PRE-DESIGN INVESTIGATIONS WORK PLAN

FORMER GENERAL MOTORS FAIRFAX I PLANT
KANSAS CITY, KANSAS

Conestoga-Rovers & Associates

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1.0 INTRODUCTION AND BACKGROUND

Conestoga-Rovers & Associates (CRA) has prepared this Work Plan for soil and groundwater investigations at the former General Motors (GM) Fairfax I Plant Site in Kansas City, Kansas (Site). Refer to Figure 1.1 for the project location. This Work Plan is being prepared under the review of the Kansas Department of Heath and Environment (KDHE) and their Voluntary Cleanup and Property Redevelopment Program (VCPRP). GM submitted a number of documents to the KDHE at the time of entry into the VCPRP in June 2000 and these are listed in Section 8.0 of this Work Plan. These past studies have identified an Area of Interest (AOI) requiring additional remediation at the Site. The purpose of this Work Plan is to outline procedures for pre-design investigations that are necessary to select and construct a remedial action for the Site.

GM had previously concluded that remediation of soils was required at the AOI and that a number of options were available for consideration (CRA, June 2000). Investigations presented in this Work Plan will result in sufficient data that can then be used to evaluate remediation alternatives and to design a selected remedial action for the Site soils.

Although the Fairfax I Plant Site is vacant, redevelopment plans have and are being considered by GM and other parties. Operations at the facility ceased in 1986/87, and the facility was demolished in 1987. Soil and groundwater contamination were discovered at the north end of the main plant building in the area of a rail spur and an aboveground tank farm (AOI) in 1987 during an Environmental Site Assessment (ESA) that was completed prior to demolition of the Fairfax I Plant. Subsurface environmental investigations and remediation systems were completed by GM in this AOI subsequent to discovery of soil and groundwater contamination (CRA, July 3, 2000). Groundwater quality data collected in October 1998 indicated that a localized area of groundwater contaminated by volatile organic compounds (VOCs) remains in this area. Soil and groundwater investigations have delineated the source and extent of this localized area of contamination (CRA, June 2000). Soil and groundwater investigations described in this Work Plan are intended to provide data adequate to assess the feasibility of source remediation options.

The former Fairfax I Plant Site is located in the floodplain of the Missouri River. Underlying Site geology soils typically consist of an upper layer of silty clay ranging in thickness from approximately seven to fifteen feet. This silty clay is underlain by fine to medium sands to depths of 25 to 40 feet, which grades into medium to coarse sands with some gravel and clay interbeds to depths of 60 to 80 feet. This interbedded layer is underlain by medium to coarse sands and gravels to the top of the shale bedrock. Shale

bedrock occurs at approximately 102 to 117 feet below grade. Groundwater is expected to flow to the northwest and toward the Missouri River.

The primary sources of contamination of soil and groundwater discovered at the Site in 1987 during the ESA were determined to be gasoline and paint thinner from a tank farm. In addition, suspect historic releases of perchloroethylene (PCE) which likely occurred prior to GM operations (U.S. Government) or from adjacent properties have been determined. The last few rounds of sampling at the Site have not indicated PCE levels above RSK standards on the former Fairfax 1 Plant property. Figure 1.2 provides the locations of soil sampling conducted at the Site. GM initiated its own voluntary cleanup program in 1988, which included semi-annual groundwater monitoring, groundwater contamination plume definition, and remedial design and construction. The remediation system for the small tank farm area comprised groundwater extraction and treatment by air stripping along with soil vapor extraction and treatment by thermal oxidation. The remedial action was initiated in 1991 and shutdown in 1994. The semi-annual groundwater monitoring at the Fairfax I Plant Site (which included analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX); and 1,2-dichloroethylene (DCE)) was also discontinued in 1994.

Figure 1.3 illustrates the monitoring well locations sampled during the October 1998 event conducted by CRA. Results of the comprehensive groundwater sampling event were presented in a draft report to GM on November 13, 1998. A comparison of groundwater quality data collected from the monitoring wells located on the former Fairfax I property with groundwater quality standards indicated exceedances at only one on-Site monitoring well (MW-103A). Other groundwater contamination has been detected off the former Fairfax I property and is related operations at adjacent properties. As illustrated in Figure 1.3, MW-103A is located within the AOI at the north-central portion of the Fairfax I property near the former rail spur, aboveground tank farm and the location of the remediation system that operated from 1991 to 1994. Concentrations of VOCs in groundwater collected from MW-103A were detected above KDHE cleanup standards at similar levels to those detected during the 1991 to 1994 remediation program. Concentrations of VOCs in groundwater samples collected from MW-103A indicated elevated levels of benzene, toluene, acetone, xylenes, and 4-methyl-2-pentanone (MIBK). These parameters were also detected in soil samples collected in the nearby area prior to plant demolition.

The continued and relatively consistent levels of VOCs at MW-103A during and post remediation and the historical documentation of contaminated soils suggested a local source of residual soil or light non-aqueous phase liquid (LNAPL) contamination may be affecting groundwater quality. Based on this Site data, GM determined that

additional investigative work at the former Fairfax Plant I Site was necessary in the vicinity of monitoring well MW-103A.

During the early 1990s, GM and the KDHE discussed the option of entering into a Consent Order. Negotiation of the Consent Order was delayed pending the finalization of KDHE's VCPRP. KDHE contacted GM in April 1998 to determine if GM wished to continue the Consent Order negotiations or if they would apply for the VCPRP. GM agreed to enter the VCPRP and its application has been approved by the KDHE.

The primary purpose of the field investigations outlined in this Work Plan is to collect soil and groundwater data to support a feasibility assessment and design of a selected remedial option for the soil contamination, which is present in the vicinity of MW-103A (AOI). This Work Plan provides a background and project objectives in Section 1.0. Section 2.0 presents the specific scope of work (SOW) to be completed in the field. Section 3.0 provides an overview of sampling and testing procedures. Health and Safety protocol is generally discussed in Section 4.0. Project Reporting is explained in Section 5.0. Sections 6.0 and 7.0 provide an overview on the project team and project schedule, respectively. Section 8.0 is a list of more recent documents submitted to KDHE by GM concerning the project Site.

In addition, the Site-specific Sampling and Analysis Plan (SAP) is found in Appendix A, the Quality Assurance Project Plan (QAPP) is provided in Appendix B, the Health and Safety Plan (HASP) is found in Appendix C and the summary of remedial technologies is provided in Appendix D.

2.0 SCOPE OF WORK

The SOW to be implemented as part of this VCI Work Plan relates to first, the collection of soil data to evaluate and implement remedial options for soils; and second, the collection of groundwater data to confirm previous results and to support risk based closure. The SOW includes the following major field/data collection components:

- obtain soil samples at shallow depths and at depths near the water table in order to provide physical and chemical data to support a feasibility assessment and remedial design (Figure 2.1);
- monitor groundwater quality (including a limited set of natural attenuation parameters) and water levels in the Site area (Figure 2.2); and
- perform hydraulic response testing at three of the monitoring wells in order to provide an assessment of in-situ hydraulic conductivity for use in potential dewatering planning, or natural attenuation evaluations.

Specifics of the SOW for this investigation are discussed in the following sections. Tables 2.1 and 2.2 provide a sampling key for the proposed soil and groundwater sampling locations within the AOI containing MW-103A respectively. The proposed sampling locations of proposed borings and existing groundwater monitoring wells are provided in Figures 2.1 and 2.2, respectively. The SAP is found in Appendix A, the QAPP is provided in Appendix B, the HASP is found in Appendix C and the summary of remedial technologies is provided in Appendix D. Appendix D also provides a list of data needs, upon which this Work Plan is based. Samples collected as part of the SOW presented herein will allow future evaluation of the technologies listed in Appendix D.

2.1 SOIL SAMPLING

Table 2.1 provides a sampling key for the proposed seven soil sampling locations (SB-101 through SB-107) within the AOI containing MW-103A. Figure 1.2 illustrates previous soil sampling locations. The proposed locations for these borings are provided in Figure 2.1. These soil sampling locations have been selected to be representative of soil impacted within the source area and are based upon previous Site contamination delineation. Two samples (shallow and deep) within the vadose zone are proposed to be collected at each of the seven borings. Five of the seven borings (SB-101 through SB-105) are presumed to be located within the MW-103A AOI in order to collect samples for chemical analyses to support this pre-design feasibility evaluation. These five borings have also been selected to further delineate the presence of VOCs within the

MW-103A AOI. Two of the soil borings (SB-106 and SB-107) are to be located within a clean zone on the periphery of the MW-103A AOI to collect geotechnical samples that will enable an assessment of the aquifer hydrogeologic characteristics.

Analyses to be performed on the soil samples selected from the above-mentioned borings are discussed herein. Each boring location will have soil samples collected for VOCs by USEPA's Method SW-846-8260B and a limited set of natural attenuation parameters (NAPs) (including total kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, Ortho phosphate, pH, total heterotrophic microbial count, and BTEX degrading microbial count) as indicated in Table 2.1 by various analytical methods as provided within the QAPP.

Four soil samples from borings SB-106 and SB-107 are proposed for geotechnical sampling including fraction of organic carbon (f_{oc}) by USEPA Method 9060A, grain size (ASTM D 422-63 or D 1140-92), bulk density (ASTM D 1556-90, D 2167-94, or D 2922-91), and permeameter (triaxial permeability) testing (ASTM D 5084-90). Two samples (one each) from borings SB-106 and SB-107 will be collected for grain size, bulk density, and permeameter testing.

2.2 GROUNDWATER SAMPLING

Groundwater samples will be collected from shallow monitoring wells located on or adjacent to the former Fairfax I Plant property. Only shallow monitoring wells will be sampled as previous studies and other historical sampling events have demonstrated that contamination on the former Fairfax I property is limited to the shallow groundwater zone. These samples will be analyzed for VOCs since they are the only chemicals of concern (COCs) in this media. Monitoring wells on the former property and near MW-103A will be sampled. The main objective of the sampling is to confirm results from the more recent events in 1998 and 1999. These earlier events demonstrated that groundwater quality was below the applicable KDHE (RSK) standards at all locations; with the exception of MW-103A.

A summary of shallow groundwater monitoring wells (including their screen interval depths) in the vicinity of MW-103A that will be sampled within this field effort is presented in Table 2.2. These ten monitoring wells (MW-1, MW-1A, MW-102A, MW-103A, MW-104, MW-105, MW-108, MW-109, MW-110A, MW-115A, and MW-160A) are a subset of those previously selected (in the 1998 and 1999 groundwater sampling event) and will each be sampled during this field effort. The locations for these monitoring wells are provided in Figure 2.2.

Analyses to be performed on the samples extracted from the above-mentioned wells are discussed herein. Groundwater samples collected as part of this field effort will be analyzed for VOCs by Method SW-846 8260 and a limited set of natural attenuation parameter analyses (including total and dissolved metals (calcium, magnesium, and manganese), kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, Ortho phosphate, total organic carbon (TOC), chemical oxygen demand (COD), total heterotrophic microbial count, and BTEX degrading microbial count) by various analytical methods provided within the QAPP. Field measurements of natural attenuation parameters such as dissolved oxygen (DO), pH, and redox will also be collected at the time of groundwater sampling.

Water level measurements are necessary to provide a current groundwater flow map within the Fairfax I area. This contour map will allow the evaluation of the relative hydraulic (upgradient and downgradient) connections between two sampling locations (i.e. off-Site and on-Site and/or source area evaluations). Table 2.2 provides the list of monitoring wells that are included in the water survey. These water level measurements will be collected prior to the sampling event for those monitoring wells in order to provide hydraulic control for contouring purposes.

2.3 GROUNDWATER HYDRAULIC RESPONSE TESTING

Groundwater hydraulic response tests are proposed for three wells (MW-1A, MW-103A, and MW-115A) to evaluate the in-situ hydraulic conductivity of shallow groundwater zone underlying the Site. The response tests will be conducted using rising-head techniques for wells with screens that intersect the water table and will be analyzed using the method of Bouwer and Rice (1976). This method is commonly used to analyze the data obtained from monitoring wells installed in unconfined aquifers and will likely be appropriate for this Site.

2.4 LAND USE DOCUMENTATION

GM will develop a property use plan and implement any necessary zoning changes or deed restrictions that are required for the selected use. Currently, GM assumes that the former Fairfax Plant property will remain as a commercial/industrial end use. Additionally, based upon GM's current property use plan, all risk-based remedial objectives for the property will assume a commercial/industrial receptor scenario.

As part of the SOW presented herein, CRA will document land use and property restrictions for surrounding properties. Future zoning changes or other proposed governmental restrictions on property use will be defined.

2.5 RECEPTOR SURVEY

CRA will perform a literature search, file review and other records reviews to determine if there are any sensitive receptors in the Site area. This will include an inventory of public and private water supply wells in the area. Additionally, the records review will also identify:

- Surface water bodies (e.g. the Missouri River);
- Endangered species or other sensitive habitats;
- Wetlands; and
- Other pertinent receptors of potential concern.

2.6 PERMIT PROCESS REVIEWS

As part of the SOW described herein, CRA will research and identify necessary permits for the remedial alternatives listed in Appendix D. Local, State and Federal permits or licensing requirements will be established for each technology. The permit processes for solid waste management, water discharge, and air quality/issues will be identified for the pertinent technologies.

3.0 SAMPLING AND TESTING PROCEDURES

A Site-specific SAP has been developed for the work described herein. The purpose of the SAP is to detail the investigative sampling and analytical protocols to be followed during soil and groundwater sampling activities. The SAP is included as Appendix A. A Site-specific QAPP (Appendix B) has also been prepared to address laboratory analyses of soils and groundwater samples.

4.0 HEALTH AND SAFETY

A Site-specific HASP has been developed for the work described herein. The Site-specific HASP will be kept on-Site at all times during performance of the work, and is included as Appendix C.

5.0 REPORTING

A report will be prepared documenting field procedures, field observations, and analytical data generated. The report will include observations and conclusions that can be made concerning acquired physical and chemical data in regard to the feasibility assessment and design of a remedial action for the soils in the AOI. A list of potential remedial technologies is presented in Appendix D. These represent a short list of feasible actions for the contaminated soils. The final report will evaluate the data in light of these six technologies. Information on land use (current and future) for the GM property and surrounding areas will be presented. Additionally, the results of the receptor survey will be summarized within this report. Also, necessary permits for the six technologies will be identified as part of the pre-design feasibility analysis. The final report will also include a set of recommendations for the contaminated soils and a schedule of remedial design and implementation. The report will be submitted to the KDHE after all laboratory data has been validated, and GM has reviewed the report.

6.0 PROJECT TEAM

The following individuals from CRA's Chicago, Illinois office will be utilized for completion of this project:

Project Manager:	Phil Harvey
Project Engineer:	Talaat Balba
Project QC Officer:	Steve Day
Project HSO:	Matt Lazaric
Sampling Team:	CRA Field Staff

7.0 SCHEDULE AND REPORTING

CRA estimates that approximately one to two weeks will be required to complete the soil and groundwater sampling. A final report providing the data and recommendations for remedial actions can be provided in 6 weeks upon receipt of the final laboratory analyses. Assuming that three to four weeks will be needed for the laboratory to complete their analyses and validations; the final report should be submitted to KDHE approximately 8 to 10 weeks after field work is completed.

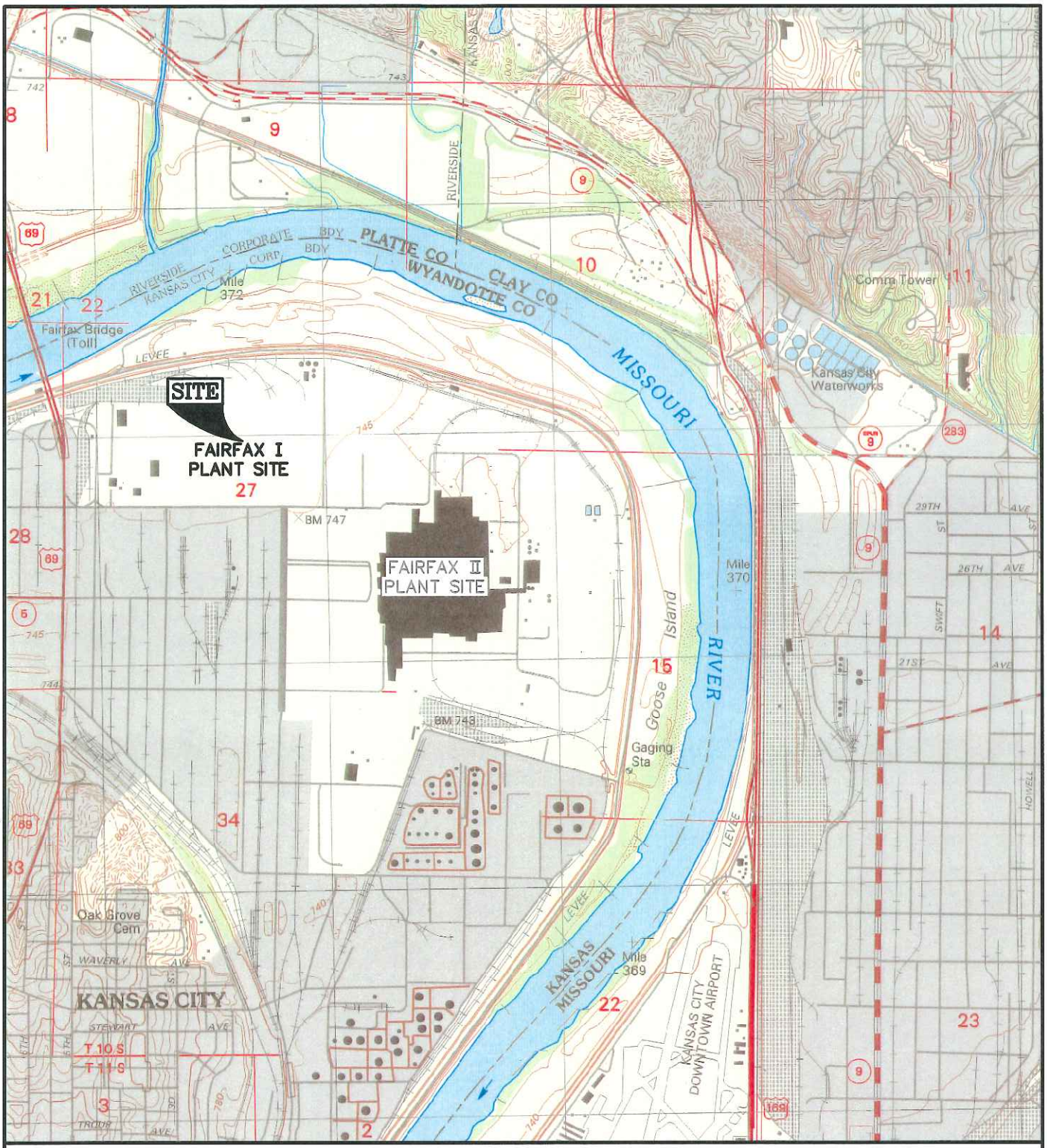
8.0 REFERENCES

CRA, July 2000; Environmental Site Assessment Summary of Subsurface Conditions. (Report).

CRA, June 2000; Results of Soil and Groundwater Investigations Near Monitoring Well MW-103A. (Report).

GM, June 30, 2000; Application to the VCPRP. (letter prepared by GM and sent to Mr. Franky Arnwine).

CRA, July 3, 2000; Chronology of Remediation Activities. (letter prepared by CRA for Ken Richards, GM and sent to KDHE).



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NORTH KANSAS CITY, MO–KS 1990

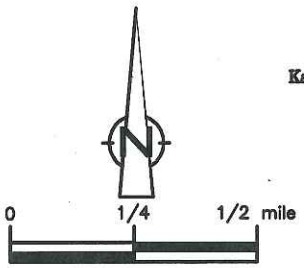

figure 1.1

SITE LOCATION MAP
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

CRA

12559–31(008)GN–C0001 SEP 04/2001

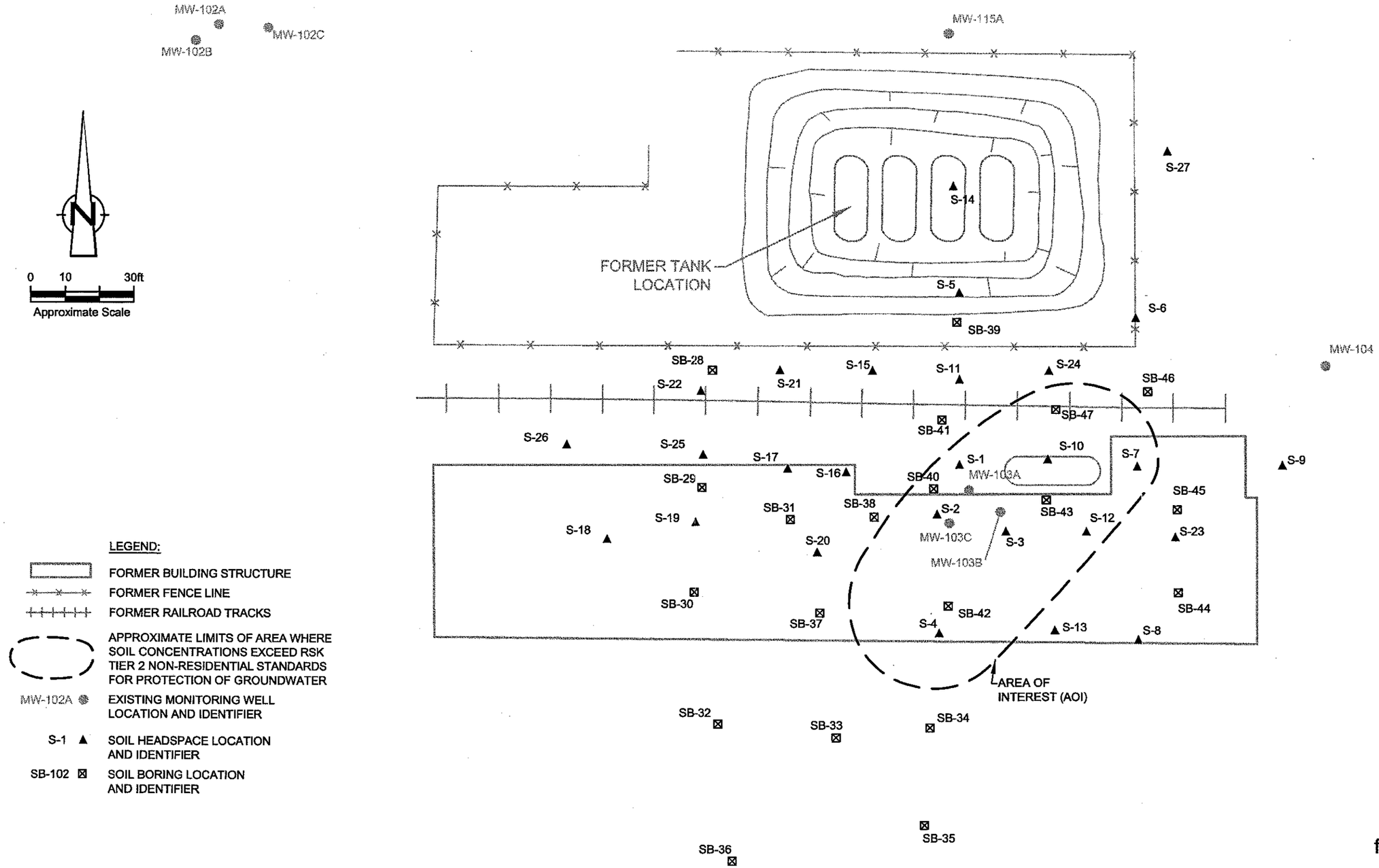

figure 1.2

1999 SOIL BORING AND SOIL GAS LOCATIONS
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

CRA

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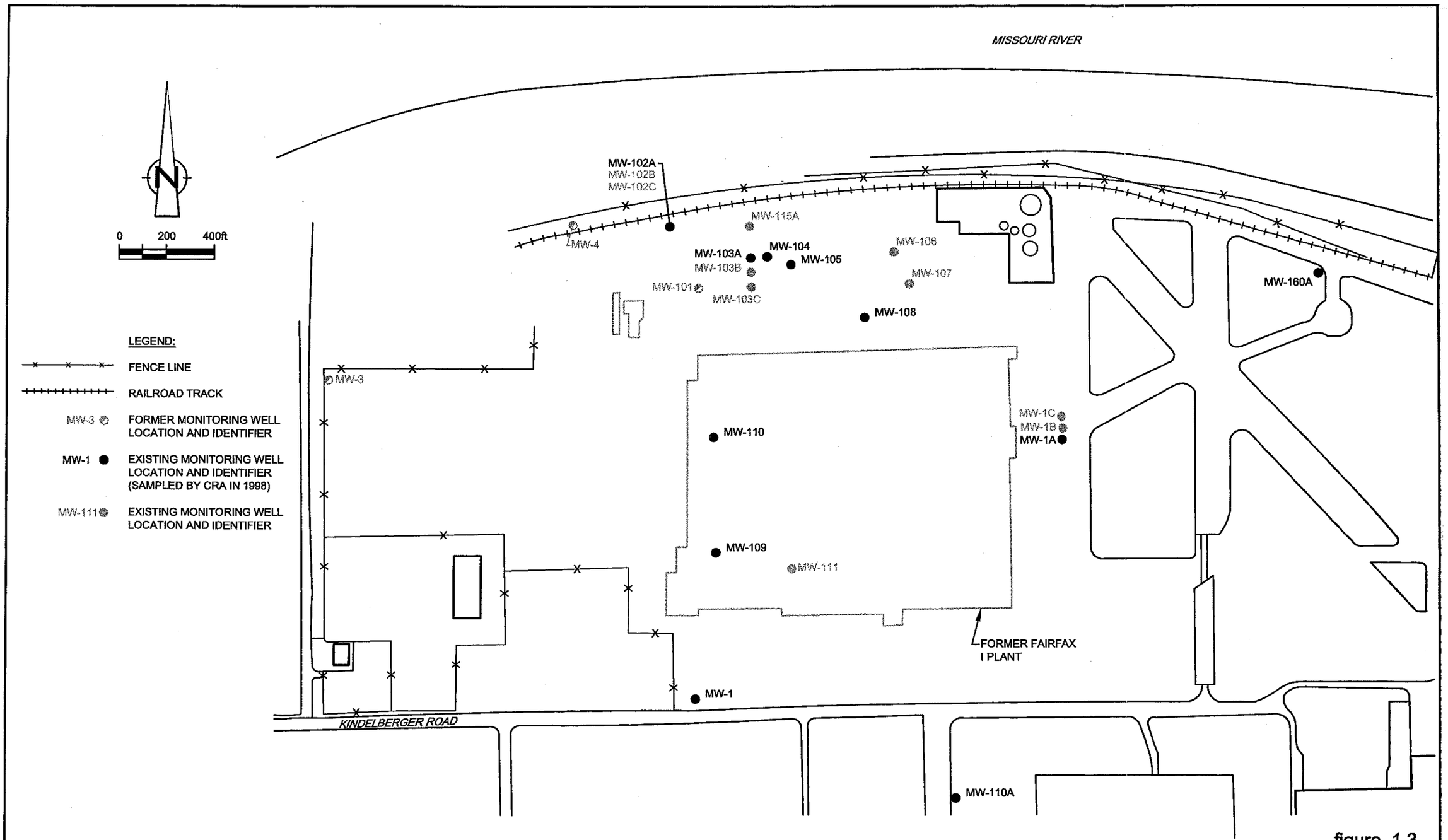

figure 1.3

EXISTING MONITORING WELL LOCATIONS
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

