

2005 GROUNDWATER MONITORING WORK PLAN

**General Motors Corporation
Grand Rapids Metal Plant
Wyoming, Michigan**

**APRIL 2004
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LIST OF ACRONYMS

COC	Chain of Custody
CRA	Conestoga-Rovers & Associates
DO	Dissolved Oxygen
DOT	Department of Transportation
GM	General Motors Corporation
MDEQ	Michigan Department of Environmental Quality
ORP	Oxidation-Reduction Potential
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCI	Reactivity, Corrosively, and Ignitability
SOW	Scope of Work
SVE	Soil Vapor Extraction
SVOCs	Semi-Volatile Organic Compounds
TAT	Turnaround Time
TCL	Target Compound List
TOC	Total Organic Carbon
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The purpose of this Groundwater Monitoring Work Plan (Work Plan) is to present the protocol to be used for the implementation of the collection and analysis of groundwater samples during the 2005 Quarterly Groundwater Monitoring Program at the General Motors Corporation (GM) Grand Rapids Metal Fabrication Plant located at 300 36th Street in Wyoming, Michigan (Site). Figure 1.1 presents the Site location.

1.1 SITE BACKGROUND

The Site background is presented in the Work Plan and the Data Report submitted to the Michigan Department of Environmental Quality (MDEQ) under separate cover on November 24, 2002 and March 2, 2004, respectively. A Site plan is presented on Figure 1.2.

1.2 PURPOSE OF GROUNDWATER MONITORING WORK PLAN

The purpose of this Work Plan is to outline the activities proposed to collect groundwater analytical data to further evaluate remedial alternatives for the chlorinated compound impacted groundwater both on and off-Site and confirm the currently defined extent of contamination.

2.0 CURRENT CONDITIONS

2.1 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination is presented in the Supplemental Work Plan and the Data Report submitted to the MDEQ under separate cover on April 2, 2004 and December 15, 2004, respectively. Plan 1 presents a summary of select Target Compound List (TCL) volatile organic compounds (VOCs) in groundwater at the Site, including the results from the June, September, and December 2004 Quarterly Groundwater monitoring events. The TCL VOCs were selected for reporting because they were detected in previous rounds of groundwater sampling and remain on the list as the chemicals of concern.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

Information regarding the geologic conditions at the Site was collected during previous environmental investigations. Site geology and hydrogeology are presented in the Supplemental Work Plan and the Data Report submitted to the MDEQ under separate cover on April 2, 2004 and December 15, 2004, respectively.

3.0 SCOPE OF WORK

The SOW for this Work Plan includes the collection of one groundwater sample from 31 monitoring wells and three surface water locations from culverts along the Cole Drain, per quarter, plus the collection of quality assurance/quality control (QA/QC) samples, with three additional monitoring wells sampled semi-annually. The monitoring fieldwork will adhere to the methods and procedures specified in this Work Plan and applicable Quality Assurance Project Plan (QAPP). The QAPP is presented under separate cover as Appendix A of the Work Plan dated November 2002, which was submitted to the MDEQ.

3.1 SAMPLING PROCEDURES

A total of 42 samples will be collected from 31 monitoring well locations quarterly, three well locations semi-annually, and three surface water locations quarterly. Sampling locations and analysis are provided in Table 3.1 and on Figure 3.1. Sampling will be completed as outlined below.

3.1.1 STATIC WATER LEVELS

Static water levels will be collected from all on-Site monitoring well locations and the three surface water culvert locations. Depth to water will be recorded to the nearest hundredth of a foot, utilizing the top of riser as the reference point. Surface water levels will be recorded to the nearest hundredth of a foot, utilizing the top of the culvert as the reference point.

3.1.2 GROUNDWATER MONITORING

A total of 39 groundwater samples will be collected from 31 monitoring well locations, including QA/QC samples, per quarter during the implementation of this Work Plan, with three additional wells sampled semi-annually. Quarterly and semi-annual sampling will begin in April 2005.

