Industrial Landfill/GWCT Sampling & Analysis Report

General Motors Corporation
Massena, New York

January 2000

Volume I

Prepared By:

Camp Dresser & McKee
Cambridge, Massachusetts 02139

GM
POWERTRAIN

MASSENA PLANT
P.O. Box 460
Massena, New York
13662-0460

January 14, 2000

Chief, New York/Caribbean Superfund Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency - Region II
290 Broadway, 20th Floor
New York, New York 10007-1866

Attention: GM/Massena Superfund Site Project Manager

Re: General Motors-Massena Superfund Site, Massena, New York
EPA Orders Index No. II CERCLA-20207 and 20215
– Industrial Landfill/Ground Water Colletion Trench Sampling Program Final Report

Dear Ms. Kelly:

In accordance with the Industrial Landfill/GWCT Sampling and Analysis Work Plan, enclosed is the final report which provides the results of the sampling program. As discussed in section 2.4 of the Work Plan, the final report includes the results of the Industrial Landfill immunoassay field testing and laboratory analysis of the samples collected during the field program. The results of the geotechnical investigation are also included in the report and will be used to complete the final design of the ground water collection trench.

Should you or your staff have any questions regarding the contents of the report, please contact me at (315) 764-2233 or Jim Hartnett at (315) 764-2239.

Sincerely,

DC Premo

Douglas C. Premo
GM Project Coordinator

Enclosure

1 copy (excluding plans or reports):

Chief, New York/Caribbean Superfund Branch
Office of Regional Counsel
U.S. Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007-1866
Attention: GM/Massena Superfund Site Attorney

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2 copies (or 5 copies if plan or report):

Chief, New York/Caribbean Superfund Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency, Region II
290 Broadway, 20th Floor
New York, New York 10007-1866
Attention: GM/Massena Superfund Site Project Manager

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2 copies (or 3 if plan or report):

Mr. Ken Jock
Environmental Director
St. Regis Mohawk Tribe
Tribal Community Health Building
Route 37
Hogansburg, NY 13655

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1 copy (or 2 copies if plan or report):

New York State Department of Environmental Conservation
317 Washington Street
Watertown, New York 13601-3787
Attention: Regional Hazardous Waste Engineer - Darrell M. Sweredoski, P.E.

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Section 1
Introduction

1.1 Document Intent

This Sampling and Analysis Report was prepared by Camp Dresser and McKee (CDM) for General Motors to document the investigation of the Industrial Landfill at the General Motors Powertrain Facility in Massena, New York. This document presents the scope, methodology and results of work performed to implement the *Industrial Landfill/Groundwater Control Trench Sampling and Analysis Work Plan* (CDM, July 1999).

1.2 Objectives of the Sampling and Analysis

The main objective of this sampling and analysis work was to collect sufficient additional analytical and geotechnical engineering data in several areas of the site to supplement existing data and allow CDM to develop final designs and address the EPA comments. The work was performed at the request of the U.S. Environmental Protection Agency (EPA) to provide additional information on the contents of the landfill and to collect additional data to finalize remedial designs. The specific objectives relative to the Industrial Landfill and GWCT are stated below.

1.2.1 Industrial Landfill

In a letter dated May 27, 1998, EPA requested that GM perform additional characterization of the materials contained in the Industrial Landfill. The letter indicated that performance of Geoprobe sampling on a fifty foot grid with accompanying immunoassay analysis would be considered adequate to address concerns raised by the St. Regis Mohawk Tribe (SRMT).

Chemical data on the landfilled material is not critical for the technical design of the Industrial Landfill closure or the GWCT. However, additional data on the physical properties of the landfill contents were collected which will add to the understanding of the physical properties of the landfill and will be useful in finalizing the designed closure.

1.2.2 Groundwater Control Trench Alignment

In the letter dated May 27, 1988, EPA required additional physical data be provided to alleviate concerns raised during review of the Preliminary Design. EPA recognized that some of the additional data requested was already available but emphasized that additional data should be collected to support the proposed remedial design. The Sampling and Analysis Work Plan identified data which, when collected, would complement the existing data and facilitate preparation of the final remedial design.

The objectives of additional characterization of the GWCT alignment include:

- collect geotechnical data on clay soils;
- collect data on stratigraphy between stations 9+00 and 13+00;
- collect data on stratigraphy between stations 24+00 and the end of the GWCT;
- evaluate the extent of PCB contamination outside of the GWCT alignment; and
- evaluate the appropriate end point of the GWCT.

Soil borings along the eastern side of the GWCT were also used to install monitoring wells and evaluate the groundwater quality along the GM/SRMT property line.

1.3 Background

This section provides a summary of the Industrial Landfill including a site description, site history, and a summary of previous investigations.

1.3.1 Site Description

General Motors Powertrain owns and operates an aluminum and iron casting facility in the Town of Massena, County of St. Lawrence, State of New York. The facility consists of approximately 270 acres, including two parcels of land located between N.Y. Route 37 and the Raquette River.

The GM facility is bordered on the north by the St. Lawrence River, on the east by the St. Regis Mohawk Indian Reservation, on the south by the Raquette River, and on the west by the Reynolds Metals Company and property owned by Conrail, as shown on **Figure 1-1**.

The Industrial Landfill is located in the northeast corner of the General Motors property. It is bounded to the north by the St. Lawrence River and on the east by the St. Regis Mohawk Indian Reservation. It covers approximately 12 acres and rises approximately 35 feet above the surrounding land.

1.3.2 Site History

GM has operated an aluminum casting plant at this location since 1958. From 1968 to 1980, PCBs were a component of the hydraulic fluids used in some diecasting machines at the facility. PCBs provided protection against fire and thermal degradation in the high temperature manufacturing environment. GM no longer uses the same diecasting process or PCBs at the facility.

During operations PCB-containing material dredged from the 1.5 Million Gallon Lagoon and from the wastewater treatment plant was periodically deposited in the Industrial Landfill as well as the North and East Disposal areas. The Industrial landfill also received foundry sand; soil, and concrete excavated during plat construction; furnace and solid industrial waste; construction debris, soil and tree stumps. The Industrial Landfill was covered with an interim cap constructed in 1987 and 1988. CDM developed a preliminary design for landfill closure and construction of site-wide groundwater controls in June 1994.

1.3.3 Previous Investigations

In 1979, Dames & Moore conducted a preliminary investigation to evaluate the effects of disposal practices on groundwater quality a the GM facility (Dames & Moore, January 1982). Investigations in the vicinity of the Industrial Landfill included soil borings and monitoring well installations.

For a Remedial Investigation Feasibility Study (RI/FS), RMT performed additional work in 1985, 1986 and 1987. As part of these investigations soil borings were advanced through and in the vicinity of the Industrial Landfill, soil samples were collected and analyzed for grain size and PCB content and monitoring wells were installed a sampled.

As part of a Comprehensive Sampling and Analysis program, ERM advanced soil borings, installed monitoring and production wells, and performed pumping tests at the Industrial Landfill in 1993.

A compilation of existing soil boring and monitoring well construction logs was presented in Volume II of CDM's *Preliminary Design Report for the Industrial Landfill, East Disposal Area/Containment Area and Site-Wide Groundwater Controls* (CDM, June 1994).

1.4 Document Format

A description of the Sampling and Analysis scope of work and methodology is provided in Section 2. The results of the field program and a laboratory data review are provided in Section 3. Section 4 provides the geologic and hydrogeologic setting of the Industrial Landfill and evaluation of the distribution of PCBs. Tables and figures are provided at the end of each section.

Supporting field and analytical data are included in a separate volume to this document. Boring and monitoring well construction logs are included in Appendix A. Hydraulic conductivity test data are provided in Appendix B. Calculations are provided in Appendix C. Laboratory analytical data for the landfill investigation are provided in Appendix D.

The scope of work and results of the geotechnical evaluation are presented in this document. However, interpretation of geotechnical conditions as they effect the remedial design will be presented in the final design documents.