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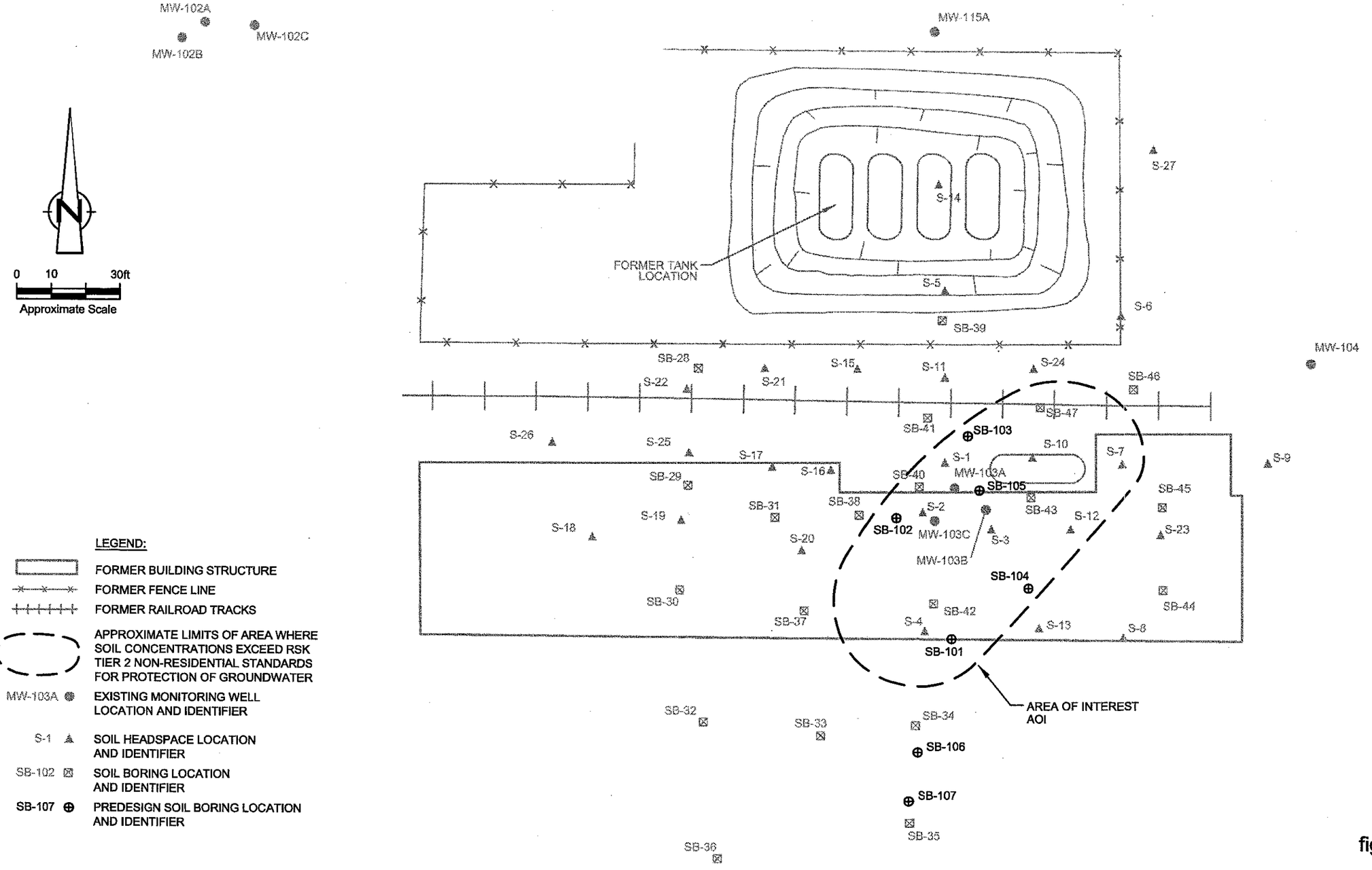

figure 2.1

PREDESIGN SOIL BORING LOCATIONS
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

CRA

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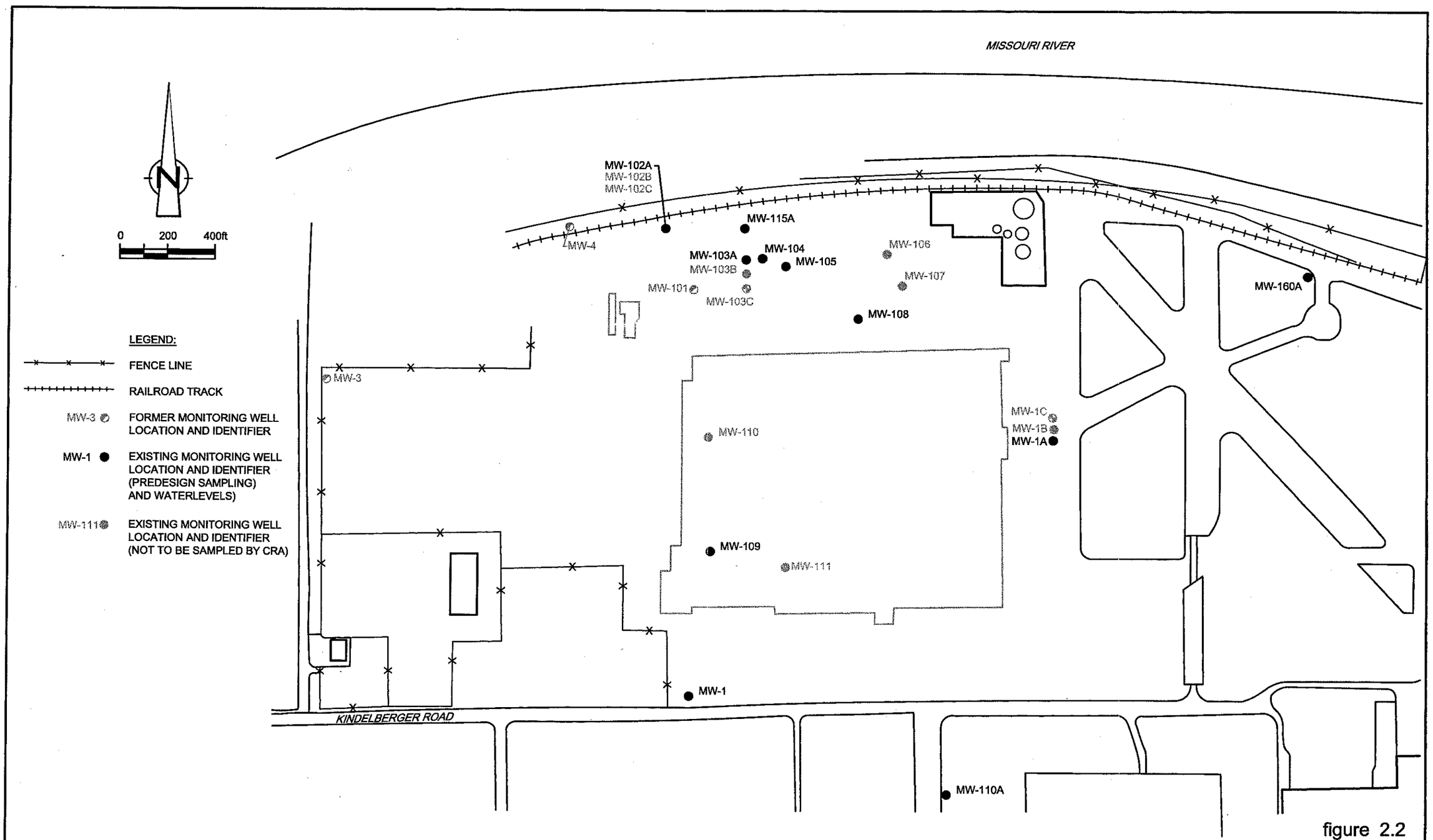

figure 2.2

PREDESIGN MONITORING WELL SAMPLING AND WATER LEVEL SURVEY LOCATIONS
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

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TABLE 2.1

PROPOSED SOIL SAMPLE KEY
GM FAIRFAX I SITE, KANSAS

Sample Location ID	*Upper Depth (ft bgs [1])*	*Lower Depth (ft bgs)*	*Chemical Analyses*	*Physical Analyses*	*Closest Previous Location*
SB-101	8	10	VOCs[2], NAP[3]	none	SB-40
SB-101	12	14	VOCs, NAP	none	SB-40
SB-102	8	10	VOCs, NAP	none	SB-42
SB-102	12	14	VOCs, NAP	none	SB-42
SB-103	8	10	VOCs, NAP	none	S-1
SB-103	12	14	VOCs, NAP	none	S-1
SB-104	8	10	VOCs, NAP	none	S-12, S-13
SB-104	12	14	VOCs, NAP	none	S-12, S-13
SB-105	6	8	VOCs, NAP[4]	none	MW-103A
SB-105	12	14	VOCs, NAP[4]	none	MW-103A
SB-106	2	4	none	K_v[6], gs[7], bulk density	Clean[8], SB-34
SB-106	6	8	VOCs, f_{oc}[5]	K_v, gs, bulk density	Clean, SB-34
SB-106	12	14	VOCs, f_{oc}	K_v, gs, bulk density	Clean, SB-34
SB-107	2	4	none	K_v, gs, bulk density	Clean, SB-35
SB-107	6	8	VOCs, f_{oc}	K_v, gs, bulk density	Clean, SB-35
SB-107	12	14	VOCs, f_{oc}	K_v, gs, bulk density	Clean, SB-35

Notes:

[1] ft bgs = feet below ground surface

[2] VOC = volatile organic compound, analytical method USEPA SW-846 8260B

[3] NAP = natural attenuation parameters (limited set), various USEPA SW-846 analytical methods
Soil NAP limited set includes total kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, Ortho phosphate, pH, total heterotrophic microbial count, and BTEX degrading microbial count

[4] Microbial counts not included within these samples.

[5] f_{oc} = fraction of organic carbon

[6] K_v = vertical hydraulic conductivity from permeameter testing (samples collected with Shelby tubes)

[7] gs = grain size samples

[8] Clean = sample location within formerly determined area of clean soil

TABLE 2.2

PROPOSED GROUNDWATER SAMPLING KEY
GM FAIRFAX I SITE, KANSAS

TOC[1] Elevation (ft AMSL[2])	*Sample Location ID*	*Top Screen Depth (ft bgs)*	*Bottom Screen Depth (ft bgs)*	*Chemical Analyses*	*Physical Analyses*	*Water Level Measurement*
746.43	MW-1	17.25	32.25	VOCs[3], NAP[4], FP[5]	none	yes
748.82	MW-102A	16.02	31.02	VOCs, NAP, FP	none	yes
747.71	MW-103A	17.30	32.30	VOCs, NAP, FP	none	yes
746.51	MW-104	15.05	30.05	VOCs, NAP, FP	none	yes
746.7	MW-105	17.75	32.75	VOCs, NAP, FP	none	yes
747.17	MW-108	16.61	31.61	VOCs, NAP, FP	none	yes
746.11	MW-109	17.50	32.50	VOCs, NAP, FP	none	yes
743.89	MW-110A	21.45	36.45	VOCs, NAP, FP	none	yes
748.07	MW-115A	14.35	29.35	VOCs, NAP, FP	none	yes
746.56	MW-160A	22.55	37.55	VOCs, NAP, FP	none	yes
745.93	MW-1A	22.19	37.19	none	none	yes

Notes:

[1] TOC = top of casing

[2] ft AMSL = feet above mean sea level

[3] VOC = volatile organic compound, analytical method USEPA SW-846 8260B

[4] NAP = natural attenuation parameters (limited set), various USEPA SW-846 analytical methods
Groundwater NAP limited set includes total and dissolved metals(calcium, magnesium, manganese), total kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, carbon oxygen demand (COD), total organic carbon (TOC), Ortho phosphate, pH, total heterotrophic microbial count, and BTEX degrading microbial count. Microbial (50 g) samples to be collected in sterile, air tight sample jars, and are to be shipped the same day they are collected.

[5] Field measurements of natural attenuation parameters such as dissolved oxygen (DO), pH, specific conductance, temperature, and redox will also be collected at the time of groundwater sampling using low-flow methods and a flow-through cell.

APPENDIX A

SAMPLING AND ANALYSIS PLAN

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1.0 INTRODUCTION AND BACKGROUND

Conestoga-Rovers & Associates (CRA) has prepared this Sampling and Analysis Plan (SAP) for soil and groundwater investigations at the former General Motors (GM) Fairfax I Plant Site in Kansas City, Kansas (Site). The Work Plan for this SAP was prepared under the review of the Kansas Department of Heath and Environment (KDHE) and their Voluntary Cleanup and Property Redevelopment Program (VCPRP). GM entered the VCPRP in June 2000 for the former Fairfax I Plant Site. GM submitted a number of documents to the KDHE at the time of entry into the VCPRP in June 2000 and these past studies have identified an Area of Interest (AOI) requiring additional remediation at the Site. The purpose of the Work Plan is to outline procedures for pre-design investigations that are necessary to select and construct a remedial action for the Site. This SAP details the investigative sampling and analytical protocols to be used during soil and groundwater sampling such that the objectives of the Work Plan are achieved.

GM had previously concluded that remediation of soils was required at the AOI and that a number of options were available for consideration (CRA, June 2000). Investigations presented in the Work Plan will result in sufficient data that can then be used to evaluate remediation alternatives and to design a selected remedial action for the Site soils.

The Fairfax I Plant Site is vacant, however, redevelopment plans have and are being considered by GM and other parties. Operations at the facility ceased in 1986/87, and the facility was demolished in 1987. Soil and groundwater contamination were discovered at the north end of the main plant building in the area of a rail spur and an aboveground tank farm (AOI) in 1987 during an Environmental Site Assessment (ESA) that was completed prior to demolition of the Fairfax I Plant. Subsurface environmental investigations and remediation systems were completed by GM in this AOI subsequent to discovery of soil and groundwater contamination. Groundwater quality data collected in October 1998 indicated that a localized area of groundwater contaminated by volatile organic compounds (VOCs) remains in this area. Soil and groundwater investigations have delineated the source and extent of this localized area of contamination (CRA, June 2000). Soil and groundwater investigations described in this Work Plan are intended to provide data adequate to assess the feasibility of source remediation options.

The former Fairfax I Plant Site is located in the floodplain of the Missouri River. Underlying Site geology soils typically consist of an upper layer of silty clay ranging in thickness from approximately seven to fifteen feet. This silty clay is underlain by fine to

medium sands to depths of 25 to 40 feet, which grades into medium to coarse sands with some gravel and clay interbeds to depths of 60 to 80 feet. This interbedded layer is underlain by medium to coarse sands and gravels to the top of the shale bedrock. Shale bedrock occurs at approximately 102 to 117 feet below grade. Groundwater is expected to flow to the northwest and toward the Missouri River.

The primary sources of contamination of soil and groundwater discovered at the Site in 1987 during the ESA were determined to be gasoline and paint thinner from a tank farm along with suspect historic releases of perchloroethylene (PCE) which likely occurred prior to GM operations. GM initiated its own voluntary cleanup program in 1988, which included semi-annual groundwater monitoring, groundwater contamination plume definition, and remedial design and construction. The remediation system for the small tank farm area comprised groundwater extraction and treatment by air stripping along with soil vapor extraction and treatment by thermal oxidation. The remedial action was initiated in 1991 and shutdown in 1994. The semi-annual groundwater monitoring at the Fairfax I Plant Site (which included analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX); and 1,2-dichloroethylene (DCE)) was also discontinued in 1994.

Results of the comprehensive groundwater sampling event were presented in a draft report to GM on November 13, 1998. A comparison of groundwater quality data collected from the monitoring wells located on the former Fairfax I property with groundwater quality standards indicated exceedances at only one monitoring well (MW-103A) on the property. Other groundwater contamination exists at areas adjacent to the former Fairfax I property and this is related to operations at adjacent facilities. As illustrated in Figure 1.3, MW-103A is located within the AOI at the north-central portion of the Fairfax I property near the former rail spur, aboveground tank farm and the location of the remediation system that operated from 1991 to 1994. Concentrations of VOCs in groundwater collected from MW-103A were detected above KDHE cleanup standards at similar levels to those detected during the 1991 to 1994 remediation program. Concentrations of VOCs in groundwater samples collected from MW-103A indicated elevated levels of benzene, toluene, acetone, xylenes, and 4-methyl-2-pentanone (MIBK). These parameters were also detected in soil samples collected in the nearby area prior to plant demolition.

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During the early 1990s, GM and the KDHE discussed the option of entering into a Consent Order for the Fairfax I/II Site. Negotiation of the Consent Order was delayed pending the finalization of KDHE's VCPRP. KDHE contacted GM in April 1998 to determine if GM wished to continue the Consent Order negotiations or if they would apply for the VCPRP.

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2.0 SCOPE OF WORK

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- obtain soil samples at shallow depths and at depths near the water table in order to provide physical and chemical data to support a feasibility assessment and remedial design;
- monitor groundwater quality (including a limited set of natural attenuation parameters) and water levels in the Site area; and
- perform hydraulic response testing at three of the monitoring wells in order to provide an assessment of in-situ hydraulic conductivity for use in potential dewatering planning, or natural attenuation evaluations.

3.0 EQUIPMENT CLEANING

A temporary equipment decontamination facility will be constructed and operated at the Site. Decontamination will be conducted using a high-pressure, low volume steam cleaner. All decontamination will be conducted on-Site at the temporary equipment decontamination facility to be determined by Fairfax II-GM personnel. Decontamination water will be containerized per Section 10.0, herein.

3.1 DRILLING EQUIPMENT

Upon mobilization of the drill rig to the Site and prior to drilling, the rig and all associated equipment will be thoroughly steam cleaned to remove oil, grease, mud and other foreign matter. Before drilling at each subsequent borehole location, the augers, cutting bits, samplers and associated equipment will be decontaminated to prevent cross-contamination from the previous drilling activities. Equipment decontamination will be accomplished by flushing and wiping the components to remove all visible sediments followed by:

i) steam-cleaning and high pressure washing with potable water to remove particulate matter and surface films; and

ii) rinsing thoroughly with potable water.

3.2 SAMPLING EQUIPMENT

All sampling equipment will be decontaminated prior to field use and after each sample is collected to prevent cross-contamination between samples. Duplicate samples will be collected concurrently with original samples; therefore, sampling equipment will not be decontaminated before collection of the duplicate samples. Decontamination of equipment used for collecting samples for laboratory analyses will be performed as follows:

i) wash with distilled water and Alconox™ detergent using a brush, if necessary, to remove all visible foreign matter;

ii) rinse thoroughly with distilled water; and

iii) allow the equipment to air dry on a clean plastic sheet as long as possible.

Following the final rinse, equipment will be visually inspected to verify that it is free of soil particles and other solid material that could contribute to possible sample cross-contamination. All decontamination of sampling tools and equipment will be conducted at the temporary equipment decontamination facility.

4.0 GENERAL SAMPLING PROTOCOLS

4.1 SAMPLE LABELING

Each sample will be labeled with a unique sample code that will facilitate tracking and cross-referencing of sample information. An example of the sample identification code system is as follows:

Sample ID: GW-060198-XX-001

GW - designates media (GW-groundwater, S-soil)
060198 - designates date of collection presented as month/day/year
XX - sampler's initials
001 - sequential number starting with 001 at the start of the project

Quality Control (QC) samples also will be numbered with a unique sample number, consistent with the numbering system described above.

4.2 CHAIN-OF-CUSTODY FORMS

CRA chain-of-custody records will be used to track all samples from time of sampling to the arrival of samples at the laboratory. Each sample container being shipped to the laboratory will contain a chain-of-custody form. The chain-of-custody form consists of four copies, which are distributed to the sampler, to the shipper, to the contract laboratory, and to the office file of CRA. The sampler and shipper will maintain their copies while the other two copies will be enclosed in a waterproof enclosure within the sample container.

The laboratory, upon receiving the samples, will complete the remaining copies. The laboratory will maintain one copy for its records. The executed original will be returned to CRA with the data deliverables package.

4.3 SAMPLE CONTAINERS AND HANDLING

All samples will be placed in appropriate sample containers, labeled and properly sealed. Foam chips or bubble pack will be used to cushion sample containers. Samples will be kept cool by the use of sealed plastic bags of ice. A trip blank will accompany each shipment of groundwater samples submitted for analysis.

Samples will be shipped by commercial courier or transported by hand to the project laboratory. Two seals of CRA chain-of-custody tape will be placed over the lid on the front and back of each shipping cooler. The seal will secure the lid and provide evidence that the samples have not been tampered with en route to the laboratory. Clear tape will be placed over the seals to ensure that they are not accidentally broken during shipment.

Upon receipt of the cooler by the laboratory, the designated sample custodian will inspect the cooler. The condition of the cooler and seal will be noted on the chain-of-custody form. The sample custodian will then check the contents of the cooler against the information noted on the chain-of-custody form. If damage or discrepancies are observed, they will be duly recorded in the remarks column of the chain-of-custody form, the form then will be signed and dated. Moreover, any observed damage or discrepancies will be reported immediately to the laboratory project manager who will contact CRA for guidance.