Samples will be collected from the following 30 groundwater monitoring wells; 85-1, 85-2, 85-3, 85-5B, 85-6, 85-7, 86-1, 86-3, 87-1, 87-2, 87-4, 87-5, 87-9, 87-10, 87-11, 87-13, MW1-03, MW2-03, MW3-03, MW4-03, MW5-03, MW6-03, MW7-03, MW8-04, MW9-04, MW10-04, MW11-04, MW13-04, MW14-04, and MW15-04; and from purge well 86-2; and

analyzed for TCL VOCs on a quarterly basis. Additionally, groundwater samples collected from 85-5B, 85-7, 87-1, 87-2, 87-4, 87-5, 87-10, 87-11, MW2-03, MW3-03, MW5-03, MW9-04, MW11-04 and from purge well 86-2 will be analyzed for in-situ chemical oxidation parameters and in-situ bioremediation parameters on a semi-annual basis. In-situ chemical oxidation parameters include total alkalinity as CaCO₃, chloride, hardness, nitrate, nitrite, sulfate, sulfide, total organic carbon (TOC), calcium, magnesium, and manganese. In-situ bioremediation parameters include orthophosphate (as P), phosphorus, total kjeldahl nitrogen (TKN), ammonia, dissolved organic carbon (DOC), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved iron, and anaerobic total microbial population. Samples will be collected from the following three monitoring wells semi-annually; 88-2, 88-3 and 88-4 and analyzed for TCL VOCs. Samples will be collected from four wells; 85-3, 85-5B, 85-6, and 86-1, and will be analyzed for TCL semi-volatile organic compounds (SVOCs) on a quarterly basis. Monitoring well 87-8 will not be sampled as it has not shown signs of contamination during previous monitoring rounds and data from the well is not required to delineate the extent of either the on-Site or off-Site plume. Purge well PWDISCH will not be sampled as the groundwater treatment system has been shutdown and there are additional monitoring wells in the immediate vicinity that will be sampled. Table 3.2 presents the sampling and analysis plan.

3.1.3 SURFACE WATER MONITORING

A total of three surface water samples will be collected from three surface water culvert locations per quarter during the implementation of this Work Plan. Quarterly and semi-annual sampling will begin in April 2005.

Samples will be collected from culvert locations C-1, C-2, and C-3 and analyzed for TCL VOCs.

4.0 SAMPLING PROCEDURES

Proposed sample locations are presented on Figure 3.1. All sampling will be performed in accordance with the procedures outlined below.

4.1 STATIC WATER LEVELS

Static water levels will be collected from all on-Site monitoring well locations and the three surface water locations. Depth to water will be recorded to the nearest hundredth of a foot, utilizing the top of riser as the reference point. Surface water levels will be recorded to the nearest hundredth of a foot, utilizing the top of the culvert as the reference point.

4.2 GROUNDWATER SAMPLE COLLECTION

One groundwater sample will be collected from each of the location list above, per quarter or semi-annually, as presented in Section 3.1.2.

Low-flow groundwater purging and sampling methods will be used to sample the monitoring wells listed, including purge well 86-2. The purge pump from 86-2 will be removed prior to the initiation of sampling activities.

Groundwater samples will be collected after low-flow purging indicates that the field parameters have stabilized. Field parameters will consist of pH, specific conductance, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Stabilization will be considered according to the tolerances listed below:

- pH = ± 0.1 s.u. of the average of three consecutive readings;
- Specific Conductance = ± 0.005 milliSiemen per centimeter (mS/cm) of the average of three consecutive readings less than 1 μ mhos/cm, and ± 0.010 mS/cm of the average of three consecutive readings for greater than 1 mS/cm;
- Temperature = ± 3 percent of the average of three consecutive readings;
- DO = $\pm 10\%$ of the average of three consecutive readings;
- ORP = ± 10 millivolts of the average of three consecutive readings; and
- Turbidity = < 5 NTU.