R:\2940-000\SITE\FIG-1.DWG
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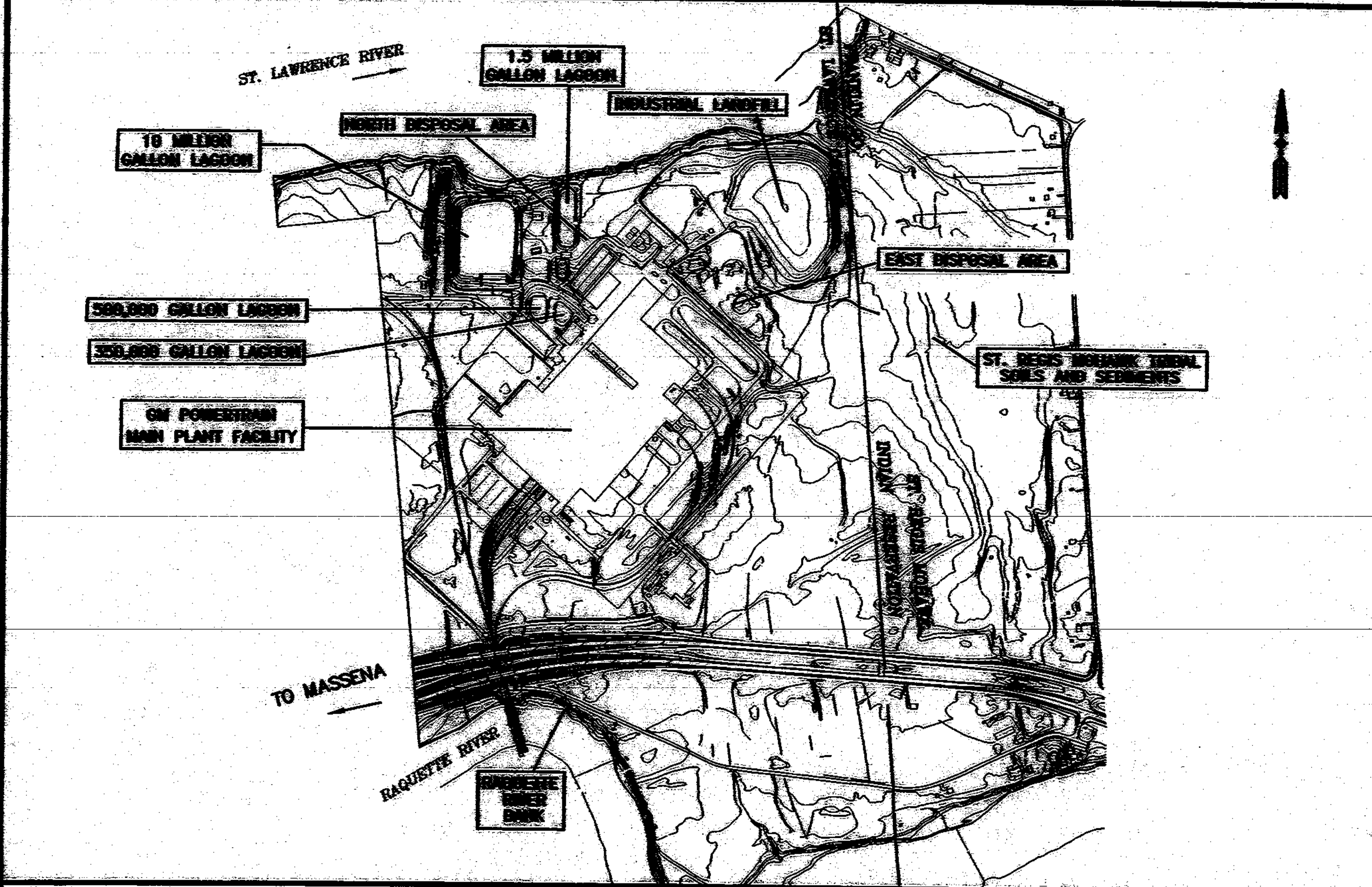

CDM environmental engineers, scientists, planners, & management consultants

GENERAL MOTORS
MASSENA, NEW YORK
LOCATION PLAN
FIGURE 1-1

Section 2
Sampling and Analysis Scope and Methodology

2.1 Introduction

This section provides a description of the sampling and analysis scope of work and methodology. The sampling and analysis work was comprised of two major tasks: an investigation of the Industrial Landfill using Geoprobes and a geotechnical and hydrogeological investigation of the stratigraphy surrounding the landfill with soil borings and monitoring well installations. The following subsections document the investigation scope and methodology for the Geoprobing, soil boring, monitoring well installation and analytical tasks. Oversight of the field program was provided by representatives of EPA (TAMS Consultants) and the Saint Regis Mohawk Tribe. Variances from the Work Plan are described in Section 2.6.

2.2 Geoprobe Borings

2.2.1 Locations

The presence or absence of landfilled material containing greater than 500 mg/kg PCBs was investigated by the advancement of 153 Geoprobe borings (Industrial Landfill Geoprobe or ILGP-001 through -153). Geoprobe locations were laid out on a 50-foot grid over the top of the Industrial Landfill. This spacing resulted in 150 probe locations. Three additional probes were attempted in areas where several refusals were encountered. If refusal was encountered within 10 feet of the ground surface, an additional attempt was made within 5 feet of the original location. Additional Geoprobe attempts at the same location were given a letter designation corresponding to the number of attempts made (e.g., ILGP-012A was the first offset of ILGP-012, ILGP-012B was the second off set attempt). In accordance with the work plan, if refusal was encountered at depths greater than 10 feet the Geoprobe truck was directed to the next location. Geoprobe locations are shown on **Figure 2-1. Table 2-1** presents a summary of the Geoprobe borings performed on the Industrial Landfill. The depths listed in Table 2-1 are the maximum depths reached through all attempts at each location.

Two additional Geoprobe borings (ILGP-154 and ILGP-155) were advanced along the toe of the landfill to provide additional geotechnical and chemical data along the proposed alignment of the groundwater collection trench.

2.2.2 Methodology

Geoprobe direct push borings were advanced in four-foot lengths by a pneumatic hammer attached to a hydraulic derrick which was mounted on the back of a pick-up truck. Push rods and sampler were removed from the hole between samples. A probe point was fixed in place and advanced to the beginning of the target sample depth. Upon reaching the target sample depth, the probe point was released to be pushed up into the sample tube with the sample as the sampler was advanced. Soil samples were collected in clear plastic sleeves. After retrieval, the plastic sample sleeve was cut open lengthwise with a two knife tubing cutter. Soil samples and recoveries were described prior to sample collection. Upon completion, the boring was filled with granulated bentonite.

2.2.3 Soil Sampling

Soil samples were collected continuously from the base of the cap to the top of the pre-landfill ground surface using a four-foot long, one-inch diameter Geoprobe sampler. After descriptions were recorded, a portion of the material collected from each 4-foot penetration was homogenized and placed in clean glassware for immunoassay analysis. Typically, an equal portion of the entire recovered sample was collected. If a particular stained interval was observed in the sleeve, that interval was targeted for sampling and analysis. **Table 2-2** presents a summary of the Industrial Landfill soil sampling and analysis.

2.3 Soil Borings

2.3.1 Locations

Soil borings were advanced at the locations described in the work plan. Soil boring locations are presented on Figure 2-1.

2.3.2 Methodology

The borings were drilled using a CME-75 truck mounted drill rig equipped with a safety hammer operated with a rope on a cathead. The borings were advanced with 4 in. inside diameter flush-joint casing using wash rotary and mud rotary techniques. The casing was advanced by spinning, and the cuttings were washed out with either water or a polymer slurry.

Test Borings B-601, B-602 and B-604, which were completed as monitoring wells, were drilled using only water so that no potentially detrimental material was introduced into the borehole that might impact future water quality samples. The casing was advanced continuously to keep the borehole open during drilling. Borings B-603 and B-605 were drilled using water until approximately 20 ft., where the drillers switched to a polymer slurry. The polymer slurry allowed the borehole to remain open without the use of casing. The polymer slurry was recirculated using a mud tub. The cuttings generated from the drilling operation were placed in drums which were managed by GM. All drilling fluids remaining from the drilling operations were treated on-site in the plant treatment system.

Groundwater levels in each soil boring were typically measured in the morning prior to any drilling activities. Upon completion of the geotechnical investigation, Borings B-601, B-602 and B-604 were completed as monitoring wells. Borings B-603 and B-605 were grouted to the surface using a cement-bentonite grout.

All borings were monitored in the field by a Camp Dresser and McKee (CDM) representative. Boring locations shown on the location plan were determined by survey. Locations and elevations were surveyed and the locations staked prior to the initiation of field work. Boring location B-605 was not moved after initial staking. The as-built locations and elevations of the three monitoring wells and boring B-603 were surveyed after the field work was completed. The logs of the test borings are provided in Appendix A.

2.3.3 Soil Sampling

Soil samples were collected continuously from the ground surface to total depth. The samples were collected using 2-inch diameter split-spoons, 3-inch diameter lined split-spoons, or 3-inch diameter thin-walled tubes.

The 2-inch diameter split-spoon samples were collected according to ASTM D-1586 (2-inch diameter split spoon sampler driven 24 inches by blows from a 140-pound hammer falling freely for 30-inches). The number of blows required to drive the sampler each 6-inch increment was recorded and the Standard Penetration Resistance (N-value) was determined as the sum of the blows over the middle 12-inches of penetration. Representative soil samples from each split spoon were collected and stored in jars for subsequent review and laboratory testing.

The 3-inch diameter lined split-spoons were driven 24 inches using a 140-pound hammer falling 30 inches. The lined split spoons were used to collect samples for possible permeability testing of material which could not likely be collected with a thin-walled tube. The liners consisted of clear plastic tubes. Upon retrieval of the sample, the ends of the liner were capped and the sample stored for subsequent review and laboratory testing.

The 3-inch diameter thin-walled tubes were pushed hydraulically 24 inches. Upon retrieval, the ends of the sample were sealed with wax. Any space between the end of the sample and the end of the tube was then filled with sand and the ends of the tube were capped with plastic caps secured with PVC tape. The ends were then sealed with another coating of wax, and the samples were placed upright in a special container for storage and transport.

A summary of soil boring sampling and testing is provided in **Table 2-3**.

2.4 Monitoring Wells

2.4.1 Locations

Three monitoring wells were installed during the field program. Two wells were installed along GM's eastern property line abutting the St. Regis Mohawk Tribal Reservation. One additional monitoring well was requested by EPA at the beginning of the field program. This well was installed in Boring B-604 between the northwest corner of the Industrial Landfill and the St. Lawrence River. The screen interval of each monitoring well was selected to evaluate the interval with the highest likely hydraulic conductivity based on soil sample visual classifications. Monitoring well surveyed locations and construction details are provided in **Table 2-4**.

