | 85.1 |
| | 2.5 - 3.5 | 576.5 - 577.5 | 178 |
| | 3.5 - 4.5 | 575.5 - 576.5 | 118 |
| | 4.5 - 5.5 | 574.5 - 575.5 | 96.3 |
| | 5.5 - 6.5 | 573.5 - 574.5 | 280 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 47.5 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 84.7 |
| | 8.5 - 9.5 | 570.5 - 571.5 | 1.3 |
| | 9.5 - 10.5 | 569.5 - 570.5 | 1.3 |
| | 10.5 - 11.5 | 568.5 - 569.5 | <1 |
| | 11.5 - 12.5 | 567.5 - 568.5 | <1 |
| 8SB | 0 - 1 | 579.0 - 580.0 | excavated |
| | 1 - 2 | 578.0 - 579.0 | 19.7 |
| | 2 - 3 | 577.0 - 578.0 | 11.9 |
| | 7 - 8 | 572.0 - 573.0 | 161 |
| | 8 - 9 | 571.0 - 572.0 | <1 |
| | 9 - 10 | 570.0 - 571.0 | <1 |
| 8W | 0 - 5.5 | 574.5 - 580.0 | excavated |
| | 5.5 - 6.5 | 573.5 - 574.5 | 420 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 280 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 240 |
| | 8.5 - 9.5 | 570.5 - 571.5 | 44 |
| | 9.5 - 10.5 | 569.5 - 570.5 | 73 |
| | 10.5 - 11.5 | 568.5 - 569.5 | 160 |
| | 11.5 - 12.5 | 567.5 - 568.5 | 27.5 |
| | 12.5 - 13.5 | 566.5 - 567.5 | 130 |
| | 13.5 - 14.5 | 565.5 - 566.5 | 186 |
| | 14.5 - 15.5 | 564.5 - 565.5 | 178 |
| | 15.5 - 16.5 | 563.5 - 564.5 | <1 |
| 8WA | 0 - 5.5 | 574.5 - 580.0 | excavated |
| | 5.5 - 6.5 | 573.5 - 574.5 | 275 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 207 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 207 |
| | 8.5 - 9.5 | 570.5 - 571.5 | 391 |
| | 9.5 - 10.5 | 569.5 - 570.5 | 21.0 |
| | 10.5 - 11.5 | 568.5 - 569.5 | 74.1 |
| | 11.5 - 12.5 | 567.5 - 568.5 | 2.0 |
| | 12.5 - 13.5 | 566.5 - 567.5 | <1 |

## Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 8WB | 0 - 5.5 | 574.5 - 580.0 | excavated |
| | 5.5 - 11.5 | 568.5 - 547.5 | unexcavated |
| | 11.5 - 12.5 | 567.5 - 568.5 | 25 |
| | 12.5 - 13.5 | 566.5 - 567.5 | <1 |
| 8WC | 0 - 1 | 579.0 - 580.0 | excavated |
| | 1 - 2 | 578.0 - 579.0 | 52.5 |
| | 5 - 6 | 574.0 - 575.0 | 1.0 |
| 8WD | 0 - 1 | 579.0 - 580.0 | excavated |
| | 1 - 2 | 578.0 - 579.0 | <1 |
| 9 | 0 - 6 | 574.0 - 580.0 | excavated |
| | 6 - 7 | 573.0 - 574.0 | 332.8 |
| | 9 - 10 | 570.0 - 571.0 | <1 |
| 9E | 0 - 2.5 | 577.5 - 580.0 | excavated |
| | 2.5 - 3.5 | 576.5 - 577.5 | 96 |
| | 3.5 - 4.5 | 575.5 - 576.5 | 164.0 |
| | 4.5 - 5.5 | 574.5 - 575.5 | 9.0 |
| | 5.5 - 6.5 | 573.5 - 574.5 | <1 |
| 9N | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 3.5 |
| | 3 - 4 | 576.0 - 577.0 | 218 |
| | 4 - 5 | 575.0 - 576.0 | 418 |
| | 5 - 6 | 574.0 - 575.0 | <1 |
| | 6 - 7 | 573.0 - 574.0 | 37.4 |
| | 7 - 8 | 572.0 - 573.0 | 2.2 |
| | 8 - 9 | 571.0 - 572.0 | <1 |
| 9NA | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| | 4 - 5 | 575.0 - 576.0 | <1 |
| | 7 - 8 | 572.0 - 573.0 | <1 |
| 9S | 0 - 1.5 | 578.5 - 580.0 | excavated |
| | 1.5 - 2.5 | 577.5 - 578.5 | 54.6 |
| | 2.5 - 3.5 | 576.5 - 577.5 | 22.4 |
| | 3.5 - 4.5 | 575.5 - 576.5 | 73.6 |
| | 4.5 - 5.5 | 574.5 - 575.5 | 290.9 |
| | 5.5 - 6.5 | 573.5 - 574.5 | 115.1 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 71.6 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 67.0 |
| | 8.5 - 9.5 | 570.5 - 571.5 | 13.7 |
| | 9.5 - 10.5 | 569.5 - 570.5 | 49.4 |

## Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 9SA | 0 - 1.5 | 578.5 - 580.0 | excavated |
| | 1.5 - 10.5 | 569.5 - 578.5 | unexcavated |
| | 10.5 - 11.5 | 568.5 - 569.5 | 285.3 |
| | 11.5 - 12.5 | 567.5 - 568.5 | 63.4 |
| | 12.5 - 13.5 | 566.5 - 567.5 | <1 |
| 9SB | 0 - 1 | 579.0 - 580.0 | excavated |
| | 1 - 2 | 578.0 - 579.0 | 112.7 |
| | 3 - 4 | 576.0 - 577.0 | <1 |
| | 7 - 8 | 572.0 - 573.0 | 24.1 |
| | 8 - 9 | 571.0 - 572.0 | 4.3 |
| | 9 - 10 | 570.0 - 571.0 | <1 |
| 9SC | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 23.5 |
| | 3 - 4 | 576.0 - 577.0 | 43 |
| | 4 - 5 | 575.0 - 576.0 | 2.6 |
| | 5 - 6 | 574.0 - 575.0 | <1.0 |
| 10 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| 11 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| 12 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| 17 | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1.0 |
| 18 | 0 - 1 | 579.0 - 580.0 | unexcavated |
| | 1 - 2 | 578.0 - 579.0 | <1 |
| 19 | 0 - 3.5 | 576.5 - 580.0 | excavated |
| | 3.5 - 4.5 | 575.5 - 576.5 | 101.8 |
| | 4.5 - 5.5 | 574.5 - 575.5 | 85.0 |
| | 5.5 - 6.5 | 573.5 - 574.5 | 253 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 97.0 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 96.7 |
| | 8.5 - 9.5 | 570.5 - 571.5 | 6.3 |
| | 9.5 - 10.5 | 569.5 - 570.5 | 1.6 |
| | 10.5 - 11.5 | 568.5 - 569.5 | <1 |
| | 11.5 - 12.5 | 567.5 - 568.5 | <1 |

## Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 19E | 0 - 2.5 | 577.5 - 580.0 | excavated |
| | 2.5 - 3.5 | 576.5 - 577.5 | 47 |
| | 3.5 - 4.5 | 575.5 - 576.5 | 70 |
| | 4.5 - 5.5 | 574.5 - 575.5 | 110 |
| | 5.5 - 6.5 | 573.5 - 574.5 | 200 |
| | 6.5 - 7.5 | 572.5 - 573.5 | 53 |
| | 7.5 - 8.5 | 571.5 - 572.5 | 3.3 |
| | 8.5 - 9.5 | 570.5 - 571.5 | <1 |
| | 9.5 - 10.5 | 569.5 - 570.5 | <1 |
| 19EA | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| | 3 - 4 | 576.0 - 577.0 | 72.5 |
| | 4 - 5 | 575.0 - 576.0 | <1 |
| | 5 - 6 | 574.0 - 575.0 | 22.0 |
| | 6 - 7 | 573.0 - 574.0 | <1 |
| 19EB | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | <1 |
| | 3 - 4 | 576.0 - 577.0 | <1 |
| 19W | 0 - 3 | 577.0 - 580.0 | excavated |
| | 3 - 4 | 576.0 - 577.0 | 140 |
| | 4 - 5 | 575.0 - 576.0 | 150 |
| | 5 - 6 | 574.0 - 575.0 | 190 |
| | 6 - 7 | 573.0 - 574.0 | 240 |
| | 7 - 8 | 572.0 - 573.0 | 140 |
| | 8 - 9 | 571.0 - 572.0 | 45 |
| | 9 - 10 | 570.0 - 571.0 | <1 |
| | 10 - 11 | 569.0 - 570.0 | <1 |
| 19WA | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 203 |
| | 3 - 4 | 576.0 - 577.0 | 161 |
| | 4 - 5 | 575.0 - 576.0 | 94 |
| | 5 - 6 | 574.0 - 575.0 | 183 |
| | 6 - 7 | 573.0 - 574.0 | 265 |
| | 7 - 8 | 572.0 - 573.0 | 176 |
| | 8 - 9 | 571.0 - 572.0 | 140 |
| | 9 - 10 | 570.0 - 571.0 | <1 |