Forty-three samples, including QA/QC samples, will be collected and analyzed for TCL VOCs and four samples will be collected and analyzed for TCL SVOCs, each quarter. In addition, 16 groundwater samples, including QA/QC samples, will be collected and analyzed for in-situ chemical oxidation parameters and in-situ bioremediation parameters, and three additional TCL VOCs samples, semi-annually. Table 3.2 presents the sampling and analysis plan.

Groundwater samples will be placed into a pre-cleaned laboratory-provided container, properly labeled, placed on ice and submitted under proper COC protocol via overnight courier to the laboratory to be analyzed on a standard two-week turn around time (TAT).

4.3 SURFACE WATER SAMPLE COLLECTION

One surface water sample will be collected from each of the location list above, per quarter, as presented in Section 3.1.3.

Surface water samples will be collected as grab samples and analyzed for TCL VOCs. Surface water will be collected in a clean sampling container and poured into a pre-cleaned laboratory-provided container, properly labeled, placed on ice and submitted under proper COC protocol via overnight courier to the laboratory to be analyzed on a standard two-week TAT.

4.4 DECONTAMINATION

Each well will be sampled using designated ¼-inch dedicated tubing. All non-disposable sampling equipment will be decontaminated prior to each use by using an Alconox wash, potable water rinse, followed by a deionized water rinse and allowed to air dry.

5.0 ANALYTICAL PROTOCOLS

Groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, and/or in-situ chemical oxidation parameters and in-situ bioremediation parameters, as presented in the SOW and on Table 3.2. All samples will be analyzed using the United States Environmental Protection Agency approved methods set forth in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, 3rd Edition and Promulgated Update, November 1986, "Standards Methods for the Examination of Water and Wastewater", APHA, 19th Edition, 1995, and "Methods for Chemical Analysis of Water and Waste", EPA-600/4-79-020, revised March 1983. Quality Control/Quality Assurance samples will be collected for data and sample quality assessment in accordance with the QAPP. The QAPP is presented in Appendix A of the Work Plan dated November 2002, which was submitted to the MDEQ.

Following receipt of final analytical data, a data quality assessment and validation will be prepared by a CRA chemist, in accordance with the QAPP presented in Appendix A of the Work Plan dated November 2002, which was submitted to the MDEQ.