2.4.2 Construction

Monitoring wells were constructed with 2-inch interior diameter schedule 40 PVC machine slotted screens and risers. Screen intervals were 10-foot long on wells MW-601 and MW-604. Monitoring well MW-602 was constructed with a 5 foot screen interval to account for the thinner sand interval encountered in the boring at that location. Each well was constructed with a 2-foot silt trap sump. Monitoring well construction details are provided in Table 2-4. Monitoring well schematics are presented on the monitoring well logs presented in Appendix A.

2.4.3 Development

Each newly installed monitoring well was developed using a WaTerra inertial pump. This pump is comprised of a power head attached to the well's surface casing, dedicated polyethylene tubing and a check valve. The power head moves the tubing up and down creating a pumping action at the check valve and water is discharged at the surface. A doughnut shaped polyethylene block can be installed around the check valve to generate surging action across the well screen.

Each newly installed well was developed initially with the surge block installed. The tubing was withdrawn from the well in stages so that the surge block operated across the entire screened interval. The surge block was then removed and the well pumped with the WaTerra pump until the turbidity level stabilized below 50 nephthalometric turbidity units (NTUs). Development water was pumped to drums provided by and managed by GM.

2.4.4 Hydraulic Testing

Rising head and falling head hydraulic conductivity tests were performed on each newly installed well. Tests were performed using a Hermit 2000 automated data logger, down hole pressure transducer and an approximately six-foot long solid PVC slug. Initial water levels were measured prior to installing the pressure transducer. The falling head test was started when the slug was rapidly lowered into the well, displacing water and causing an instantaneous rise of the water level in the well. The falling water levels were recorded at logarithmic time intervals by the data logger. The water level was allowed to equilibrate prior to withdrawing the slug and performing the rising head test. Rising head tests were performed by withdrawing the slug and recording the rising water levels.

2.4.5 Groundwater Sampling

Groundwater samples were collected after purging the wells of a minimum of three well volumes and monitoring to establish that field measured water parameters (temperature, conductivity, dissolved oxygen, salinity and turbidity) had stabilized. Purging and sampling were performed utilizing the dedicated WaTerra pump system for monitoring wells MW-601 and MW-604. These two wells yielded groundwater samples with turbidity values below 50 NTUs. Although Monitoring well MW-602 had produced water with less than 50 NTUs during well development, turbidity values less than 700 NTUs were not produced during sampling even after purging of more than six well volumes. Therefore, monitoring well MW-602 was resampled through the WaTerra tubing using a peristaltic pump to purge the well.

Samples were collected for volatile organic compounds (VOCs), Semi-VOCs and PCBs, kept on ice and transferred to the laboratory under chain-of-custody.

2.5 Sample Analysis

2.5.1 Headspace Screening

Headspace screening for volatile organic compounds was performed in the field and in the field laboratory trailer. Headspace screening for geotechnical borings surrounding the landfill was performed on the headspace of the soil classification sample jars. For Geoprobe samples, the acrylic tube was cut open with a tube cutter containing two razor knives. This resulted in a one inch wide removable lid in the acrylic tube. The sample was scarified with a screwdriver and the probe of the organic vapor monitor (OVM) placed in the headspace created by lifting one side of the 1-inch wide lid. The probe was moved slowly down the sample and any positive readings noted. If any areas of the sample core were found to release VOCs, a portion of this interval was placed in a zip lock bag and a reading taken from the bag after the sample was broken up and/or shaken to release VOCs. If no VOCs were noted during the initial pass with the probe, an interval was selected for headspace screening either randomly or based on visual observations. During periods of rain when the OVM was affected by high humidity, headspace readings for VOCs were performed in the field trailer on the samples submitted for immunoassay testing. OVM readings were recorded on the geoprobe boring logs.

2.5.2 Immunoassay Testing

Field immunoassay testing for PCBs (EPA Method 4020) was performed on the Geoprobe samples collected from the Industrial Landfill. Standards and dilutions were selected to provide a detection limit of 500 mg/kg. Therefore, immunoassay testing was designed to identify soil samples with concentrations greater than or less than 500 mg/kg. A total of 697 samples and 76 blind duplicates were tested.

PAH immunoassay tests were performed on 77 samples with standards and dilutions selected to identify soil concentrations greater than or less than 50 and 500 mg/kg total PAHs. Immunoassay testing was also performed on rinsate blanks. The detection limit was greater than or less than 100 μg/l (0.1 mg/l). Immunoassay testing was performed in accordance with the test kit manufacturer's instructions.

2.5.3 Laboratory Analyses

A total of 70 samples and eight of the 200 series blind duplicates were sent to the laboratory for PCB analysis. Samples were analyzed by EPA Method 8080. Eight samples were forwarded to the laboratory for PAH analyses by EPA Method 8270.

2.6 Variances from the Approved Work Plan

A number of modifications were made to the methods and procedures delineated in the Sampling and Analysis Work Plan during the field program. Modifications were made, as necessary, to accommodate conditions encountered in the field, to address comments and/or to better achieve work plan objectives. After the first week of Geoprobing, GM transmitted a list of proposed modifications to EPA in a letter dated October 4, 1999. A discussion of variances and modifications follows.

2.6.1 Geoprobe Borings

Three additional Geoprobe borings were advanced in the Industrial Landfill to provide additional information in areas were several refusals were encountered. The additional borings were ILGP-151, 153, and 153. They are identifiable on Figure 2-1 as Geoprobe borings which are not located on the regular grid spacing.

Two additional Geoprobe borings (ILGP-154 and ILGP-155) were advanced along the toe of the landfill to provide additional geotechnical and chemical data along the proposed alignment of the groundwater collection trench.

2.6.2 Soil Borings

After the boring locations were staked in the field, it was noted that the proposed location of boring B-603 lay just outside the GM perimeter fence. In addition, the ground surface at the location precluded truck access. A suitable location was available just inside the fence line. The purposes of this boring were to evaluate the geotechnical characteristics of the soil along the proposed alignment of the groundwater collection trench and to evaluate the presence or absence of PCBs identified in MW-16. These objectives could still be met at a location inside the fence line. Therefore, the location of B-603 was moved to be within the fenced property.

As mentioned above, Geoprobes were used to offset boring B-603 to provide additional geotechnical and chemical data along the proposed alignment of the groundwater collection trench.

2.6.3 Monitoring Well Installation

At EPA's request, an additional monitoring well was installed at the B-604 location. The purpose of this well was to allow collection and testing of groundwater quality samples at this location. This well was developed and sampled along with the two monitoring wells proposed in the Work Plan.

2.6.4 Field Testing

Headspace Screening

The Work Plan states that soil samples from the Geoprobe borings would be placed in bowls, covered with foil and screened for VOCs after 5 minutes. However, during the initial borings it was noted that the volume of soil collected in the 4-foot long sampler would not fit in the bowls and that transferring soil to bowls and covering them with foil would interfere with screening and sampling discrete intervals within the samples. An alternative method was identified in the field by the CDM and TAMS representatives where the entire length of the soil sample could be screened in the acrylic tube and selected intervals could be further screened for headspace in a controlled repeatable manner.

Upon retrieval from the sampler, the acrylic tube was placed on a table and opened with a cutter containing two razor knives. This results in a one inch wide removable lid in the acrylic tube. The sample was scarified with a screwdriver and the probe of the organic vapor monitor (OVM) placed in the headspace created by lifting one side of the 1-inch wide lid. The probe was moved slowly down the sample and any readings noted. If any areas of the sample core were found to release VOCs, a portion of this interval was placed in a zip lock bag and a reading was taken from the bag after the sample was broken up and/or shaken to release VOCs. If no VOCs were noted during the initial pass with the probe, an interval was selected for headspace screening either randomly or based on visual observations. This method appeared to improve our ability to rapidly screen the entire sample core and to perform interval specific headspace screening on selected intervals.

Because the OVM is affected by humidity during rain (it gives false positive readings and is subject to damage), an alternative was discussed for those days where Geoprobing would proceed in the rain. On these days, samples collected in the field would be sealed and transported to the field trailer where the immunoassay testing was performed. Each sample was then screened by the immunoassay analyst by inserting the OVM probe into a headspace created between the lid of the jar and the sample. The screening results were recorded on the remarks column of the immunoassay testing results sheet.

<u>PAH Analyses</u>

The Work Plan stated that immunoassays for total PAHs would be performed on the samples selected for laboratory analysis. However, a detection limit was not specified and the provision for confirmatory laboratory analysis was not explicit. An aliquot of the samples being sent to the laboratory was reserved for total PAH analysis by immunoassay. The total PAH immunoassay analyses were performed with detection limits of 50 and 500 mg/kg. A subset of 10 percent of the samples analyzed for total PAHs by immunoassay was analyzed for PAHs by the analytical laboratory using EPA Method 8270.

2.6.5 Laboratory Analyses

<u>Rinsate Blanks</u>

The Work Plan called for collection of a rinsate blank on a daily basis and analysis of these blanks using immunoassay techniques. Because the detection limit of the aqueous immunoassay test is approximately 100 ppb, one rinsate blank was collected and forwarded to the laboratory for analysis by EPA Method 8082 as an additional quality control check.

<u>Duplicates</u>

During sample collection, blind duplicates were submitted to the field laboratory at a rate of just over 10 percent of the samples collected as required by the Work Plan. These samples were labeled as being from the fictitious boring ILGP-200 but the parent sample and duplicate pairs were not known to the immunoassay analyst. Duplicate samples were selected for laboratory analysis from the ILGP-200 series samples. In some instances, the duplicate series sample was improperly selected based on immunoassay testing results without verifying that the parent sample had been forwarded to the laboratory. As a result the number of duplicate pairs submitted to the laboratory was four, not seven as required by the Work Plan.