5.0 INVESTIGATION PROTOCOLS

5.1 FIELD SCREENING TECHNIQUES

During advancement of soil borings and boreholes for monitoring wells, all soil samples will be screened for the presence of organic vapors using field-screening techniques. Field screening will be performed using a photoionization detector (PID). Soil samples will be prepared for field screening in the following manner.

- A discrete, representative portion of soil will be collected from each split-spoon and deposited into a glass jar or polyethylene bag;
- The soil will remain undisturbed for several minutes to equilibrate; and
- The PID will be used to monitor the air contained in the jar or bag for the presence of organic vapors.

5.2 BOREHOLE ADVANCEMENT

Geoprobe Soil Borings

Seven soil borings (SB-101 through SB-107) will be advanced during the pre-design studies in the vicinity of MW-103A (within the AOI). These borings will be used to obtain representative physical and chemical samples of impacted soils. Borings for fraction of organic carbon (f_{oc}) content will be taken in soil outside of the impacted area.

Boreholes will be advanced using direct push (e.g., Geoprobe®) drilling methods. Each delineation boring will be advanced to a depth of approximately 14 feet below ground surface (bgs). Continuous soil samples will be collected in advance of the drilling equipment. Soil samples will be described and classified according to the Unified Soil Classification System (USCS) by a CRA geologist. Field screening will be conducted on each split-spoon sample in accordance with Section 5.1.

Two samples (shallow and deep e.g. 8-10 and 12-14 ft bgs) within the vadose zone are proposed to be collected at each of the seven borings. Five of the seven borings (SB-101 through SB-105) are to be located within the MW-103A AOI in order to collect samples for chemical analyses to support this pre-design feasibility evaluation. These five borings have also been selected to further delineate the presence of VOCs within the MW-103A AOI. Two of the soil borings (SB-106 and SB-107) are to be located within a clean zone on the periphery of the MW-103A AOI to collect geotechnical samples that will enable an assessment of the aquifer hydrogeologic characteristics. Field screening

will not be conducted on the intervals selected for geotechnical analyses. Geotechnical samples will be collected in Shelby tubes in accordance with ASTM D-1587-83. Soil samples will be collected in accordance with Section 5.3.

Analyses to be performed on the soil samples selected from the above-mentioned borings are discussed herein. Each boring location will have soil samples collected for VOC and a limited set of natural attenuation parameter (NAP) analyses (including total nitrogen (N), ammonia-N, nitrate-N, Ortho phosphate, pH, total heterotrophic microbial count, and BTEX degrading microbial count). Four soil samples from borings SB-106 and SB-107 are proposed for geotechnical sampling including fraction of organic carbon (f_{oc}), grain size, bulk density, and permeameter testing. Two samples (one each) from borings SB-106 and SB-107 will be collected for grainsize, bulk density, and parameter testing.

Upon completion, each soil boring will be abandoned by backfilling with bentonite chips. The ground surface at each location will be returned, as closely as possible, to its original condition.

5.3 SOIL SAMPLING PROTOCOLS

Soil samples will be collected for visual classification, geotechnical testing, VOC and a limited set of natural attenuation parameter analyses (including total nitrogen (N), ammonia-N, nitrate-N, Ortho phosphate (P), pH, total heterotrophic microbial count, and BTEX degrading microbial count) according to the following procedures:

i) A new pair of disposable nitrile or latex gloves will be used for each sample.

ii) Prior to use at each sampling location all sampling equipment will be decontaminated in accordance with Section 3.2.

iii) For split spoon samples: The split spoon will be advanced to the designated sampling interval, retrieved, and opened on a clean surface (e.g., a sheet of aluminum foil). The entire length of the soil sample will be visually classified.

iv) Sufficient soil will be removed from the split spoon for sample analysis of VOC, natural attenuation parameters, and f_{oc} content. This soil will then be transferred to pre-cleaned laboratory supplied containers.

v) Sample intervals selected for VOC analysis will be collected using Encore™ samplers. Three Encore™ samplers will be pushed into the soil (in close proximity to one another) to recover a total of approximately 15 grams of soil for each sample interval selected for analysis.

vi) A representative portion of the sample will be transferred into a glass jar or an airtight polyethylene bag for PID field screening according to the protocols provided in Section 5.1.

vii) Sample containers will be placed in a cooler immediately and chilled with ice.

viii) To prevent cross-contamination of samples, all equipment used during the sampling procedures that may have come in contact with contaminated soils will be decontaminated in accordance with Section 3.2.

5.4 GROUNDWATER SAMPLING PROTOCOLS

5.4.1 MONITORING WELL PURGING AND SAMPLING

A round of groundwater samples will be collected from the existing groundwater monitoring wells. Analyses to be performed on the samples extracted from the monitoring wells are discussed herein. Groundwater samples collected as part of this field effort will be analyzed for VOCs by Method SW-846 8260 and a limited set of natural attenuation parameter analyses (including total and dissolved metals (calcium, magnesium, and manganese), kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, Ortho phosphate, total organic carbon (TOC), chemical oxygen demand (COD), total heterotrophic microbial count, and BTEX degrading microbial count) by various analytical methods provided within the QAPP. Field measurements of natural attenuation parameters such as dissolved oxygen (DO), pH, and redox will also be collected at the time of groundwater sampling.

Each groundwater monitoring well will be purged prior to sampling using low flow methods to minimize the presence of fine-grained, suspended sediment. During monitoring well purging the turbidity, temperature, pH and conductivity of the groundwater will be monitored to confirm stabilization of groundwater within the monitoring well with the screened formation and thus collection of representative groundwater samples from the aquifer. Specifically, groundwater samples will be collected in accordance with the following protocols:

i) A new pair of disposable gloves (nitrile or latex) will be used for each sample.

ii) The depth to water in each well and total depth of the well will be measured to the nearest 0.01 foot using an electronic water level meter. The measuring device will be decontaminated prior to use following the cleaning sequence provided in Section 3.2.

iii) Field measurements of pH, conductivity and temperature of the purged water will be monitored and recorded following removal of each well volume and prior to sample collection.

Field instruments will be calibrated daily prior to use. Well purging will continue until three consecutive and consistent readings of the stabilization parameters are achieved. The monitoring well will be considered stable if three consecutive values are within ±10 percent of the average value of the last three stabilization parameters. Alternatively, if the monitoring well fails to stabilize a minimum of five well volumes will be removed prior to sampling.

In the event that a well is purged dry prior to achieving three well volumes, groundwater will be allowed to recover to a level sufficient for sample collection. Upon recovery, groundwater samples will be collected.

iv) Prior to sampling, each well will be purged using a bailer or pump. The monitoring wells will be purged by removing a minimum of three standing well volumes of groundwater. Where the volume of standing water is calculated as follows:

$$V = 23.5 \cdot r^2 \cdot h$$

where:

V	=	volume of standing water in gallons
r	=	radius of the well in feet (0.0833 for a 2-inch well)
h	=	depth of water in feet

v) Field measurements of redox, DO, pH, conductivity, and temperature of the evacuated water will be collected and recorded following removal of each standing well volume and prior to sample collection. Field instruments will be calibrated as specified by the manufacturer prior to use. Well purging will be performed for a minimum of three well volumes and until three consecutive and consistent stabilization parameters (±1 pH unit, ± 10 percent for conductivity and temperature) are obtained. Well purging will continue until a maximum of five standing well volumes have been removed. In the event that a well is bailed/pumped dry prior to achieving five well volumes, groundwater will be permitted to recover to a level sufficient for sample collection. The time that the well was bailed dry will be recorded and the well will be monitored for recovery. Upon recovery, the sample will be collected.

vi) After purging the required volume of well water, groundwater samples will be collected using bladder pump, precleaned stainless steel bailer, disposable bailer or electronic submersible stainless steel pump. Water will be emptied directly into the appropriate sample containers. Containers will be filled with minimal sample agitation. The groundwater samples may be collected from the bailer or

pump used to purge the monitoring well as described above. Groundwater samples will be collected in order of decreasing analyte volatility.

vii) Samples collected for dissolved analyses will be field filtered prior to sample preservation. Immediately upon collection, the sample will be field filtered using a peristaltic pump equipped with a dedicated length of silicone tubing and a dedicated 0.45-micron filter. The sample will initially be placed in an unpreserved laboratory-supplied sample container. The sample will then be pumped through the filter apparatus into a preserved laboratory-supplied sample container. If a pump is used to purge the monitoring well, groundwater sample collection and field filtering for dissolved analytes will be collected directly from the pump.

viii) Field duplicate samples will be collected at a frequency of one per ten investigative samples collected or at a minimum of one per sampling event.

6.0 ANALYTICAL PROTOCOLS AND METHODS

Groundwater samples to be collected from the existing monitoring wells will be analyzed for VOCs by U.S. EPA SW-846 Method 8260 and a limited set of natural attenuation parameters as listed above. CRA's project chemist will complete a data quality assessment and validation of all analytical results.

6.1 QUALITY ASSURANCE/QUALITY CONTROL

To ensure the validity of the sampling and analysis program, field quality control (QC) samples will be collected with the investigative samples. Field QC samples will consist of collection of one duplicate groundwater sample during each monitoring event and analyzed by the laboratory to provide information on the precision of the sampling procedures. In addition, trip blank samples will be prepared by the laboratory, shipped with the sample containers, and returned with the field samples.

The laboratory's quality assurance (QA) program includes analyzing method blank samples, surrogate spikes, and matrix spike/matrix spike duplicate (MS/MSD) samples. MS/MSD samples are designated/collected in the field and analyzed by the laboratory to provide information regarding the accuracy and precision of the analyses relative to the sample matrices. MS/MSD samples will be designated/collected at a frequency of one per twenty investigative samples. Method blank samples and surrogate spikes are internal laboratory QC samples that are analyzed to determine if laboratory conditions or procedures have resulted in sample contamination, and to evaluate laboratory instrument performance on an individual sample basis, respectively. Method blank samples are analyzed at a minimum frequency of one per twenty investigative samples. Surrogate compounds are added to every sample being analyzed for organic constituents.

More specifics on the Quality Control process is provided, herein, within Appendix C. Appendix C presents the project specific Quality Assurance Project Plan (QAPP) for the Site.

7.0 HYDRAULIC MONITORING AND RESPONSE TESTING

7.1 GROUNDWATER HYDRAULIC MONITORING

Prior to collecting groundwater samples, the groundwater level in each monitoring well will be measured using an electronic sounding device. Water levels will be recorded in the field log to the nearest 0.01 foot. Measurements will be in reference to a surveyed point on the well casing. All monitoring wells to be sampled will be surveyed for vertical and horizontal control. Measuring devices will be decontaminated after each use.

7.2 GROUNDWATER HYDRAULIC RESPONSE TESTING

Groundwater hydraulic response tests will be performed to evaluate the in-situ hydraulic conductivity of water bearing stratigraphic units underlying the Site. The response tests will be conducted using rising-head techniques for wells with screens that intersect the water table. Rising head tests require the withdrawal of a known volume of water from the well and the measurement of the rate at which the water returns (recovers) to its static elevation. The rate of recovery is a function of the hydraulic conductivity of the formation.

Water levels will be measured either manually or using a pressure transducer to record hydraulic head changes. The method selected will be determined from the types of soils at the Site. In general, relatively impermeable soil (silt or clay) recharge slowly allowing for the collection of depth to water measurements manually. More permeable material (sand or gravel) recharge quickly necessitating the use of a transducer for data collection.

The rate of well recovery is plotted and analyzed using an appropriate analytical method. The Bouwer and Rice (1976) method is commonly used to analyze the data obtained from monitoring wells installed in unconfined aquifers and will likely be appropriate for this Site.

8.0 MATERIALS AND EQUIPMENT

The following equipment may be used for well development, purging, and sampling at the Site depending on well configuration, groundwater flow rate and quality, depth to water table, and parameters of interest.

Bailers

Reusable or disposable bailers may be used for well development, purging, and sampling. Reusable bailers will be constructed of stainless steel. Disposable single-use bailers will be constructed of polyethylene, PVC, or Teflon®.

Rope

Rope will be made of braided nylon. New rope will be used for each well or sampling point.

Pumps

The following pumps may be used for well development and purging:

- submersible impeller driven pumps (e.g., Grundfos® pumps, whale pumps);
- submersible pneumatic pumps (e.g. bladder pumps); and
- peristaltic pumps.

The following pumps may be used for well sampling:

- Submersible impeller driven pumps – stainless steel construction (e.g., Grundfos® pumps);
- Submersible impeller driven pumps – PVC construction (e.g., whale pumps) will be not be used for collecting VOC samples (including formaldehyde);
- Submersible pneumatic pumps (e.g. bladder pumps); and
- Peristaltic pumps may only be used if conditions prohibit the use of the other types of pump (e.g., a well with a bent casing).

9.0 SITE SURVEYING

A certified survey company will be retained to layout and locate all boring locations, and survey ground surface elevations. The survey will locate horizontal coordinates to an accuracy of ±1 foot and vertical elevations to ±0.01 feet based on a Site-specific datum.

10.0 WASTE HANDLING PROTOCOLS

Investigation derived waste (IDW) materials generated during equipment decontamination, monitoring well development and purging, and monitoring well sampling will be handled according to the procedures outlined below:

i) Purge water removed during monitoring well sampling will be discharged directly on the nearby ground surface as previous sample events indicate that only low concentrations of VOCs have been detected in the groundwater.

ii) Liquids resulting from equipment decontamination will be containerized in 55-gallon capacity DOT 17-H/E steel drums or polyethylene temporary storage tanks. Upon completion of investigation activities, a sample of the containerized water will be obtained for waste characterization and profiling. The final disposition of the water, including potential discharge to the Fairfax II process wastewater treatment system, will be based on the sample results and handled by GM at the Fairfax II Plant.

iii) Disposable personal protective equipment (PPE) used during the investigation will be containerized and disposed of properly by GM at the Fairfax II Plant .

All drums will be labeled as to their origin and contents and stored at a suitable location on Site pending final disposal disposition. Personnel from the adjacent GM Fairfax II Plant will be informed of all IDW generated during the investigations. Ultimate handling and disposal procedures will be the responsibility of GM.

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND SHORT FORMS

AOI	-	Area of Interest
CRA	-	Conestoga-Rovers & Associates
GAP	-	GAP EnviroMicrobial Services
GC/MS	-	Gas Chromatography/Mass Spectrometry
ICP	-	Inductively Coupled Plasma Spectroscopy
ICS	-	Interference Check Sample
GM	-	General Motors
KDHE	-	Kansas Department of Health and Environment
LCS	-	Laboratory Control Sample
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
ORP	-	Oxidation-Reduction Potential
PE	-	Performance Evaluation
%R	-	Percent Recovery
%RSD	-	Percent Relative Standard Deviation
QA	-	Quality Assurance
QA/QC	-	Quality Assurance/Quality Control
QAPP	-	Quality Assurance Project Plan
QC	-	Quality Control
RPD	-	Relative Percent Difference
SAP	-	Sampling and Analysis Plan
Site	-	Former GM Fairfax I Plant Site
SOP	-	Standard Operating Procedure
SRM	-	Standard Reference Material
STL	-	Severn Trent Laboratories
TCL	-	Target Compound List
U.S. EPA	-	United States Environmental Protection Agency
VCRP	-	Voluntary Cleanup and Property Redevelopment Program
VOCs	-	Volatile Organic Compounds

1.0 INTRODUCTION

The Kansas Department of Health and Environment (KDHE) requires that investigations performed for their Voluntary Cleanup and Property Redevelopment Program (VCPRP) include a Quality Assurance Project Plan (QAPP) to ensure that data of known and documented quality are obtained. This QAPP presents the organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities associated with the pre-design investigations at the Former General Motors Fairfax I Plant in Kansas City, Kansas (Site). The pre-design investigative activities are described in "Pre-Design Investigations Work Plan, Former General Motors Fairfax I Plant, Kansas City, Kansas" (Work Plan). This QAPP also describes or provides references to related Work Plan documents for the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, laboratory analyses, and field measurements.

All QA/QC procedures will be in accordance with applicable professional technical standards, KDHE requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP has been prepared by Conestoga-Rovers & Associates (CRA) in accordance with the requirements specified in Section 9 of "Voluntary Cleanup and Property Redevelopment Program Manual", KDHE, Division of Environment, Bureau of Environmental Remediation (undated publication).

2.0 PROJECT DESCRIPTION

This QAPP has been prepared by CRA for the pre-design investigations to be conducted at the Former General Motors (GM) Fairfax I Plant Site.

2.1 SITE DESCRIPTION

A description of the Site, the regional setting, descriptions of the Site geology and hydrogeology, and a summary of previous studies, data collection and remedial activities are provided in Section 1.0 of the Work Plan. The previous studies conducted at the Site identified the presence of volatile organic compounds (VOCs) in soil and groundwater located at the north end of the main plant building in the area of a rail spur and an aboveground tank farm. The soil and groundwater in this Area of Interest (AOI) were the subject of a remedial action that consisted of soil vapor extraction and treatment and groundwater extraction and treatment. The remedial action was initiated in 1991 and was discontinued in 1994. Semi-annual groundwater monitoring at the Site was conducted from 1988 until the remedial action was discontinued in 1994.

In October 1998, a comprehensive groundwater monitoring event was conducted at the Site. The groundwater data indicated that VOCs are present above applicable groundwater quality standards in a localized area within the AOI. This localized area is in the vicinity of monitoring well MW-103A, which is shown on Figure 1.3 of the Work Plan. The VOC data from groundwater samples collected from this monitoring well indicate that acetone, benzene, 4-methyl-2-pentanone (also known methyl isobutyl ketone or MIBK), toluene and xylenes are present at elevated concentrations.

In 1999, a soil investigation was conducted to delineate the source and extent of VOCs in this localized area. The soil sampling locations from the 1999 investigation are shown on Figure 1.2 of the Work Plan. The results from the soil investigation confirmed that the VOC-impacted soil is limited to the area in the vicinity of monitoring well MW-103A.

2.2 PROJECT OBJECTIVES AND SCOPE

The objective of the pre-design investigations is to obtain data from soil and groundwater samples to support a feasibility assessment and design of a selected remedial option for the soil contamination that is present in the vicinity of monitoring well MW-103A. A detailed discussion of the project objectives is provided in Section 2.0 of the Work Plan.

Soil samples will be collected from seven soil boring locations (to be denoted as SB-101 through SB-107) within the MW-103A AOI. The locations of these sampling locations are presented on Figure 2.1 of the Work Plan. Five of the seven locations (SB-101 through SB-105) will be located within the MW-103A AOI. The data from the samples collected from these locations will be used to further delineate the VOCs within the MW-103A AOI and to support the pre-design feasibility evaluation. The remaining locations (SB-106 and SB-107) will be located within a clean zone on the periphery of the MW-103A AOI and will be analyzed for VOCs and geotechnical parameters. The data from these samples will be used for VOC delineation and to assess the aquifer hydrogeologic characteristics. Additional details regarding the soil sampling program are provided in Section 2.1 of the Work Plan.

Groundwater samples will be collected from shallow monitoring wells located in or adjacent to the former Fairfax I Plant property. The data from the samples collected will primarily be used to confirm the groundwater quality data from the more recent sampling events, which demonstrated that with the exception of groundwater in the vicinity of monitoring well MW-103A the groundwater quality met the appropriate KDHE standards. In addition, the groundwater monitoring data will be used to evaluate natural attenuation processes, groundwater flow characteristics, and hydraulic conductivity of the shallow groundwater zone underlying the Site. Additional details regarding the groundwater monitoring program are provided in Sections 2.2 and 2.3 of the Work Plan.

2.3 PARAMETERS TO BE TESTED

Sample matrices, analytical parameters and frequencies of sample collection for the soil and groundwater sampling programs are presented in Table 2.1. Soil samples will be analyzed for VOCs, natural attenuation evaluation parameters (including microbial

enumeration), and geotechnical parameters. Target analytes and quantitation limits for soil samples are presented in Table 2.2. Groundwater samples will be analyzed for VOCs and natural attenuation evaluation parameters. Target analytes and quantitation limits for groundwater samples are presented in Table 2.3. In addition, water level measurements will be obtained at each well in the monitoring program prior to sample collection. The monitoring wells included in the program are identified in Table 2.2 of the Work Plan.

2.4 PROJECT SCHEDULE

The project schedule is presented in Section 7.0 of the Work Plan.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Conestoga-Rovers and Associates (CRA), has overall responsibility for the pre-design investigation activities at Site. CRA will perform all sampling and oversee the investigative activities.

Severn Trent Laboratories, Inc. (STL) located at 4101 Shuffel Drive in North Canton, Ohio (phone number 330-497-9396) will perform all chemical analyses of samples collected during the pre-design investigative activities. GAP EnviroMicrobial Services (GAP) located at 1020 Hargrieve Road, Unit 14 in London, Ontario, Canada (phone number 519-681-0571) will perform microbiological testing of samples collected during the pre-design investigative activities. A qualified geotechnical testing firm will be retained to perform grain size testing.

All firms will provide project management as appropriate to their responsibilities. CRA will provide administrative oversight and QA/QC for all deliverables. CRA will maintain a file copy of all laboratory deliverables. All final project deliverables will be issued by CRA.

Figure 3.1 presents the key staff organization with QA responsibilities for the project. A summary of each of the key person's responsibilities is presented below:

Phil Harvey - Project Manager - CRA

- overview of field activities
- overview of laboratory activities
- advise on field corrective action procedures
- data assessment
- preparation and review of reports
- technical representation of project activities
- coordinate CRA's technical group
- evidence file custodian

Steve Day - Quality Assurance Officer - CRA

- review laboratory QA/QC
- oversee data validation and assessment

- advise on laboratory corrective action procedures
- preparation and review of reports
- QA/QC representation of project activities

John Hargens - Field Quality Assurance Officer – CRA

- overview and review field QA/QC
- management of field activities and field QA/QC
- data assessment
- internal field performance and system audits
- technical representation of field activities
- preparation of standard operating procedures (SOPs) for field activities
- implement and document field corrective actions, if necessary

Garry Palmateer – Project Manager - GAP
Amy McCormick - Project Manager - STL

- ensures all resources of the laboratory are available on an as-required basis
- overview of final analytical reports
- approve final reports prior to submission to CRA

Garry Palmateer – Operations Manager - GAP
Chris Oprandi - Operations Manager – STL

- coordinate laboratory analyses
- supervise in-house chain-of-custody
- schedule sample analyses
- oversee data review
- oversee preparation of analytical reports

Sandra Kajan – QA Officer - GAP
Opal Davis Johnson - QA Officer - STL

- overview laboratory quality assurance
- overview QA/QC documentation
- conduct detailed data review

- implement and document laboratory corrective actions, if required
- technical representation of laboratory QA procedures
- oversee preparation of laboratory SOPs

Michele VanDyke – Sample Custodian - GAP
Lois Ezzo - Sample Custodian – STL

- receive and inspect the incoming sample containers
- record the condition of the incoming sample containers
- sign appropriate documents
- verify correctness of chain-of-custody documentation
- notify laboratory Project Manager of sample receipt and inspection
- assign a unique identification number to each sample and record the information in the sample receiving log
- initiate transfer of the samples to appropriate lab sections
- control and monitor access/storage of samples and extracts

4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analyses, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness and comparability.

4.1 PRECISION

Precision is a measure of degree to which two or more measurements are in agreement.

4.1.1 FIELD PRECISION OBJECTIVES

Precision of the field sample collection procedures will be assessed by the data from analysis of field duplicate samples. Relative percent differences (RPDs) will be calculated for detected analytes from field duplicate sample sets. RPDs of 40 percent and 60 percent for water and soil sample field duplicates, respectively, will be used as advisory limits. Professional judgment will be used for any data qualification.

Field precision for measurements obtained during groundwater monitoring will be assessed through the collection and measurement of duplicate samples or calibration solutions at a frequency of one per ten or fewer groundwater samples. The precision control limits for field measurements obtained during the field activities are summarized in the SOPs in Attachment 1.

4.1.2 LABORATORY PRECISION OBJECTIVES

Precision in the laboratory will be assessed through the calculation of RPDs for replicate/duplicate sample analyses. The equation to be used to determine precision is

presented in Section 13.1 of this QAPP. Precision control limits for the analyses are presented in Table 4.1.

4.2 ACCURACY

Accuracy is the degree of agreement between a measured value and the accepted reference value.