## Table 5-11
## Summary of Previous PCB Soil Sampling at the #8 Mold Line (D.28)
Saginaw Metal Casting Operations
Saginaw, Michigan

| Sample ID | Depth Below Basement Floor* (feet) | Sample Elevation (ft MSL) | Total PCB Concentration (ppm) |
|---|---|---|---|
| 19WB | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 235 |
| | 3 - 4 | 576.0 - 577.0 | 261 |
| | 4 - 5 | 575.0 - 576.0 | 192 |
| | 5 - 6 | 574.0 - 575.0 | 384 |
| | 6 - 7 | 573.0 - 574.0 | 286 |
| | 7 - 8 | 572.0 - 573.0 | 398 |
| | 8 - 9 | 571.0 - 572.0 | 324 |
| | 9 - 10 | 570.0 - 571.0 | 38 |
| 19WC | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 10 | 570.0 - 578.0 | unexcavated |
| | 10 - 11 | 569.0 - 570.0 | 52.2 |
| | 11 - 12 | 568.0 - 569.0 | <1 |
| 19WD | 0 - 2 | 578.0 - 580.0 | excavated |
| | 6-Feb | 574.0 - 578.0 | unexcavated |
| | 6 - 7 | 573.0 - 574.0 | 225 |
| | 9 - 10 | 570.0 - 571.0 | 71.2 |
| | 11 - 12 | 568.0 - 569.0 | 63 |
| 19WE | 0 - 2 | 578.0 - 580.0 | excavated |
| | 2 - 3 | 577.0 - 578.0 | 81.1 |
| | 3 - 4 | 576.0 - 577.0 | 81 |
| | 4 - 5 | 575.0 - 576.0 | 300 |
| | 6 - 7 | 573.0 - 574.0 | 31.0 |
| | 7 - 8 | 572.0 - 573.0 | 32.0 |
| | 8 - 9 | 571.0 - 572.0 | 18.0 |
| | 9 - 10 | 570.0 - 571.0 | <1.0 |
| 20 | 0 - 1.5 | 578.5 - 580.0 | excavated |
| | 1.5 - 2.5 | 577.5 - 578.5 | <1 |

Notes:
* = Basement floor elevation is 580.0 ft MSL.
1. Samples collected below former excavation or in unexcavated areas.
2. PCB results taken from RMT drawing titled "Contaminated Soil Excavation", 4/19/89, revised 5/19/89, RMT Project 1073.15 SGI CFD GMC.
3. See Figure 5 - 4d for sample locations.

# Table 5-12
## Summary of Proposed Saginaw River Sampling Locations
## Saginaw Metal Casting Operations
## Saginaw, Michigan

| Sample Station | Location | Rationale | Number of Samples | | | Comment |
|---|---|---|---|---|---|---|
| | | | Surface Water | Sediment | | |
| | | | | Analyze | Hold | |
| SW/SD-1 | Just upstream of SPDES outfall for Saginaw Rock Products Co. | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-2 | SPDES outfall for Saginaw Rock Products Co. | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-3 | Just downstream of SPDES outfall for Saginaw Rock Products Co. | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-4 | West bank upstream of site | Upstream/Cross-stream reference | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-5 | Just upstream of SPDES outfall for Michigan Sugar Company | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-6 | SPDES outfall for Michigan Sugar Company | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-7 | Just downstream of SPDES outfall for Michigan Sugar Company | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-8 | East bank upstream of site | Upstream/Cross-stream reference | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-9 | East bank upstream of site | Upstream reference | 8 | 8 | | Analyze all; station approx. 2,000 feet long |
| SW/SD-10 | Just upstream of SMCO Former Outfall #001 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-11 | SMCO Former Outfall #001 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-12 | Just downstream of SMCO Former Outfall #001 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-13 | Adjacent to MW-01530 | Groundwater discharge | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-14 | Adjacent to Retention Basin (Area C) | Potential historical discharge point | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-15 | Across river from site | Cross-stream reference | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-16 | Just upstream of City of Saginaw CSO #007R | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-17 | City of Saginaw CSO #007R | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-18 | Just downstream of City of Saginaw CSO #007R | Potential point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-19 | Adjacent to MW-03240 | Groundwater discharge | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-20 | Adjacent to MW-03746 | Groundwater discharge | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-21 | Just upstream of SCMO Former Outfall #002 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-22 | SCMO Former Outfall #002; adjacent to MW-04747 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| SW/SD-23 | Just upstream of SCMO Former Outfall #002 | Potential historical point source | 1 | 1 | 3 | Analyze 1 sediment; hold rest |
| | | TOTAL | 28 | 30 | 66 | |