Section 3
Sampling and Analysis Results

3.1 Introduction

This section presents the results of the sampling and analysis program. These results are presented in tabular and narrative form. A laboratory data quality assessment is provided in Section 3.7. Data evaluation is presented in Section 4.

3.2 Geoprobe Borings

One hundred and fifty three Geoprobe borings were advanced through the Industrial Landfill. Depths of penetration ranged from 8.0 to 36 feet. If refusal was encountered within 10 feet of ground surface, borings were relocated, typically within five feet of the staked location, and advanced again until depths greater than 10 feet were reached. This was the case at all but one location (ILGP-119), where refusal was encountered at a depth of 8 feet on three attempts. Based on partial recoveries, refusals were typically encountered on concrete, or rock located within or near the bottom of the landfill. Native material was reached and identified in approximately half the borings advanced (70 out of 153). In another 14 borings, the anticipated pre-landfill surface elevation was reached but native material was not noted.

The landfill is capped with an interim clay cap, topsoil and grass. The thickness of the compacted clay observed in Geoprobe borings ranged from 4 to 23 inches and averaged approximately 10.5 inches. Compacted clay thicknesses of less than 6 inches were observed at only two locations (ILGP-111, 4" and ILGP-139, 4.5").

The soil types observed in the landfill fell into four general lithologies:

1) General Fill, consisting of fine sand, silt, gravel and clay
2) Foundry Sand, consisting primarily of fine to medium sand
3) Miscellaneous Debris, consisting of metal, wood, plastic, brick fragments, etc., and
4) Native Soil, consisting primarily of fine sand and silt, which typically contained rootlets and trace organic material.

Soil samples were typically dry to moist. The percent moisture recorded for analytical samples ranged from 3 to 29 percent (a native soil sample) and averaged approximately 12 percent. Geoprobe boring logs are presented in Appendix A.

3.3 Soil Borings and Monitoring Wells

3.3.1 Soil Borings

Soil borings were advanced where additional stratigraphic and/or geotechnical information was required and where monitoring wells were installed to characterize groundwater quality proximate to the Industrial Landfill. Soil types encountered in CDM borings are generally consistent with soil descriptions from previous borings. Soils were described and classified in the field, and visual classifications are included in this section. Geotechnical laboratory results, when available, will be used to verify these classifications. Soil boring and monitoring well installation logs are provided in Appendix A.

Boring B-601 is located south of the landfill along the fence line between the GM property and the St. Regis Tribal Reservation. At boring B-601, soil types from the ground surface downward include ten feet of loose, grading to medium dense to dense brown fine sand with some silt (SM), underlain by 18 feet of medium dense brown to olive grey silt with trace clay (ML), underlain by 23 feet of interbedded dense grey silt and fine to coarse sand (ML/SM), underlain by a very dense grey silt with some gravel and trace fine sand (ML). Monitoring well MW-601 was screened from 42 to 52 feet below ground surface across the interbedded silt and sand.

Boring B-602 is located on the east side of the Industrial Landfill. At boring B-602, soil types from the ground surface downward include four feet of medium dense brown silt with little clay (CL), underlain by three feet of very stiff grey brown mottled clay with little silt (CL), underlain by 13 feet of dense grey silt (ML), underlain by four feet of very dense grey medium to fine sand with trace silt and fine gravel (SP), underlain by grey silt with little fine sand and fine gravel (ML). Monitoring well MW-602 was screened from 20 to 25 feet below ground surface across the grey medium to fine sand.

Boring B-603 is located at the northeast corner of the Industrial Landfill. At boring B-603, soils from the ground surface include six and one half feet of medium dense grey brown sand with some gravel (SP/GP), underlain by nine and one half feet of very stiff grey brown mottled clay (CL), underlain by 17 feet of dense grey silt and fine sand with little fine gravel (ML), underlain by very dense grey silt with little fine sand and gravel (ML). Undisturbed tube samples were collected from the clay layer and three-inch lined split spoon samples were collected from the dense grey silt near the base of the boring. No visible evidence of contamination was noted in B-603.

Boring B-604 is located at the northwest corner of the Industrial Landfill. Soils at this location include two feet of brown to olive grey stiff clay with some silt (CL), underlain by 10 feet of medium dense grey silt with some clay (CL), underlain by four feet of hard grey-olive mottled clay (CL), underlain by four feet feet of medium dense grey silt (ML), underlain by 14 feet of interbedded medium to fine sand with little silt and very dense grey silt (SM/ML), underlain by very dense grey silt (ML). Monitoring well MW-604 was screened from 25 to 35 feet below ground surface across the medium to fine sand with little silt (SM).

Boring B-605 is located west of the Industrial Landfill along the groundwater collection trench alignment north of the North Disposal Area. Soils at this location include four feet of medium dense brown to olive silt (ML), underlain by eight feet of very stiff clay with trace to little silt (CL), underlain by ten feet of dense grey silt (ML), underlain by 16 feet of interbedded fine to coarse sand and dense grey silt (SW/ML), underlain by very dense grey silt (ML).

3.3.2 Monitoring Wells

Monitoring wells were installed in three soil borings. Monitoring well construction details were provided in Table 2-4. Monitoring wells were developed prior to groundwater sampling and hydraulic conductivity testing. Each of the newly installed wells was tested by rising and falling head slug tests. The results of the hydraulic conductivity testing are provided on **Table 3-1**. Hydraulic calculations are provided in Appendix B.

3.4 Immunoassay Testing

3.4.1 PCBs

The results of PCB immunoassay testing and laboratory analyses of Industrial Landfill Geoprobe boring soil samples are provided on **Table 3-2**. A comparison of parent and duplicate sample results is provided in **Table 3-3**. Results of PCB immunoassay testing and laboratory analyses of soil boring and peripheral Geoprobe samples are provided in **Table 3-4**.

A total of 697 samples and 76 blind duplicates from the Industrial Landfill were tested for PCBs by immunoassay. Standards and dilutions were selected to provide a detection limit of 500 mg/kg. Therefore, immunoassay testing was designed to identify soil samples with concentrations greater than or less than 500 mg/kg. Of the 697 samples tested for PCBs by immunoassay; 193 (27.7%) had negative photometer readings indicating PCB concentrations greater than 500 mg/kg. A total of 70 samples were forwarded to the lab, 46 of which had negative photometer readings and 24 of which had tested less than 500 mg/kg by immunoassay (positive photometer readings). For the 46 samples which had negative photometer readings, the lowest laboratory derived concentration was 1.8 mg/kg, the highest was 18,000 mg/kg, the mean was 1,109 mg/kg, and the median was 250 mg/kg. PCBs were also detected in each of the samples sent to the lab which tested less than 500 mg/kg by immunoassay. Laboratory concentrations of these samples ranged from 0.10 to 180 mg/kg, the mean was 32 mg/kg and the median was 15.5 mg/kg.

Comparison of the immunoassay tests and the laboratory data indicate a significant conservative bias in the immunoassay testing. There were no false negatives (immunoassay tests less than 500 mg/kg but laboratory results greater than 500 mg/kg). However, only thirteen of the 46 samples (28%) which had negative photometer readings (i.e., tests indicating greater than 500 mg/kg by immunoassay) contained greater than 500 mg/kg based on laboratory analysis. Several factors which may have contributed to this conservative bias are discussed in Section 3.6.

Immunoassay testing was also performed on rinsate blanks. The detection limit was greater than or less than 100 μg/l (0.1 mg/l). None of the rinsate blanks contained detectable concentrations of PCBs.

3.4.2 PAHs

The results of PAH immunoassay testing and laboratory analyses of Industrial Landfill Geoprobe boring soil samples are provided on **Table 3-5**.

PAH immunoassay tests were performed on 77 samples with standards and dilutions selected to identify soil concentrations greater than or less than 50 and 500 mg/kg total PAHs.
Of the 77 samples tested, 12 tested greater than 50 mg/kg total PAHs and 2 tested greater than 500 mg/kg total PAHs. Eight samples were sent to the laboratory. Immunoassay test results correlated with laboratory results.

3.5 Laboratory Analyses

3.5.1 Soil

The results of PCB immunoassay testing and laboratory analyses of Industrial Landfill Geoprobe boring soil samples are provided on Table 3-2. A comparison of parent and duplicate sample results is provided in Table 3-3. Results of PCB immunoassay testing and laboratory analyses of soil boring and peripheral Geoprobe samples are provided in Table 3-4. The results of PAH immunoassay testing and laboratory analyses of Industrial Landfill Geoprobe boring soil samples are provided on Table 3-5.

3.5.2 Groundwater

Groundwater analytical results are provided in **Table 3-7**.

3.6 Immunoassay Data Quality Review

Immunoassay test kits are designed to be conservative. They are designed to provide a 95 percent confidence level that if the test kit result indicates a sample is less than the target level it is, in fact, less than that level. Conversely, the maximum expected false negative rate is 5 percent. The conservative bias is proportional to the dilution of the standards. For example, a test kit designed to read greater than or less than 1 ppm actually tests greater than or less than approximately 0.7 ppm to provide the 95% confidence level. Accordingly, the test kit designed to test greater than or less than 500 ppm actually tests greater than or less than approximately 350 ppm. However, based on the comparison of the immunoassay data with the laboratory data, the conservative bias of the test kits that occurred on the landfill samples was larger than designed.

