DRAFT FOR REVIEW
DECEMBER 12, 2007

REQUEST FOR AMENDMENT
40 CFR 761.61 (C) APPROVAL

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL AND COVER SYSTEM DESIGN
WEST PLANT AREA

GM POWERTRAIN FACILITY
105 GM DRIVE
BEDFORD, INDIANA

U.S. EPA ID NO. IND 006036099

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LIST OF ACRONYMS AND TERMS

AAQMP	-	Ambient Air Quality Monitoring Plan
Agreement	-	Performance Based Corrective Action Agreement
AMSL	-	above mean sea level
AOI	-	Area of Interest
ASTM	-	American Society for Testing and Materials
bgs	-	below ground surface
CA	-	Corrective Action
cm/s	-	centimeters per second
CFR	-	Code of Federal Regulations
CLP	-	Community Liaison Panel
Cover System	-	West Plant Area Cover System
CQA	-	Construction Quality Assurance
CRA	-	Conestoga-Rovers & Associates, Inc.
cy	-	cubic yards
DNAPL	-	Dense Non-Aqueous Phase Liquid
Facility	-	GM Powertrain Facility
ft	-	feet
GM	-	General Motors Corporation
HASP	-	Health and Safety Plan
IDEM	-	Indiana Department of Environmental Management
IM	-	Interim Measure
LLDPE	-	Linear Low Density Polyethylene Liner
mg/kg	-	milligram per kilogram
mm	-	millimeter
NAPL	-	Non-Aqueous Phase Liquid
OM&M	-	Operation, Maintenance, and Monitoring Plan
PCB	-	Polychlorinated Biphenyl
QAPP	-	Quality Assurance Project Plan

LIST OF ACRONYMS AND TERMS

RA	-	Removal Action
RCRA	-	Resource Conservation and Recovery Act
Report	-	Design Report, Over 50 mg/kg PCB Soil Source Removal and Cover System, East West Plant Area
RFI	-	RCRA Facility Investigation
Site	-	GM Powertrain Facility
SSC	-	Site Source Control
TCL/TAL	-	Total Compound List/Total Analyte List
TM	-	Technical Memorandum
TSCA	-	Toxic Substances Control Act
U.S. EPA	-	United States Environmental Protection Agency
USGS	-	United States Geological Survey
Vault	-	Toxic Substances Control Act compliant vault in the East Plant Area
WMP	-	Waste Management Plan
Work Plan	-	West Plant Area Interim Measure Work Plan

1.0 INTRODUCTION

This Report presents a request for amendment to the 40 Code of Federal Regulations (CFR) 761.61 (c) approval granted by the United States Environmental Protection Agency (U.S. EPA) and the Indiana Department of Environmental Management (IDEM) on October 26, 2006 for activities associated with the East Plant Area of the General Motors Corporation (GM) Powertrain Facility (Facility) located in Bedford, Indiana. This Amendment, entitled Request for Amendment to the 40 CFR 761.61 (c) Approval Over 50 milligrams per kilogram (mg/kg) Polychlorinated Biphenyl (PCB) Soil Source Removal, West Plant Area, provides for select soil removal and disposal in the East Plant Area vault, placement of fill and capping of a historic fill area in the West Plant Area of the same Facility. This request has been prepared as part of the West Plant Area Interim Measure (IM) by Conestoga-Rovers & Associates, Inc. (CRA), on behalf of GM, as part of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) activities being conducted under the Performance-Based CA Agreement (Agreement) (effective March 20, 2001, and amended on October 1, 2002) between U.S. EPA and GM for the Facility.

The Facility location and Facility plan are presented on Figures 1.1 and 1.2, respectively.

This Report is submitted in support of the November 15, 2007 letter request to amend the 40 CFR 761.61 (c) Approval issued for the East Plant Area IM and the Northern Tributary IM Work Plan by U.S. EPA. A copy of this approval is included in Appendix A.

1.1 GENERAL

The Facility is located at 105 GM Drive in Bedford, Lawrence County, Indiana, 47421. The Facility produces aluminum casting products, such as transmission cases, pistons, and engine blocks. Major aluminum production processes include die casting and permanent molding. The Facility has been operating as an aluminum foundry since 1942, with major facility modifications completed in 1950, 1953, 1966, 1971, 1974, 1979, and 1980.

1.2 PURPOSE

The purpose of this Report is to present a summary of the current conditions of the West Plant Area and to provide the details related to the implementation of the Source Removal for the West Plant Area. This Report summarizes the information obtained during Site investigation activities conducted by GM, including:

- a review of regional geology, hydrogeology, and hydrology;
- a review of local geological, hydrogeological, and hydrological conditions at the West Plant Area; and
- a summary of existing conditions and information relating to the nature and extent of PCB impacts at the West Plant Area.

1.3 REPORT ORGANIZATION

The Report consists of the following documents:

- Text;
- Figures;
- Tables;
- Preliminary Construction Drawings; and
- Appendices.

The approved Ambient Air Quality Monitoring Plan (AAQMP) (CRA, May 2004) as modified (CRA, January 2007) presented in Appendix B, Quality Assurance Project Plan (QAPP) (CRA, July 25, 2006) presented in Appendix E, and Consolidated Health and Safety Plan (HASP) (CRA, April 2007) presented in Appendix C, will apply to the source removal activities.

This Report is organized as follows:

Section 2.0 - Summary of Corrective Action
This section provides an outline of the West Plant Area IM.

<u>Section 3.0 – Site Information</u>
This section provides background information related to Site land use, geology, hydrogeology, hydrology, etc.

<u>Section 4.0 – Source Excavation and Placement of ≥50 mg/kg PCB Soil in the Vault</u>
This section describes the material excavation rationale and the methodology of material excavation and placement within the East Plant Area Vault (Vault).

<u>Section 5.0 – Cover System Design</u>
This section describes the West Plant Area Cover System (Cover System) design rationale and components.

<u>Section 6.0 – Cover System Material Details</u>
This section specifies requirements for materials used in the Cover System construction.

<u>Section 7.0 – West Plant IM Construction</u>
This section describes support facilities, creation of the Cover System Development Plan and post construction monitoring.

<u>Section 8.0 – Sediment and Erosion Control</u>
This section describes methods and best practices to be implemented by the selected contractor to control erosion.

<u>Section 9.0 – Institutional Controls and Monitoring</u>
This section presents institutional controls to be implemented and monitoring to be completed during the completion of excavation activities.

<u>Section 10.0 – Operation, Maintenance, and Monitoring</u>
This section describes the requirement for long term monitoring and maintenance of the Cover System.

<u>Section 11.0 – Administrative Tasks</u>
This section describes required permits, applications and approvals to complete prior to commencing construction. Financial assurance for the long-term care of the Cover System is also discussed.

<u>Section 12.0 - Project Schedule</u>
This section presents the project schedule.

Section 13.0 - Community Relations

This section presents various means of community participation and awareness.

Section 14.0 - References

This section presents references cited in this Report.

2.0 SUMMARY OF WEST PLANT AREA CORRECTIVE ACTION

The proposed IM to be implemented for the West Plant Area consists of the following major components:

i) excavation of ≥50 mg/kg PCB soils from Area of Interest (AOI) 21 area one and AOI 21 area two (AOI 21-1 and AOI 21-2, respectively) as described in the West Plant Area IM Work Plan (Work Plan);

ii) transportation of the excavated ≥50 mg/kg PCB soils related to the implementation of the soil excavation and disposal in the Toxic Substance Control Act (TSCA) Compliant Vault in the East Plant Area (Vault);

iii) construction of a gravel collector drain and sump to collect non-aqueous phase liquid (NAPL) if it is encountered during the excavation. Collected NAPL/groundwater will be separated. NAPL will be characterized for off-Site disposal. Collected water will be pumped to the existing wastewater treatment facility for treatment prior to discharge;

iv) construction of a low permeability cover system over soil excavation areas. This system will consist of vegetated clay/flexible membrane liner (FML) composite cover system meeting TSCA design requirements. An asphalt cover will also be installed to allow the area to be used as a parking lot for the Facility. This system will include placement of <50 mg/kg PCB soil from the Removal Action (RA) to provide backfill for ≥50 mg/kg PCB excavations and as grading fill for the parking lot;

v) abandonment of selected stormwater infrastructure in AOI 21-1 as described in the Work Plan, including the MH-ST-43 catch basin. This will include pumping each pipe section full of grout to prevent any future infiltration and/or flow. In addition, the 22-inch inlet and 24-inch outlet to and from the catch basin, as well as the 48-inch outfall to the west of GM Drive, will be sealed with plugs after grouting; and the catch basin will be grouted within 3 feet (ft) of the surface. The area will be regraded/restored to ensure proper drainage, ensuring the roadway does not flood during precipitation events;

vi) operation and maintenance of a water treatment system (already constructed) for treatment of potentially contaminated waters generated during construction and filling of the Vault, and any necessary NAPL/groundwater collection system installed as part of this IM;

vii) implementation of access/deed restrictions; and

viii) implementation of operation, maintenance, and monitoring programs.

Construction of the Vault was completed based on the East Plant Area Vault Design Report included in the East Plant Area IM Vault Development Plan (CRA, February 2006). Soil Source Removal within the East Plant Area was completed under the East Plant Area Soil Source Removal Design Report (CRA, May 2006).

3.0 SITE INFORMATION

3.1 SITE LOCATION AND DESCRIPTION

The Facility lies on approximately 152.5 acres of land on either side of GM Drive and extends north along Bailey Scales Road. The Facility property boundaries, buildings, and support facilities are presented on Figures 1.1 and 1.2.