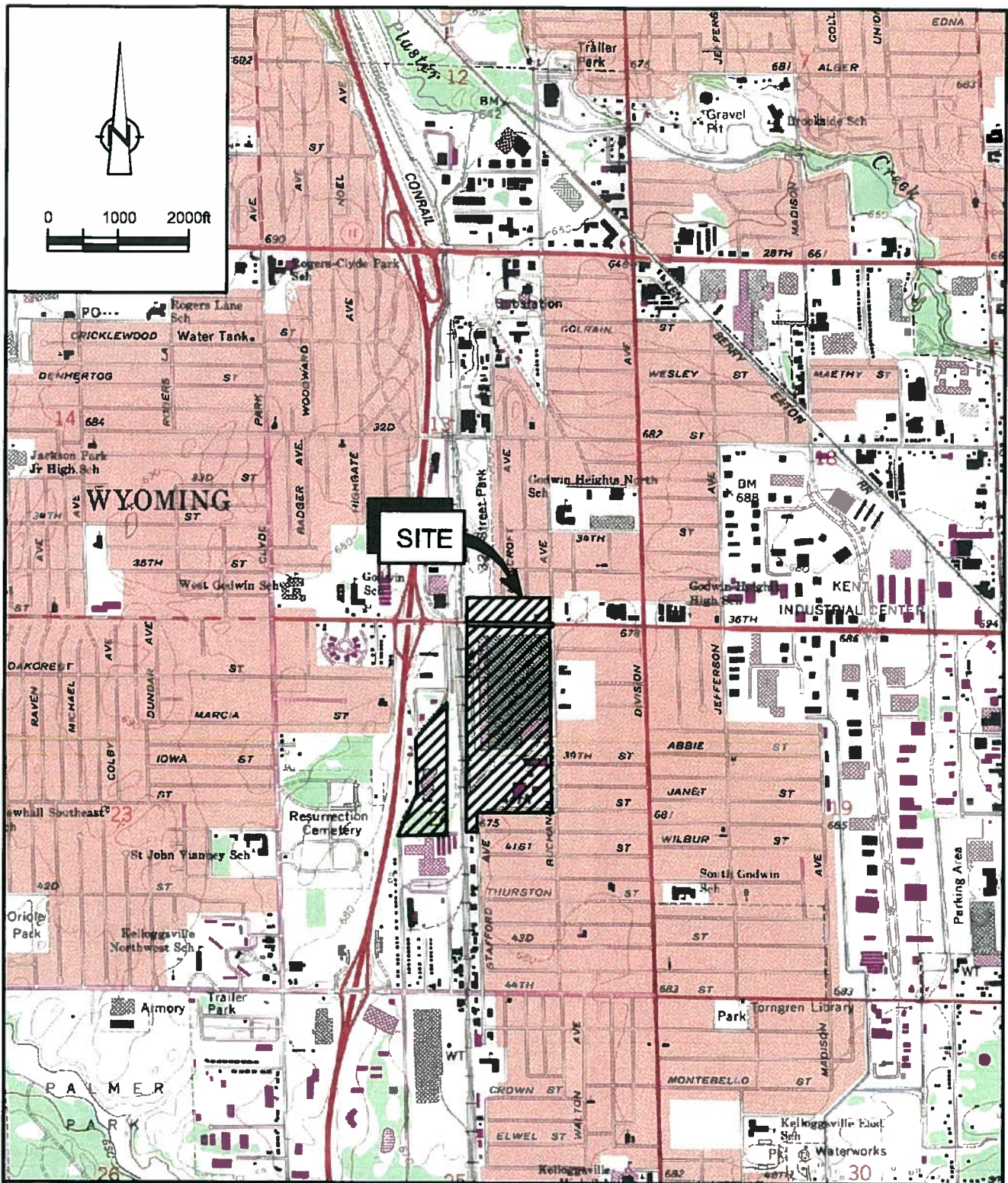
6.0 REPORTING

Upon completion of the field activities, receipt of final analytical results, and data quality assessment and validation, a report summarizing the results will be generated for each quarterly sampling event. A single report will be prepared summarizing the results of the entire 2005 sampling, as well as providing remedial options for the Site.

7.0 SCHEDULE

Groundwater field activities will be initiated in April 2005. A generalized proposed schedule for the implementation of the field activities and reporting is presented below.