As part of the immunoassay data quality evaluation, CDM contacted Strategic Diagnostics Inc, (SDI), the manufacturer of the EnSys test kits used at the GM Industrial Landfill characterization, to discuss the Industrial Landfill immunoassay results. SDI ran EnSys and RaPIDAssay immunoassay test kits on ten samples which had been analyzed by CDM and the laboratory. SDI ran the EnSys kits with detection levels of 150 and 500 mg/kg. The results of SDI's comparative analyses are provided on **Table 3-6**. Two of SDI's tests resulted in false positives at the 500 mg/kg detection level (corresponding laboratory concentrations were 480 and 240 mg/kg). Three of the tests resulted in false positives at the 150 mg/kg level (corresponding laboratory concentrations were 88, 15 and 0.23 mg/kg). Five of the ten SDI results correlated with the field immunoassay testing and five did not. Where different, the SDI testing showed less conservative bias than the field immunoassays. However, SDI did note a greater conservative bias in the analyses than is typical for the EnSys test kits.

SDI reviewed the procedures used by the field testers and reviewed records for other projects which used kits from the same test kit lot. No irregularities were identified in the testing procedure performed in the field and no reports of abnormally high false positive rates were reported for other projects where test kits from the same lot were used. SDI noted that the dilution performed on this project (to get to greater than or less than 500 mg/kg) was the largest amount of dilution recommended for use with the EnSys test kit. SDI also noted that similar conservative biases were not noted for the EnSys tests run at the 1 and 10 mg/kg test levels during this project and previously run PCB immunoassays using the EnSys test kit at the GM site.

SDI indicated that interference, sample heterogeneity, mixtures of Aroclors and/or a compounding conservativism in the dilution may have contributed to the conservative bias and the rate of false positives observed on this project. Interference with the test kits may occur in samples that contain substances which react or interfere with the immunoassay test. SDI noted that interference most often occurs during the extraction of absorption phase. In these cases, the immunoassay test kit may indicate a concentration greater than the target amount and the laboratory results indicate a concentration less than that amount (SDI, personal communication, January 6, 2000).

Sample heterogeneity could also cause discrepancies between field and laboratory results. Comparison of the field immunoassay duplicate pair results show that 10 of 74 (13.5%) did not correlate with the parent sample immunoassay test result. Although there is relatively good agreement between the results for a soil matrix, this result indicates some heterogeneity is present in the samples analyzed. This is consistent with field observations where a four-foot long Geoprobe sample tube might contain a variety of soils or materials. Most of the samples collected had a significant proportion of fines (silt and clay) which made homogenization difficult. Although the samples were transferred from the Geoprobe sleeves to a stainless steel bowl and mixed, the fine grained material would often ball up during the homogenization step. This is significant because small aliquots of the soil are used for both the immunoassay testing (10 grams) and laboratory analysis (30 grams). Sample heterogeneity would be expected to yield random discrepancies between the field testing and laboratory. However, if the field analyst typically selected the smaller fraction due to the smaller aliquot requirement or a more stained portion of the sample to be conservative this might result in a discrepancy with a conservative bias.

Although the majority of samples contained exclusively Aroclor 1248, the presence of Aroclor 1254 or 1260 was noted in 9 of the 70 samples sent to the laboratory. The EnSys test kit used at the Industrial Landfill was calibrated based on Aroclor 1248 but is twice as sensitive to Aroclor 1254 and 1260. The minimum detection limit for Aroclor 1248 is 1 mg/kg which was diluted to read greater than or less than 500 mg/kg for this project. The same kit has a minimum detection limit of 0.5 mg/kg for Aroclor 1254 and/or 1260 which would result in a test concentration of greater than or less than 250 mg/kg at the dilution used. These test concentrations listed do not include the approximately 0.7 conservative bias factor discussed above. Therefore, the presence of Aroclor 1254 could result in a conservative bias and resulting false positive immunoassay results.

It is probable that a combination of factors resulted in the significant conservative bias between the field and laboratory results. Due to the conservative bias, immunoassay tests results less than 500 mg/kg strongly indicate a real (laboratory tested) concentration of less than 500 mg/kg

PCBs. However, it is very likely that a significant portion of the samples with immunoassay results greater than 500 mg/kg are also actually less than 500 mg/kg PCBs.

To apply the immunoassay results to the entire data set, CDM performed an analysis of the immunoassay photometer readings compared to laboratory analytical results. None of the samples tested in the lab that had photometer readings between 0.00 and -0.57 had a laboratory measured PCB concentration greater than 500 mg/kg. A plot of the photometer readings vs. the natural logarithm (ln) of the laboratory PCB results yields a linear correlation. A linear least squares best fit line through the plotted data provided the following equation:

$$Photometer = -0.166 \times \ln[LabPCB(mg/kg)] + 0.497$$

with a correlation coefficient (r^2) of 0.671. Substitution of a PCB concentration of 500 mg/kg into this equation yields a photometer reading of -0.535 as the value equivalent to 500 mg/kg PCBs in a sample. A total of 88 samples had photometer readings between 0.00 and -0.53. Seventeen of these samples were sent to the laboratory and all had detectable concentrations of PCBs less than 500 mg/kg. Based on the photometer vs. lab result correlation, immunoassay samples with readings greater than -0.53 should be considered to contain PCBs at concentrations less than 500 mg/kg within a confidence level of approximately 95%. It is important to note that the false positive result for samples with photometer readings less than -0.53 is still approximately 55 percent. Therefore, it is still likely that a percentage of the samples which had photometer readings less than -0.53 contain PCBs at concentrations less than 500 mg/kg. However, this percentage cannot be accurately estimated with the data available. Therefore, an adjusted immunoassay result based on photometer readings greater than or less than -0.53 is used in the data evaluations provided in Section 4.

There were no discrepancies noted between PAH immunoassay testing and the corresponding laboratory analytical results.

The 86.5 percent agreement between immunoassay field duplicate pairs indicates that although some heterogeniety is present, the samples are representative of the sample interval tested. Because the immunoassay results are conservative, they are useful to characterize the material within the landfill which does not contain PCBs greater than 500 mg/kg. When adjusted to equate photometer readings less than -0.53 to indicate PCB concentrations greater than 500 mg/kg, they are useful in characterizing the rest of the landfill material tested. However, it is important to consider that there was still an approximate 55 percent false positive rate for those samples sent the the laboratory which had photometer readings less than -0.53. Therefore, the number of samples and volumes of material represented by the immunoassay results as containing greater that 500 mg/kg is likely to still be conservative.

3.7 Laboratory Data Quality Assessment

3.7.1 Introduction

This section presents the data quality assessment (DQA) for the laboratory results of PCB and PAH testing of soil and groundwater conducted as part of the Industrial Landfill sampling and analysis program. Soil samples were collected September 27, 1999 through October 27, 1999. Groundwater samples were collected on December 9 and 13, 1999. In accordance with the work plan, soil samples were tested in the field using the EnSys Immunoassay kit for PCBs and a fraction of all the soil samples collected were sent to Galson Laboratories for analysis. Samples were analyzed for PCB Aroclors using EPA method 8082, and a smaller subset of samples were analyzed for PAHs using EPA method 8270. Groundwater samples were analyzed for PCB aroclors using EPA Method 8082, semi-volatile organic compounds (SVOC) by EPA Method 8270 and volatile organic compounds (VOC) using EPA Mehtod 8260. Each sample delivery group (SDG) was reported in conformance to NY DEC ASP Level B deliverables package. The samples submitted for laboratory testing are listed below, organized by the SDG designation given to the sample set at the laboratory.

Samples Submitted for Laboratory Analysis

Soil

SDG	L54748	L55089	L55115	L55142	L54564	L54956	L55305
Parameter	PCB	PCB	PCB	PAH	PCB	PCB	PCB
Sample list	ILGP-004-04 -005-05 -011-04 -022-02 -032-05 -033-08 -033-09 -045-07 -069-05 -069-06 -100-05 -100-06 -107-02 -109-05 -110-05 -115-02 -123-02 -200-25 -200-32	ILGP-037A-04 -037A-06 -038-06 -038-07 -038-08 -048-04 -048-05 -049-05 -059-05 -059-06 -060A-04 -060A-05 -061-05 -061-06 -061-07 -145-04 -145-05 -200-47 -200-49	ILGP-006-06 -007-04 -007-05 -007-07 -015-05 -015-06 -016-04 -016-07 -025A-05 -131-02 -138B-03 -140A-05 -141-06 -141-07 -141-07 (Native) -142-05 -143-04 -200-59	ILGP– 006-06 -007-05 -015-05 -015-06 -016-04 -016-07 -025A-05 -131-02	ILGP-001-05 -002-03 -009-04 -009-05 -018-03 -019-05 -019-06 -020-06 -030-05 -041-05 -053-04 -064-02 -200-01 -200-07 -Rinsate-3	ILGP-081-02 -081-06 -082-06 -082-08 -082-09 -092-01 -092-02 -200-40	ILGP-154-01A -154-01B -154-02A -154-02B -154-04A -154-04B -154-04C -155-02A -155-02B Note: This SDG contained the final samples collected for the ILGP and also included samples from the Raquette River study which are not included in this discussion

Groundwater

SDG	L56369	
Parameter	VOC, SVOC, PCB	Collected on:
Sample list	MW-601-01 MW-602-01 MW-602-02 MW-603-01 MW-603-02 MW-604-01 Trip Blank Trip Blank	12/9/99 12/9/99* 12/13/99* 12/9/99 12/9/99 12/9/99 12/13/99

The intent of this review is to provide a general assessment of the overall quality of the data packages. This DQA is based upon the review of the summary data package submitted for each SDG and a random sample of the raw data submitted.