Currently, the Facility is bordered by residential and undeveloped areas to the north; by the Canadian and Pacific Railway, and IMCO (a Kaiser aluminum recycling facility) to the south; by residential and undeveloped areas to the east; and by the railway, industrial and residential properties and a cemetery to the west.

The Facility is currently zoned and utilized for industrial purposes. The reasonably foreseeable future land use is industrial.

The Vault is under construction in the East Plant Area, east of GM Drive, west of the Stormwater Lagoon. The current Vault design volume capacity is approximately 135,000 cubic yards (cy) of which 2.5%, approximately 3,000 cy, of capacity remaining as of November 2007. This will accommodate the prescribed quantity of PCB contaminated material requiring excavation in the West Plant Area.

3.2 GEOLOGIC/HYDROGEOLOGIC/HYDROLOGIC CONDITIONS

3.2.1 REGIONAL PHYSIOGRAPHY AND TOPOGRAPHY

The State of Indiana covers an area of approximately 36,300 square miles. The state's topography ranges from 324 to 1,257 feet above mean sea level (AMSL). The lowest point of elevation is in the southwest corner of Indiana, where the Wabash River flows into the Ohio River. The highest point is in Wayne County in east central Indiana.

3.2.2 REGIONAL LAND USE

Regional land use in this area is mixed, consisting of industrial, commercial, residential and agricultural. The primary crops are corn, soybeans, feed grains, and hay. Raising livestock is common throughout the area. Industrial and commercial uses are also important, especially near urban areas. Oil and gas (in the east central section) was discovered in 1889, however, this resource was depleted by 1912. There are several oil and natural gas fields located in the southwestern portion of Indiana.

3.2.3 REGIONAL GEOLOGY

The Facility lies within an area of Indiana that was not glaciated (driftless area) during the last glacial period on the North American continent. The maximum progression of the Illinoian Glacial advance (the furthest advance of the Laurentide Ice Sheet) lies to the west, north, and east of the immediate region surrounding the Facility (Figure 3.1). Consequently, the surficial geology of the area generally consists of a relatively thin layer of unconsolidated deposits of sand, clay, and fragments of chert produced by the weathering of limestone bedrock and wind-deposited silty material, known as loess. Thicker deposits of proglacial outwash, lake sediment, and recent alluvium occurs along the major stream valleys (Figure 3.2). The surficial deposits range in thickness from zero ft along bedrock outcrops to approximately 100 ft thick along Salt Creek and the East Fork of the White River (Gray, 1974).

The bedrock within the region is near the eastern margin of a structure known as the Illinois Basin. The bedrock formations in this area generally dip to the southwest at approximately 20 to 25 ft per mile. The Cincinnati Arch lies to the east of the Illinois Basin and covers much of Indiana (Figure 3.2) (Indiana Geological Survey, 2001).

Two regional structures are within the vicinity of the Facility, the Leesward Anticline and the Mt. Carmel fault (Figure 3.2). The Leesward Anticline is located to the north and east of Bedford and plunges to the south-southeast. The Mt. Carmel fault is a normal fault with the downthrown side located to the west of the fault. This fault is located to the north and east of the Facility and truncates the Leesward Anticline on its western side. The Mt. Carmel fault generally acts as a hinge line, with gentler dips to the west of the fault and slightly steeper dips to the east (Melhorn and Smith, 1959).

Bedrock within the immediate vicinity of the Facility (Figure 3.3) consists of the lower beds of the Middle Mississippian St. Louis Limestone (the oldest formation within the Blue River Group) and is only approximately 25 ft thick in the immediate vicinity of the Facility (Melhorn and Smith, 1959). Immediately underlying the St. Louis Limestone, and outcropping to the east of the Facility, are the Salem Limestone, the Harrodsburg Limestone, and the Ramp Creek Limestone Formations, respectively. These Mississippian formations comprise the Sanders Group. The Salem Limestone formation is approximately 70 to 80 ft thick, where fully preserved, the Harrodsburg Limestone formation is approximately 80 to 90 ft thick in the area, and the Ramp Creek is approximately 20 ft thick (Melhorn and Smith, 1959). Figure 3.4 presents a generalized stratigraphic column for Paleozoic formations in Indiana.

The uppermost formation of The Borden Group is the Edwardsville Shale Formation, which underlies the limestones in the area. The Borden Group consists of approximately 500 to 800 ft of silty, calcareous shale, interbedded with some siltstone, sandstone and minor limestone.

The Sanders and Blue River Groups have been described to consist mostly of carbonates, with minor amounts of chert, shale, siltstone, anhydrite, gypsum, and calcareous sandstone. A thin bed of brown dolomitic limestone commonly marks the bottom of the St. Louis Limestone. The Salem Limestone, which is more massively bedded limestone, is also known as the Indiana Limestone, the Bedford Limestone, or the Oolitic Limestone and is quarried as fine building stone. However, some horizons may contain geodes, joints and solution fractures, which render the formation less suitable for quarrying (Fenelon and Bobay, 1994).

Numerous joints and fractures are present in these formations with master sets trending east-west within these Mississippian limestones, with minor sets 90 degrees to the master sets (Powell, 1976 and 2001). Numerous sinkholes can be observed on the United States Geological Survey (USGS) topographic quadrangles approximately 5 to 10 miles to the west of the Facility, with much less surface expression through the mid and eastern portions of the county. Several caverns have been mapped in Lawrence County, including one of the largest mapped caverns in the United States, the Blue Springs Cavern, located approximately five miles southwest of the City of Bedford. Other mapped caverns in the area include the Shiloh Cave, the No Sweat Cave, the Dog Hill Cave, the Donnehue Cave, and the Salt Creek Cave. Other unmapped caverns within close proximity to the Facility include: Mouse Hole Cave, located one mile east-northeast; Eighteenth Street Cave, located one and one-half miles to the south-southeast; and Armstrong Caves I and II, located one and one-half miles to the west-southwest (Etzel, 1982). The City of Bedford lies within the physiographic province known as the Mitchell Plain, or Plateau (karst plain). The Mitchell Plain extends from near Bloomington south to the Ohio River within the State of Indiana.

3.2.4 REGIONAL HYDROGEOLOGY

Groundwater resources are found in Lawrence County along the valleys of the major rivers or streams and within the thick Mississippian carbonate aquifer system (within the western portion of Lawrence County) and the Silurian-Devonian carbonate bedrock aquifer (within the eastern portion of Lawrence County).

There are two basic types of aquifers: unconfined and confined. Unconfined aquifers in Lawrence County generally occur along the Salt Creek and the East Fork of the White River within the proglacial outwash deposits, glaciolacustrine deposits, and recent alluvium. The tops of unconsolidated aquifers are often exposed to the surface or have a very thin covering of non-aquifer material, generally comprised of silt and clay (Fenelon and Bobay, 1994).

Groundwater flow within the confined (carbonate) aquifers takes place along the joints, fractures, and bedding planes that eventually may become enlarged by solution to cave passages or karst features. Recharge to a karst system occurs through surface openings that vary in scale from narrow, solutionally widened joints to large sinkholes. Discharge typically occurs through springs, which are solutionally widened joints or bedding planes, but may be enlarged, to sizable cave openings. Most groundwater within this aquifer system discharges to surficial water bodies, to underground water bodies, and to springs (Etzel, 1982).

3.2.5 REGIONAL HYDROLOGY

Most of the rivers in the East Fork White River Basin drain to the southwest. According to USGS Water Resources Division, the annual average flow recorded in 2006 at the East Fork White River gauging station, located 7.8 miles southeast of Bedford in Lawrence County, is 6,175 cubic feet per second (cfs).

Major tributaries to the East Fork White River include the Muscatatuck River, Salt Creek, Driftwood River, Flatrock River, and the Big Blue River. Drainages in the East Fork White River Basin include the Lost River, Sugar Creek, Graham Creek, Clifty Creek, Big Creek, Indian Creek, White Creek, Brandywine Creek, and the Little Blur River.

Rivers in the eastern half of the East Fork White River Basin have a subparallel drainage. Those rivers include the Sugar Creek, Big Blue River, Little Blue River, Flatrock River, Clifty Creek, Sand Creek, Vernon Forth, Graham Creek, and the East Fork White River from Medora to Jonesville (see Figure 3.5 for the Lower East Fork White River Drainage Map).

Drainage of the Mitchell Plain in central Lawrence County (west of the Facility), northeast Orange County, and Monroe County is different from the rest of the East Fork White River Basin. In the streams that flow across the Mitchell Plain, surface water may be intercepted by swallow holes and diverted underground into the groundwater system or subterranean channels.

3.3 WEST PLANT AREA SETTING

The West Plant Area is located on the portion of the Facility to the west of GM Drive and south of Breckenridge Road. It is bordered to the east by GM Drive and the East Plant Area; to the north by Breckenridge Road and residential properties Parcels 378 through 382, and 384 through 386; to the west by residential properties Parcels 1, 2, 19, 399, and a trucking company; and to the south by rail road tracks.

3.3.1 WEST PLANT AREA GEOLOGY

The natural soil in the immediate vicinity of the Facility is known as Crider. Crider soil is a fine-grained, silt loam to silty clay loam. Crider soil develops on 20 inches to 45 inches of silty loess over clayey material derived from limestone (USDA, 1985).