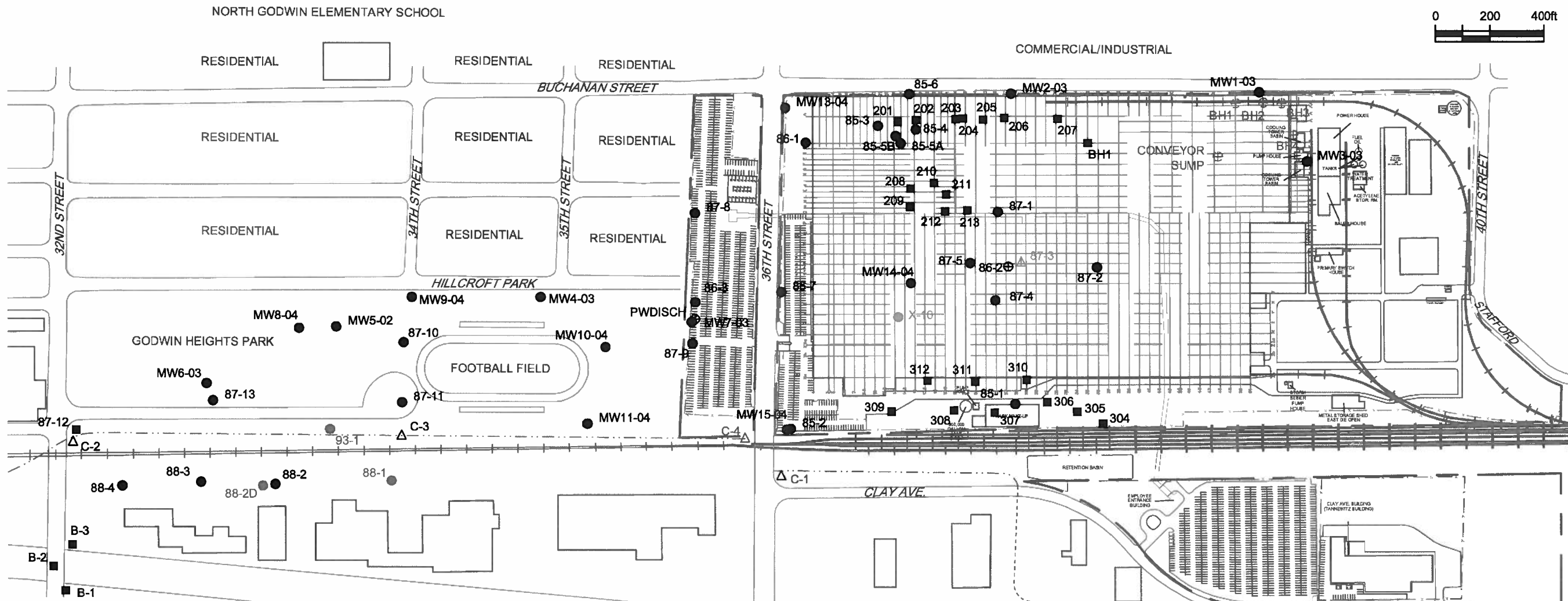
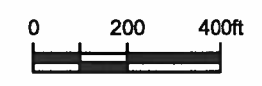
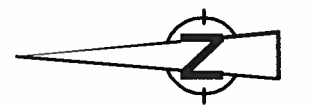
- Quarterly Groundwater Monitoring – Approximately four to five days per event;
- Submittal of Quarterly Groundwater Reports – Approximately four to five weeks from completion of field activities; and
- Submittal of Summary Report – Approximately two to three weeks from completion of final Quarterly Groundwater Report.