4.2.1 FIELD ACCURACY OBJECTIVES

Accuracy of the field sample collection procedures will be assessed by the data from field and trip blank samples. Field and trip blank sample data will be evaluated using the procedures specified in Section 10.0. Qualification of the associated sample data will be performed by CRA's QA Officer using professional judgment. Accuracy will be ensured through adherence to all sample handling procedures, sample preservation requirements, and holding time periods.

Accuracy of field measurements obtained during groundwater monitoring will be assessed by analyzing calibration check samples. Accuracy control limits for the field measurements obtained during the field activities are presented in the SOPs in Attachment 1.

4.2.2 LABORATORY ACCURACY OBJECTIVES

Laboratory accuracy will be assessed by determining percent recoveries from the analysis of matrix spikes, laboratory control samples (LCSs), or standard reference materials (SRMs). The equation to be used to determine accuracy for this project is presented in Section 13.2. Accuracy control limits are presented in Table 4.1.

The accuracy of the VOC analyses also will be monitored through the analysis of surrogate compounds. Surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compounds are not expected to be found occurring naturally in the samples, but behave analytically similar to the compounds of interest. Consequently, surrogate compound percent

recoveries will provide information on the effect that the sample matrix exhibits on the accuracy of the analyses. Table 4.2 provides surrogate compound percent control limits for the VOC analyses.

4.3 COMPLETENESS

Completeness is a measure of the amount of valid (usable) data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

4.3.1 FIELD COMPLETENESS OBJECTIVES

Field completeness is a measure of the amount of valid measurements obtained from all measurements taken during the project. The equation for completeness is presented in Section 13.3 of this QAPP. Field completeness for this project will be 90 percent or greater.

4.3.2 LABORATORY COMPLETENESS OBJECTIVES

Laboratory completeness is a measure of the amount of valid measurements compared to the total number of all the measurements obtained for the project. The equation for completeness is presented in Section 13.3 of this QAPP. Laboratory completeness for this project will be 90 percent or greater.

4.4 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

4.4.1 MEASURES TO ENSURE REPRESENTATIVENESS OF FIELD DATA

Representativeness is dependent upon the proper design of the sampling program. Representativeness will be ensured by following the Sampling and Analysis Plan (SAP) presented in Appendix A of the Work Plan.

4.4.2 MEASURES TO ENSURE REPRESENTATIVENESS OF LABORATORY DATA

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing field duplicate samples. The sampling network was designed to provide data representative of Site conditions. During development of this network, consideration is given to past waste disposal practices, existing analytical data, and physical setting and processes. The rationale for the sampling network is provided in Section 2.0 of the Work Plan.

4.5 COMPARABILITY

Comparability is an expression of the confidence with which one data set can be compared with another.

4.5.1 MEASURES TO ENSURE COMPARABILITY OF FIELD DATA

Comparability is dependent upon the proper design of the sampling program, and will be ensured by following the SAP and using proper sampling techniques.

4.5.2 MEASURES TO ENSURE COMPARABILITY OF LABORATORY DATA

The laboratory data to be obtained during the sample collection activities will be comparable to existing data when similar sampling and analytical methods are used. Comparability also is dependent on similar QA objectives. The method selected for VOC analysis is the same method that was used during the 1998 and 1999 monitoring events. Therefore, the VOC data from the pre-design investigations will be comparable

to previous VOC data. The geotechnical testing methods are standard methods that will provide data comparable to previous geotechnical data.

Although the natural attenuation evaluation and microbiological parameters have not been included in previous monitoring events, the methods to be used for the analysis of these parameters are standard U.S. EPA or other published methods that can be used during future events, if necessary.

4.6 LEVEL OF QC EFFORT

To assess the quality of data resulting from the field sampling program, field duplicate samples, matrix spike samples, laboratory duplicate samples, laboratory control samples, field blank samples, and trip blank samples will be collected/designated and submitted for analysis.

Field duplicate samples will be analyzed to check for sampling and analytical reproducibility. Field duplicate sample data will be used to measure precision throughout the sampling event. Field duplicate samples will be collected at a frequency of one per ten or fewer investigative samples of each matrix. Field duplicate samples will be collected only for samples being collected for delineation of the extent of VOC contamination or for comparison to KDHE VOC cleanup standards.

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected/designated for VOCs and natural attenuation evaluation parameters at a minimum frequency of 1 per 20 or fewer samples for each applicable analysis.

Field blank samples will be submitted at a frequency of 1 per 10 sampling equipment cleanings or a least once per day of sampling equipment cleanings, whichever is more frequent. Field blank samples will be collected by routing distilled or deionized water through decontaminated sampling equipment. Field blank samples will be analyzed to check procedural contamination and/or ambient conditions and/or sample container contamination at the Site that may cause sample contamination. Field blank samples will not be collected for the samples collected using pre-cleaned or pre-cleaned, disposable sampling equipment. Field blank samples will not be collected for samples designated for geotechnical or microbiological testing.

Trip blank samples, which are prepared by the laboratory and consist of organic-free water poured into the sample vials, will be included in each shipping cooler of VOC sample vials to be used for collecting groundwater samples. Trip blank samples will be handled in a manner consistent with actual field sample handling and will be shipped back to the laboratory with the samples. Trip blank samples will provide the means to assess potential cross-contamination of groundwater samples during shipment and handling. However, it should be noted that trip blanks will not be opened in the field.

The level of QC effort provided by the laboratories for analysis of the samples will be equivalent to the level of QC effort specified in the analytical methods identified in Table 8.1 and detailed in Section 9.0.

The level of QC effort for the field measurements of pH, conductivity, temperature, dissolved oxygen, and oxidation-reduction potential will be as described in the SOPs in Attachment 1. Temperature readings will be obtained with pH measurements.

5.0 SAMPLING PROCEDURES

The procedures and protocols for collecting samples and for performing all related field activities are described in the SAP.

6.0 SAMPLE CUSTODY AND DOCUMENT CONTROL

Custody is one of several factors that is necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample or evidence file is in a person's custody if:

- the item is in actual possession of a person; or
- the item is in the view of the person after being in actual possession of the person; or
- the item was in actual physical possession but is locked up to prevent tampering; or
- the item is in a designated and identified secure area.

6.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

The sample packaging and shipping procedures summarized below will insure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering and other sample designations are included in the SAP.

The field logbook will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the Site could reconstruct a particular situation solely from the logbook entries.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel and will be stored at CRA's Chicago, Illinois office when not in use. Each logbook will be identified by the project-specific document number (12559).

The title page of each logbook will contain the following information:

- project name;
- project start date; and

- end date.

Entries into the logbook will contain a variety of information. At the beginning of each day's logbook entry, the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be entered.

All field measurements obtained and samples collected will be recorded. All logbook entries will be made in ink, signed, and dated with no erasures. If an incorrect logbook entry is made, the incorrect information will be crossed out with a single strike mark that is initialed by the person making the erroneous entry. The correct information will be entered into the logbook adjacent to the original entry.

Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded in the logbook. Photographs taken at a location, if any, will also be noted in the logbook. All equipment used to obtain field measurements will be recorded in the field logbook. In addition, the calibration data for all field measurement equipment will be recorded in the field logbook or on standard field forms.

Samples will be collected following the sampling procedures documented in the SAP. The equipment used to collect samples, time of sample collection, sample description, and volume and number of containers will be recorded in the field logbook. Documentation of field measurements obtained and samples collected will be consistent with the requirements of the SAP and the Work Plan.

The sample packaging and shipping procedures summarized below will ensure that the samples arrive at the laboratory with the chain-of-custody intact:

1. The field sampler is personally responsible for the care and custody of the samples until they are transferred to another person or the laboratory. As few people as possible will handle the samples.
2. All sample containers will be identified by using sample labels that include the unique sample identification number and date and time of collection.
3. Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook entry would explain that a pencil was used to fill out the sample label because the ball-point pen would not function in freezing weather.

4. Samples will be accompanied by a properly completed chain-of-custody form. The sample identification numbers, number of containers, requested analyses, and date and time of sample collection will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving the samples will sign and record the date and time on the form. The chain-of-custody form documents sample custody transfers from the sampler to another person, to the laboratory, or to/from a secure storage area.
5. Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed chain-of-custody form enclosed in and secured to the inside top of each sample cooler. Table 6.1 presents the container, preservation, shipping, and packaging requirements for the samples. Shipping coolers will be secured with custody tape for shipment to the laboratory. The custody tape is then covered with clear plastic tape to prevent accidental damage to the custody tape.
6. Whenever samples are collocated (i.e., split) with another entity, it will the responsibility of the other entity to prepare its own chain-of-custody form. The identification numbers and locations of the split samples will be recorded in the field logbook.
7. All sample shipments will be accompanied by the chain-of-custody form identifying its contents. The chain-of-custody form is a four part carbonless-copy form. The form is completed by the sampling team which, after signing and relinquishing custody to the shipper, retains the bottom (goldenrod) copy. The shipper, if different than the sampling team members, retains the pink copy after relinquishing custody to the laboratory. The yellow copy is retained by the laboratory and the fully executed white copy is returned as part of the data deliverables package.
8. If the samples are sent by common carrier, a bill of lading will be used and copies will be retained as permanent documentation. Commercial carriers are not required to sign the chain-of-custody form as long as the form is sealed inside the sample cooler and the custody tape remains intact.
9. Samples usually will be transported or shipped to the laboratory the same day the samples are collected in the field.

6.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

The sample custodian will assign a unique number to each incoming sample for use in the laboratory. The unique number and customer number will then be entered into the sample receiving log. The date and time of laboratory receipt and the condition of the samples will also be noted.

Sample custody procedures and document control for the laboratory will be consistent with the each laboratory's standard operating procedures for sample receiving and sample control.

6.3 STORAGE OF SAMPLES

All samples will be stored within an access-controlled location and will be maintained properly preserved (as defined in Table 6.1) until completion of all analytical work or, at a minimum, for 30 days after receipt of the final report by CRA.

6.4 FINAL EVIDENCE FILES CUSTODY PROCEDURES

Evidential files for the entire project will be maintained by CRA and will consist of the following:

1. project plan;
2. project log books;
3. field data records;
4. sample identification documents;
5. chain-of-custody records;
6. correspondence;
7. references, literature;
8. final data packages;
9. miscellaneous - photos, maps, drawings, etc.; and
10. final report.

The laboratories will be responsible for maintaining analytical log books and laboratory data. Raw laboratory data files will be inventoried and maintained by the laboratory for a period of five years, at which time CRA will advise the laboratory regarding the need for additional storage.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy for all the instruments and measuring equipment which are used for conducting field tests and laboratory analyses. These instruments and equipment will be calibrated prior to each use or according to a periodic schedule.

7.1 FIELD INSTRUMENTS/EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specification and requirements presented in the SOPs in Attachment 1. The field instruments used for the project will be those specified in Attachment 1 or instruments with equivalent capability.

Equipment to be used during field sampling will be examined to confirm that it is in operating condition. This includes checking the manufacturer's operating manual for each instrument to ensure that all maintenance requirements are being observed. Individual calibration records for each field instrument that will be used for the project will be reviewed to ensure that any prior equipment problems have not been overlooked and all necessary repairs to equipment have been completed.

7.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit.

The records of calibration will be kept as follows:

1. If possible, each instrument will have record of calibration permanently affixed with an assigned record number.
2. A logbook will be assigned to each instrument showing description, manufacturer, model numbers, date of last calibration and the signature of the person who

calibrated the instrument, due date of next calibration and compensation or correction figures, as appropriate.

3. A written stepwise calibration procedure will be available for each piece of test and measurement equipment.
4. Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag or will otherwise be removed from service, as appropriate.

Specific calibration procedures are detailed in the analytical methods provided in Section 8.0.

8.0 ANALYTICAL PROCEDURES

The samples collected during the pre-design investigations will be analyzed using the methods presented in Table 8.1.

9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

This section presents the internal quality control (QC) checks and the frequency at which they will be employed for field and laboratory measurements.

9.1 FIELD QC

QC procedures for field measurements will be limited to checking the reproducibility of the measurement in the field by obtaining multiple readings and by calibrating the instruments in accordance with the appropriate instrument manual.

QC of field sampling will involve collecting field duplicate, field blank, and trip blank samples in accordance with the applicable procedures and frequencies described in Section 4.6, and the level of QC effort indicated in Table 2.1.

9.2 LABORATORY QC

Specific procedures related to internal laboratory QC samples are detailed in the following subsections. The internal laboratory QC checks for the analyses will follow the appropriate methods specified in Table 8.1 and are summarized in the following subsections.

9.2.1 INSTRUMENT PERFORMANCE CHECKS

Performance checks ensure that the mass resolution, identification, and sensitivity of the gas chromatography/mass spectrometry (GC/MS) instruments used for analyzing VOCs are achieved. Prior to use, each instrument must be successfully "tuned" using 4-bromofluorobenzene. The tuning acceptance criteria will be as specified in the method for VOC analysis identified in Table 8.1.

9.2.2 INITIAL AND CONTINUING CALIBRATION CHECKS

The requirements for instrument calibration ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the

instrument is capable of acceptable performance at the beginning of an analysis sequence. Continuing calibration checks document that the initial calibration is still valid and that satisfactory maintenance and adjustment of the instrument on a day-to-day basis is achieved. The specific control criteria and corrective action requirements for initial and continuing calibration will be as specified in the methods presented in Table 8.1.

9.2.3 INTERNAL STANDARDS PERFORMANCE

Internal standards area and retention time data are evaluated to ensure that mass spectrometer sensitivity and response is stable during every run. Acceptance criteria and corrective action requirements will be as specified in the method for VOC analysis presented in Table 8.1. The response of internal standards in the samples are required to be within -50 to +100 percent of the response of the corresponding internal standards from the continuing calibration standard. The retention times of internal standards in the samples are required to be within ±0.50 minutes of the retention time of the corresponding internal standards from the continuing calibration standard.

9.2.4 METHOD BLANK SAMPLES

Method blank samples will be prepared and analyzed at a frequency of 1 per 20 samples or, in the event that an analytical batch consists of less than 20 samples, 1 method blank sample will be analyzed. The method blank sample, an aliquot of analyte-free water or suitable solid material (sodium sulfate, Ottawa sand), will be carried through the entire analytical procedure. The method blank sample acceptance criteria requires that no target analytes to be detected in the method blank sample at a concentration greater than five times the reporting limit [10 times for common laboratory contaminants (e.g., acetone, methylene chloride, toluene, 4-methyl-2-pentanone, 2-butanone, and phthalate esters)].

9.2.5 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

A matrix spike and matrix spike duplicate (MS/MSD) sample set will be analyzed at a minimum frequency of 1 per 20 or fewer investigative groundwater or soil samples for

all analyses except microbiological and geotechnical analyses. Percent spike recoveries will be used to evaluate accuracy and the presence of matrix interference. The relative percent difference (RPD) between the spike and spike duplicate will be used to assess analytical precision relative to the sample matrix. Percent recovery and RPD control limits are summarized in Table 4.2.

9.2.6 LABORATORY DUPLICATE SAMPLES

Laboratory duplicate samples will be analyzed at a minimum frequency of 1 per 20 or fewer samples for the soil pH analyses. The RPD between the sample result and duplicate result will be used to assess analytical precision relative to the sample matrix. RPD control limits are summarized in Table 4.2.

9.2.7 SURROGATE COMPOUNDS

Surrogate compounds (surrogates) are added to all samples designated for VOC analysis prior to analysis. In addition, all method blank samples, standards, and MS/MSD samples will be spiked with surrogates prior to analysis.

Surrogates will be spiked into samples according to the appropriate analytical methods. Surrogate spike recoveries will fall within the control limits specified in Table 4.3 for all analyte concentrations that are within the quantitation limits without dilution. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates below the instrumental quantitation range.

9.2.8 CALIBRATION STANDARDS

All primary standard reference materials will be traceable to U. S. EPA or National Institute of Standards and Technology (NIST) reference standards, if possible. Each calibration standard will receive a reference number that is traceable to the lot number from the primary reference standard from which it was prepared. The procedures for preparing calibration standards are contained within the methods of analysis in Table 8.1.

9.2.9 REAGENT CHECKS

Reagents prepared for instrumental methods of analysis will be monitored by method blank samples and QC check samples, where appropriate. The acceptance criteria and corrective action criteria for reagent checks are the same as the criteria for method blank samples.

9.2.10 LCS SAMPLES

LCS samples (also known as QC Check Samples) will be analyzed to determine the accuracy of the analytical methods. LCS samples generally are prepared from standards that are from a different source than the calibration standards or are standard reference materials. The percent recoveries will be calculated and compared to the acceptance criteria. In most cases, sample analyses cannot proceed if the LCS acceptance criteria is not achieved. Corrective actions for outlying LCS data will be consistent with those specified in the methods.

9.2.11 INTERFERENCE CHECK SAMPLES

To verify that proper inductively coupled plasma spectrometer (ICP) inter-element and background correction factors have been established by the laboratory, an interference check sample (ICS) will be analyzed prior to and after each analysis sequence. Percent recovery acceptance criteria for the ICS data will be ±20 percent. Samples associated with outlying ICS data will be flagged by the laboratory in the final report.

9.2.12 ICP SERIAL DILUTION ANALYSES

ICP serial dilution data are used to determine whether significant chemical or physical interferences exist due to the sample matrix. This QC check consists of a field sample being diluted by a factor of 10 and analyzed. The acceptance criteria for ICP serial dilution data will be ±10 percent difference between the undiluted and diluted analyses for analytes detected at greater than 50 times the instrument detection limit. Samples

associated with outlying ICP serial dilution sample data will be flagged by the laboratory in the final report.

9.2.14 STERILITY CHECKS

The sterility of media, dilution and rinse water, and glassware and equipment used in the microbiological methods of analysis will be checked by preparing control plates for each series of samples. The control plates are incubated in the same manner as the samples and the presence of contamination is determined when the plates are counted.

9.2.15 POSITIVE AND NEGATIVE CONTROLS

For each lot of medium used in the microbiological methods of analysis, the analytical procedure will be checked by testing with known positive and negative control cultures, as applicable. A positive control culture is expected to form colonies and a negative control culture is not expected to form colonies in a specific medium.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

All data generated during field and laboratory activities will be reduced and validated prior to reporting. No field or laboratory data will be disseminated until they have been subjected to the procedures which are summarized in the subsections below.

10.1 DATA REDUCTION

10.1.1 FIELD DATA REDUCTION PROCEDURES

Field data reduction procedures will be minimal in scope compared to those implemented for laboratory data. Only direct reading instrumentation will be employed in the field. The use of field instrument meters will generate data read directly from the meters following calibration as outlined in the SOPs in Attachment 1. These data will be recorded into field logbooks immediately after the measurements are taken. If errors are made, results will be legibly crossed out, initialed by the field sampler and corrected in a space adjacent to the original (erroneous) entry. Data transcribed from the field logbook into summary tables for reporting purposes will be verified for correctness by the Field QA Officer or his designee.

10.1.2 LABORATORY DATA REDUCTION PROCEDURES

Laboratory data reduction procedures typically will be followed according to the following general protocol:

1. Raw data produced and checked by the responsible analyst is turned over for independent review by another analyst.
2. The area supervisor or senior chemist reviews the data for attainment of quality control acceptance criteria.
3. The area supervisor will decide whether any sample re-analysis is required.
4. Upon completion of all reviews and acceptance of the raw data by the area supervisor, a report will be generated and sent to the laboratory Project Manager.
5. The laboratory Project Manager will complete a thorough inspection of all reports.

6. Following review and approval of the preliminary report by the laboratory Project Manager, final reports will be generated and signed by the laboratory Project Manager.

STL's and GAP's data reduction procedures will adhere to the requirements of the analytical methods. Specific equations used for data reduction are contained in the methods.

10.2 DATA REPORTING

Data reporting procedures will be conducted for field and laboratory analyses as described in the following subsections.

10.2.1 FIELD DATA REPORTING

Field data generally will be reported within technical reports and memoranda generated throughout the duration of the project.

10.2.2 LABORATORY DATA REPORTING

The task of reporting laboratory data begins after the laboratory's data reduction procedure has been concluded. The laboratory Project Manager will perform a final review of the report summaries and case narratives to determine whether the report meets the project requirements.

The laboratory reports for chemical analyses will consist of the following deliverables:

1. Case Narrative
   - i) date of issuance;
   - ii) any deviations from intended analytical strategy;
   - iii) laboratory batch number;
   - iv) number of samples and respective matrices;
   - v) project name and number;
   - vi) condition of samples upon receipt;

vii) discussion of whether or not sample holding times were met;
viii) discussion of technical problems or other observations that may have created analytical difficulties; and
ix) discussion of any internal laboratory quality control checks that failed to meet the acceptance criteria.

2. Chemistry Data Package
   i) dates of sample collection, receipt, preparation, and analysis;
   ii) cross-reference of laboratory to project sample identification numbers;
   iii) description of data qualifiers used;
   iv) methods of sample preparation and analysis;
   v) sample results in tabular format;
   vi) MS/MSD data, laboratory duplicate data, LCS data, surrogate compound percent recovery data; and
   vii) fully executed chain-of-custody document.

The laboratory reports for microbiological analyses will consist of a narrative describing the testing procedures, condition of samples upon receipt, discussion of technical or internal laboratory QC problems, the results of the testing, the significance of the results, and the fully executed chain-of-custody document.

The laboratory reports for geotechnical analyses will consists of tabular and graphical displays of the data, as appropriate, and the fully executed chain-of-custody document.

10.3 DATA VALIDATION

Data validation procedures will be performed for both field and laboratory operations as described in the following subsections.

10.3.1 PROCEDURES USED TO EVALUATE FIELD DATA

Procedures to evaluate field data for this project primarily consist of checking for transcription errors and review of field logbooks. This task will be the responsibility of the Field QA Officer, or his designee.

10.3.2 PROCEDURES TO VALIDATE LABORATORY DATA

Validation of the chemistry data will be performed by CRA's QA Officer or his designee based on the relevant and applicable evaluation criteria outlined in "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", EPA540/R-99/008, October 1999 and "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", EPA-540/R-94-013, February 1994.

The evaluation and action criteria specified in these documents (referred to hereafter as the National Functional Guidelines) will be used for validating the data. However, the acceptance criteria for QC data will be the control limits determined statistically by the laboratory. Qualifiers assigned to the data will be consistent with the data qualifiers specified in the National Functional Guidelines.

The following QC data deliverables will be evaluated on 100 percent of the data.

Organic Analyses

1. Technical Holding Times;
2. Blanks;
3. Surrogate Spikes;
4. MS/MSD Results;
5. Laboratory Control Samples;
6. Field Duplicates; and
7. Trip Blank Samples.

Inorganic Analyses

1. Technical Holding Times;
2. Blanks;
3. MS/MSD or Laboratory Duplicate Results;
4. Laboratory Control Samples; and
5. Field Duplicates.

The results of the data validation process will be documented in a memorandum that specifies all limitations on the usability of the analytical data.

Geotechnical and microbiological data will be reviewed for completeness and compliance with the requested testing procedures. Any deviations or problems noted during this review will be documented in a memorandum that details any limitations on the usability of the data.

11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the SAP and QAPP. The audits of field and laboratory activities include two separate, independent parts: internal and external audits.

11.1 FIELD PERFORMANCE AND SYSTEM AUDITS

11.1.1 INTERNAL FIELD AUDIT RESPONSIBILITIES

Internal audits of field activities, including sampling and field measurements, will be conducted by the Field QA Officer or his designee.

11.1.2 INTERNAL FIELD AUDIT FREQUENCY

These audits will verify that all established procedures are being followed. Internal field audits will be conducted at the beginning of sample collection activities to identify deficiencies in the field sampling and documentation procedures. Any deficiencies identified will be documented and corrective actions will be taken to rectify the deficiencies. Follow-up audits will be performed as necessary to verify that deficiencies have been corrected, and that QA procedures are maintained throughout the project.

11.1.3 INTERNAL FIELD AUDIT PROCEDURES

Internal field audits will include the examination of field sampling records, field instrument operating records, field instrument calibration records, and chain-of-custody documentation. In addition, sample collection, handling, and packaging in compliance with the established procedures will be reviewed during field audits.

11.1.4 EXTERNAL FIELD AUDIT RESPONSIBILITIES

External field audits may be conducted by KDHE.

11.1.5 EXTERNAL FIELD AUDIT FREQUENCY

External field audits may be conducted any time during the field operations. These audits may or may not be announced and are at the discretion of KDHE.