The overburden materials at the West Plant Area consist mostly of fill material, including clay, sand, and silt. Within AOIs 21-1, 21-2, and 21-4, this fill material was placed in a preexisting ravine sloping to the northeast, east, and north, respectively. The fill in AOI 21-2 was placed in a ravine which connects with the ravine excavated within the East Plant Area Vault. The thickness of the overburden materials varies considerably across the West Plant Area. The depth of native material through AOI 21-1 ranges approximately 4 to 8 ft below ground surface (bgs). The depth to native material varies throughout AOI 21-2, ranging from approximately 2.0 to 27.5 ft bgs. The average depth of fill in this AOI is approximately 12.7 ft bgs. Figure 3.6 shows the location of the AOIs to be excavated under this Report.

The overburden within the West Plant Area is underlain by the St. Louis and Salem Limestone Formations. The St. Louis Limestone Formation has been identified to be highly weathered and fractured near surface. Fracture density appears to decrease with depth. The highly weathered and fractured St. Louis Limestone is underlain by the Salem Limestone (also known as the Indiana, Bedford, or Oolitic Limestone) which is the limestone formation utilized by local quarries for fine building stone. The Salem Limestone is also somewhat weathered and fractured at the erosional rock surface but is generally more massive and less weathered and fractured than the St. Louis Limestone. The Salem Limestone becomes more massive with depth. The location of St. Louis and Salem Formation contacts through the East Plant Area are presented on Figure 3.7. Available bedrock topographic information is presented on Figure 3.8.

Additional information on the West Plant Area geology has been previously presented in the Soil Technical Memorandum (TM) (CRA, April 2004) and RCRA Facility Investigation (RFI) Work Plan (CRA, October 2001).

3.3.2 WEST PLANT AREA HYDROGEOLOGY

The Conceptual Site Model for the shallow bedrock groundwater flow is presented on Figure 3.9. This Conceptual Site Model describes the shallow groundwater flow through the upper fractured/weathered bedrock at the Facility. Recharge to the shallow groundwater flow system occurs through the overburden materials and directly into bedrock, where exposed. Discharge of the shallow bedrock groundwater flow system occurs through springs and seeps in topographically low areas (e.g., creeks and ditches). Perched groundwater within the unconsolidated overburden material has also been observed at a few locations across the Facility. These perched groundwater lenses are not continuous across the Facility and, where observed, occur within the more granular fill material. Discharge from perched groundwater within AOI 4 have been observed and are currently being controlled through the installation and operation of the SSC Systems.

The shallow groundwater flow system contours (the uppermost potentiometric surface) are presented on Figure 3.10. The overburden and shallow bedrock groundwater flow system in the AOI 21-2 area flows to the east. In the area where fill is proposed to be removed from AOI 21-2, groundwater flows toward the underdrain system of the constructed Vault, just downgradient of this fill area. This underdrain system, along with the proposed perimeter bedrock groundwater collection trench that will be installed along the perimeter of the East Plant Area, will ensure that any overburden groundwater present in this fill area will be collected and treated.

The results of groundwater sampling across the Facility and the completed dye tracer testing support the Conceptual Site Model described above (draft CA 750 Environmental Indicator Report, CRA, August 2007).

3.3.3 WEST PLANT AREA HYDROLOGY

The Facility is situated on a topographic ridge, such that the Facility is drained by surface runoff primarily to the east and northeast in small valleys, which are tributaries of Bailey's Branch of Pleasant Run Creek. According to Facility personnel, surface water runoff from the Facility to the west of the Facility is minimal. The ridge top is approximately 150 ft to 185 ft higher than the valley bottom, located approximately one-half mile northeast of the Facility.

Stormwater from the manufacturing portions (e.g., improved surfaces) of the Facility is currently collected in the Stormwater Lagoon. Stormwater from non-operational portions of the Facility (i.e., property located north and east of the Stormwater Lagoon) drains directly to several unnamed ditches and eventually to Bailey's Branch of Pleasant Run Creek, except where construction activities require collection and treatment of stormwater (e.g., Cover System construction activities).

3.4 EXTENT OF CONTAMINATION

In AOI 21-1 a surficial soil sample at boring B-X129Y247 collected during the CA exhibited a total PCB concentration of 67 mg/kg. This result was detected near the intersection of Breckenridge Road and GM Drive. Twelve subsequent soil borings (RFI Work Plan: Addendum No. 7 (CRA, November 2004)) were completed to delineate horizontal and vertical extent of PCBs in soil at this location. Figure 3.11 shows the boring locations and Table 3.1 presents the data for all collected soil samples in AOI 21-1. Currently the area around the boring location B-X129Y247 is fenced to prevent potential exposure to the surficial soil.

In AOI 21-2, a surficial soil sample at soil boring B-X143Y193B had a total PCB concentration greater than the Site Screening Level (7.4 mg/kg). The area is located south of AOI 21-1, to the northeast of the existing office building in a grassy area between the building and GM Drive. Subsequent delineation activities, which included 70 additional borings, were completed as part of RFI Work Plan: Addendum No. 7 (CRA, November 2004). The boring locations for AOI 21-2 are presented on Figure 3.12

and soil sample results are presented on Table 3.2. Because PCB concentrations in surface soils at several soil boring locations in this area are above the Site Screening Level, AOI 21-2 is currently fenced to prevent potential exposure to the soil.

As much of the ≥50 mg/kg PCB mass as practical will be removed from AOI 21-2 as part of the West Plant Area IM. Delineation of the ≥50 mg/kg PCB soil is based on the investigations completed during the various phases of the RFI. These data are presented in the Work Plan. The data utilized in the delineation are presented in Tables 3.1 and 3.2. Figures 3.13.1 through 3.13.11 present a 3-dimensional view of the extent of PCB impacted material in AOI 21-2. The total estimated volume of ≥50 mg/kg PCB soil delineated is 1,440 cy.

The data obtained through the completion of the investigations in the West Plant Area, were divided into 2-foot intervals for the purpose of defining the limits of material removal. Elevation intervals ranged from 0 – 2 ft bgs through 20 – 22 ft bgs. For each of these intervals, the limit of ≥50 mg/kg PCB soil was determined. This information is presented on Drawings C-01 through C-13. For each interval, the limit of <50 mg/kg PCB soil which requires removal to reach ≥50 mg/kg PCB soil at lower elevation intervals, was also determined and is identified on the same drawings. Figure 3.14 presents a plan view of the final definition of the prescribed excavation limits per interval. Figure 3.14 also presents a plan view of the extent of the ≥50 mg/kg PCB soil and the extent of the <50 mg/kg PCB soil to be moved at the surface. Figure 3.15 presents a cross section through the area and alternative slopes to be used pending soil stability. Figures 3.16 and 3.17 present areas that may not be possible to excavate due to safe soil slope limitations and the location of the adjacent pressurized gas line. The extent of excavation identified shows limits that may not be possible to excavate to protect the pressurized gas line based on reasonable worst-case assumptions. Other utilities and the road also warrant consideration, although protection of the pressurized gas line should protect these features as well. The perimeter excavation will proceed at a 3:1 slope with a 2:1 slope from the gas line. The slope from the gas line will be kept as steep as safely possible and as field conditions permit. Approximately 6,000 to 8,000 cy of <50 mg/kg PCB soil will be to be excavated and stockpiled to access the ≥50 mg/kg PCB soil. At a 2:1 slope from the gas line approximately 225 cy of delineated ≥50 mg/kg PCB soil will not safely be accessible. Delineated ≥50 mg/kg PCB soil will be removed to the extent it may be safely removed without exposing or otherwise compromising the integrity of the pressurized gas line.

4.0 SOURCE EXCAVATION AND PLACEMENT OF PRESCRIBED ≥50 MG/KG PCB SOIL

4.1 MATERIAL HANDLING

In general, the following procedures will be utilized for each 2-foot layered interval during the prescribed excavation of ≥50 mg/kg PCB soil:

- Environmental controls (silt fencing, surface water diversions, and air monitoring) will be put in place prior to any intrusive activities. Air monitoring activities will be completed in accordance with the air monitoring procedures identified in the attached AAQMP (Appendix B). The monitoring requirements are summarized in Table 4.1 and the air monitoring locations are presented on Figure 4.1;
- Overlying soil/fill in the West Plant Area, surrounding the ≥50 mg/kg PCB soil, will be removed, temporarily staged and placed and compacted as backfill in the excavation footprint prior to construction of the Cover System and parking lot;
- The top of the ≥50 mg/kg PCB soil will be surveyed;
- Prescribed areas of ≥50 mg/kg PCB soil (Figure 3.14) will be excavated with sidewalls as close to vertical as practical. Excavated ≥50 mg/kg PCB soil will be placed and compacted in the Vault;
- The excavation will be surveyed to ensure the limits of removal have been reached as closely as practical;
- Any soil which needs to be removed to access ≥50 mg/kg PCB soil at lower elevations, will be removed, placed and compacted in a previously excavated area or within the footprint of the Cover System;
- Spray-on paper mulch will be used to provide an effective additional control for both dust and vapor phase PCBs emissions. The entire waste surface will be mulched, except for the working face during active periods. The working face will then be mulched at the conclusion of each day;
- Additional <50 mg/kg PCB soil fill from the RA will be imported and placed/compacted to bring excavated areas to grade; and
- Disturbed areas will be designated to receive additional grading fill and/or Cover System placement, if subsequent work will not commence within 30 days.

If collectable dense non-aqueous phase liquid (DNAPL) is encountered during the ≥50 mg/kg PCB soil excavation, it will be placed into a tank for temporary storage. Once a sufficient volume of DNAPL has been collected and characterized, it will be disposed of at an approved off-Site facility. Any water collected with the DNAPL will be separated and transported for treatment at the on-Facility wastewater treatment facility.