SOURCE: USGS QUADRANGLE MAP;
 GRAND RAPIDS WEST, MICHIGAN



figure 1.1
 SITE LOCATION
 GRAND RAPIDS METAL PLANT
 Wyoming, Michigan

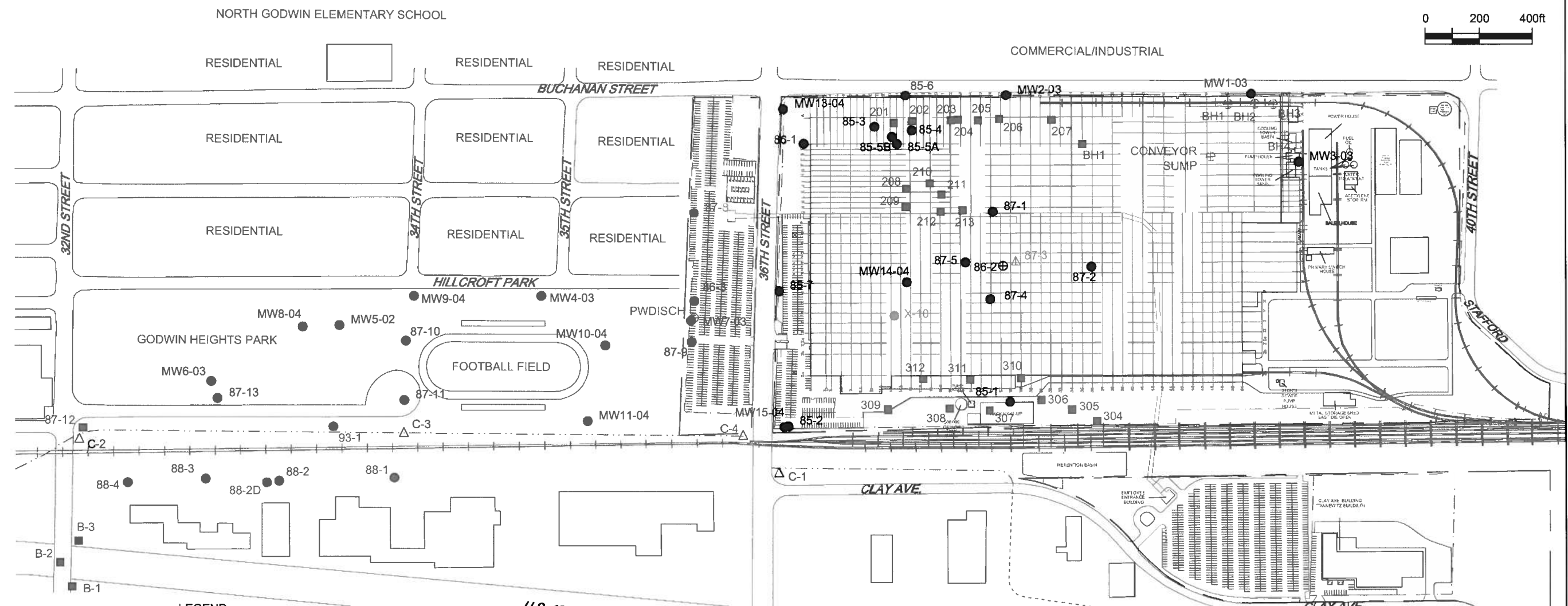
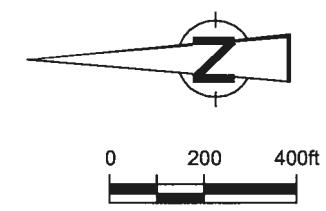


- LEGEND**
- 87-2 MONITORING WELL LOCATION
 - ⊕ PWDISCH PURGE WELL LOCATION
 - 307 SOIL BORING LOCATION
 - X-10 DESTROYED/REMOVED MONITORING WELL LOCATION
 - △ C-2 CULVERT LOCATION
 - △ 87-3 ABANDONED AIR PURGE WELL
 - ⊕ BH1 APPROXIMATE LOCATION OF DEWATERING WELLS
 - — — — — APPROXIMATE SITE BOUNDARY
 - - - - - FENCE
 - +—+—+— RAILROAD
 - - - - - COLE DRAIN

SOURCE: EDI ENGINEERING & SCIENCE,
JUNE 1987 AND JUNE 1988
AND EARTH TECH, SEPTEMBER 2001.

figure 1.2
SITE PLAN
GRAND RAPIDS METAL PLANT
Wyoming, Michigan





- LEGEND**
- 87-2 MONITORING WELL LOCATION SAMPLED QUARTERLY
 - 88-3 MONITORING WELL LOCATION SAMPLED SEMI-ANNUALLY
 - ⊕ PWDISCH PURGE WELL LOCATION
 - 307 SOIL BORING LOCATION
 - X-10 DESTROYED/REMOVED/NOT SAMPLED MONITORING WELL LOCATION
 - △ C-2 CULVERT LOCATION
 - △ 87-3 ABANDONED AIR PURGE WELL
 - ⊕ BH1 APPROXIMATE LOCATION OF DEWATERING WELLS
 - — — — — APPROXIMATE SITE BOUNDARY
 - - - - - FENCE
 - +—+—+— RAILROAD
 - - - - - COLE DRAIN

SOURCE: EDI ENGINEERING & SCIENCE,
 JUNE 1987 AND JUNE 1988
 AND EARTH TECH, SEPTEMBER 2001.

figure 3.1
 SAMPLE LOCATIONS
 GRAND RAPIDS METAL PLANT
 Wyoming, Michigan



TABLE 3.1

**MONITORING WELLS AND ANALYSIS
2005 GROUNDWATER MONITORING WORK PLAN
GENERAL MOTORS CORPORATION
GRAND RAPIDS METAL PLANT
WYOMING, MICHIGAN**