11.1.6 OVERVIEW OF THE EXTERNAL FIELD AUDIT PROCESS

External field audits will include reviewing the field activity information presented in the SAP and this QAPP.

11.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

11.2.1 INTERNAL LABORATORY AUDIT RESPONSIBILITIES

Internal laboratory audits are conducted by the laboratory QA Officers or their designee.

11.2.2 INTERNAL LABORATORY AUDIT FREQUENCY

Internal laboratory system audits are performed on an annual basis, and internal laboratory performance audits are conducted on a quarterly basis.

11.2.3 INTERNAL LABORATORY AUDIT PROCEDURES

The internal laboratory system audits will include examining laboratory documentation regarding sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records. Performance audits will involve analyzing performance evaluation samples provided through external performance evaluation programs (e.g., APG's WP Study). The laboratory QA Officer will evaluate the results of the systems and performance audits and provide a final report to section managers and the Operations Manager that includes any deficiencies and/or noteworthy observations.

11.2.4 EXTERNAL LABORATORY AUDIT RESPONSIBILITIES

External laboratory audits will be conducted by KDHE, the National Environmental Laboratory Accreditation Program, Canadian Association for Environmental Analytical Laboratories, or other accreditation authority.

11.2.5 EXTERNAL LABORATORY AUDIT FREQUENCY

External laboratory audits generally are conducted on an annual basis, but the audit frequency is at the discretion of the accreditation authority.

11.2.6 OVERVIEW OF THE EXTERNAL LABORATORY AUDIT PROCESS

External laboratory audits will include, but not be limited to, review of laboratory analytical procedures, laboratory on-site audits, and/or submitting performance evaluation samples to the laboratory for analysis.

12.0 PREVENTIVE MAINTENANCE

12.1 FIELD INSTRUMENT PREVENTIVE MAINTENANCE

The field equipment for this project includes pH/temperature, dissolved oxygen, oxidation-reduction potential, and conductivity meters. Specific preventive maintenance procedures to be followed for field equipment are those recommended by the manufacturer. Field instruments will be checked and calibrated daily before use. The maintenance schedule and trouble-shooting procedures for field instruments are presented in Table 12.1.

12.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

As part of their QA/QC program, the laboratories conduct routine preventive maintenance program to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees will regularly perform routine scheduled maintenance and repair of (or coordinate with the instrument manufacturer for the repair of) instruments. Maintenance that is performed will be documented in the laboratory's maintenance logbooks. Laboratory instruments are maintained in accordance with manufacturer's specifications.

Table 12.1 provides examples of the frequency at which components of key analytical instruments or equipment will be maintained.

13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

The following sections include the procedures and formulae utilized to assess the levels of precision, accuracy, and completeness achieved for the project.

13.1 PRECISION ASSESSMENT

Precision of measurements will be assessed by determining the RPD between the data from either duplicate spiked sample analyses or duplicate sample analyses. RPD is calculated by dividing the absolute value of the difference between two numbers by their arithmetic mean and multiplying by 100. RPD data is used to evaluate the analytical precision of two replicate measurements (e.g., matrix spike/matrix spike duplicate). RPD data control charts are developed and maintained on a matrix and analyte-specific basis. RPD is calculated using the following simplified formula:

$$RPD = \frac{|R_1 - R_2|}{R_1 + R_2} X \ 200$$

where:

R_1 = value of first result
R_2 = value of second result

13.2 ACCURACY ASSESSMENT

Accuracy of measurements will be assessed by determining the percent recovery (%R) of analytes spiked into samples or blank matrix materials. The %R of a parameter is calculated by dividing the amount recovered by the known amount added and multiplying by 100. The %R data are evaluated to establish the analytical accuracy of a measurement. Percent recovery control charts are developed and maintained on a matrix and analyte-specific basis. Percent recovery is calculated using the following formula:

$$\%R = \frac{SSR - SR}{SA} \ X \ 100$$

where:

SSR = Spiked Sample Result
SR = Sample Result or Background
SA = Spike Added

13.3 COMPLETENESS ASSESSMENT

Completeness will be assessed by comparing the number of valid (usable) sample results to the total possible number of results within a specific sample matrix and/or analysis. Percent completeness will calculated using the following formula:

$$\% \text{ Completeness} = \frac{\text{Number of Valid (usable) measurements}}{\text{Number of Measurements Planned}} \times 100$$

14.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, and data validation and assessment. All corrective action proposed and implemented will be documented.

14.1 FIELD CORRECTIVE ACTION

Corrective action in the field may be necessary when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP), sampling procedures and/or field analytical procedures require modification, due to unexpected conditions. In general, the field sampling team may identify the need for corrective action. The field sampling team, in consultation with the Field QA Officer, will recommend a corrective action. The Field QA Officer will approve the corrective action that will be implemented by the field team. It will be the responsibility of the Field QA Officer to ensure the corrective action has been implemented.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The Field QA Officer will identify deficiencies and recommended corrective action to the Project Manager. Implementation of corrective actions will be performed by the Field QA Officer and field team. Corrective action will be documented in the field logbook and/or the project file.

14.2 LABORATORY CORRECTIVE ACTION

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, or potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with analysts and section leaders, it may be necessary for the laboratory QA Officer to approve the implementation of corrective action. The analytical methods specify some conditions during or after analysis that may automatically trigger corrective action or optional procedures. These

conditions may include dilution of samples, additional sample extract cleanup, or automatic re-injection/re-analysis when certain QC criteria are not met.

The bench chemist will identify the need for corrective action. The Operations Manager or section leaders, in consultation with the laboratory supervisor and staff, will approve the required corrective action to be implemented by the laboratory staff. The laboratory QA Officer will ensure implementation and documentation of the corrective action.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in the laboratory's corrective action report or analytical logbook and the case narrative report sent from the laboratory.

The need for corrective action may also be identified during systems or performance audits. In these cases, the need for corrective action will be identified by the auditor and the corrective action taken to resolve the problem will be documented by the laboratory QA Officer. The corrective action taken will depend upon the QA/QC criteria that was violated. All problems requiring corrective action and the corrective action taken will be reported to the laboratory Project Manager.

14.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

CRA's QA Officer may identify the need for corrective action during either data validation or data assessment. Potential types of corrective action may include resampling by the field team or reanalysis of samples by the laboratory.

The corrective actions taken are dependent upon the ability to mobilize the field team and whether the data to be collected is necessary to meet the required quality assurance objectives (e.g., the holding time for samples is not exceeded). Should CRA's QA Officer identify a situation requiring corrective action, CRA's Project Manager will be responsible for approving the implementation of corrective action.

15.0 QUALITY ASSURANCE REPORTING

Reports on data quality will be prepared following each sampling round or at the conclusion of the project. These reports will include an assessment of measurement quality indicators (i.e., data accuracy, precision, and completeness) and QA problems, corrective action taken, and resolutions.

CRA's QA Officer will be responsible within the organizational structure for preparing these reports. CRA's Project Manager will be provided with these reports for inclusion in the Pre-Design Investigations Report. This report will also include a separate QA/QC section that will summarize data quality information and details an overall assessment of the data based on the objectives outlined in this QAPP.

ATTACHMENT 1

FIELD EQUIPMENT STANDARD OPERATING PROCEDURES

Title		*SOP Number*
1.	pH/Temperature	PHT-12559
2.	Conductivity	SC-12559
3.	Dissolved Oxygen	DO-12559
4.	Oxidation-Reduction Potential	ORP-12559
5.	Soil Headspace VOC Screening	SVS-12559

pH/TEMPERATURE

Scope and Application: This method is applicable to surface water, wastewater and groundwater.

Method: Potentiometric

Reference: "Methods for Chemical Analysis of Water and Wastes:", EPA-600/4-79-020, revised March 1983, Method 150.1

Sensitivity: 0.01 pH unit; 0.1 ^{O}C

Optimum Range: pH 1.00 to 12.00; temperature -5 to 50 ^{O}C

Sample Handling: Determined on site

Reagents and Apparatus:

1. Temperature compensated pH meter, YSI Model 3560 Water Quality Monitoring System;
2. Combination pH electrode YSI Model 3530;
3. Thermilinear thermister YSI Model 3510 temperature probe;
4. pH buffer solutions, pH 4.00, 7.00, and 10.00 (certified buffer solutions);
5. Distilled or deionized water in wash bottle.

Calibration:

1. Switch On/Off key to On. Before connecting the pH electrode, zero the electronics with the shorting cap attached to the meter. Turn on the meter and set the pH function switch to pH. Connect the shorting cap to the pH input jack and set the manual temperature compensation knob to 25°C. Adjust the CAL control to indicate 7.00 ±0.01 on the pH-mV display. Disconnect the shorting cap from the pH input and connect it to the mV input jack. The monitor is now zeroed.
2. Test the 3530 pH electrode for noise and offset as follows: Rinse the 3530 and the YSI 3510 Temperature Probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00 buffer into a 50 mL sample cup then immerse both of the sensors into the buffer at 25.0 ±0.1°C (use the °C display to confirm the temperature). Allow the sensors to equilibrate. A display value other than 7.00 shows electrode background noise and offset. The 3530 background noise and offset at pH 7.00 should not exceed ±0.2 pH units at 25°C. Replace pH probe if background noise exceeds this tolerance.

3. Set the function switch to pH ATC. Connect the 3510 to the pH ATC input jack. While the 3510 can be used in ether location, the pH ATC function will not work unless the 3510 is connected to the pH ATC input.

4. Rinse the 3530 and a YSI 3510 Temperature Probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00 buffer into a 50 ml sample cup, immerse both of the sensor into the buffer. Allow the sensors the equilibrate in the buffer until a stable reading is obtained. Read the temperature and adjust the pH manual temperature compensation knob to the same value. Adjust the CAL control knob for 700 ±0.01 pH units in the display and discard the buffer. Rinse the sensors with deionized or distilled water, followed by a rinse of the next desired buffer (typically pH 4.00 or 10.00). Half fill another disposable 50 ml sample cup with the next buffer for calibration and immerse the sensors. Allow the sensors to equilibrate until a stable reading is obtained. The temperature of the two buffers should not differ by more than ±0.1°C. Adjust the SLOPE control until the display is within 0.01 pH units of the buffer;s stated value. Discard the buffers. The pH system is now calibrated and ready for use.

Procedure:

1. Calibrate meter using calibration procedure.

2. Set up meter as outlined in the operating maual.

3. Pour the sample into clean sample jar or plastic cup.

4. Record temperature and pH of the sample in the logbook.

5. Rinse with water and pH 7.00 buffer.

6. Repeat steps 3 through 5 for each sample.

7. Recheck calibration with pH 7.00 buffer solution after every 10 or fewer samples and after the last sample.

8. Store pH electrode in soaker bottle when not in use.

Quality Control:

1. Duplicate 1 out of 10 samples. If less than 10 samples are analyzed, a duplicate is still required. Duplicates must be ±0.2 pH units.

   If the results are outside of the control limits, rinse electrodes and repeat analysis. If results are still outside of the control limits, recollect samples and repeat

analysis. If the results are still outside of the control limits, check calibration and recalibrate if necessary (see item 2, below). If drift is suspected to be the cause of the problem, clean the electrode and recalibrate. If drift is still apparent, replace electrode.

2. Calibration check results must be ±0.10 pH unit of the true value. If the result is outside of ±0.10 pH unit, rinse electrodes and check solution again. If still outside the control limit, recalibrate the meter and reanalyze all samples analyzed since the last in-control calibration.

3. All glassware is to be soap and water washed, tap water rinsed and distilled or deionized water rinsed prior to analyses.

Interferences:

Interferences in pH measurements occur with presence of weak organic and inorganic salts and oil and grease. If oil and grease are visible, note in logbook. Clean electrode with soap and water, followed by 10% HCl and deionized water rinse. Recalibrate meter before analysis of next sample.

CONDUCTIVITY

Scope and Application: This method is applicable to surface water, wastewater and groundwater.

Method: Specific Conductance

Reference: "Methods for Chemical Analysis of Water and Wastes" EPA-600/4-79-020, revised March 1983, Method 120.1

Sensitivity: 0.1 mmhos/cm

Optimum Range: 0 - 100.0 mmhos/cm

Sample Handling; Determine on site

Reagents and Apparatus:

1. Conductivity meter - YSI Model 3560 Water Quality Monitoring System;
2. Conductivity Cell - YSI Model 3520 Flow-Through Conductivity Cell (K=5/cm);
3. Thermilinear Thermister - YSI Model 3510 Temperature Probe;
4. Deionized water;
5. Conductivity standard, 1.0mmho/cm @25°C - YSI Model 3167.

Notes:

The conductivity meter is factory calibrated. The calibration is checked using a solution of known conductance.

Calibration Check

Connect the 3520 cell and a 3510 Temperature Probe to the 3500, and remove them from the sample chamber. Set the conductivity function switch to 2 ATC. Rinse the inside and outside of the cell and the probe with about 1/3 the content of the 3167 bottle. Place both of the sensors into the remainder of the solution in the bottle and allow them to come to temperature equilibrium. Make sure that the 3250 body is immersed so that the liquid level is half way up the knurled portion of the cell. Read the displayed value and determine if the cell/instrument is within specified accuracy. The displayed value is corrected to 25°C automatically and should be 1.000 ±070 mmho/cm. If the value is not within specification replace 3250 cell.

Procedure:

1. Check calibration of meter.

2. Set up meter as outlined in the operating manual.

3. Before any conductivity cell is used, it should be soaked in distilled or deionized water for at least one hour. To make conductivity measurements, connect a YSI 3520 Flow-Through Conductivity Cell to the 3500. Set the conductivity function switch to 2 and observe the displayed value after the reading is stable. The display reads out in mmho/cm.

4. If the overrange signal (1._____) is displayed, the conductivity of the water being measured is greater than 1.999 mmho/cm. Reset the function switch to 20. If the overrange signal is still displayed, reset to 100. If the overrange signal is still displayed, either the conductivity is greater than 100.0 mmho/cm and the YSI 3500 Water Quality Monitor can not be used for conductivity determinations.

5. Record conductance readings in field logbook.

6. Repeat steps 3 through 5 for remaining samples.

Quality Control:

1. The quality control calibration check standard must be analyzed initially, after every 10 or fewer samples and after the last sample. If less than 10 samples are analyzed, the calibration standard is still required to be analyzed. The standard must be within ±10 percent of the true value or the samples run after the last acceptable check standard are to be reanalyzed. Record the calibration standard in the field logbook.

2. Duplicate a minimum of 1 out of 10 samples. If less than 10 samples are analyzed, a duplicate is still required. Duplicate values are to be within ±15% of each other. If outside of this range, reanalyze the samples. If still outside the acceptance range, recollect sample and reanalyze. If still out, replace probe.

DISSOLVED OXYGEN

Scope and Application: This method is applicable to surface water, wastewater and groundwater.

Method: Potentiometric

Reference: "Methods for Chemical Analysis of Water and Wastes:", EPA-600/4-79-020, revised March 1983, Method 360.1

Sensitivity: 0.1 mg/L as O_2

Optimum Range: 0.1 mg/L to 20 mg/L O_2

Sample Handling: Determined on site

Reagents and Apparatus:

1. Temperature compensated dissolved oxygen (DO) meter, Corning Check Mate System;
2. Zero oxygen standard;
3. DO sensor filling solution;
4. DO membrane replacement kit;
5. Distilled or deionized water in wash bottle.

Setting Up DO Sensor:

The sensor is shipped dry and must be filled before use.

1. Unscrew the membrane cap from sensor and fill using DO electrolyte.
2. Tap membrane cap gently to remove air bubbles. Gently screw cap onto probe body allowing surplus electrolyte to run out. (Caution: Do not overtighten)
3. Fit sensor to meter module.
4. Allow 30 minutes for polarization of electrode.

Calibration:

1. Remove wetting cap from tip of sensor. Switch on meter.

2. For first calibration point, place sensor in zero oxygen solution. Allow sufficient time for sensor to stabilize.

3. Move the sensor in a gentle circular motion.

4. Make sure sensor is immersed to a depth of 40 mm to cover the temperature sensing element.

5. Press "CAL" key. CAL 1 is displayed on meter and after endpointing, the display automatically updates to zero.

6. For second calibration point, hold sensor in air. Press "CAL" key. CAL 2 is displayed. After endpointing, the display automatically updates to 100% O_2.

7. To adjust oxygen calibration for salinity and barometric pressure, press "Mode" key. In mg/L O_2 mode, press "CAL" key and 100 is displayed. Use down arrow and up arrow on the keypad to adjust the display according to the salinity and barometric pressure tables contained on the operating instruction leaflet.

Procedure:

1. Calibrate meter using calibration procedure.

2. Pour the sample into clean sample jar or plastic cup.

3. Place sensor in sample. After following the immersion, stirring and stabilization steps referred to during calibration, press "READ" key to obtain sample result.

4. Record result in the field logbook.

5. Repeat steps 2 through 4 for each sample.

Quality Control:

1. Duplicate 1 out of 10 samples. If less than 10 samples are analyzed, a duplicate is still required. Duplicates must be within 15%.

   If the results are outside of the control limits, rinse electrode and repeat analysis. If results are still outside of the control limits, recollect samples and repeat analysis.

If the results are still outside of the control limits, check calibration and recalibrate if necessary (see item 2, below). If unable to recalibrate, replace sensor membrane.

2. Check calibration using zero oxygen standard every 10 or fewer samples. Calibration check results must be within 10% of the true value. If the result is outside of 10%, rinse electrodes and check solution again. If still outside the control limit, recalibrate the meter and reanalyze all samples analyzed since the last in control calibration.

3. All glassware is to be soap and water washed, tap rinsed and distilled or deionized water rinsed prior to analyses unless pre-cleaned sample jars are used.

Interferences:

Interferences in DO measurements generally occur due to membrane coating. Clean probe as specified in the sensor manual.

The presence of other gases such as chlorine, nitrous and nitric oxide, hydrogen sulfide and sulfur dioxide interfere with DO measurements. The sulfur based compounds will tarnish the electrodes resulting in sluggish or erratic measurements. Polishing the electrodes as specified in the operating manual will restore the performance of the meter. Recalibrate meter before analysis of next sample.

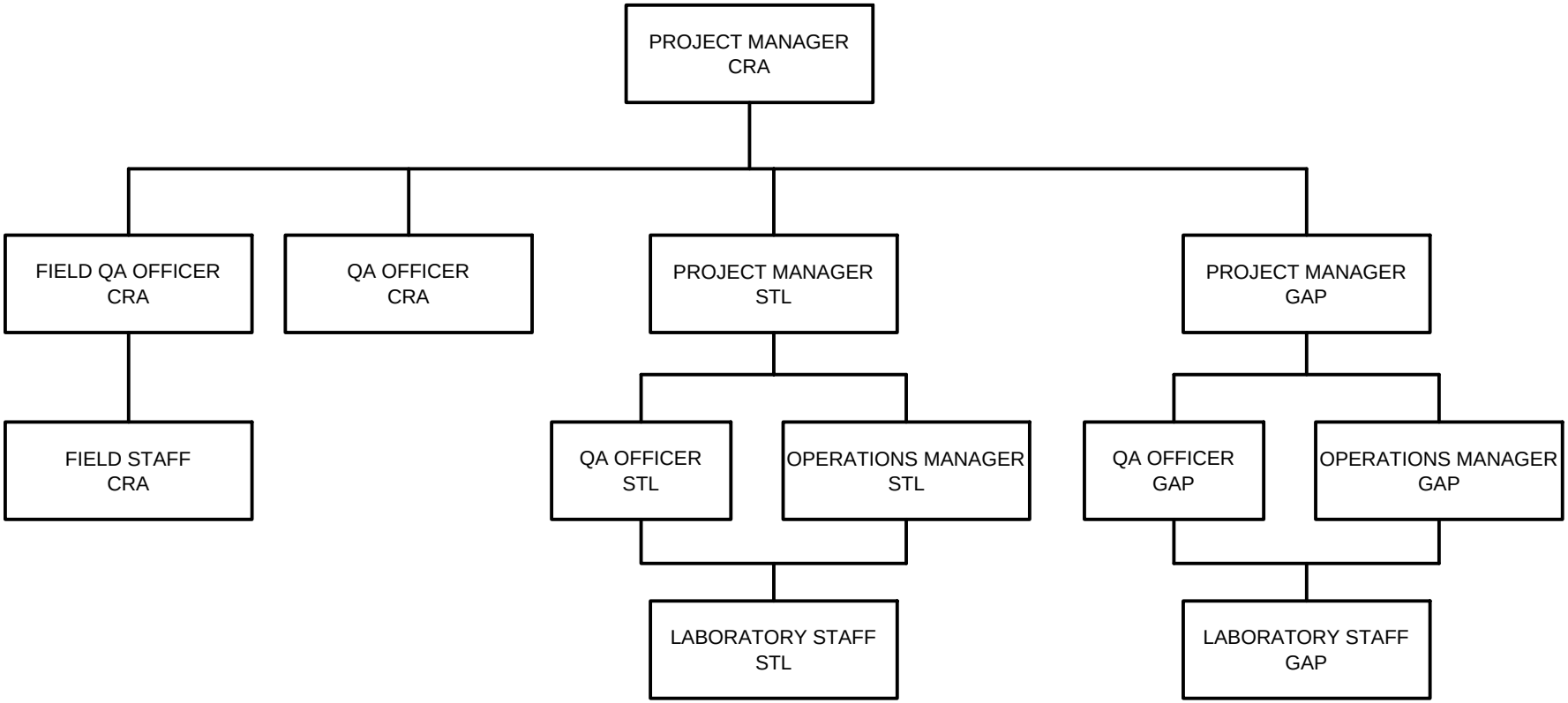

figure 3.1

PROJECT QA/QC ORGANIZATION
FORMER FAIRFAX I PLANT SITE
Kansas City, Kansas

TABLE 2.1

SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

				QC Samples [1]			
Sample Matrix	*Field Parameters*	*Laboratory Parameters* [2]	*Number of Samples*	*Field Blanks*	*Field Duplicates*	*MS/MSD* [3]	*Total*
Groundwater	pH,Temperature, Conductivity, DO, ORP, Water Level	TCL VOCs	10	1	1	1	13
		Natural Attenuation[4]	10	1	0	1	12
	Water Level	none	5	NA[5]	NA	NA	5
Soil	none	TCL VOCs,	14	2	2	1	19
		Natural Attenuation[6]	10	1	0	1	12
		Organic Carbon	4	0	0	1	5
		Geotechnical[7]	6	0	0	0	6

[1] One trip blank sample will be included in each cooler containing multiple groundwater VOC samples.

[2] Target Compound List (TCL) Volatile Organic Compounds (VOCs)

[3] Matrix spike/matrix duplicate (MS/MSD) analyses will be collected at a frequency of one per group of twenty (20) or fewer investigative samples. Triple the normal sample volumes will be collected for VOCs (soil and groundwater) and double the normal volume for the remaining groundwater parameters. Additional sample volume is not required for soil natural attenuation parameters. MS/MSD analyses are not applicable to the microbiological testing methods. A laboratory duplicate sample will be analyzed for soil pH.

[4] Natural Attenuation parameters for groundwater samples consist of ammonia, COD, nitrate, orthophosphate, total and dissolved metals (calcium, magnesium, manganese, and iron), TKN, TOC, and total heterotrophic and BTEX-degrading microbial enumeration.

[5] NA - Not applicable

[6] Natural Attenuation parameters for soil samples consist of ammonia, nitrate, orthophosphate, pH, moisture content, and total heterotrophic and BTEX-degrading microbial enumeration.

[7] Geotechnical testing include grain size distribution and bulk density.