All transport, storage, and disposal methods outlined in the Waste Management Plan (WMP) provided in the Downstream Parcels Removal Action Work Plan (CRA, May 2004) will be followed for collected DNAPL. Solids/debris will be removed, as necessary, characterized, and properly disposed of in accordance with the WMP.

Should buried containers be found during excavation, containers will be handled in accordance with the standard operation procedures for drum handling provided in Appendix D. Contents inside the container will be sampled, and transported to a secure staging area on Facility property pending characterization and proper disposal of the waste.

4.2 PHASING OF SOIL REMOVAL

Excavation ≥50 mg/kg PCBs will be completed and surveyed prior to the excavation of adjacent <50 mg/kg PCB material. Material with PCB concentrations ≥50 mg/kg will be transported directly to the Vault for placement. A temporary staging facility will be constructed to stage approximately 4,200 cy of <50 mg/kg PCB material in the West Plant Area.

4.3 LIMITATIONS ON SOIL REMOVAL DUE TO TECHNICAL IMPRACTICABILITY

Portions of the prescribed ≥50 mg/kg PCB soil in AOI 21-2 are at a depth proximate to the pressurized gas line that are anticipated to make portions of the delineated areas unsafe and impractical to remove. The gas main services the Plant and local residences and would not be practical to relocate or shut down during the installation of sheet piling or supports for the gas line which could allow for removal of all of the ≥50 mg/kg PCB soil in AOI 21-2. The extent of ≥50 mg/kg PCB soil in AOI 21-2 which can not practically be removed will be determined based on soil conditions identified during construction. It is expected a slope for the excavation between 2:1 and 3:1 with 5 ft steps is likely. A geotechnical engineer will be present during excavation in the vicinity of the gas line to determine an appropriate slope. These areas are identified on Figures 3.16 and 3.17, and on Drawings C-02 through C-13.

4.4 USE OF <50 MG/KG PCB SOIL FROM THE REMOVAL ACTION

Backfill material will be required to be placed to backfill excavations of ≥50 mg/kg PCB soil, and to grade the West Plant Area surface in a suitable manner for Cover System construction. Suitable material for use as backfill under the low permeability cover is available from the RA. The RA soil to be utilized are those containing <50 mg/kg PCBs. During placement the backfill material will be compacted to control differential settlement of the Cover System, once constructed.

It is appropriate to utilize the <50 mg/kg PCB soil from the RA as backfill and grading fill for a number of reasons. First, the reuse of the <50 mg/kg PCB soil reduces local truck traffic that results in congestion and degraded roads, as well as providing a beneficial reuse of the material. In addition, the area is well situated for consolidation of soil as groundwater flow from this area is into the ravine that connects to the East Plant Area Vault underdrain system. Any groundwater which flows beyond the underdrain system would be collected by the proposed Perimeter Groundwater Collection Trench downgradient of the Vault.

All <50 mg/kg PCB soil will be managed to mitigate runoff, ensure any potentially contaminated runoff is collected, and to ensure dust/air emissions are controlled. The controls will include silt fences and hay bales enclosing the stockpiles as well as along drainage pathways. Stockpiles not in use will be covered. All water that comes in contact with the <50 mg/kg PCB soil will be contained and directed to collection sumps. Water will be collected from these sumps and treated prior to discharge. The quantity of water requiring treatment will be minimized by the placement of tarps during inactive grading fill placement periods to minimize contact of precipitation with the grading fill.

4.5 STORMWATER CONTROL

Stormwater controls, including check dams, diversion dikes and drainage swales, to control run-on from adjacent areas, will be constructed prior to initiating significant excavation. Within the work area, any water which is accumulated will be considered to be impacted and will be collected for treatment prior to discharge. Construction of stormwater controls prior to initiating excavation will control the potential for off-Site releases and minimize the amount of stormwater that contacts contaminated material.

The contractor will be required to control stormwater runoff in order to meet the following requirements:

i) prevent surface water runoff from flowing from contaminated areas to clean areas;

ii) minimize stormwater entering a work zone from adjacent areas and ponding on-Site in excavated areas through use of temporary berms/swales, proper grading, and by expediting backfilling of excavations;

iii) ensure that IM activities do not impact stormwater runoff; and

iv) create a low area within each excavation (sump) to collect and remove water from the excavation. Excavations will be maintained dewatered to the extent practical.

This stormwater will be transferred from the sump(s) to the wastewater treatment facility for treatment prior to discharge.

5.0 RESTORATION/COVER SYSTEM

The West Plant Area Cover System will consist of a low permeability cover over the excavated area of the West Plant Area (see Figure 5.1). The purpose of the Cover System is to prevent direct contact and reduce infiltration of precipitation through the soil and subsequent percolation of potentially impacted infiltration into the groundwater. In addition, the Cover System will provide long-term protection against erosion and subsequent transport of contaminants. This section presents the basis for the design of the Cover System and a description of the Cover System design components. In general, the Cover System will consist of a composite cap with vegetative surface. In an area close to the Plant a hard surface cap (asphalt or concrete) is proposed to be used as a parking lot in place of the former East Lot. Should it be determined that any of these areas will no longer be subject to regular vehicular traffic, the vegetated cover may be established over this area. Either vegetated or asphalt covers are acceptable as part of the cover system for this area. Figure 5.1 shows the proposed limits of conceptual vegetative and asphalt covers.

5.1 COVER SYSTEM COMPONENTS – VEGETATED COVER

The proposed Cover System is a modified version of the RCRA Subtitle C cover designed to use synthetic materials instead of soil materials. The proposed Cover System is consistent with the recommended Final Design for the East Plant Area Cover System (CRA, April 2007).

The proposed vegetative cover system cross-section is as follows (bottom to top):

- grading layer (depth varies as necessary);
- soil barrier layer – clay (12 inches);
- 60 ml Linear Low Density Polyethylene Liner;
- geonet drainage layer;
- common fill (12 inches); and
- vegetative cover (6 inches).

The proposed hard surface cover system cross-section is as follows (bottom to top):

- grading layer (depth varies as necessary);
- compacted clean fill (24 inches);
- granular base (6 inches); and
- asphalt/concrete (4 to 6 inches) pending composition.

A detailed description of each of these components is presented in Section 5.1.

A biotic barrier and/or gas venting layer was not included in the design as material is primarily soil with low organic content. This material is not expected to create gas at a rate that would create a problem.

5.1.1 GRADING LAYER

The optimized grading layer will be constructed with soil materials excavated during the RA with PCB concentrations of <50 mg/kg. The grading layer will be designed to optimize the functionality of the Cover System. Benefits of the optimized grading layer include:

- reduced infiltration resulting in lower groundwater recharge in the West and East Plant Area and ultimately less shallow groundwater collection in the trench;
- more effective stormwater management resulting in less erosion and reduced OM&M;
- minimized impact of differential settlement resulting in less OM&M; and
- elevated parking lot to the match the plant grade.

Approximately 8,500 cy yards of <50 mg/kg PCB fill from the RA will be used to fill the excavations and buildup a base for the parking lot.

5.1.2 SOIL BARRIER LAYER

The barrier layer will consist of a one-foot thick layer of compacted clay soil. The clay soil used in the construction of the barrier layer of the Cover System will comply with the following specifications:

- the permeability of the clay liner will be 1 x 10^{-7} centimeters per second (cm/s) or less;
- more than 50 percent of the clay must pass the No. 200 sieve; and
- the clay will have Atterberg limits of greater than 30 for the liquid limit and greater than 15 for the plasticity index.

Atterberg limits are laboratory classification criteria, which provide guidance in classifying soils and identifying their potential handling characteristics for use as a liner material. Typically, soils that have higher Atterberg limits will have lower hydraulic conductivities. However, the hydraulic conductivity of the soil is also dependent upon the compacted density and moisture content, and overall, the primary characteristic of concern of any cover system is the hydraulic conductivity of the re-compacted clay soils and associated cover system components.

The Construction Quality Assurance Plan (CQA) (Appendix E) presents a testing program to verify that the construction and materials are in compliance with the specifications. Further requirements of the clay liner material are presented in Section 6.1.

5.1.3 LINEAR LOW DENSITY POLYETHYLENE LINER (LLDPE)

The use of LLDPE provides excellent reduction in infiltration and also significantly reduces the trucking necessary to import additional clay barrier materials. The use of the LLDPE will further remove the requirement for the importation of clay. In addition, the LLDPE approach is generally easier to install than re-compacted clay, less susceptible to differential settlement issues, and more forgiving of freeze/thaw damage than a straight clay layer.

Textured LLDPE liner to be used on the 4 horizontal ft to 1 vertical ft (4H:1V) side slope areas of the East Plant Area Cover System will also be used in the West Plant Area Cover System For simplicity of supply and installation. As the LLDPE liner material is not susceptible to frost damage, it does not need to be below the frost penetration depth (see reference information in Appendix F).

Both LLDPE and High Density Polyethylene liners meet the technical requirements and are considered appropriate for use in the East Plant Area cover system, however LLDPE was selected based on its additional flexibility and superior yield properties.

The CQA Plan presents a testing program to verify that the construction and materials are in compliance with the specifications.

5.1.4 GEONET DRAINAGE LAYER

By providing efficient lateral drainage, the use of a geonet drainage material effectively reduces infiltration, and significantly reduces the trucking necessary to import sand drainage materials. The use of the geonet will reduce the volume of material requiring importation for drainage sand. Design calculations verifying the performance of the geonet for lateral drainage are presented in Appendix G (calculations presented are for the East Plant Area Cover System. Calculations for the final West Plant Design will be included should the cover construction differ from the East Plant Area).