Laboratory quality control data associated with these samples were reviewed in accordance with EPA SW-846 and EPA Region II CLP data validation criteria as referenced in Organics Data Review , SOP No. HW-6, Revision 11, June, 1996. The analytical criteria was assessed against the methods as written in SW-846 and acceptance criteria and guidelines for action were as given in the EPA Region II guidance. This assessment includes a review of the reported quality control results, sample results and associated chain of custody (both field generated and internal laboratory) documents. Project-generated quality control data were also reviewed. Field blank samples as well as field duplicate samples were included as part of the sampling program.

3.7.2 Data Summary Review

The data summary packages for each SDG was reviewed.
The data summary packages included:

- Cover letter
- Sample receipt and deliverable package checklists
- NYS DEC Summary Forms
- Chain of Custody forms
- Quality Control Data Summary
- Sample Data (Form I)

This assessment includes a review of:

- Sample Holding Time Data
- Matrix Spike/Matrix Spike Duplicates
- Surrogate Spike Recovery
- Laboratory Reference Samples
- Laboratory Method Blanks
- Sample results

It was noted that the sample preparation method used for soil samples varied by analytical batch between EPA method 3550 (sonication) and method 3540 (soxhlet) extraction techniques. While both of the preparation methods used are valid techniques for the analytical methods used (8082 and 8270); it is preferable to maintain consistent preparation and analysis techniques for a data set.

3.7.3 Chain-of-Custody (COC) and Hold Times

Review of COC documents, prep laboratory records and summary tables in the report packages indicate that samples were received at the laboratory in good condition and within the required holding times. NYS DEC requirements specify a holding time of up to five days beyond the verified time of sample receipt (VTSR) for sample extraction and 40 days from the time of sample extraction to analysis. In addition, the VTSR must be within 48 hours of sample collection.

3.7.4 Blanks

Soil

Laboratory method blanks were prepared and analyzed with each analytical batch. Laboratory blank results showed the absence of any contamination problems with aqueous blanks reported as non-detect at 0.56 μg/L PCB Aroclors (0.56U) and solid blanks non-detect at 330 μg/kg PCB Aroclors and PAH compounds (330U). The field rinsate blank submitted as part of SDG L54564 was reported as a non-detect (0.56U PCB Aroclors).

Groundwater

Laboratory method blanks were prepared and analyzed with each analytical batch. Methylene chloride was detected in two of the Laboratory Blanks analyzed with the samples at 9 and 5 μg/L. Results for samples MW-601-01, MW-603-01, MW-603-02 and the Trip Blank received at the laboratory on 12/10/99 reported methylene chloride as estimated values below the reporting limit with a qualification for the blank results (2JB). It is recommended that the methylene chloride results be reported as "not detected" at the standard reporting limit (5U). Laboratory blank results showed the absence of any contamination problems with aqueous blanks in the analysis of samples for semi-volatiles and PCBs. It was noted that a few sample results included phenol detected at the reporting limit and diethylphthalate detected below the reporting limit; but these compounds did not appear in the laboratory blanks.

3.7.5 Matrix Spike/Duplicate

Soil

The MS/MSD results produced little useful information. The dilutions required due to the levels of PCB found in the samples caused the spiked compounds to be "diluted out" and unquantifiable in a majority of the MS/MSD sets. The MS/MSD performed on the one sample with lower PCB concentrations (B-603 S-13 as part of SDG L55305) showed recoveries and precision within acceptance limits. The MS/MSD for PAH analysis (SDG 55142 sample ILGP-006-06) showed acceptable recovery of the spiked compounds and precision between the spiked pair as just above the advisory limits. Additional evaluation of the MS/MSD pairs is discussed in Section 5.0.

Groundwater

Recovery of spiked target compounds from sample MW-602-02 indicate that the analyses (VOC, SVOC and PCB) were in control relative to precision and accuracy. Additionally, blank spike samples were analyzed by each method with acceptable results.

3.7.6 Surrogate Compound Recovery

Soil

As in the discussion of the MS/MSD data, the dilution required for PCB analysis caused the surrogate compounds to be "diluted out" and little useful information was available for review. The surrogate recoveries for control samples (blanks and blank spikes) were all within acceptance limits. The surrogate compounds recoveries for those samples not requiring dilutions of 10x or greater showed acceptable recoveries. The surrogate recoveries for the PAH analyses (SDG 55142) were all within acceptance limits.

Groundwater

Recovery of surrogate spike compounds from the VOC, SVOC and PCB analytical samples showed acceptable recoveries.

3.7.7 Laboratory Reference Samples

The laboratory analyzed Blank Spiked (BS) samples with each analytical batch and the recovery of PCB and PAH from these control samples was within acceptance limits. It was noted that the acceptable recovery limits for PCB in the BS varied from batch to batch (68-106%R for Aroclor 1016 and 80-117%R Aroclor 1260 in batches L54748 and L54564, 58-106%R for Aroclor 1016 and 50-117%R Aroclor 1260 in batches L55089, L55115 and L54956). The recoveries reported for all samples were greater than 50% and the recovery for at least one of the two spiked Aroclors was within the most stringent acceptance limits.

3.7.8 Field Duplicates

A fraction of the samples collected were submitted to the laboratory as blind field duplicates. Unfortunately, of the 10 samples submitted as duplicates only three samples had the parent sample submitted for laboratory analyses (the remaining seven were only tested using the field test method). The results of the complete duplicate analyses are presented below.

Field Duplicates (results as μg/kg)

Duplicate Sample	Original Sample	Original Result	Duplicate Result	RPD
ILGP-200-01	IGLP-009-04	25,000 AR1242 7,700 AR1254	26,000 AR1242 7,700 AR 1254	3.92% 0.00%
ILGP-200-07	IGLP-053-04	1,500,000 AR1248	1,900,000 AR1248	23.5%
ILGP-200-40	IGLP-081-02	17,000 AR1248	25,000 AR1248	38.1%
ILGP-200-59	IGLP-016-04	17,000AR1242	94,000 AR1248	N/A

The results of the duplicate analyses for samples IGLP-009-04, ILGP-053-04 and IGLP-081-02 showed general agreement between the duplicate pairs. However, in the analysis of IGLP-016-04 and its duplicate, the laboratory identified the Aroclor as 1242 in the original analysis and 1248 in the duplicate. The quantitation of Aroclor based on those identifications shows 139% relative percent difference (RPD). This result may be attributable to:

- Environmental weathering of the Aroclor making laboratory identification of the PCB tenuous between 1242 and 1248
- Sample heterogeneity
- Field error in mislabeling or attributing the sample and duplicate

When Aroclor 1242 is subjected to environmental weathering, the lighter weight components (early eluting peaks on a GC) are often diminished in relation to the heavier components and the GC pattern may be appear similar to Aroclor 1248.

Review of the sample results indicates that the landfill material is extremely heterogeneous. Samples from the same Geoprobe boring at varying depths can contain varying concentrations of differing PCB Aroclors.

This is an isolated incongruity and all other precision data indicate that the system was achieving the required quality objectives.

3.7.9 Raw Data Review

Soil

In order to perform a random sampling review of the raw data, three SDGs were selected at random and eight samples from those SDGs were selected. The raw data from each of these SDGs was reviewed to evaluate whether or not the calibration requirements and sample result calculations were properly performed. EPA method 8082 specifies that quantification is based on the average response of five peaks for each Aroclor. The full five level calibration response factor for each Aroclor is applied to the average response from the same five peaks detected in a sample to arrive at the extract concentration. The sample preparation information is then used to calculate the final soil concentration.

The continuing calibration data was reviewed to ensure that the daily check standard results were acceptable and continuing calibration standards for each Aroclor detected in field samples in that analytical sequence were analyzed. The raw data from each of the selected samples was then used to verify the calculated sample results reported on the sample result forms (Form I). The samples that were reviewed are listed below.

The following samples were subjected to raw data review:

SDG	Sample
L54956	ILGP-081-02
L54956	ILGP-092-01
L54748	ILGP-033-09
L54748	ILGP-045-07
L54748	ILGP-100-06
L55115	ILGP-006-06
L55115	ILGP-016-07
L55115	ILGP-141-07

All of the raw data reviewed (initial calibration, continuing calibration and sample result calculations) was found to be acceptable.

Groundwater

The raw data package received for this SDG was reviewed to ensure that the calibration requirements and sample result calculations were properly performed. Continuing calibration data was reviewed to ensure that the daily check standard results were acceptable. The raw data from sample MW-601-01 was then used to verify the calculated sample results reported on the sample result forms (Form I). All of the raw data reviewed (initial calibration, continuing calibration and sample result calculations) were found to be acceptable.

3.7.10 Evaluation of MS/MSD Data as Replicates

Because of the paucity of precision data from field duplicates and the fact that required dilutions rendered the spike recoveries from MS/MSD samples mostly useless for determining quality – the MS/MSD data was evaluated as replicate data. Because the Aroclor concentration(s) inherent to the sample greatly exceeded the spike amounts in the MS/MSD samples, and the spiked Aroclors were not the same as those found in the parent samples – the MS/MSD could be used as a gauge of laboratory analytical precision. Three sample/MS/MSD groups from three SDGs were evaluated.