TABLE 2.2

TARGETED QUANTITATION LIMITS FOR SOIL SAMPLES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Parameter	*Targeted Quantitation Limit* [1]
Volatile Organic Compounds (µg/kg)	
Acetone	20
Benzene	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	5
2-Butanone	20
Carbon disulfide	5
Carbon tetrachloride	5
Chlorobenzene	5
Dibromochloromethane	5
Chloroethane	5
Chloroform	5
Chloromethane	5
1,1-Dichloroethane	5
1,2-Dichloroethane	5
cis-1,2-Dichloroethene	2.5
trans-1,2-Dichloroethene	2.5
1,1-Dichloroethene	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
trans-1,3-Dichloropropene	5
Ethylbenzene	5
2-Hexanone	20
Methylene chloride	5
4-Methyl-2-pentanone	20
Styrene	5
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	5
Toluene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	5
Vinyl chloride	5
Xylenes (total)	10
Natural Attenuation Evaluation Parameters (mg/kg)	
Ammonia	0.5
Nitrate	5
Total Kjeldahl Nitrogen	50

TABLE 2.2

TARGETED QUANTITATION LIMITS FOR SOIL SAMPLES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Parameter	*Targeted Quantitation Limit* [1]
Total Organic Carbon	100
Orthophosphate	1
Moisture Content	1%
pH (soil)	1 SU
Total Heterotrophic Microbial Enumeration	10 CFU/g2
BTEX-degrading Microbial Enumeration	10 CFU/g

[1] The targeted quantitation and detection limits for soil are based on wet weight. The limits calculated by the laboratory on a dry weight basis will be higher.

[2] CFU - Colony Forming Units

TABLE 2.3

TARGETED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

2

Parameter	*Targeted Quantitation Limit* [1]
Volatile Organic Compounds (µg/L)	
Acetone	10
Benzene	1
Bromodichloromethane	1
Bromoform	1
Bromomethane	1
2-Butanone	10
Carbon disulfide	1
Carbon tetrachloride	1
Chlorobenzene	1
Dibromochloromethane	1
Chloroethane	1
Chloroform	1
Chloromethane	1
1,1-Dichloroethane	1
1,2-Dichloroethane	1
cis-1,2-Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,1-Dichloroethene	1
1,2-Dichloropropane	1
cis-1,3-Dichloropropene	1
trans-1,3-Dichloropropene	1
Ethylbenzene	1
2-Hexanone	10
Methylene chloride	1
4-Methyl-2-pentanone	10
Styrene	1
1,1,2,2-Tetrachloroethane	1
Tetrachloroethene	1
Toluene	1
1,1,1-Trichloroethane	1
1,1,2-Trichloroethane	1
Trichloroethene	1
Vinyl chloride	1
Xylenes (total)	1
Natural Attenuation Evaluation Parameters (mg/L)	
Ammonia	0.2
Chemical Oxygen Demand (COD)	20
Nitrate	0.1
Orthophosphate	0.1
Total Kjeldahl Nitrogen (TKN)	1.0
Total Organic Carbon	1
Calcium (total and dissolved)	5
Iron (total and dissolved)	0.1
Magnesium (total and dissolved)	5

TABLE 2.3

TARGETED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Parameter	*Targeted Quantitation Limit* [1]
Manganese (total and dissolved)	0.015
Total Heterotrophic Microbial Enumeration	1 CFU/mL[2]
BTEX-degrading Microbial Enumeration	1 CFU/mL
Field Measurements	
pH	0.01 SU
Temperature	0.1 ºC
Conductivity	0.1 mmho/cm
Dissolved Oxygen	1 mg/L
ORP	1 mV

[1] The targeted quantitation limits are presented for guidance and may not be achievable for all samples.

[2] CFU - Colony Forming Units

TABLE 4.1

PERCENT RECOVERY AND RELATIVE PERCENT DIFFERENCE CONTROL LIMITS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Analyses	*% Recovery Control Limits* [1]	
	MS/MSD	*LCS*
Volatile Organic Compounds (groundwater)		
Acetone	45-128 (30)	22-200
Benzene	78-118 (20)	80-116
Bromodichloromethane	80-146 (30)	87-130
Bromoform	58-176 (30)	76-150
Bromomethane	55-145 (30)	64-129
2-Butanone	71-123 (30)	28-237
Carbon disulfide	69-138 (41)	73-139
Carbon tetrachloride	63-176 (30)	75-149
Chlorobenzene	76-117 (20)	76-117
Chloroethane	59-142 (30)	66-126
Chloroform	83-141(30)	84-128
Chloromethane	40-137 (39)	48-123
Dibromochloromethane	71-158 (30)	81-138
1,1-Dichloroethane	88-127 (30)	86-123
1,2-Dichloroethane	71-160 (30)	79-136
1,1-Dichloroethene	62-130 (20)	63-130
cis-1,2-Dichloroethene	87-114 (30)	85-113
trans-1,2-Dichloroethene	85-116 (30)	79-120
1,2-Dichloropropane	87-114 (30)	82-115
cis-1,3-Dichloropropene	82-130 (30)	84-130
trans-1,3-Dichloropropene	73-147 (30)	84-130
Ethylbenzene	86-132 (30)	86-116
2-Hexanone	81-128 (30)	35-200
Methylene chloride	82-115 (30)	78-118
4-Methyl-2-pentanone	82-135 (30)	78-141
Styrene	83-120 (30)	85-117
1,1,2,2-Tetrachloroethane	88-116 (30)	85-118
Tetrachloroethene	85-121 (30)	88-113
Toluene	70-119 (20)	74-119
1,1,1-Trichloroethane	71-162 (30)	78-140
1,1,2-Trichloroethane	86-129 (30)	83-122
Trichloroethene	62-130 (20)	75-122
Vinyl chloride	88-126 (30)	61-120
Xylenes (total)	89-121 (30)	87-116
Volatile Organic Compounds (soil)		
Acetone	10-200 (66)	58-130
Benzene	55-138 (20)	75-129

TABLE 4.1

PERCENT RECOVERY AND RELATIVE PERCENT DIFFERENCE CONTROL LIMITS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Analyses	*% Recovery Control Limits* [1]	
	MS/MSD	*LCS*
Bromodichloromethane	47-131 (51)	72-125
Bromoform	26-141 (64)	43-149
Bromomethane	15-152 (72)	24-152
2-Butanone	21-195 (60)	27-200
Carbon disulfide	27-149 (73)	50-137
Carbon tetrachloride	32-143 (68)	57-137
Chlorobenzene	49-139 (22)	75-127
Chloroethane	32-140 (66)	31-144
Chloroform	59-128 (128)	73-115
Chloromethane	28-130 (81)	15-136
Dibromochloromethane	44-135 (61)	49-135
Volatile Organic Compounds (soil)		
1,1-Dichloroethane	56-130 (54)	77-119
1,2-Dichloroethane	56-126 (38)	78-121
1,1-Dichloroethene	43-147 (27)	55-142
cis-1,2-Dichloroethene	48-127 (52)	77-114
trans-1,2-Dichloroethene	47-127 (58)	68-117
1,2-Dichloropropane	54-125 (43)	78-116
cis-1,3-Dichloropropene	30-138 (49)	71-125
trans-1,3-Dichloropropene	34-134 (57)	67-125
Ethylbenzene	36-133 (72)	79-114
2-Hexanone	20-190 (70)	29-200
Methylene chloride	45-129 (49)	58-130
4-Methyl-2-pentanone	42-143 (60)	68-142
Styrene	23-136 (65)	80-114
1,1,2,2-Tetrachloroethane	33-162 (90)	70-133
Tetrachloroethene	31-137 (81)	72-120
Toluene	46-147 (24)	71-130
1,1,1-Trichloroethane	48-132 (57)	67-123
1,1,2-Trichloroethane	58-128 (52)	82-116
Trichloroethene	46-143 (23)	70-131
Vinyl chloride	30-136 (80)	24-152
Xylenes (total)	33-135 (78)	80-114
Natural Attenuation Evaluation Parameters (groundwater)		
Ammonia	63-126 (29)	85-114
Chemical Oxygen Demand	62-134 (29)	83-118
Nitrate	47-154 (30)	90-110

TABLE 4.1

PERCENT RECOVERY AND RELATIVE PERCENT DIFFERENCE CONTROL LIMITS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Analyses	*% Recovery Control Limits* [1]	
	MS/MSD	*LCS*
Orthophosphate	90-110 (20)	89-115
Total Kjeldahl Nitrogen	40-153 (57)	70-142
Total Organic Carbon	72-136 (20)	88-115
Calcium (total and dissolved)	75-125 (20)	80-120
Iron (total and dissolved)	75-125 (20)	77-127
Magnesium (total and dissolved)	75-125 (20)	80-120
Manganese (total and dissolved)	75-125 (20)	80-120
Natural Attenuation Evaluation Parameters (soil)		
Ammonia	48-121 (20)	85-110
Nitrate	58-136 (20)	90-112
Orthophosphate	90-110 (20)	90-110
pH (soil)	NA-NA[2] (20)	97-103
Total Kjeldahl Nitrogen	80-120 (20)	80-120
Total Organic Carbon	51-128 (20)	51-128

[1] Values in parentheses are the maximum RPD values allowed for MS/MSD analytes. Laboratory control limits are updated on a periodic basis and the control limits in effect when the samples are analyzed will be used for data validation purposes.

[2] NA - MS/MSD analysis not applicable

TABLE 4.2

SURROGATE COMPOUND PERCENT RECOVERY CONTROL LIMITS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

		% Recovery Control Limits	
Analysis	***Surrogate Compound***	***Water***	***Soil***
Volatile Organic Compounds	Toluene-d_8	76-110	84-138
	4-Bromofluorobenzene	74-116	59-113
	1,2-Dichloroethane-d_4	61-128	70-121
	Dibromofluoromethane	73-122	59-138

[1] Laboratory control limits are updated on a periodic basis and the control limits in effect

when the samples are analyzed will be used for data validation purposes.

TABLE 6.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Matrix	*Analyses*	*Sample Containers* [1]	*Preservation* [2]	*Maximum Holding Time from Sample Collection* [3]	*Volume of Sample*	*Shipping*	*Normal Packaging*
Groundwater							
	TCL VOCs	Three 40-mL septum top vials	Iced HCl to pH<2	14 days for analysis	Fill completely	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Total and Dissolved Metals	One 1-L polyethylene each (total and dissolved metals)	Iced HNO_3 to pH<2	180 days for analysis (Mercury - 28 days)	Fill to neck of bottle	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Ammonia, TKN, COD, Orthophosphate	One 1-L polyethylene	H_2SO_4 to pH<2	28 days for analysis	Fill completely	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Nitrate	One 250-mL polyethylene	Iced	48 hours for analysis	Fill to neck of bottle	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Total Organic Carbon	One 40-mL septum top vial	H_2SO_4 to pH<2	28 days for analysis	Fill completely	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Microbial Enumeration (heterotrophic and BTEX-degrading)	Two 120-mL sterile	Iced	24 hours for incubation	Fill to 100-mL mark	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
Soil							
	TCL VOCs	Three 5-g En Core Samplers	Iced	48 hours for preparation 14 days for analysis	Fill completely	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Organic Carbon, Ammonia, TKN, Orthophosphate	One 500-mL glass	Iced	28 days for analysis	Fill to shoulder of jar	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Nitrate	No additional jar required	Iced	48 hours for analysis	Fill to shoulder of jar	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
Soil							
	Microbial Enumeration (heterotrophic and BTEX-degrading)	One 120-mL glass	Iced	24 hours for incubation	Fill to shoulder of jar	Federal Express Priority 1 or Courier	Bubble Wrap or Foam Chips
	Geotechnical	One 500-mL glass	none	none	Fill to shoulder	Federal Express	Bubble Wrap

TABLE 6.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Matrix	*Analyses*	*Sample Containers* [1]	*Preservation* [2]	*Maximum Holding Time from Sample Collection* [3]	*Volume of Sample*	*Shipping*	*Normal Packaging*
	(Grain Size, Bulk Density, Moisture Content)				of jar	Priority 1 or Courier	or Foam Chips

[1] Where possible, analyses will be combined into the minimum number of sample containers with respect to sample preservation requirements.

[2] Samples requiring refrigeration will be shipped in coolers containing bagged, cubed ice. Following laboratory receipt and log-in, these samples will be stored at 4° ± 2°C.

[3] Maximum holding times presented are technical holding times and are based on the time elapsed from sample collection.

TABLE 8.1

SUMMARY OF ANALYTICAL METHODS
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Parameter[1]	*Preparation/Analysis Method*[2]
Groundwater	
TCL VOCs	SW-846 5030B/8260B
Ammonia	EPA 350.3
Chemical Oxygen Demand	EPA 410.4
Nitrate	EPA 300.0
Orthophosphate	EPA 365.2
Total Kjeldahl Nitrogen	EPA 351.3
Total Organic Carbon	EPA 415.1
Calcium (total and dissolved)	SW-846 3010A/6010B
Iron (total and dissolved)	SW-846 3010A/6010B
Magnesium (total and dissolved)	SW-846 3010A/6010B
Manganese (total and dissolved)	SW-846 3010A/6010B
Total Heterotrophic Microbial Enumeration	Lorch, et al., 1995
BTEX-degrading Microbial Enumeration	Balba, et al., 1998
Field pH	See Attachment 1
Field Temperature	See Attachment 1
Field Conductivity	See Attachment 1
Field ORP	See Attachment 1
Field DO	See Attachment 1
Soil	
TCL VOCs	SW-846 5035/8260B
Ammonia	EPA 350.3
Nitrate	EPA 300.0
Total Kjeldahl Nitrogen	EPA 351.3
Total Organic Carbon	Walkley-Black
Orthophosphate	EPA 365.2
pH (soil)	SW-846 9045C
Total Heterotrophic Microbial Enumeration	Lorch, et al., 1995
BTEX-degrading Microbial Enumeration	Balba, et al., 1998
Grain Size Distribution	ASTM D 422, D1140
Bulk Density	ASTM D 854
Moisture Content	ASTM D 2216

[1] VOCs - Volatile Organic Compounds

[2] SW-846 - "Test Methods for Evaluation Solid Waste, Physical/Chemical Methods", EPA SW-846, 3rd Edition.
EPA - "Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983.
Walkley-Black - "Methods of Soil Analysis", American Society of Agronomy, 1965.
Lorch, H.J., Benckieser, G., Ottow, J.C.G., 1995. Basic methods for counting microorganisms in soil and water "Methods in Applied Soil Microbiology and Biochemistry", Academic Press, pp. 146-161.
Balba, M.T., Al-Awadhi, N., Al-Daher, R., 1998. Bioremediation of oil contaminated soil: microbiological methods for feasibility assessment and field evaluation, Journal of Microbiological Methods 32 (1998), 155-1
ASTM - "Annual Book of ASTM Standards", American Society for Testing and Materials.

TABLE 12.1

ROUTINE PREVENTIVE MAINTENANCE
PROCEDURES AND SCHEDULES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Instrument	*Maintenance Procedures/Schedule*	*Spare Parts in Stock*
Gas Chromatograph/Mass Spectrometer	1. Replace pump oil as needed. 2. Change septa weekly or as often as needed. 3. Change gas line dryers as needed. 4. Replace electron multiplier as often as needed. 5. Replace gas jet splitter as needed. 6. Replace GC injector glass liner weekly or as often as needed. 7. Replace GC column as needed. 8. Check to ensure that gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 9. Check to ensure the pressure on the primary regulator never falls below 100 psi.	1. Syringes 2. Septa 3. Various electronic components 4. Glass jet splitters 5. GC columns 6. Glass liners
Purge and Trap Sample Concentrator	1. Replace trap as needed. 2. Decontaminate the system after running high concentration samples or as required by blank analysis. 3. Leak check system daily and as often as needed 4. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 5. Check to ensure the pressure on the primary regulator never run below 100 psi.	1. Traps 2. Spargers 3. Various electronic components/ circuits 4. Plumbing supplies - tubing, fittings

TABLE 12.1

ROUTINE PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES FORMER FAIRFAX I PLANT SITE KANSAS CITY, KANSAS

Instrument	*Maintenance Procedures/Schedule*	*Spare Parts in Stock*
Inductively Coupled Plasma Spectrometer	1. Clean torch assembly and mixing chamber when discolored or after eight hours of running high dissolved solid samples. 2. Clean nebulizer as needed. 3. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP.	1. Torch and mixing chamber 2. Nebulizer
Autoanalyzer	1. Inspect pump tubes after each 8-hour run; replace if discolored or distorted. 2. Inspect colorimeter daily; replace lamp as necessary.	1. Pump tubes 2. Colorimeter lamp
Ion Chromatograph	1. Change pre-column as needed. 2. Replace injection loop monthly or as often as needed. 3. Replace column as needed. 4. Clean/replace conductivity detector as needed.	1. Syringes 2. Injection loops 3. Pre-columns 4. Detectors 5. Chromatography column
pH Meter	1. Check battery and replace if discharged. 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly in water. Rinse thoroughly with water. 3. Keep electrode properly filled with	1. Standard pH buffer solutions 2. Electrolyte filling solution 3. Electrodes

TABLE 12.1

ROUTINE PREVENTIVE MAINTENANCE
PROCEDURES AND SCHEDULES
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Instrument	*Maintenance Procedures/Schedule*	*Spare Parts in Stock*
	appropriate filling electrolyte solution.	
Conductivity Meter	1. Check battery and replace if discharged 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water.	1. Standard conductance solutions 2. Electrodes
ORP Probe	1. Check battery before use and replace if discharged. 2. Keep electrode properly filled with appropriate filling solution. 3. After use, rinse probe thoroughly with distilled water.	1. Batteries 2. Filling Solution
DO Probe	1. Check battery before use and replace if discharged. 2. Keep electrode properly filled with appropriate filling solution. 3. Check membrane and o-ring after each use. 4. After use, rinse probe thoroughly with distilled water.	1. Batteries 2. Filling Solution 3. Membranes 4. O-Rings

APPENDIX C

HEALTH AND SAFETY PLAN

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(Following Text)

LIST OF APPENDICES

1.0 GENERAL

A Pre-Design Investigation for soil and groundwater will be implemented at the former General Motors (GM) Fairfax I Plant Site in Kansas City, Kansas (Site) by Conestoga-Rovers & Associates (CRA). The activities outlined in the Scope of Work (SOW) may involve drilling, monitoring, and sampling within the limits of, and adjacent to, the Site. During this program, personnel may come in contact with soils, groundwater, and debris that may contain hazardous materials. This Health & Safety Plan (HASP) has been developed to ensure that contact with hazardous materials is minimized.

This HASP is designed to ensure the following:

i) that Site personnel are not adversely exposed to the compounds of concern as well as the physical and biological hazards present on Site;

ii) that public welfare or the environment are not adversely impacted by off-Site migration of contaminated materials due to work activities at the Site; and

iii) that all operations, procedures, and equipment at the Site will meet the requirements of 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, and the applicable subparts of 29 CFR 1926 and 29 CFR 1910.

For the purpose of this HASP, all investigative activities carried out on-Site involving contact with potentially contaminated materials will be considered contaminated operations requiring personal protective equipment (PPE). Similar activities occurring off-Site are considered non-contaminated operations requiring a modified level of PPE from that for on-Site work.

All investigative operations at the Site will be conducted in accordance with the provisions of the HASP. Cost and/or scheduling considerations will not be considered as justification for modifying this plan.

2.0 SITE CHARACTERIZATION AND HAZARD ANALYSIS

CRA was retained by GM to conduct soil and groundwater investigations at the Site. The property includes the former Fairfax I Plant facility (approximately 132 acres) and the active Fairfax II Plant facility. The Site (Fairfax I) as described in this plan comprises property owned by GM in Kansas City. The GM Fairfax I Plant is located along Kindelberger Road and Fairfax Trafficway in Kansas City, Kansas in an industrial area known as the Fairfax District. The Site is located south of a bend in the Missouri River, with the river located north, east, and southeast of the Site. A levee is present between the Site and the Missouri River. Fairfax I is located on the northwestern portion of the Site.

The Fairfax I Plant Site is vacant, however, redevelopment plans have and are being considered by GM and other parties. Operations at the facility ceased in 1986/87, and the facility was demolished in 1987. Soil and groundwater contamination were discovered at the north end of the main plant building in the area of a rail spur and an aboveground tank farm (AOI) in 1987 during an Environmental Site Assessment (ESA) that was completed prior to demolition of the Fairfax I Plant. Subsurface environmental investigations and remediation systems were completed by GM in this AOI subsequent to discovery of soil and groundwater contamination (CRA, July 3, 2000). Groundwater quality data collected in October 1998 indicated that a localized area of groundwater contaminated by volatile organic compounds (VOCs) remains in this area. Soil and groundwater investigations have delineated the source and extent of this localized area of contamination (CRA, June 2000). Soil and groundwater investigations described in this Work Plan are intended to provide data adequate to assess the feasibility of source remediation options.

The former Fairfax I Plant Site is located in the floodplain of the Missouri River. Underlying Site geology soils typically consist of an upper layer of silty clay ranging in thickness from approximately seven to fifteen feet. This silty clay is underlain by fine to medium sands to depths of 25 to 40 feet, which grades into medium to coarse sands with some gravel and clay interbeds to depths of 60 to 80 feet. This interbedded layer is underlain by medium to coarse sands and gravels to the top of the shale bedrock. Shale bedrock occurs at approximately 102 to 117 feet below grade. Groundwater is expected to flow to the northwest and toward the Missouri River.

The primary sources of contamination of soil and groundwater discovered at the Site in 1987 during the ESA were determined to be gasoline and paint thinner from a tank farm along with suspect historic releases of perchloroethylene (PCE) which likely occurred

prior to GM operations. GM initiated its own voluntary cleanup program in 1988, which included semi-annual groundwater monitoring, groundwater contamination plume definition, and remedial design and construction (CRA, July 3, 2000). The remediation system for the small tank farm area comprised groundwater extraction and treatment by air stripping along with soil vapor extraction and treatment by thermal oxidation. The remedial action was initiated in 1991 and shutdown in 1994. The semi-annual groundwater monitoring at the Fairfax I Plant Site (which included analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX); and 1,2-dichloroethylene (DCE)) was also discontinued in 1994.

The investigative activities to be performed as part of the SOW may include:

- water level survey;
- oversight of advancement of soil borings;
- soil sampling;
- land survey of boring locations; and
- groundwater sampling.

A summary of the contaminants of concern (COCs) for the above activities and their related health effects is presented in Table 1 of this HASP. Risks associated with these activities will be minimized by implementing engineering controls, safe work practices, and the proper use of personal protective equipment. Table 2 summarizes the potential hazards associated with activities at the Site.

3.0 BASIS

The Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, CFR, Parts 1910 and 1926 (29 CFR 1910 and 1926) including the amended sections in 29 CFR 1910.120 and current Threshold Limit Values (TLVs) as provided by the American Conference of Governmental Industrial Hygienists (ACGIH) provide the basis for this HASP. Some of the specifications within this section are in addition to OSHA regulations and reflect the positions of the U.S. Environmental Protection Agency (USEPA), the National Institute for Occupational Safety and Health (NIOSH) and the U.S. Coast Guard (USCG) regarding procedures required to ensure safe operations at potential hazardous waste sites.

The safety and health of the public and on-Site personnel and the protection of the environment will take precedence over cost and schedule considerations for all project work.

4.0 RESPONSIBILITIES AND ADMINISTRATION

The following individuals are designated to carry out stated job responsibilities related to this project.

Project Manager:	Phil Harvey
Project Chemist:	Steve Day
Project Industrial Hygienist:	Matthew Lazaric
Project Sampling Team:	CRA Staff
GM Facility Contact:	Kevin Brown

CRA will ensure that an on-Site individual is designated as the Site Health and Safety Officer (HSO). The HSO will supervise the implementation of the HASP and will be responsible for all decisions regarding operations and work stoppages due to health and safety considerations. The HSO will have first aid/CPR training.

The responsibilities of the HSO are as follows:

i) be responsible for controlling and maintaining Site access;

ii) be responsible for implementation of the HASP at the initiation of Site work;

iii) conduct the pre-entry safety briefing for all on-Site personnel with regard to the HASP and other safety requirements to be observed during field sampling, including:

   a) potential hazards,

   b) personal hygiene principles,

   c) personal protective equipment,

   d) respiratory protection equipment usage, and

   e) emergency response procedures.

iv) review and modify the HASP as more information becomes available concerning the hazardous materials involved;

v) supervision and enforcement of safety equipment usage;

vi) supervision and inspection of equipment cleaning;

vii) personnel training in safety equipment usage and emergency procedures;

viii) monitoring of the health and safety program under direction of an industrial hygienist;

ix) suspend work activity if unsafe working conditions develop;

x) inform workers of the nature of chemical exposure risk as required by the "Right-to-Know" Law;

xi) recommend a medical examination when a worker appears to require it;

xii) coordination of the Emergency Response Plan;

xiii) assure that safety equipment is provided, maintained and accessible to Site personnel;

xiv) maintain a log with a sign in/out sheet for personnel performing activities and visitors entering the Site;

xv) assure that workers comply with the "buddy system" while working on Site;

xvi) investigate all accidents, injuries, illnesses, spills, fires, incidents, and near misses; and

xvii) assure that personnel adhere to GM's Fairfax facility-specific health and safety requirements.