The CQA Plan presents a testing program to verify that the construction and materials are in compliance with the specifications. Further requirements for the geonet are provided in Section 6.3.

5.1.5 COMMON FILL LAYER

One foot of cover fill material will be placed below the topsoil as a common fill layer to protect the lower cap layers from intrusion by plant roots or burrowing animals. This layer will add depth to the surface layer, increasing its water storage capacity and protecting the underlying layers from freezing and erosion.

The CQA Plan presents a testing program to verify that the construction and materials are in compliance with the specifications. Further requirements for the common fill layer are provided in Section 6.4.

5.1.6 TOPSOIL AND VEGETATIVE COVER LAYER

A 6 inch topsoil and vegetative cover layer will be included to prevent wind and water erosion, provide storage for vegetation, maximize evapotranspiration, and significantly reduce the volume of infiltrating stormwater that will migrate to the drainage layer or potentially come in contact with the waste. The vegetative layer also functions to enhance aesthetics and to promote a self-sustaining ecosystem on top of the landfill. The cap and surrounding areas will be seeded to prevent soil erosion.

The CQA Plan presents a testing program to verify that the construction and materials are in compliance with the specifications. Further requirements for the topsoil and vegetative cover layer are provided in Section 6.5.

5.2 COVER SYSTEM COMPONENTS – HARD SURFACE COVER

The proposed cover system for areas requiring a hard surface cover to support vehicular traffic is an asphalt cover. This hard surface cover meets TSCA requirements for asphalt covers identified in 40 CFR 761.61 (a) (7).

6.0 COVER SYSTEM MATERIAL DETAILS

6.1 COMPACTED CLAY MATERIAL

All clay material used as part of the Cover System clay layers will be from the Vault excavation, or from an approved source and will be free of unsuitable materials including:

- frozen material or material containing snow or ice;
- trees, stumps, branches, roots, or other wood or lumber;
- wire, steel, cast iron, cans, drums, or other foreign material; and
- materials containing hazardous or toxic constituents at hazardous or toxic concentrations.

The required physical characteristics of the proposed compacted clay layer material is as follows:

- Minimum of 50 percent passing the No. 200 sieve and a minimum of 25 percent smaller than 0.002 millimeter (mm) diameter. Maximum of 10 percent having a dimension greater than 0.75 inches;
- Free of rocks larger than 2 inches, organic matter, inorganic clays of high plasticity in accordance with ASTM D2487, swelling clays, or very soft clays;
- Upper (last) lift to contain no stones larger than 0.5 inches that could damage overlying liner; and
- Compactable to a density necessary to achieve an in-place permeability of a maximum of 1×10^{-7} cm/s.

Testing and analysis of the clay material will be performed as follows:

- Maximum Dry Density, ASTM D698: 1 sample per 1,500 cy, or portion thereof, of material required;
- Particle Size, ASTM D422: 1 sample per 1,500 cy, or portion thereof, of material required;
- Moisture Content, ASTM D2216: 1 sample per 1,500 cy, or portion thereof, of material required;
- Atterberg Limits, ASTM D4318: 1 sample per 1,500 cy, or portion thereof, of material required;

- Soil Classification, ASTM D2487: 1 sample per 1,500 cy, or portion thereof, of material required;
- Laboratory Re-compacted Permeability, ASTM D5084: 1 sample per 10,000 cy, or portion thereof, of material required; and
- Chemical Analysis (applies to imported material; Total Compound List/Total Analyte List (TCL/TAL) and Cyanide, see Table E.6.2 in Appendix E (CQA Plan): 1 sample per source.

6.2 LINEAR LOW DENSITY POLYETHYLENE LINER

The following table presents the characteristics of the proposed 60-mil textured LLDPE liner.

Property	*Unit*	*Test Method*	*Minimum Average Value(1)*
Thickness • Lowest of 10 coupon values • Lowest of 8 of 10 coupon values	mil	ASTM D5994	60 51 54
Density	g/cu cm	ASTM D1505/D792	0.940 (maximum)
Tensile Strength at Break	pounds per inch	ASTM D638 Type IV Dumbell, 2 ipm	90
Asperity Height	mil	GRI Test Method GM12	10
Elongation at Break	percent	ASTM D638 Type IV Dumbell, 2 ipm Gage lengths of 50 mm	100
Carbon Black Content	percent	ASTM D1603	2 to 3 (range)
Carbon Black Dispersion for 10 Different Views • 9 in Categories 1 or 2 and 1 in Category 3		ASTM D5596	Cat 1 or 2

Property	*Unit*	*Test Method*	*Minimum Average Value*[(1)]
Puncturing Resistance	pound	ASTM D4833	90
Tear Resistance	pound	ASTM D1004	42
Oxidation Induction Time (OIT)			
• Standard	minute	ASTM D3895	100
• High Pressure	minute	ASTM D5885	400
Oven Aging at 85 degrees C	NA	ASTM D5721	NA
• Standard OIT retained after 90 days; or	percent	ASTM D3895	55
• High Pressure OIT retained after 90 days	percent	ASTM D5885	80
UV Resistance[(2)]			
• High Pressure OIT retained after 1,600 hours	percent	ASTM D5885	50

Notes:

(1) Except as indicated.

(2) 20-hour UV cycle at 75 degrees C, followed by 4 hours condensation at 60 degrees C.

ASTM - American Society for Testing and Materials

6.3 GEONET DRAINAGE LAYER AND GEOSYNTHETIC MATERIALS

The proposed geotextile fabric to be utilized as part of the geonet shall conform to acceptable values listed as follows:

Property	*Unit*	*Test Method*	*Acceptable Value*
Fabric Weight	ounce per sq yd	ASTM D5261	5.6 (minimum)
Grab Strength (MD/CD)	pound	ASTM D4632	140 (minimum)
Grab Elongation (MD/CD)	percent	ASTM D4632	50 (maximum)
Permittivity	sec-1	ASTM D4491	1.0 (minimum)
Apparent Opening Size (AOS)	Sieve Size	ASTM D4751	70 (maximum)
	mm		0.210 (maximum)

The proposed drainage net material shall comply with the following specifications:

Property	*Unit*	*Test Method*	*Minimum Acceptable Value*
Density	g/cc	ASTM D1505	0.94
Carbon Black Content	percent	ASTM D1603	2.0
Tensile Strength in Machine Direction	pounds per foot	ASTM D4595	450

The proposed drainage geocomposite material shall comply with the following specifications:

Property	*Unit*	*Test Method*	*Minimum Acceptable Value*
Ply Adhesion	pounds per inch	ASTM F904 Modified	0.5
Transmissivity	m2/sec	ASTM D4716	1 x 10-3(1)

Note:

(1) Gradient of 0.1, normal load of 1,000 psf, water at 70 degrees F, between stainless steel plate uniform sand/geocomposite/60-mil liner/steel for 100 hours.

6.4 COMMON FILL MATERIAL

All common fill material used as part of the cap layer will be imported from an approved source and will be free of unsuitable materials including:

- frozen material or material containing snow or ice;
- trees, stumps, branches, roots, or other wood or lumber;
- wire, steel, cast iron, cans, drums, or other foreign material; and/or

- materials containing hazardous or toxic constituents at hazardous or toxic concentrations.

The fill material will also be:

- graded;
- free of rocks larger than 3 inches, organic matter, very soft clays, swelling clays, or fine uniform sands that may be difficult to compact;
- consistent with any ASTM D2487 Group Symbol except those described as poorly graded and except CH, MH, OL, and OH;
- compactable to specified density; and
- sampled and analyzed for TCL/TAL parameters. A minimum of one sample per material source will be collected. For sources previously sampled and approved for use at the Site, no additional source evaluation will be required.

6.5 TOPSOIL MATERIAL AND VEGETATIVE COVER

All topsoil material used as part of the cap layer will be imported from an approved source and will be free of unsuitable materials including:

- frozen material or material containing snow or ice;
- trees, stumps, branches, roots, or other wood or lumber;
- wire, steel, cast iron, cans, drums, or other foreign material; and/or
- materials containing hazardous or toxic constituents at hazardous or toxic concentrations.

The topsoil material will also be:

- friable loam neither of heavy clay nor of very light sandy nature;
- reasonably free of roots, rocks, or lumps larger than 1 inch, weeds, vegetation, and seeds of noxious weeds;
- in the pH range of 5.5 to 7.5, determined in accordance with ASTM D4972;
- a minimum of 2 percent and maximum of 10 percent organic matter, determined in accordance with ASTM D2974;

- consistent with ASTM D2487 Group Symbol SP, SM, ML or OL;
- capable of supporting growth of grass and the specified vegetative cover; and
- sampled and analyzed for TCL/TAL parameters. A minimum of one sample per material source will be collected. For sources previously sampled and approved for use at the Site, no additional source evaluation will be required.

The seed mixture for the vegetative cover shall be as follows:

A. Seed: The latest season's crop. Weed seed content not to exceed 1 percent by weight. Comply with the tolerance for purity and germination established by Official Seed Analysis of North America. Germination to exceed 75 percent. Remove any seed that is wet, moldy, unlabeled, or otherwise damaged.