<u>Monitoring Well Identification Number</u>	<u>Quarterly Water Level</u>	<u>Sampling Analysis</u>	<u>Sampling Frequency</u>
85-1	y	1	Quarterly
85-2	y	1	Quarterly
85-3	y	2	Quarterly
85-5B	y	2, 3	Quarterly
85-6	y	2	Quarterly
85-7	y	3	Quarterly
86-1	y	2	Quarterly
86-2	y	3	Quarterly
86-3	y	1	Quarterly
87-1	y	3	Quarterly
87-2	y	3	Quarterly
87-4	y	3	Quarterly
87-5	y	3	Quarterly
87-8	y	none	
87-9	y	1	Quarterly
87-10	y	3	Quarterly
87-11	y	3	Quarterly
87-13	y	1	Quarterly
88-2	y	1	Semi-Annual
88-3	y	1	Semi-Annual
88-4	y	1	Semi-Annual
MW1-03	y	1	Quarterly
MW2-03	y	3	Quarterly
MW3-03	y	3	Quarterly
MW4-03	y	1	Quarterly
MW5-03	y	3	Quarterly
MW6-03	y	1	Quarterly
MW7-03	y	1	Quarterly
MW8-04	y	1	Quarterly
MW9-04	y	3	Quarterly
MW10-04	y	1	Quarterly
MW11-04	y	3	Quarterly
MW13-04	y	1	Quarterly
MW14-04	y	1	Quarterly
MW15-04	y	1	Quarterly
PWDISCH	y	none	
C-1	y	1	Quarterly
C-2	y	1	Quarterly
C-3	y	1	Quarterly

Notes:

- 1 - Sampling analysis includes TCL VOCs.
- 2 - Sampling analysis includes TCL SVOCS and TCL VOCs.
- 3 - Sampling analysis includes TCL VOCs, total alkalinity (as CaCO₃), chloride, hardness, nitrate, nitrite, sulfate, sulfide, total organic carbon, calcium, magnesium, manganese, orthophosphate (as P), phosphorus, total kjeldahl nitrogen, ammonia, dissolved organic carbon, biochemical oxygen demand, chemical oxygen demand, anaerobic total microbial population, and dissolved iron (Fe(II)).

TABLE 3.2

SAMPLING AND ANALYSIS PLAN
 2005 GROUNDWATER MONITORING WORK PLAN
 GENERAL MOTORS CORPORATION
 GRAND RAPIDS METAL PLANT
 WYOMING, MICHIGAN

<i>Proposed Investigation Activity</i>	<i>Reason for Activity</i>	<i>Quantity of Sample Locations</i>	<i>Quantity of Samples</i>	<i>Sample Matrix</i>	<i>Analysis</i>
In Situ Chemical Oxidation	Evaluate ISCO remedial alternative	14	16 ⁽¹⁾	groundwater	Alkalinity, Total (as CaCO ₃), Chloride, Hardness, Nitrate, Nitrite, Sulfate, Sulfide, Total Organic Carbon, Calcium, Magnesium, Manganese, Dissolved Iron
Monitored Natural Attenuation	Evaluate In Situ Bioremediation	14	16 ⁽¹⁾	groundwater	Orthophosphate (as P), Phosphorus, Total Kjeldahl Nitrogen (TKN), Ammonia, Dissolved Organic Carbon (DOC), Biochemical Oxygen Demand (COD), Anaerobic Total Microbial Population
Quarterly Monitoring	Vertical/horizontal delineation	37	42 ⁽¹⁾	groundwater & surface water	TCL VOCs
		4	5 ⁽¹⁾	groundwater	TCL SVOCs

Notes:

- ⁽¹⁾ Number of samples includes Quality Assurance/Quality Control samples.
- TCL - Target Compound List
- VOCs - Volatile Organic Compounds
- SVOCs - Semi-volatile Organic Compounds