5.0 MEDICAL SURVEILLANCE

In accordance with requirements detailed in 29 CFR 1910.120(f), all Site personnel (including contractors and/or subcontractors) who may be exposed to potentially contaminated materials will have received, within one year prior to starting field activities, medical surveillance by a licensed physician or physician's group.

Medical records for all on-Site personnel will be maintained by their respective employers. The medical records will detail the tests that were taken and will include a copy of the consulting physician's statement regarding the tests and the employee's suitability for work.

Each employer will ensure that its personnel involved in on-Site work will have all necessary medical examinations prior to commencing work which requires respiratory protection or exposure to hazardous materials. Personnel not obtaining medical certification will not perform work within contaminated areas.

Interim medical surveillance will be completed if an individual exhibits poor health or high stress responses due to on-Site activity or when accidental exposure to elevated concentrations of contaminants occurs.

6.0 TRAINING

CRA will require that all Site personnel, prior to entering the Site, complete training sessions in accordance with 29 CFR 1910.120(e). This training shall consist of a minimum of 40 hours of instruction off Site and three days of actual field experience under the direct supervision of a trained, experienced supervisor. Each employer will maintain documentation stating that its on-Site personnel have complied with this regulation.

Prior to commencing Site activities, a Site-specific pre-entry safety briefing will be conducted. Topics covered during the pre-entry safety briefing will include:

i) Site-specific health and safety hazards;

ii) level of PPE required;

iii) safe use of equipment;

iv) decontamination procedures; and

v) emergency response procedures.

In addition, CRA will attend orientations and review procedures associated with GM Fairfax-facility specific health and safety protocol.

All personnel who attend this briefing will sign the HASP Acknowledgment Form presented as Appendix A.

All personnel working on-Site shall attend regular safety ("tailgate") meetings. These meetings will be conducted by the HSO, and will cover specific health and safety issues, Site activities, changes in Site conditions, and a review of topics covered in the Site-specific pre-entry briefing. Topics discussed in the safety meetings will be documented along with the signatures of personnel who attend.

7.0 WORK AREAS

Specific work areas, as defined below, will be delineated by temporary fencing or a flagged line.

a) Exclusion Zone (EZ) - This zone will include all areas where potentially contaminated soils or materials are to be handled and all areas where contaminated equipment or personnel travel.

b) Contaminant Reduction Zone (CRZ) - This zone will occur at the interface of the EZ and Support Zone (SZ) and will provide access for the transfer of construction materials and Site equipment to the EZ, the decontamination of vehicles prior to leaving the EZ, the decontamination of personnel and clothing prior to entering the SZ, and for the physical segregation of the SZ and EZ.

c) Support Zone (SZ) - This area is the portion of the Site defined as the area outside the zone of significant air and soil contamination. The SZ will be clearly delineated and procedures implemented to prevent active or passive migration of contamination from the work Site.

8.0 PERSONAL PROTECTIVE EQUIPMENT

CRA will require that engineering controls and work practices designed to reduce and maintain employee exposure at or below the permissible exposure limits (PELs) for the contaminants of concern will be implemented. When engineering controls and work practices are not feasible, a reasonable combination of engineering controls, work practices and PPE shall be used to reduce and maintain employee exposure at or below the PELs for the contaminants of concern.

CRA will require that all on-Site personnel are equipped with PPE appropriate for the nature of work being completed. CRA will require that all safety equipment and protective clothing are kept clean, well-maintained, and that their integrity is intact.

Safety equipment and apparel as required will be Level D, Modified Level D and Level C PPE (as determined by the action levels set forth in Section 9.0) within the EZ. Any decision regarding the upgrading of personal protective equipment will be in conjunction with the Project Industrial Hygienist.

For intrusive activities, Level C or Modified Level D PPE will be required. For intrusive activities conducted off the landfills, and for all monitoring and sampling activities, it is anticipated that Level D PPE will be required. Level C PPE may be required during these activities if the action levels in Section 9.0 are exceeded.

Level D PPE

Type	*Properties*	*Item*
Foot protection	Steel-toe/reinforced shank	Boots
Head protection	Meets ANSI Z89.1 standard	Hard hat
Hand protection	Puncture/tear resistant	Leather/cotton gloves
Eye protection	Meets ANSI Z87.1 standard	Glasses/goggles with side shields

Modified Level D PPE

Type	***Properties***	***Item***
Foot protection	Steel-toe/reinforced shank	Boots
Foot protection	Chemical resistant (latex)	Overboots
Head protection	Meets ANSI Z89.1 standard	Hard hat
Hand protection	Chemical resistant (nitrile)	Inner gloves
Hand protection	Chemical resistant, puncture/ tear resistant (nitrile)	Outer gloves
Eye protection	Meets ANSI Z-87.1 standard	Glasses/goggles with side shields
Body protection	Chemical resistant (tyvek)	Coverall

Level C PPE

Type	***Properties***	***Item***
Foot protection	Steel-toe/reinforced shank	Boots
Foot protection	Chemical resistant (latex)	Overboots
Head protection	Meets ANSI Z89.1 standard	Hard hat
Hand protection	Chemical resistant (nitrile)	Inner gloves
Hand protection	Chemical resistant, puncture/ tear resistant (nitrile)	Outer gloves
Eye protection	Meets ANSI Z87.1 standard	Glasses/goggles with side shields
Body protection	Chemical resistant (tyvek)	Coverall
Respiratory protection	NIOSH approved	Full-face air-purifying respirator with organic vapor/ acid gas/HEPA filter

Additional protective equipment guidelines to be implemented include:

i) prescription eyeglasses in use on the Site will be safety glasses with side shields;

ii) protective gloves (leather palm) will be worn over nitrile gloves by Site personnel involved in drilling activities;

iii) during periods of respirator usage, respirator cartridges and filters will be changed daily, or upon breakthrough, whichever occurs first;

iv) on-Site personnel who have not passed a respirator fit test will not be permitted to enter or work in the EZ;

v) personnel required to wear a respirator will not be permitted to have beards, or long sideburns or mustaches that interfere with the proper fit of the respirator;

vi) all PPE worn onsite will be decontaminated or discarded at the end of each work day;

vii) duct tape will be used to ensure that disposable coveralls and gloves are tightly secured when personnel are working within the EZ; and

viii) no watches, rings, or other accessories will be permitted during sampling activities.

9.0 RESPIRATOR PROGRAM

Prior to arriving at the Site, all on-Site personnel will have received training in the use of, and have been fit tested for a full-facepiece respirator. Companies employing individuals required to perform intrusive work at the Site shall have a written respiratory program that complies with 29 CFR 1910.134.

During intrusive activities, a photo-ionization detector (PID) will be used to determine if organic vapors and some inorganic gases are present in the breathing space. A background reading will be established prior to commencing work activities at each work location.

Sustained (greater than 2-3 minutes) vapor monitoring action levels to determine the level of respiratory protection necessary during field activities will be:

Sustained Photoionization Organic Vapor Reading Above Background	***Protection Level***
0 - 1 ppm	Level D
1 - 25 ppm	full-facepiece air purifying respirator (Level C)
>25 ppm	shut down activities

Work will be stopped and the work area will be allowed to vent if monitoring indicates that organic vapors are present at concentrations which present Immediate Danger to Life and Health (IDLH) conditions, or in excess of the protection factor afforded by the air purifying respirator (whichever is lower).

Air monitoring should continue, at a safe distance, if operations are stopped due to action level exceedences, to determine if a threat to the surrounding community exists.

10.0 JUSTIFICATION

These action levels assume that all NIOSH criteria for using an air-purifying respirator (APR) have been met. An APR can typically be worn in concentrations of up to 50 times the TLV for a given contaminant. All of the contaminants of concern have TLVs or PELs equal to or greater than higher than 1 ppm. Because of differences in sensitivities with direct reading instruments, a 50 percent safety factor is included when determining action levels. Therefore, the calculation to determine when a respirator could no longer be used would be:

1 ppm (TLV) x 50 (protection factor) x 0.5 (50% safety factor) = 25 ppm

The primary routes of exposure of contaminants to individuals performing field investigative tasks include direct contact, ingestion and inhalation. The risk of exposure due to direct contact and ingestion will be minimized through the proper use of PPE as described in Section 8.0 and by exercising ordinary caution during sampling activities. In order to minimize exposure by the inhalation pathway, the respirator and air monitoring programs discussed in Sections 9.0 and 12.0 will be undertaken.

11.0 PERSONAL HYGIENE

CRA will require that all personnel performing or supervising work within the EZ observe and adhere to the personal hygiene-related provisions of this section.

On-Site personnel found to be disregarding the personal hygiene-related provisions of this HASP will, at the discretion of the HSO, be barred from the Site.

CRA will ensure that the following equipment/facilities are available for the personal hygiene of all on-Site personnel:

i) suitable disposable outerwear, gloves, respiratory protection and footwear on a daily basis for the use of on-Site personnel;

ii) disposal containers for used disposable outerwear; and

iii) potable water and a suitable sanitation facility.

CRA also will enforce the following regulations for personnel actively participating in the field sampling program:

i) on-Site personnel will wear appropriate PPE when in the EZ;

ii) used disposable outerwear will not be reused if deemed to be unsuitable to provide the necessary protection, and when removed, will be placed inside disposal containers provided for that purpose;

iii) smoking, eating and drinking will be prohibited within the EZ. These activities will be permitted only within designated areas; and

iv) on-Site personnel will thoroughly cleanse their hands, face, neck area and other exposed areas before smoking, eating or drinking and before leaving the Site.

12.0 AIR MONITORING

During work, air quality will be monitored on a periodic basis.

The air monitoring program will consist of monitoring with a PID for organic vapors in the breathing space. Operation and calibration procedures will be according to manufacturers' instructions. Calibration and maintenance records will be kept in the field log.

Identification of volatile organic vapor levels in excess of the action levels cited in Section 9.0 shall be reported to the HSO who, in conjunction with the Project Industrial Hygienist, will determine when PPE should be upgraded or operations be shut down and restarted.

If work is stopped because action levels have been exceeded, air monitoring will continue from a safe distance to determine if there is a threat to the surrounding community.

13.0 COMMUNICATIONS

Emergency numbers including the police department, fire department, ambulance, hospital and appropriate Regulatory agencies (Table 3) will be prominently posted near the Site telephone(s). These will include specific GM-Fairfax facility emergency contacts.

Prior to initiating Site activities, the emergency medical facility will be notified of Site activities to ensure preparedness to respond to any Site-related injuries. To ensure familiarity with the hospital route, at least one CRA Site representative will drive the route to the hospital, prior to Site activities.

14.0 EMERGENCY AND FIRST AID EQUIPMENT

Safety equipment will be available for use by Site personnel and will be located and maintained on-Site. The safety equipment will include, but is not limited to, the following:

i) a portable emergency eye wash;

ii) one ABC type dry chemical fire extinguishers; and

iii) a first-aid kit for a minimum of ten personnel.

15.0 EMERGENCY RESPONSE PLAN

Prior to commencing work, CRA will coordinate the development of an emergency contingency plan. The plan is intended to provide immediate response to a serious Site occurrence such as injury, explosion or fire. A list of emergency contact numbers is presented as Table 3 of this HASP.

In the event of injury to on-Site personnel, the following protocol will be followed:

i) notify the HSO;

ii) evacuate all personnel upwind;

iii) exit Site;

iv) contact the designated hospital and describe the injury;

v) decontaminate personnel if possible, and administer appropriate first aid. If personnel cannot be decontaminated, alert hospital to possible problems of contamination; and

vi) transport personnel to the medical facility along a predefined route.

16.0 EQUIPMENT AND PERSONNEL DECONTAMINATION

During the Phase II field investigative program, procedures will be implemented to reduce the amount of contact of both personnel and equipment with potentially contaminated materials. These procedures include the following:

i) proper work practices that will lead to minimal direct contact with potentially contaminated material; and

ii) use of disposable equipment and clothing as much as practicable.

All equipment used for the collection of samples for chemical analysis will be cleaned according to the following protocol:

- wash and scrub with low phosphate detergent;
- tap water rinse and steam clean;
- thorough rinse with deionized water;
- air dry; and
- wrap in aluminum foil for transport.

Tap water may be used from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute.

All cleaned equipment will be placed on polyethylene sheeting or aluminum foil in order to avoid contacting a contaminated surface before use.

Before use and between monitoring at each well, the water level measuring device will be cleaned by rinsing the unit with a detergent solution followed by a deionized water rinse.

All personnel will remove their protective clothing and wash their hands, face, neck area and other exposed areas before entering the lunch and break areas to eat, drink or smoke.

17.0 CONTAMINATION MIGRATION CONTROL

All vehicles and equipment used within the EZ will be decontaminated on Site as determined necessary by the HSO prior to leaving the Site. Decontamination, when required, will consist of the thorough cleaning of those parts of the equipment which come in contact with potentially contaminated material. The HSO will certify that each piece of equipment is clean or has been decontaminated prior to removal from the Site.

Personnel engaged in vehicle decontamination will wear protective equipment including suitable disposable clothing, respiratory protection and face shields.

TABLE 1

CONTAMINANTS OF CONCERN
GENERAL MOTORS FAIRFAX I/II PLANTS
KANSAS CITY, KANSAS

Contaminant	TLV	PEL	IDLH	IP (eV)	Flammability Range	Routes of Exposure	Symptoms of Exposure	Other
Benzene	0.5ppm	1ppm	500ppm	9.2	1.2% - 7.8%	Inhalation, Ingestion, Contact	Eye, skin, nose and upper respiratory system irritant	Human carcinogen and skin absorptive
1,2-dichloroethylene	200ppm	200ppm	1000ppm	9.8	5.6% - 12.8%	Inhalation, Ingestion, Contact	Eye and skin irritant, and central nervous system depressant	None
Ethylbenzene	100ppm	100ppm	800ppm	8.8	0.8% - 6.7%	Inhalation, Ingestion, Contact	Eye, skin and mucous membrane irritant, headaches, and dermatitis	None
Perchloroethylene	25ppm	100ppm	150ppm	9.3	NA	Inhalation, Ingestion, Contact	Eye, nose, and throat irritant, nausea, flush face, dizziness, headaches, and kidney damage	Animal carcinogen
Toluene	50ppm	200ppm	500ppm	8.8	1.1% - 7.1%	Inhalation, Ingestion, Contact	Eye and nose irritant, dizziness, headaches, liver and kidney damage	Skin absorptive
Xylene	100ppm	100ppm	900ppm	8.5	0.9% - 6.7%	Inhalation, Ingestion, Contact	Eye, skin, nose and throat irritant, dizziness, exitement, nausea and vomiting	None

NA - Not Applicable
NL - Not Listed
PEL - Permissible Exposure Limit
IDLH - Immediate Danger to Life and Health
IP - Ionization Potential
ppm - parts per million
eV - electron volts

TABLE 2

SITE HAZARD ANALYSIS
GENERAL MOTORS FAIRFAX I/II PLANTS
KANSAS CITY, KANSAS

Site Activities	***Hazards***	***Prevention***
Oversite of Soil Boring Advancement, Monitoring Well Installation, and Soil Gas Sampling Activities	Chemical hazards due to inhalation and dermal contact.	Proper use of PPE.
	Exposure to temperature extremes.	Monitor for heat or cold stress.
	Physical hazards associated with operation of heavy equipment.	Maintain a safe distance from equipment.
		Avoid wearing loose fitting clothing.
		Avoid overhead power lines (20 feet).
		Check and mark underground utilities.
	Physical hazards including steep grades and unstable surfaces.	Use "buddy system" during site activities.
	Biological hazards.	Proper PPE, exercising ordinary caution, use of buddy system during during Site activities.
	High noise level.	Use hearing protection.
	Slip, trip, fall.	Clean mud, snow, or grease from steps of rig.
Sampling Activities	Chemical hazards due to inhalation and dermal contact.	Proper use of PPE.
	Exposure to temperature extremes.	Monitor for heat or cold stress.
	Physical hazards including steep grades and unstable surfaces.	Use "buddy system" during site activities.
	Biological hazards.	Proper PPE, exercising ordinary caution, use of buddy system during during Site activities.

TABLE 3

EMERGENCY CONTACTS
GENERAL MOTORS FAIRFAX I/II PLANTS
KANSAS CITY, KANSAS

Agency/Firm	*Emergency Telephone Number*	*Business Telephone Number*
Local Emergency Services		
GM Fairfax II Plant Site		
Fire Department	911	
Police Department	911	
Ambulance	911	
Hospital (North Kansas City) 2800 Clay Edwards Drive North Kansas City, Missouri 64116		(816) 691-2000
National Poison Center		(800) 942-5969
National Response Center		(800) 424-8802
GM Fairfax Contact - Kevin Brown		(913) 573-7355
CRA Industrial Hygiene - Chicago (Matthew Lazaric)		(773) 380-9933
CRA Project Manager - Phil Harvey		(773) 380-9933
CRA Project Engineer - Sara Anderson		(773) 380-9933
CRA Project Chemist - Steve Day		(773) 380-9933

Directions to the Hospital: Go **southeast** on **US 24** to **I 70** approximately 0.6 miles. Proceed **southeast** on **I 70** approximately 2.9 miles to **I 29**. Take **I 29 north** about 4.1 miles and exit onto **Clay Edwards Drive**.

APPENDIX A

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

APPENDIX A

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

The following employees have read and understood the attached Health and Safety Plan:

Name	*Employer*	*Date*

APPENDIX B

RESPIRATORY PROTECTION PROGRAM

RESPIRATORY PROTECTION PROGRAM

FORMER GENERAL MOTORS FAIRFAX I PLANT
KANSAS CITY, KANSAS

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1.0 RESPIRATORY PROTECTION

1.1 PRACTICE

The primary control of respiratory hazards shall be accomplished, whenever feasible, through the use of engineering controls, hazard substitution, revised work practices or other administrative controls. However, when such controls are not feasible, appropriate respiratory protection shall be used in accordance with the procedures established in this SOP. Any deviation from the requirements set forth must have approval from an IH.

1.1.1 AUTHORIZATION

CRA employees requiring respiratory protection must have authorization from an IH. Office management shall notify an IH of respirator needs. The work situation will then be assessed and a respirator will be issued based on the hazard(s) the individual is exposed to. Reassessment of the hazard and the individual's needs will be repeated periodically.

1.1.2 MEDICAL SURVEILLANCE

All personnel designated to use respirators must successfully complete a physical exam as part of the medical requirements placed on persons exposed to hazardous substances and for users of respiratory protection (29 CFR 1910.134 and 1910.120). The medical exam will be repeated annually. All medical data will be reviewed by a consulting occupational physician. The physician will generate a written opinion on the suitability of the employee to wear a respirator.

1.1.3 AIR QUALITY

When air supplied respirators are used, the breathing air shall meet the Compressed Gas Association (CGA-CG7.1) Standards for Grade D breathing air or better.

1.1.4 AIR CYLINDERS

Cylinders used to supply breathing air are tested and maintained as prescribed in Shipping Container Specifications (49 CFR 178). SCBA cylinders are approximately 2400 psi pressure when full. Compressed air cylinders are visually inspected annually and hydrostatically tested once every five years for steel cylinders and once every three years for composite cylinders. These test dates are stamped on the cylinder for future reference.

1.2 FIT TESTING

1.2.1 QUALITATIVE OR QUANTITATIVE FIT TESTING

Fit testing of the respirator will be conducted by an IH or other designated, trained personnel following the medical evaluation. All users of respirators must be fit tested to assure proper protection. Only the brand and size a person is fitted for is allowed to be used in the field. DO NOT SUBSTITUTE RESPIRATORS FOR A BRAND AND SIZE THAT YOU HAVE NOT BEEN PROPERLY FITTED FOR. The fit test will be accomplished quantitatively for full face APRs. Records will be maintained by the Corporate IH with copies available in CRA field offices for audit purposes. After fit testing, the employee will be issued an authorization card. This card serves as a reference for the proper type of respirator to use as well as prima facie proof of proper medical and training clearance for regulatory purposes. The user shall have the card available at any time when on CRA business where respiratory protection is used or hazardous waste cleanup sites are being entered.

1.2.2 POSITIVE & NEGATIVE FIT TESTING

All personnel will be instructed in the proper method of testing respirator fit by use of the **Positive & Negative** pressure test. This test is to be done by the user each and every time a respirator is donned. This test is performed to help the wearer assess respirator function and find gross leaks between the face and facepiece. This positive-negative pressure test checks the presence and functioning of the respirator valves as well as leakage that may occur due to improper cartridge seal or respirator face fit.

1.2.2.1 POSITIVE PRESSURE

1) Block off the exhalation valve cover openings.

   MSA: Exhalation valve cover can be blocked with the palm of the hand.

   Scott: Exhalation valve covers have front openings as well as four small side openings. These openings are difficult to block off with the hands. However, a small piece of flexible material such as Saran wrap or latex can be used.

   North: Exhalation valve cover has long narrow openings around its perimeter. These can be blocked by encircling the fingers around the valve cover.

2) The person exhales gently, creating a slight positive pressure within the facepiece. The positive pressure should be maintained for at least 10 seconds.

3) If no outward leakage is detected, the person has passed the test.

4) If leakage is detected (usually felt as a cool sensation against the skin or a loss of pressure), the respirator is either malfunctioning or a gross leak between the face and facepiece is present. The following should be done when a failure occurs: Re-don or readjust the respirator.

   If the facepiece continues to lose pressure, although previous positive or negative pressure tests performed with that respirator had passed, it is probably malfunctioning. Consult Industrial Hygiene. It is also possible that there are new scars or wrinkles, beard growth, missing teeth or dentures, significant weight gain or loss, etc. to cause gross leakage into the facepiece. When such new conditions exist, reevaluation of the respirator in a test atmosphere is necessary.

1.2.2.2 NEGATIVE PRESSURE

1) Block off the respirator cartridge inlet openings.

   MSA: Cartridges can be blocked with the palms of the hands or with disposable latex gloves.

Scott: Cartridges can be blocked by using the palms of the hands or with gloves.

North: Cartridges can be blocked only with gloves.

2) Inhale gently, holding the negative pressure for at least 10 seconds.

3) If no inward leakage of air is detected, the person has passed the test.

4) If leakage is detected, see 4 above.

1.2.3 EXCEPTIONS

1.2.3.1 FACIAL HAIR

Any individual with facial hair which protrudes into the sealing surface of the masks will be refused fitting. Fitting, issuance and use will be based on clean shaven faces only. Employees with facial hair which interferes with respirator fit are not permitted to work at sites where respiratory protection must be worn.

1.2.3.2 GLASSES

Employees who wear prescription glasses and must wear a full face respirator shall be fitted with special eyeglass adapters. Contact lenses are not permitted to be worn with any type of respiratory protection.

1.3 TRAINING

Proper training of respirator users is required to insure that all respirators will provide adequate protection against respiratory hazards and so that the user will understand the device's limitations. The training will include the following elements:

1) An explanation of the nature of respiratory hazards and what may happen if the respirator is not used properly.

2) A description of what engineering and administrative controls may be utilized to reduce the effects of the respiratory hazard and why respirators are required.

3) An explanation of the various types of respirators and why specific types have been selected.

4) A discussion of the function, capabilities and limitations of respirator cartridges.

5) Instruction in the inspection, fit and maintenance of the respirator.

6) Instructions in recognizing and handling emergency situations.

1.4 MAINTENANCE AND CARE OF RESPIRATORS

A program for the maintenance and care of respirators will include the following:

1) Inspection for defects;
2) Cleaning and disinfecting;
3) Repair/miscellaneous maintenance; and
4) Storage.

1.4.1 INSPECTION FOR DEFECTS

Employees shall inspect their respirators before each use. A respirator that is not routinely used but is kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory condition. SCBA shall be inspected monthly if kept for emergency response (i.e., long duration site remediation).

Inspection shall include a check of the tightness of the connections and the condition of the face piece, headbands, valves, breathing tubes and canisters. Rubber or elastic parts shall be inspected for pliability and signs of deterioration. Any respirator with worn or defective parts will be immediately taken out of service.