B. Acceptable seed mixes/blends and seeding rate are shown in Table 1. Base seeding rates on pure live seed as follows:

$$\text{Minimum actual seeding rate} = \frac{\text{specified seeding rate}}{(\%\text{purity}/100)\text{x}(\%\text{germination}/100)}$$

TABLE 1(1)

PERMANENT SEEDING

	Seed Species and Mixtures	*Rate per Acre*	*Optimum Soil pH*
1.	Perennial Ryegrass	35 to 50 pounds	5.6 to 7.0
	plus white or ladino clover	1 to 2 pounds	
2.	Kentucky Bluegrass	20 pounds	5.5 to 7.5
	plus smooth bromegrass	10 pounds	
	plus switchgrass	3 pounds	
	plus timothy	4 pounds	
	plus perennial ryegrass	10 pounds	
	plus white or ladino clover	1 to 2 pounds	
3.	Perennial Ryegrass	15 to 30 pounds	5.5 to 7.0
	plus tall fescue	15 to 30 pounds	
4.	Tall Fescue	35 to 50 pounds	5.5 to 7.5
	plus Ladino or White Clover	1 to 2 pounds	

	Seed Species and Mixtures	*Rate per Acre*	*Optimum Soil pH*
5.	Wildflowers		
	- Heath Aster	0.1 to 0.2 pound	5.5 to 7.5
	- Partridge Pea	0.3 to 0.4 pound	5.5 to 7.5
	- Rattlesnake Master	0.2 to 0.3 pound	5.5 to 7.5
	- Round-Headed Bush Clover	0.2 to 0.3 pound	5.5 to 7.5
	- Wild Quinine	0.2 to 0.3 pound	5.5 to 7.5
	- Yellow Coneflower	0.2 to 0.3 pound	5.5 to 7.5
	- Black-Eyed Susan	0.1 to 0.2 pound	5.5 to 7.5
	- Compass Plant	0.2 to 0.3 pound	5.5 to 7.5
	- Cup Plant	0.2 to 0.3 pound	5.5 to 7.5
	- Rough Goldenrod	0.1 to 0.2 pound	5.5 to 7.5
	- Hairy Tall Ironweed	0.2 to 0.3 pound	5.5 to 7.5

Note:

(1) In accordance with the Permanent Seeding Section of the Indiana Handbook for Erosion Control in Developing Areas.

7.0 WEST PLANT IM CONSTRUCTION

7.1 CONSTRUCTION SUPPORT FACILITIES

The following sections present descriptions of the construction support facilities required for the source removal and filling. These facilities are currently in place to support the East Plant Area IM and are expected to be utilized to support the West Plant IM. If the contractor elects to establish new facilities, they will be required to meet the standards established herein.

7.1.1 SITE OFFICES

Existing site offices will be used, as needed, for the source removal activities.

7.1.2 EMERGENCY FIRST AID FACILITIES

The Contractor will be required to supply and maintain first aid facilities at each major work area. The first aid supplies must comply with the requirements of 29 CFR 1910.141.

7.1.3 FIRE FIGHTING EQUIPMENT

The Contractor will be required to provide fire fighting equipment to ensure the safety of Site personnel. Details regarding the fire fighting equipment will be proposed by the Contractor in the Contractor's Site-specific HASP. Coordination will be established with the local Fire Department and emergency responders.

7.1.4 DECONTAMINATION FACILITIES

Prior to commencing work in an Exclusion Zone at the Site, the Contractor will be required to supply and operate a personnel hygiene/decontamination facility. The Contractor will also construct and maintain equipment decontamination pads at the Site, as required.

Wastewater from the personnel hygiene/ decontamination facility will be pumped to designated storage tanks for on-Site treatment.

7.1.5 PORTABLE SANITARY FACILITIES

Portable toilet facilities will be provided and maintained by the Contractor in an area outside the Exclusion Zone. Sanitary wastes will be removed and disposed of off-Site, on a periodic basis, in accordance with applicable laws and regulations, or will be disposed of directly to the sanitary sewer.

7.1.6 UTILITIES

The Contractor will be responsible for providing electrical power, potable water, telephone service, and other utilities, as required, for the construction support facilities.

7.1.7 SITE COMMUNICATIONS

Portable two-way radios will be available for Site communications, during vault construction and filling, and for any operations in which direct visual and verbal contact is not feasible. The Contractor will be required to provide two-way radios for use by the Engineer, the Site Safety Officer, and the security personnel, as necessary. Suitable warning signals such as horns or whistles shall be designated for emergencies and identified in the Contractor's Site-specific HASP.

7.1.8 ACCESS ROADS

On-Site access roads will be constructed or improved, as necessary. All imported granular materials used for the construction of access roads, which contact contaminated soils during the course of the construction, will be placed within the vault as part of the grading fill for the East Plant Area cover system.

7.1.9 PARKING

Sufficient space for parking for Site personnel will be established by the Contractor at suitable on-Site locations. In the event an established parking area becomes encumbered by specific Site-related operations, temporary alternate space shall be provided.

7.2 COVER SYSTEM DEVELOPMENT PLAN

The Contractor will provide a detailed Cover System Development Plan describing the step-by-step approach to constructing the final cover system, and providing surface water management throughout the active filling period. The Cover System Development Plan will incorporate the following features:

a) plan(s) showing the following items:
   i) limit of the cover system;
   ii) detailed description of the schedule and approach to constructing the cover system; and
   iv) final grade of grading layer within the cover system (to be updated as filling progresses if necessary);

b) layout of haul road(s) for transporting material to the active face;

c) provisions for surface water control:
   i) at all times, the Contractor must provide capacity within the cover system area to retain runoff from the 10-year storm from exposed, potentially impacted materials. This volume of storage will be reduced, as appropriate, after areas are capped to reflect the reduction in the area of exposed waste; and
   ii) runoff from disturbed areas which has not contacted contaminated material (e.g., buffer zones, haul roads outside exclusion zone, covered areas, and Site support facility areas) will be directed around the work area;

The Contractor's Cover System Development Plan will be provided to U.S. EPA.

8.0 SEDIMENT AND EROSION CONTROL

Sediment and erosion controls that will be installed include swales, berms, plastic sheeting (tarps), straw bales, and silt fences, as necessary. The controls will serve to protect areas not impacted. The sediment and erosion controls will serve to protect the nearby creek.

The first objective is to divert surface water from unimpacted areas from entering areas of exposed grading fill, and control this water as it is diverted around exposed areas. This will be achieved by the construction of swales or berms to divert the surface water, and the implementation of controls (silt fences, straw bales, etc.), to control erosion and sediment movement from these unimpacted areas.

The second objective is to control and collect any water that contacts the grading fill. All water that contacts this material will be directed to collection sumps, or low points within the work area. Water will be collected from these sumps and treated prior to discharge. The quantity of water requiring treatment will be minimized by the coordinated placement of cover system components (i.e., the clay layer will be placed as soon as practical over areas of the grading fill which are at final grade).

9.0 INSTITUTIONAL CONTROLS AND MONITORING

Security measures to restrict access into source areas for the duration of construction, excavation, and filling activities will include site perimeter fencing with locking gates to completely enclose the work area and the ongoing presence of plant security (present 24-hours per day).

Following the completion of excavation and vault construction and filling, the need for permanent institutional controls and deed restrictions to restrict access, land use, and development will be evaluated. Where institutional controls are no longer required, the temporary fencing will be removed.

10.0 OPERATION, MAINTENANCE AND MONITORING

Long-term operation, maintenance and monitoring will be required for the Cover System. These requirements will be included in an Operation, Maintenance, and Monitoring Plan (OM&M) Plan developed for the overall Facility Remedy. This OM&M Plan will include the following information for the cover system:

a) the organizational structure for long-term operation, maintenance, and monitoring;

b) the proposed locations and details for groundwater monitoring locations;

c) the requirements for operation, maintenance, and monitoring (e.g., inspection frequencies, grass cutting, asphalt sealing, etc.);

d) the Site HASP; and

e) the sampling and analytical procedures, reporting requirements, and corrective action procedures.

11.0 ADMINISTRATIVE TASKS

11.1 PERMIT APPLICATIONS AND APPROVALS

In addition to U.S. EPA approval and IDEM approval of the proposed cover system, a soil erosion and sediment control permit will be required for the East Plant Area IM. This permit will be obtained from the Indiana Department of Natural Resources (IDNR).

11.2 FINANCIAL ASSURANCE

The proposed cover system will be constructed at an operating GM plant as part of the East Plant Area IM for the Facility. Financial assurance for the proposed cover system construction will be part of any financial assurance mechanism developed for the East Plant Area IM of the overall Corrective Measure.

12.0 PROJECT SCHEDULE

A detailed project schedule identifying the proposed phasing and duration of excavation and material placement activities will be developed and submitted by the Contractor. The overall implementation of the prescribed ≥50 mg/kg PCB soil material excavation, filling of the vault, and backfilling with <50 mg/kg PCB soils is anticipated to require approximately 2 months to complete. Cover system installation will be completed following backfilling and is expected to take approximately 1-2 months to complete.

13.0 COMMUNITY RELATIONS

Community relations activities and community participation in the review of the West Plant Area IM, including the prescribed ≥50 mg/kg PCB soil removal includes:

- project fact sheets specific to the West Plant Area IM activities, including the vault design and construction and soil removal activities;
- project web site;
- GM organized community meetings for neighbors and the general public; and
- Community Liaison Panel (CLP) involvement.