The original (parent) sample result and the MS/MSD sample result for the Aroclor present in the parent sample are presented below. Because three concentration values were available for each Aroclor detected in the samples; relative standard deviation (RSD) was used to evaluate the data rather than the RPD statistic generally used for duplicates

Results of Sample/MS/MSD groups

Sample	Original Result*	MS result*	MSD Result*	%RSD
ILGP-141-07	150,000 AR1242	180,000 AR1242	150,000 AR1242	11%
ILGP-141-07	15,000 AR1260	22,000 AR1260	18,000 AR1260	19%
ILGP-092-01	36,000 AR1248	34,000 AR1248	29,000 AR1248	11%
ILGP-033-09	31,000 AR1248	29,000 AR1248	21,000 AR1248	20%

*All results as μg/kg corrected for moisture.

These RSD levels indicate that the precision exhibited by the laboratory for the analysis of PCBs in these samples is within an acceptable range.

3.7.11 Data Review Conclusions

Soil

Evaluation of the laboratory data from the Industrial Landfill Geoprobe program indicate that the analytical program generally met requirements for precision and accuracy. The only problem encountered was the incongruous Aroclor identification and quantification for the duplicate of sample of ILGP-016-04. Data review guidelines do not require qualification of the data based solely upon the duplicate incongruity, but suggest additional investigation may be required. Because of the dilutions required for many of the samples, surrogate compound recovery and MS/MSD recoveries could not be fully evaluated. Those quality control data that yielded useful information were generally in control. Evaluation of raw data showed that the laboratory properly carried out calibration and quantification schemes. Evaluation of MS/MSD data for precision showed that the analytical laboratory yielded acceptable precision. Based on the results of this review, the data from the laboratory analysis of Geoprobe boring samples can be used without qualification.

Groundwater

Evaluation of the laboratory data from the Industrial Landfill groundwater samples indicates that the analytical program generally met requirements for precision and accuracy. Evaluation of raw data showed that the laboratory properly carried out calibration and quantification schemes.

Evaluation of MS/MSD data for precision showed that the analytical laboratory yielded acceptable precision. Based on the results of this review, the data from the laboratory analysis of the groundwater samples can be used without qualification.

Section 4
Data Evaluation

4.1 Introduction

This section presents an evaluation of data collected during the Sampling and Analysis program and information available from previous investigations. Information on the geologic setting and stratigraphy are summarized to provide context for the characterization of the Industrial Landfill and its proximity.

4.2 Geologic Setting and Stratigraphy

The.Industrial Landfill is situated at the northeast corner of the General Motors Powertrain facility. The landfill occupies approximately 12 acres and rises approximately 35 feet above the surrounding land. The volume of the landfill is estimated to be 424,000 cubic yards. The landfill has an interim clay cap which reduces the amount of water infiltrating into it. Storm water drainage from the Industrial Landfill cap flows to a perimeter swale which directs stormwater to a corrugated metal pipe culvert location at the northeast corner of the landfill. The culvert discharges to a cove at the northeast corner of the site.

Figure 4-1 presents the location of three cross sections (**Figures 4-2, 4-3, and 4-4**) drawn through the Industrial Landfill and the alignment of the groundwater collection trench. These cross sections illustrate the subsurface geology, the alignment of the proposed groundwater collection trench and the results of the Industrial Landfill characterization.

Based on historical topographic maps, the bottom of the landfill ranges from approximately Elevation 185 in the south (near ILGP-130) to approximately 168 in the northeast corner (near ILGP-140). The average elevation is approximately 176.2 feet. The Geoprobe borings which encountered native material below fill confirmed that the estimated pre-industrial landfill elevations are typically accurate within one to two feet. Shallow water levels in monitoring wells surrounding the landfill range from Elevation 187.5 at the southwestern corner (MW-6, 7/13/93), to 164.65 at the northern edge (MW-16B, 9/18/93). Based on a comparison of shallow water levels and nearby pre-Industrial Landfill ground elevations, the majority of the landfill is above the local water table.

Up to 10 feet of marine clay (which overlaps brown till) underlies the northern portion of the Industrial landfill. In the middle portion of the landfill, approximately 10 feet of brown till is present beneath the fill materials (grey till is present below the brown till). The southernmost portion of the landfill lies directly over upper grey till. There is approximately 20 feet of grey till present beneath the landfill. These units exhibit permeabilities on the order of 10^{-6} to 10^{-7} cm/sec.

Underlying the gray till is the upper glaciolacustrine unit. The upper glaciolacustrine unit appears to be present only beneath the northern portion of the landfill. The upper grey till and upper glaciolacustrine unit are underlain by approximately 40 to 60 feet of the lower grey till and the lower glaciolacustrine unit (where present).

4.3 Characterization of Industrial Landfill

4.3.1 Application of Immunoassay Data

As noted in Section 3, CDM evaluated the immunoassay and laboratory results and identified a photometer reading which more closely approximates the greater than or less than 500 mg/kg target of the investigation. This photometer reading (-0.53) is applied in this interpretive section to account for some of the conservative bias. It should be noted that the application of this photometer value is still considered conservative in that none of the samples with photometer reading between zero and -0.57 had laboratory concentrations greater than 500 mg/kg PCBs and there was still an approximate 55 percent false positive rate (immunoassays indicated greater than 500 mg/kg PCBs while the laboratory result was less than 500 mg/kg total PCBs).

4.3.2 Distribution of PCBs within the Industrial Landfill

The distribution of PCBs as indicated by the immunoassay testing is discussed below. Several figures are provided to illustrate PCB distributions and aid the discussion. Tabulated results of immunoassay and analytical testing by sample depth interval are contained in **Table 4-1.** **Figures 4-5** through **4-13** present the spatial distribution of immunoassay detections (adjusted for the photometer reading of -0.53) by four foot intervals. This presentation illustrates the distribution of PCBs by depth below the top of the landfill surface.

None of the 32 -01 (0-4') interval samples tested contained greater than 500 mg/kg PCBs based on adjusted immunoassays, and only two of 150 and three of 144 samples from the -02 (4-8') and -03 (8-12') intervals had adjusted immunoassay results greater than 500 mg/kg. Fewer -01 (0-4') interval samples were tested because based on comparison of the pre- and post-cap surface elevations and visual characterizations of the samples, it was determined that much of this material was grading fill and not landfilled material. It is apparent from these figures that the majority of landfill material containing PCBs greater than 500 mg/kg is located more than 12 feet below the landfill's surface.

Figures 4-14 through **Figure 4-21** present the distribution of adjusted immunoassay results by 5-foot elevation intervals. Tabulated results of immunoassay and analytical testing by elevation are provided in **Table 4-2.** Minimum sample elevations were calculated by subtracting the depth penetrated with that sample (e.g., interval -04 X 4-feet per sample interval = 16 feet) from the ground surface elevation of the Geoprobe location. This presentation illustrates the distribution of adjusted immunoassay results at specific elevation intervals through the landfill. The following is a discussion of the immunoassay and laboratory results by elevation interval.

A total of 40 samples were collected above El. 200. Five of these had negative photometer readings but only one of these had an adjusted immunoassay result greater than 500 mg/kg. None of the samples from this interval were sent to the lab.

A total of 92 samples were collected between El. 195 and El. 199. Four of these had negative photometer readings but none of these had an adjusted immunoassay result greater than 500 mg/kg. None of the samples from this interval were sent to the lab.

A total of 150 samples were collected between El. 190 and El. 194. Sixteen of these had negative photometer readings but only three of these had an adjusted immunoassay result greater than 500 mg/kg. None of the samples from this interval were sent to the lab.

A total of 150 samples were collected between El. 185 and El. 189. Fifty nine samples had negative photometer readings and 27 of these had an adjusted immunoassay result greater than 500 mg/kg. Twenty samples from this interval were sent to the lab and four of these had laboratory concentrations greater than 500 (ILGP-030-05, ILGP-053-04, ILGP-069-06 and ILGP-081-06).

A total of 126 samples were collected between El. 180 and El. 184. Sixty of these had negative photometer readings and 36 of these had an adjusted immunoassay result greater than 500 mg/kg. Seventeen samples from this interval were sent to the lab. Three of these had laboratory concentrations greater than 500 (ILGP-020-06, ILGP-045-07 and ILGP-061-05).

A total of 83 samples were collected between El 175 and El. 179. Thirty-three of these had negative photometer readings; twenty three of these had an adjusted immunoassay result greater than 500 mg/kg. Eleven samples from this interval were forwarded to the lab and three of these had laboratory detections greater than 500.

A total of 49 samples were collected between El. 170 and 174. Thirteen of these had negative photometer readings; ten of which had adjusted immunoassay results greater than 500 mg/kg. Eight samples from this interval were forwarded to the lab. Two of these had lab results greater than 500 (ILGP-061-07 and ILGP-082-09).

Seven samples were collected between El. 165 and El. 169. Three of these had negative photometer readings but only one of these had an adjusted immunoassay result greater than 500 mg/kg. Five samples from this interval were forwarded to the lab, one of which had immunoassay test results greater than 500 ppm. Only one of the samples from this elevation (ILGP-141-07, concentration 830 mg/kg) had a laboratory concentration greater than 500 ppm.

Figure 4-22 is a plan view identifying the location of schematic cross sectional profiles. Differential shading is used on the schematic cross sections presented in **Figures 4-23** through **4-34** to provide a different perspective to illustrate the distribution of PCBs within the landfill based on adjusted immunoassay results. A total of 146 Geoprobes are represented on the twelve sections. Most of the material potentially containing greater 500 mg/kg PCBs is distributed across a wide area located within the middle of the landfill and beneath at least 12 feet of less contaminated material. Samples were typically collected of a stained interval if noted, while many of the samples contained a mixture of materials, not all of which were stained. Based on these observations, it is likely that material with greater than 500 mg/kg of PCBs is unevely distributed within the intervals where immunoassay and laboratory testing identified concentrations greater than 500 mg/kg.