Before and after each use, respirators will be inspected for the following:

1) Tightness of connections and condition of the facepiece;

2) The headstraps or head harness should be examined for: breaks, loss of elasticity, broken or malfunctioning buckles and attachments, and excessively worn head-harness serrations that might permit slippage;

3) Valves and valve seats;

4) Connecting tube and canisters, air or oxygen cylinders;

5) Rubber or elastomer parts for pliability and deterioration; and

6) Regulators, fittings and gauges.

The following contains inspection information for various types of respirators.

Air Purifying Respirators

1) Check rubber facepiece for dirt, pliability of rubber, deterioration and cracks, tears, holes or distortion from improper storage.

2) Check straps for breaks, tears, loss of elasticity, broken snaps and proper tightness.

3) Check valves (exhalation and inhalation) for holes, warpage, cracks, etc. After removing its cover, the exhalation valve should be examined for: foreign material, distortion, defective or missing valve cover or improper installation of valve into the valve seat.

4) Check filters or cartridges for dents, corrosion, etc. (loose or missing gaskets, improperly seated cartridges).

5) Check for cracked or badly scratched lenses in full facepieces; incorrectly mounted lens, broken or missing mounting clips.

Atmosphere-Supplying Respirators

1) Check appropriate items above.

2) Check air supply system for breaks or kinks in supply hoses and detachable coupling attachments.

3) Follow manufacturer's recommendations for the specific equipment.

4) Check air supply level and warning devices.

1.4.2 CLEANING AND DISINFECTING

The respirator must be washed after each day's use. If the respirator is shared it must also be disinfected according to the manufacturer's instructions. Organic solvents of any kind must not be used for cleaning. Air purifying filters must not be wetted.

1.4.2.1 CLEANING

1) Remove any filters, cartridges or canisters and, if required by the manufacturer, straps and speaking diaphragms from the facepiece. Remove regulators on airline or SCBA.

2) Wash respirator parts excluding cartridges and canisters in warm (not to exceed 140°F), soapy water or in a product specifically designed by respirator manufacturers for this purpose. A plastic bristle hand brush may be helpful in removing dirt from respirator parts.

3) Rinse all parts thoroughly in warm water.

4) Air dry all parts.

5) Reassemble the respirator and insert new cartridges if needed.

6) Place the respirator in a plastic bag or container and seal it for storage. The respirator facepiece should be stored in its normal position so as not to distort the elastomer.

1.4.2.2 DISINFECTION

1) Disinfection should be done with a cleaner/disinfection agent purchased from the respirator vendor. If that material is not available the following NIOSH procedures can be followed:

   a) Immerse the respirator body for two minutes in a 50 ppm chlorine solution (about 2 ml bleach to 1 liter of water). Rinse thoroughly in clean water and air dry.

   b) Immerse the respirator body for two minutes in an aqueous solution of iodine (add 0.8 ml of iodine in 1 liter water). The iodine is about 7% ammonium and potassium iodide, 45% alcohol and 48% water. Rinse thoroughly in clean water and air dry.

2) Immersion times have to be limited to minimize damage to the respirator. The solutions can age rubber and rust metal parts.

   NOTE: The air-purifying elements must be removed from the respirator prior to cleaning and sanitizing the respirator. Never allow the air-purifying elements to come in contact with water or cleaning/sanitizing solution.

1.4.3 STORAGE

Respirators must be stored to protect them from contamination and mechanical damage at all times when not in use. New, cleaned or reconditioned respirators are to be kept in a clean, sealed plastic bag or container, stored in a normal position. The plastic bag should be labeled with the users name. A suitable cabinet or drawer should be used to protect respirators and supplies from dirt, extremes of temperature or bright sunlight. They are not to be left in vehicles or on site perimeter fences, in change sheds, etc.

APPENDIX C

HEAT STRESS AND COLD STRESS PROCEDURES

HEAT STRESS AND COLD STRESS PROCEDURES

FORMER GENERAL MOTORS FAIRFAX I PLANT
KANSAS CITY, KANSAS

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1.0 COLD STRESS

1.1 OVERVIEW

Fatal exposures to cold have been reported in employees failing to escape from low environmental air temperatures or from immersion in low temperature water. Hypothermia, a condition in which the body's deep core temperature falls significantly below 98.6°F, can be life threatening. A drop in core temperature to 95°F or lower must be prevented.

Air temperature is not sufficient to determine the cold hazard of the work environment. The wind-chill must be considered as it contributes to the effective temperature. The body's physiologic defense against cold includes constriction of the blood vessels, inhibition of the sweat glands to prevent loss of heat via evaporation, glucose production and involuntary shivering to produce heat by rapid muscle contraction.

The frequency of accidents increases with cold temperature exposures as the body's nerve impulses slow down, individuals react sluggishly and numb extremities make for increased clumsiness. Additional safety hazards include ice, snow blindness, reflections from snow and possible skin burns from contact with cold metal.

There are certain predisposing factors that make an individual more susceptible to cold stress. It is the responsibility of the project team members to inform the Health and Safety Officer to monitor an individual, if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a cold related illness or disorder.

1.2 PREDISPOSING FACTORS

Predisposing factors that will increase an individual's susceptibility to cold stress are listed below:

- Dehydration: The use of diuretics and/or alcohol, or diarrhea can cause dehydration. Dehydration reduces blood circulation to the extremities.

- Fatigue During Physical Activity: Exhaustion reduces the body's ability to constrict blood vessels. This results in the blood circulation occurring closer to the surface of the skin and the rapid loss of body heat.

- Age: Some older and very young individuals may have an impaired ability to sense cold.

- Alcohol Consumption: Alcohol dilates the blood vessels near the skin surface resulting in excessive body heat loss.

- Sedative Drugs: Sedatives may interfere with the transmission of impulses to the brain, thereby interfering with the body's physiological defense against cold. Some prescription drugs may react the same way.

- Poor Circulation: Vasoconstriction of peripheral vessels reduces blood flow to the skin surface.

- Heavy Work Load: Heavy work loads generate metabolic heat and make an individual perspire even in extremely cold environments. If perspiration is absorbed by the individual's clothing and is in contact with the skin, cooling of the body will occur.

- The Use of PPE: PPE usage which traps sweat inside the PPE may increase an individual's susceptibility to cold stress.

- Lack of Acclimatization: Acclimatization, the gradual introduction of workers into a cold environment, allows the body to physiologically adjust to cold working conditions.

- History of Cold Injury: Previous injury from cold exposures may result in increased cold sensitivity.

1.3 PREVENTION OF COLD STRESS

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing cold related ailments and disorders. These include acclimatization, fluid and electrolyte replenishment, eating a well balanced diet, wearing

warm clothing, the provision of shelter from the cold, thermal insulation of metal surfaces, adjusting work schedules and employee education.

- Acclimatization: Acclimatization is the gradual introduction of workers into the cold environment to allow their bodies to physiologically adjust to cold working conditions. However, the physiologic changes are usually minor and require repeated uncomfortably cold exposures to induce them.

- Fluid and Electrolyte Replenishment: Cold, dry air can cause employees to lose significant amounts of water through the skin and lungs. Dehydration affects the flow of blood to the extremities and increases the risk of cold injury. Warm, sweet, caffeine-free, non-alcoholic drinks and soup are good sources to replenish body fluids.

- Eating a Well-Balanced Diet: Restricted diets including low salt diets can deprive the body of elements needed to withstand cold stress. Eat high energy foods throughout the day.

- Warm Clothing: It is beneficial to maintain air space between the body and outer layers of clothing in order to retain body heat. However, the insulating effect provided by such air spaces is lost when the skin or clothing is wet.

The parts of the body most important to keep warm are the feet, hands, head and face. As much as 40 percent of body heat can be lost when the head is exposed.

Recommended clothing includes:

- Inner layers (t-shirts, shorts, socks) should be of a thin, thermal insulating material.

- Wool or thermal trousers. Denim is not a good protective fabric.

- Felt-lined, rubber-bottomed, leather-upper boots with a removable felt insole is preferred. Change socks when wet.

- Wool shirts/sweaters should be worn over inner layer.

- A wool cap is good head protection. Use a liner under a hard hat.

- Mittens are better insulators than gloves.
- Face masks or scarves are good protection against wind.
- Tyvek/poly-coated Tyvek provides good wind protection.
- Wear loose fitting clothing, especially footwear.
- Carry extra clothing in your vehicle.
- Shelters with heaters should be provided for the employees' rest periods if possible. Sitting in a heated vehicle is a viable option. Care should be taken that the exhaust is not blocked and that windows are partially open to provide ventilation.
- At temperatures of 30°F (-1°C) or lower, cover metal tool handles with thermal insulating material if possible.
- Schedule work during the warmest part of the day if possible, rotate personnel and adjust the work/rest schedule to enable employees to recover from the effects of cold stress.

1.3.1 EMPLOYEE EDUCATION

Employees have already been trained to recognize and treat the effects of cold stress during their 40-hour training. Signs, symptoms and treatment of cold stress should be reviewed in project safety meetings where applicable. The buddy system will help in preventing cold stress once the employees are trained to recognize the signs and symptoms of cold stress.

1.3.2 COLD STRESS PREVENTION GUIDELINES

It may not be practically feasible to implement all the above prevention measures. Follow the guidelines given below when the ambient air temperature is -5°F (-20°) or lower:

- Contact the project manager or the industrial hygienest to determine if the project team should be on-site in such temperatures;
- Dress warm;
- Replenish fluids and electrolytes at regular intervals;
- Provide shelter from the cold; and
- Adjust work/rest schedules.

1.3.3 ADJUST WORK-REST SCHEDULES

Follow the work/rest schedule on Table C.1. It is based on the cooling power of air which is a function of wind speed and ambient air temperature.

1.4 FIRST-AID TREATMENT GUIDELINES

The following describes symptoms of different stages in cold stress and the related first-aid treatment guidelines.

1.4.1 FROSTBITE

Stages

Incipient (frost nip)	May be painless. Tips of ears, nose, cheeks, fingers, toes, chin affected. Skin blanched white.
Superficial	Affects skin/tissue just beneath skin; turns purple as it thaws. Skin is firm, waxy; tissue beneath is soft, numb.
Deep	Tissue beneath skin is solid, waxy, white with purplish tinge. Entire tissue depth is affected.

First-Aid

Incipient	Warm by applying firm pressure - blow warm breath on spot or submerge in warm water (102°F to 110°F) (39°C to 43°C). Do not rub the area.
Superficial	Provide dry coverage, steady warmth; submerge in warm water.
Deep	Hospital care is needed. Do not thaw frostbitten part if needed to walk on. Do not thaw if there is danger of refreezing. Apply dry clothing over frostbite. Submerge in water; do not rub.

1.4.2 GENERAL HYPOTHERMIA

Stages

- Shivering
- Indifference
- Decreased Consciousness
- Unconsciousness
- Death

Symptoms

- Muscle Tension
- Uncontrollable Shivering
- Glassy Stare
- Decreased Muscle Function
- Speech Distortion
- Blue, Puffy Skin
- Slow Pulse
- Shallow Breathing
- Coordination Loss

- Stumbling
- Forgetfulness
- Freezing Extremities
- Dilated Pupils
- Fatigue

Emergency Response

- Keep person dry; replace wet clothing
- Apply external heat to both sides of patient using available heat sources, including other bodies.
- Give warm liquids - not coffee or alcohol - after shivering stops and if conscious.
- Handle gently.
- Transport to medical facility as soon as possible.
- If more than 30 minutes from a medical facility, warm person with other bodies.

2.0 HEAT STRESS

2.1 OVERVIEW

Heat induced occupational illnesses, injuries and reduced productivity occur in situations in which the total heat load (environmental plus metabolic) exceeds the body's capacities to maintain normal body functions without excessive strain. Heat stress is the sum of the heat generated in the body plus the heat gained from the environment minus the heat lost from the body to the environment. The body's response to heat stress is called heat strain. The level of heat stress at which excessive heat strain will result depends on the heat tolerance of the individual. Certain predisposing factors may reduce an individual's ability to tolerate heat stress.

Using PPE may put a hazardous waste worker at an increased risk of developing heat stress. Health effects may range from heat rash or heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions such as temperature and relative humidity, protective clothing which limits natural heat loss through perspiration, workload and the individual characteristics of the worker.

It is the responsibility of the project team members to inform the HSO or industrial hygienest if any of the predisposing factors listed below apply to them. This enables the HSO to monitor the individual if necessary, or use other means of preventing/reducing the individual's likelihood of experiencing a heat related illness or disorder.

2.2 PREDISPOSING

Predisposing factors that will increase the individual's susceptibility to heat stress are listed below:

- Lack of Physical Fitness: Such individuals experience more physiological strain including a higher heart rate, a higher body temperature, less efficient sweating and slightly higher oxygen consumption as compared to fit individuals.

- Obesity: Overweight individuals produce more heat per unit surface area than thin individuals and have a lowered ability to dissipate heat.

- Age: Older individuals may have a decreased ability to cope with heat stress.

- Dehydration: Dehydrated individuals will have a decreased ability to cool the body by sweating. Diarrhea can cause dehydration.

- Alcohol, Medications and Drug Use: Alcohol consumption may dehydrate individuals and certain medications/drugs may act as diuretics. Hence, the individual may have a decreased ability to lose heat by sweating.

- Infection, Sunburn, Illness and Certain Chronic Diseases: These factors may interfere with the body's normal mechanisms to lose heat.

- Heart Conditions or Circulatory Problems: Heat stress may place an additional strain on the heart and circulatory system that could harm the individual as well as decrease the individual's physiologic response.

- Low Salt Diet: Could affect the individual's electrolyte balance.

- Pregnancy

- Previous History of Heat Stroke or Heat Exhaustion: May increase the individual's susceptibility to heat stress.

- Heavy Work Load: Will generate metabolic heat thereby increasing the heat stress placed on the individual

- The Use of PPE Over Light Summer Clothing: This will decrease the ability of an individual to lose heat by sweating as evaporative cooling can no longer occur.

- Lack of Acclimatization: Acclimatization is the gradual introduction of workers into a hot environment to allow their bodies to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than non-acclimatized individuals.

2.3 PREVENTION OF HEAT STRESS

There are a variety of measures that can be implemented to prevent or reduce the likelihood of employees developing heat stress related disorders. These include fluid and electrolyte replenishment, the provision of shelter from the sun and heat, work schedule adjustment, the use of cooling devices, acclimatization, heat stress monitoring and employee education, as discussed below:

- Fluid and Electrolyte Replenishment: Personnel should drink about 16 ounces of water before starting work and drink water at every break. To encourage water consumption, cool water and disposable cups should be made available. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, personnel should be encouraged to drink more. Replacing body fluids with Gatorade is an option. It is advisable to have Gatorade on-site if the air temperature is 70°F (21°C) or more and the workers are performing tasks with a moderate to heavy work load in chemical resistant clothing.

- Shelter From the Sun and Heat: Air-conditioned (if possible) or shaded areas should be made available for rest periods. Sitting in an air-conditioned truck is an acceptable option.

- Work Schedule Adjustment: Scheduling work for early mornings and/or late afternoons will avoid the hottest parts of the day and reduce the heat stress placed on personnel. Rotation of personnel will help reduce overexertion of workers and adjusting the work-rest schedule will help personnel recover from the effects of heat stress periodically.

- Use of Cooling Devices: The use of cooling devices like field showers, hose-down areas or cooling vests should be considered for project tasks that involve heavy work loads in chemical resistant clothing.

- Acclimatization: Acclimatization is the gradual introduction of workers into a hot environment to allow their body to physiologically adjust to hot working conditions. Acclimatized individuals generally have lower heart rates and lower body temperatures. In addition, they sweat sooner and more profusely and even have more dilute sweat (thereby losing less electrolytes) than non-acclimatized individuals.

- Heat Stress Monitoring: Monitoring hot environments for potential heat stress should be initiated when the ambient air temperature is in excess of 70°F. There are several ways to monitor heat stress: measuring heart rate, oral temperature, loss of body weight and the Wet Bulb Globe Temperature using a Reuter-Stokes or Quest Electronics heat stress monitor.

- Employee Education: Workers have already been trained to recognize and treat the effects of heat stress during the 40-hour training course. Signs, symptoms and treatment of heat stress should be discussed in site safety meetings. The buddy system will help in preventing heat stress once the employees are trained to recognize the signs and symptoms of heat stress.

2.3.1 PREVENTION PRACTICES

It may not be practically feasible to implement all of the above prevention measures. The following has been developed as a field guide for use in actual field situations.

Ambient air temperature is 70°F (21°C) or more:

- Replenish fluids and electrolytes. Drink cool (50°F to 60°F/10°C to 15°C) fluids hourly. The fluids should be caffeine-free and non-alcoholic. Do not wait until you are thirsty. Your normal thirst mechanism is not sufficient to overcome the effects of dehydration. If you feel thirsty, you are already becoming dehydrated.

- Provide shelter from the sun and heat.

Ambient air temperature is 70°F (21°C) or more and chemical-resistant clothing is being used:

- Same as above;
- Adjust work schedules if feasible; and
- Initiate heat stress monitoring and/or the use of cooling devices.

2.3.2 HEAT STRESS MONITORING

Heat stress monitoring may be performed by monitoring the heart rate. Heart rate should be measured at the beginning of the work shift, at regular intervals and at the start of each rest period.

1) If the heart rate is <110 beats per minute (bpm), personnel may continue the current work/rest schedule.

2) If the heart rate is >110 bpm, take a 10 minute break. Monitor heart rate at the end of the rest period. If not <110 bpm, rest until the heart rate is <110 bpm. Reduce the current work time between breaks by approximately one hour. If the next scheduled monitoring session shows a heart rate of >110 bpm once again, reduce the work time between breaks by one hour.

2.4 HEAT STRESS FIRST AID

2.4.1 HEAT CRAMPS

Cause: Excessive water loss/electrolyte imbalance.

Symptoms	First-Aid Guidelines
Muscular pain in arms, legs, abdomen Faintness, dizziness, exhaustion Normal temp, cool moist skin	Administer sips of Gatorade (1/2 glass every 15 minutes) Do not massage cramping muscles Relax person

2.4.2 HEAT EXHAUSTION

Cause: Large amount of water loss; blood circulation diminishes.

Symptoms	First-Aid Guidelines
Moist, clammy, skin, usually pale	Move to a cool place
Dilated pupils	Apply cold, wet compresses to skin
Weak, dizzy, nauseous, headache	Raise feet 8 to 12 inches
Normal or low body temperature	Administer sips of Gatorade (1/2 glass every 15 minutes)
	Get medical attention

2.4.3 HEAT STROKE

Cause: Body overheats; temperature rises; no sweating occurs

Symptoms	First-Aid Guidelines
No sweating occurs	Get emergency medical assistance ASAP
Dry, hot skin, usually red	Remove from sunlight
Constricted pupils	Wet down body with cool water or rubbing alcohol
Hot body temperature (105°F to 110°F/40.5°C to 43.5°C)	Elevate head/shoulders
Strong, rapid pulse	Wrap in wet, cold wrapping
Unconsciousness may occur	Once cooled to 102°F (38.9°C), stop cooling measures
Muscular twitching	

APPENDIX D

POTENTIAL REMEDIAL TECHNOLOGIES

APPENDIX D

SUMMARY OF REMEDIAL TECHNOLOGIES
PRELIMINARY SCREENING OF POTENTIAL TECHNOLOGIES FOR GROUNDWATER TREATMENT
FORMER FAIRFAX I PLANT SITE
KANSAS CITY, KANSAS

Technology Type	*Description*	*Effectiveness*	*Implementability*	*Additional Data Needs*
Excavation and Off-Site Disposal	Involves removal of the source (i.e., contaminated soil) which can then be transported off-Site for disposal in accordance with applicable regulations. Backfill with clean soil is required. May require groundwater extraction and treatment to lower water table.	• Effective in treating the contaminated soils. • Can potentially result in release of additional contaminants into groundwater.	• Relatively easy to implement. • Relies on conventional construction methods and materials. • May require groundwater extraction to lower groundwater table. • Would require disposal of contaminated material and replacement with clean backfill soil. • Can be completed within 3-6 months.	None
Excavation and On-Site Landfarming	Involves excavation of the contaminated soil and placement of the soil on-Site into a layer of predetermined thickness. The soil is treated by landfarming.	• Effective in treating contaminated soils. • Air emission is a potential problem unless treatment is carried out inside a polytunnel.	• Relatively easy to implement. • Relies on conventional construction methods and materials; however, construction of the soil treatment beds is required. • Intensive labor and maintenance, requires regular tilling, irrigation, and addition of nutrients to enhance bioremediation. • Requires sufficient surface area for soil treatment beds. • Treatment can be completed within 6 months/batch. • To treat all soils in one application will require approx.3 acres of surface area (one acre for preparation and two acres for treatment	• Soil characteristics (e.g., particle size distribution, nutrient levels, moisture content, pH, etc.) • Air emission control/ permit • Need for groundwater monitoring (to protect against leachate contamination if soil layer not lined) or need for liner/pad under soil layer to protect against leaching
Excavation and On-Site Biopile Treatment	Involves excavation of the contaminated soil, mixing with additives, and placement of the soil on-Site into engineered "piles" a few layers in thickness. Air is drawn through the soil pile, which enhances bioremediation.	• Effective in treating contaminated soils in the vadose zone.	• Relatively easy to implement. • Relies on conventional construction methods and materials; however, construction of the soil pile is required. • May require injection of nutrients to enhance bioremediation. • Requires less surface area than landfarming (approx. two acres). • Estimated treatment duration is 9–12 months	• Soil characteristics (e.g., particle size, distribution, nutrient levels, moisture content, microbial count, soil permeability, pH, etc.) • Air emission control/ permit • Groundwater monitoring
In Situ Six Phase Heating	Introduction of heat into the subsurface by using resistance electric probes to increase the volatilization of contaminants from the soil. The volatilized contaminants are collected and treated aboveground by soil vapor extraction and treatment.	• Effective in treatment of VOCs even in tight soils. • Effective in treating capillary fringe zone. • Thermal treatment may adversely impact microbial population during treatment. • Technology is very inefficient in the saturated zone due to highenergy usage to boil water,, dewatering may be required. • Potential exists to mobilize contaminants if system is not carefully controlled.	• Difficult to implement due to design of thermal enhancement system. • Relies on conventional construction methods and materials; however, concurrent installation and operation of a groundwater extraction and treatment system and SVE System is required. Would require strict controls to be in place to control potential mobilization. Additional monitoring wells would be necessary to evaluate progress of treatment and control of system. • Estimated treatment duration is 18 months.	• Soil characteristics (e.g., moisture content, hydraulic conductivity, etc.) • Air emission control/ permit
In Situ Enhanced Bioremediation by Oxygen Injection	Involves injection of a flow of oxygen under pressure into the subsurface soil in a pulsed mode at low flowrates to enhance biodegradation. The gas flow is controlled such that vapors are not generated or accumulated in the vadose zone. The oxygen can be supplemented with gaseous nutrients to stimulate the bacterial growth and enhance aerobic biodegradation.	• Less effective in treatment of tight soils because of poor permeability and potential channeling. • Would be applied through series of injection points advanced through vadose zone above groundwater table.	• Moderately difficult to implement due to tight nature of clayey soils. • Relies on conventional construction methods and materials; however, requires the installation of oxygen injection system at the site. • May require injection of nutrients to enhance bioremediation. • Treatment duration 3-4 years for completion.	• Soil characteristics (e.g., nutrient levels, microbial count, TOC, soil permeability, particle size distribution, pH, etc.)
In Situ Chemical Oxidation (of hot spots/source areas) followed by Enhanced Bioremediation	Application of oxidizing agents, via direct push Geoprobe technique, to destroy BTEX compounds in source areas. Followed by oxygen injection to enhance biodegradation processes and speed up degradation rates of contaminants.	• Effective in treating capillary fringe zone. • Oxidizing agents would destroy hot spots/source area in short time. • Enhanced bioremediation is used as a polishing step to complete treatment.	• Moderately difficult to implement due to the tight nature of soil. • Relies on conventional construction methods and materials. Requires the injection of oxidizing agents to destroy hot spots and high VOC concentrations in the capillary fringe zone. • Require the instillation of oxygen injection system to deliver gaseous oxygen under pressure to enhance microbial degradation of contaminants. • The injection of gaseous nutrients may be required to enhance bioremediation. • Would require 2-3 years for completion.	• Soil characteristics (e.g., nutrient levels, microbial count, TOC, soil permeability, particle size distribution, pH, etc.) • Other hot spots requiring treatment would need to be identified