14.0 REFERENCES

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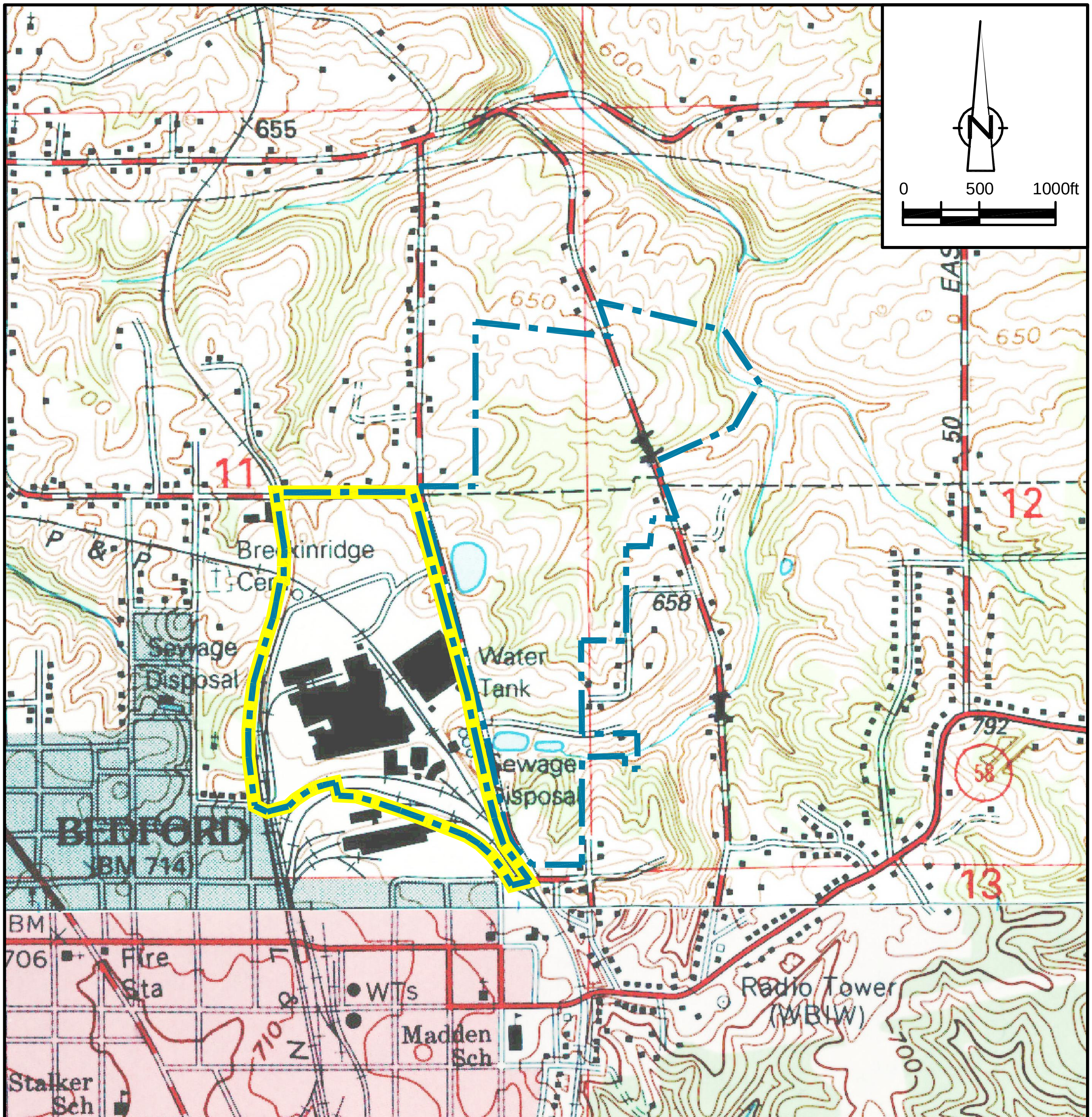


BASE SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES;
BARTLETTSVILLE, INDIANA 1994
BEDFORD EAST, INDIANA 1978
BEDFORD WEST, INDIANA 1993
OOLITIC, INDIANA 1987

INDIANA

BEDFORD

DRAFT

LEGEND

FACILITY BOUNDARY

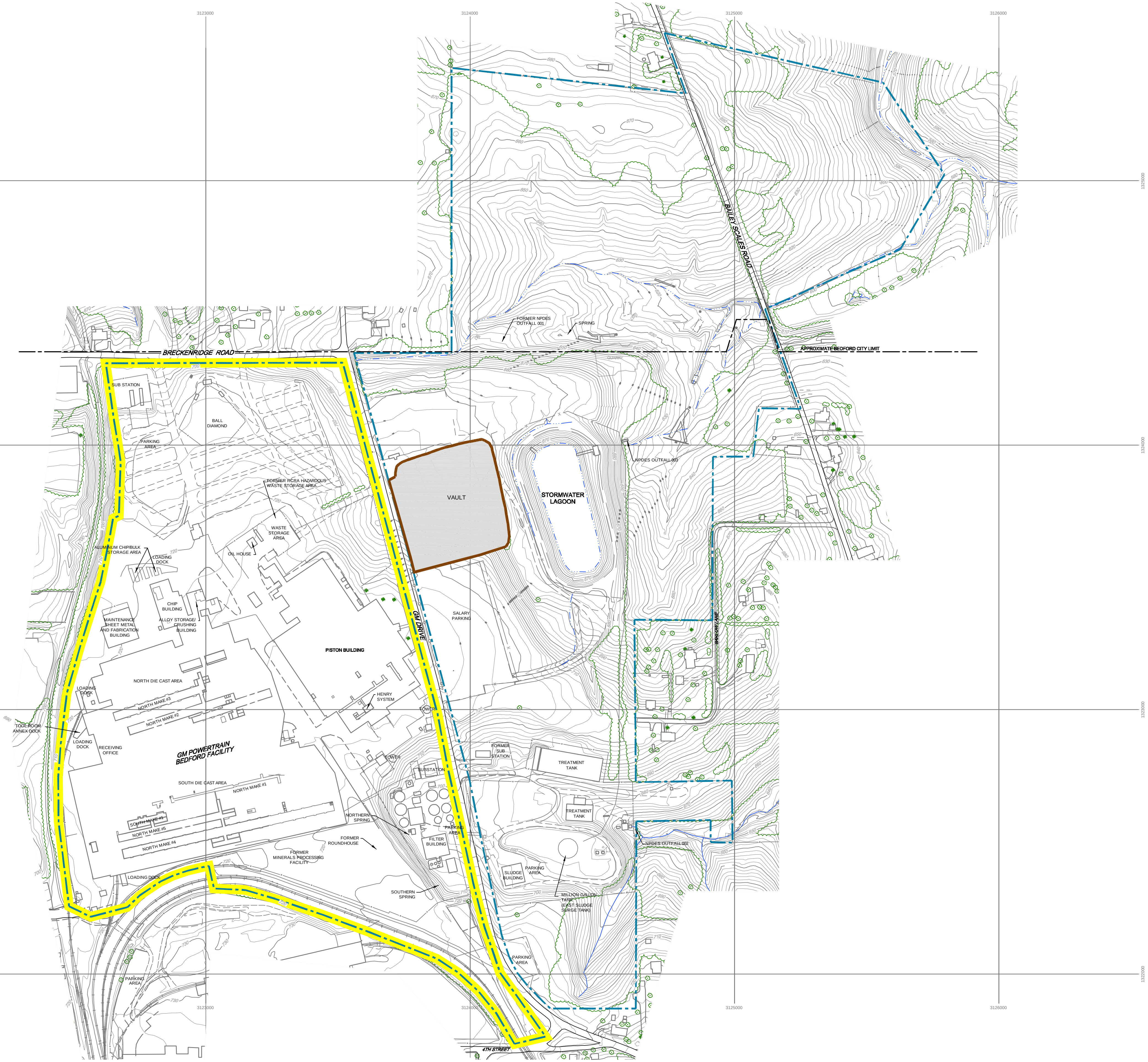
WEST PLANT AREA

figure 1.1

FACILITY LOCATION
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

CRA

13968-00(253)GN-WA005 DEC 12/2007



№.	Revision	Date	Initial

0 100 200ft

LEGEND

- 800 — EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- APPROXIMATE GM PROPERTY BOUNDARY
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- WEST PLANT AREA

NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAFT

DRAWING STATUS

Status	Date	Initial

GM POWERTRAIN BEDFORD FACILITY BEDFORD, INDIANA

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA

FACILITY PLAN

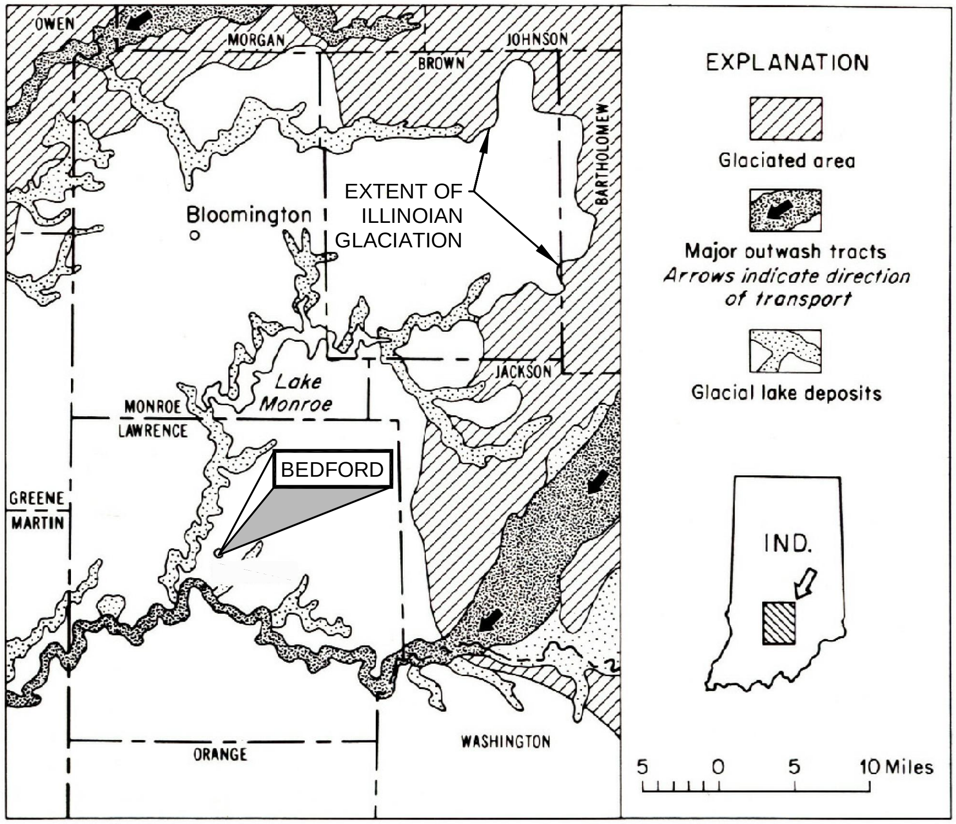
CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI. APRIL 2001 AND CRA SURVEYS 2002 TO 2005