4.3.3 Distribution by General Soil Types

As described in Section 2, the soil types observed in the landfill fell into four general lithologies:

1) General Fill, consisting of fine sand, silt, gravel and clay
2) Foundry Sand, consisting primarily of fine to medium sand
3) Miscellaneous Debris, consisting of metal, wood, plastic, brick fragments, etc., and
4) Native Soil, consisting primarily of fine sand and silt, which typically contained rootlets and trace organic material.

Tabulated results of immunoassay and analytical testing by soil type are provided in **Table 4-3**. A total of 403 of the 697 samples were general fill (soil type 1). Forty six of these had negative photometer readings while 15 had adjusted immunoassay test results greater than 500 mg/kg. A total of 27 samples of soil type 1 were forwarded to the lab. Concentrations ranged from 0.1 to 308 mg/kg with a mean of 60 and a median of 17.

A total of 274 of the 697 samples contained some foundry sand (soil type 2). 139 of these had negative photometer readings and 81 had adjusted immunoassay results greater than 500 mg/kg by. Forty samples with some foundry sand were forwarded to the laboratory. Twenty four of the 40 samples sent to the laboratory were from intervals which tested greater than 500 by immunoassay (adjusted). Of these, the laboratory concentrations ranged from 33 mg/kg to 18,000 mg/kg with a mean of 1,917 and a median of 480 mg/kg.

Fifteen of the samples collected were from soil type 3, miscellaneous debris fill. Often recoveries were low or nonexistent in this material. Four of the 15 debris fill samples had negative photometer readings and two of them tested greater than 500 mg/kg by adjusted immunoassay. One of these samples and a total of two debris fill samples were forwarded to the laboratory. Laboratory detected concentrations were 14 and 120 mg/kg with the higher concentration detected in the sample which had an adjusted immunoassay result greater than 500 mg/kg.

Five samples were identified as native material. Four of these samples had negative photometer readings and three of these samples tested greater than 500 mg/kg by adjusted immunoassay. This sample was forwarded to the lab (ILGP-141-07). The concentration detected was 830 mg/kg.

4.3.4 Volume Estimates

In the Record of Decision for Operable Unit-2, the Industrial Landfill was estimated to contain approximately 424,000 cubic yards of fill (OU-2 ROD, EPA, 1992). CDM used ArcView 3D-Analyst to calculate a volume of approximately 358,000 cubic yards between the pre-GM and the current landfill surface in the area covered by the Geoprobe investigation grid. The grid was assumed to extend 25 feet beyond the perimeter of the Geoprobe borings and, therefore, should closely represent the volume of the entire landfill. This estimate of the landfill volume was confirmed using AutoCAD, which also calculated a volume of 358,000 cubic yards.

Assuming that each soil sample collected on the 50-foot grid is associated with a volume of soil 50' x 50' x 4' (370 cubic yards), the 697 samples analyzed characterized approximately 258,000 cubic yards of the Industrial Landfill. CDM visually examined but did not test an additional 118 -01 (0-4') interval samples which, based on visual characterizations and comparison with pre cap elevations, are believed to consist of clean fill. This assumption is supported by the fact that there were no immunoassay results greater than 500 mg/kg in the -01 interval samples tested and very few immunoassay hits in the -02 (4-8') and -03 (8-12') intervals. The additional untested -01 interval samples equate to a volume of 37,000 cubic yards after adjustment for the landfill slope on the perimeter borings. Therefore, the total volume of soil characterized by the Geoprobe investigation is approximately 295,000 cubic yards. Based on this number, and our estimate of the landfill volume, the Geoprobe investigation characterized approximately 82 percent of the material contained within the Industrial Landfill.

A total of 101 samples had immunoassay results with photometer readings less than (more negative than) -0.53. Assuming these concentrations are greater than 500 mg/kg PCBs and that each exceedance is associated with a volume of soil 50' x 50' x 4', the sampling and analysis program identified 37,400 cubic yards (12.6% of the material characterized) which may have PCB concentrations greater than 500 mg/kg. Based on a 55 percent false positive occurrence noted in the laboratory results for the samples with photometer readings less than -0.53, this volume estimate of contaminated fill is considered very conservative and the actual volume could be approximately half that (18,700 cubic yards, or 6.3% of the material characterized). Based on this analysis, CDM estimates that the amount of material with PCBs greater than 500 ppm is between 6.3 and 12.6% of the 295,000 cubic yards characterized.

Applying the ratios discussed above to the entire landfill, the amount of material in the Industrial Landfill which may contain PCBs greater than 500 mg/kg ranges from 22,500 to 45,000 cubic yards (6.3% to 12.6% of 358,000 cubic yards). Previous estimates assuming a landfill volume of 424,000 cubic yards have ranged from 50,000 to 100,000 cubic yards of material with greater than 500 mg/kg PCBs (OU-2 ROD, EPA, 1992). Based on data collected as part of this sampling and analysis program, these earlier estimates may be conservative by a factor of 2.

4.4 Comparison with the OU-2 ROD

The Record of Decision for Operable Unit-2 which includes the Industrial Landfill considered that the Industrial Landfill contained approximately 424,000 cubic yards of soil, debris and sludge with PCB concentrations greater than 10 ppm. It was assumed that approximately 50,000 to 100,000 cubic yards of soil contained PCBs at concentrations greater than 500 ppm. The highest recorded PCB detection at that time was 4,300 ppm total PCBs. In addition, the OU-2 ROD stated that "Unlike the East Disposal Area, no localized areas of high level PCB contamination (known as "PCB Hotspots") were found in the Industrial Landfill." The remedy of "recontouring, regrading and containment of contaminated material in the Industrial Landfill" was selected based on these assumptions.

The results of the Geoprobe investigation indicate that many of the assumptions contained in the OU-2 ROD were conservative. As discussed under Section 4.3.4 Volume Estimates, the total volume of the landfill and the amount of material with PCB concentrations greater than 500 mg/kg PCBs is less than that assumed in the OU-2 ROD. The maximum PCB concentration detected during the Geoprobe investigation was 18,000 mg/kg which is higher than the previously detected maximum concentration of 4,300 cited in the OU-2 ROD. However, the next three highest concentration samples were equivalent to the ROD cited maximum. Excluding these three samples, the average PCB concentration of material with adjusted immunoassay results greater than 500 mg/kg, which were analyzed by the laboratory was 835 mg/kg (1686 mg/kg including the three highest samples).

In the letter dated May 27, 1998, EPA requested that GM perform additional characterization of the materials contained in the Industrial Landfill. Geoprobe sampling on a fifty foot grid with accompanying immunoassay analysis was requested to alleviate concerns the St. Regis Mohawk Tribe had about materials contained in the Industrial Landfill. The letter indicated that this program would provide adequate information to support the selected remedy. The results of the Geoprobe investigation, which are consistent with or more favorable than the assumptions stated in the OU-2 ROD, support the selected remedy of "recontouring, regrading and containment of contaminated material in the Industrial Landfill."

INDUSTRIAL LANDFILL CHARACTERIZATION
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Table 4-1

SUMMARY OF IMMUNOASSAY TESTS
AND ANALYTICAL RESULTS
BY SAMPLE INTERVAL

Sample Interval	Number of Samples Collected	Photometer Reading < 0	Photometer Reading <= -0.53	Number of Samples Sent to Lab	Samples Sent to Lab with IA<-0.53	Number of Lab Results >500 ppm
-01	32	1	0	1	0	0
-02	150	13	2	8	1	0
-03	144	12	3	3	1	0
-04	119	31	9	11	3	1
-05	102	54	31	22	12	2
-06	73	44	27	13	5	4
-07	48	23	16	7	4	3
-08	20	10	9	3	3	2
-09	9	5	5	2	1	1
Totals	697	193	102	70	30	13

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Table 4-2

SUMMARY OF IMMUNOASSAY TESTS
AND ANALYTICAL RESULTS
BY ELEVATION

Sample Elevation (ft)	Number of Samples Collected	Photometer Reading < 0	Photometer Reading <= -0.53	Number of Samples Sent to Lab	Samples Sent to Lab with IA<-0.53	Number of Lab Results >500 ppm
> 200	40	5	1	3	0	0
195-200	92	4	0	1	0	0
190-195	150	16	3	5	2	0
185-190	150	59	27	20	9	4
180-185	126	60	36	17	11	3
175-180	83	33	23	11	3	3
170-175	49	13	10	8	4	2
165-170	7	3	1	5	1	1
Totals	697	193	101	70	30	13

INDUSTRIAL LANDFILL CHARACTERIZATION
GENERAL MOTORS POWERTRAIN
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Table 4-3

SUMMARY OF IMMUNOASSAY TESTS AND ANALYTICAL RESULTS BY LITHOLOGY

Lithology	Number of Samples Collected	Photometer Reading < 0	Photometer Reading <= -0.53	Number of Samples Sent to Lab	Samples Sent to Lab with IA<-0.53	Number of Lab Results >500 ppm
1	403	46	15	27	4	0
2	274	139	81	40	24	12
3	15	4	2	2	1	0
4	5	4	3	1	1	1
Totals	697	193	101	70	30	13