Project Manager: J.M.	Reviewed By: P.G.	Date: JULY 2006	
Scale: AS SHOWN	Project №: 13968-00	Report №: 253	Drawing №: figure 1.2

13968-00(253)GN-WA006 DEC 12/2007



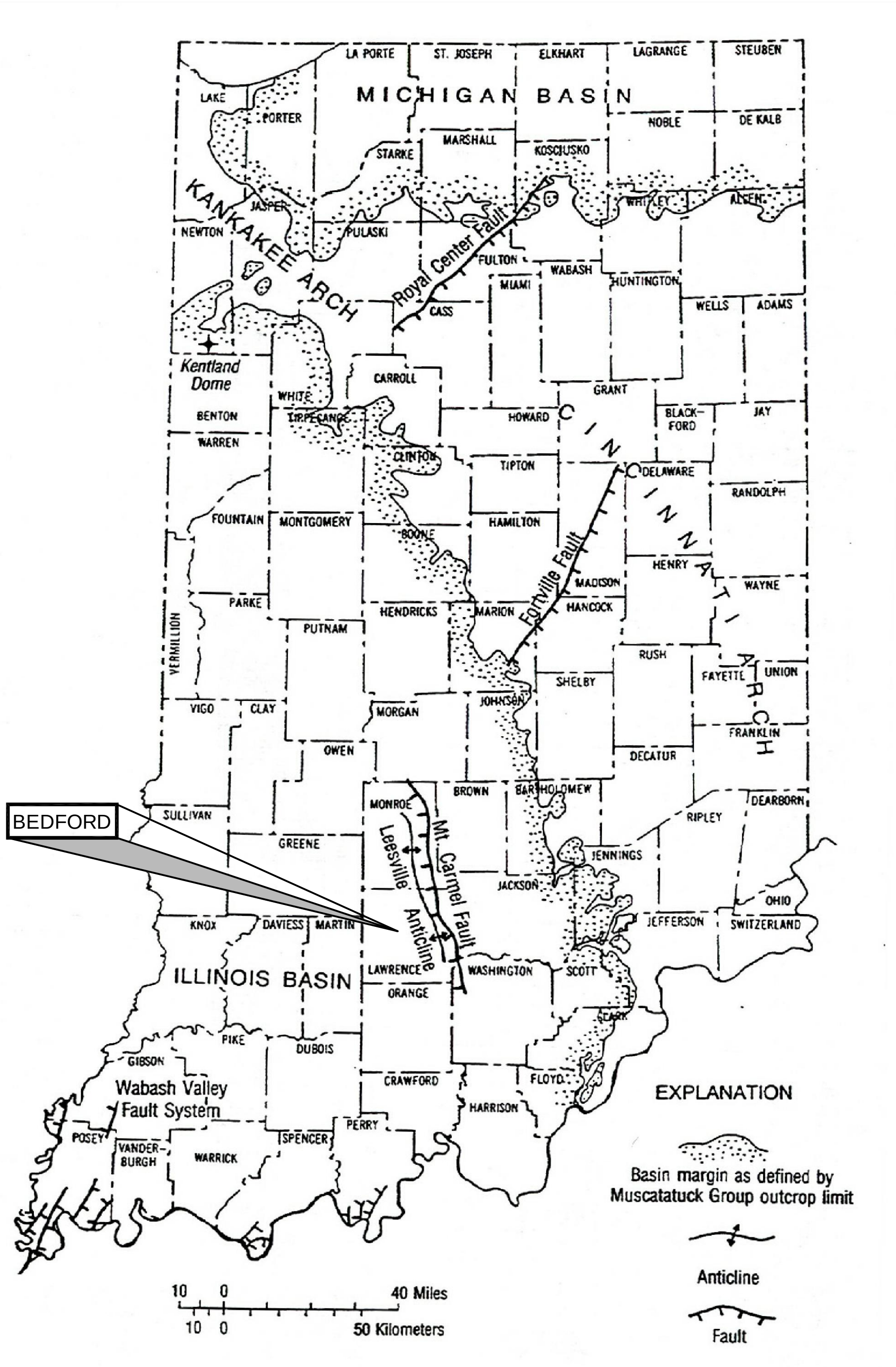
DRAFT

figure 3.1

GLACIAL FEATURES OF SOUTH-CENTRAL INDIANA
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

SOURCE: GRAY, 1974

13968-00(253)GN-WA007 DEC 12/2007

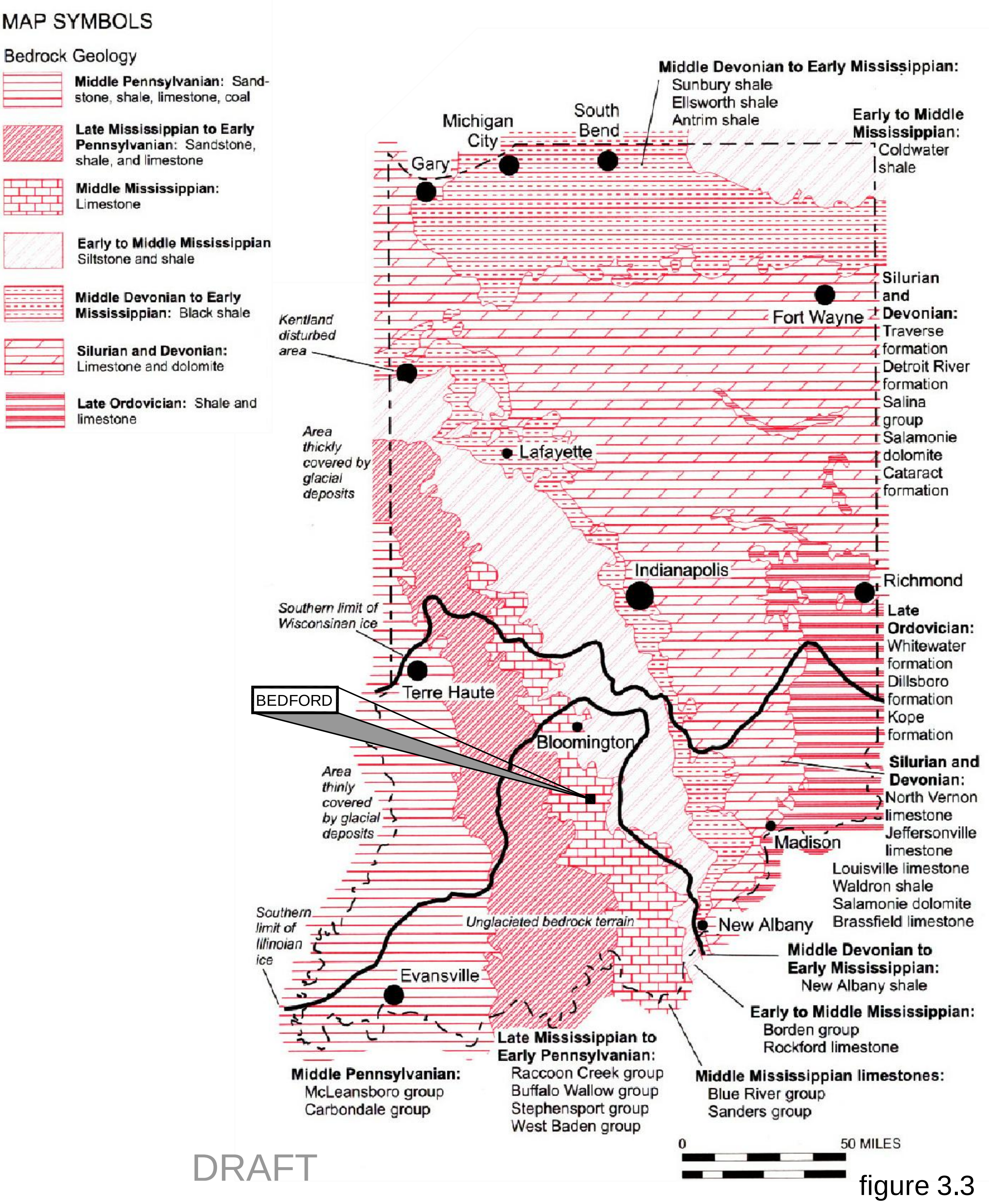


DRAFT

figure 3.2

BEDROCK STRUCTURAL FEATURES OF INDIANA
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

SOURCE: RUPP, 1991

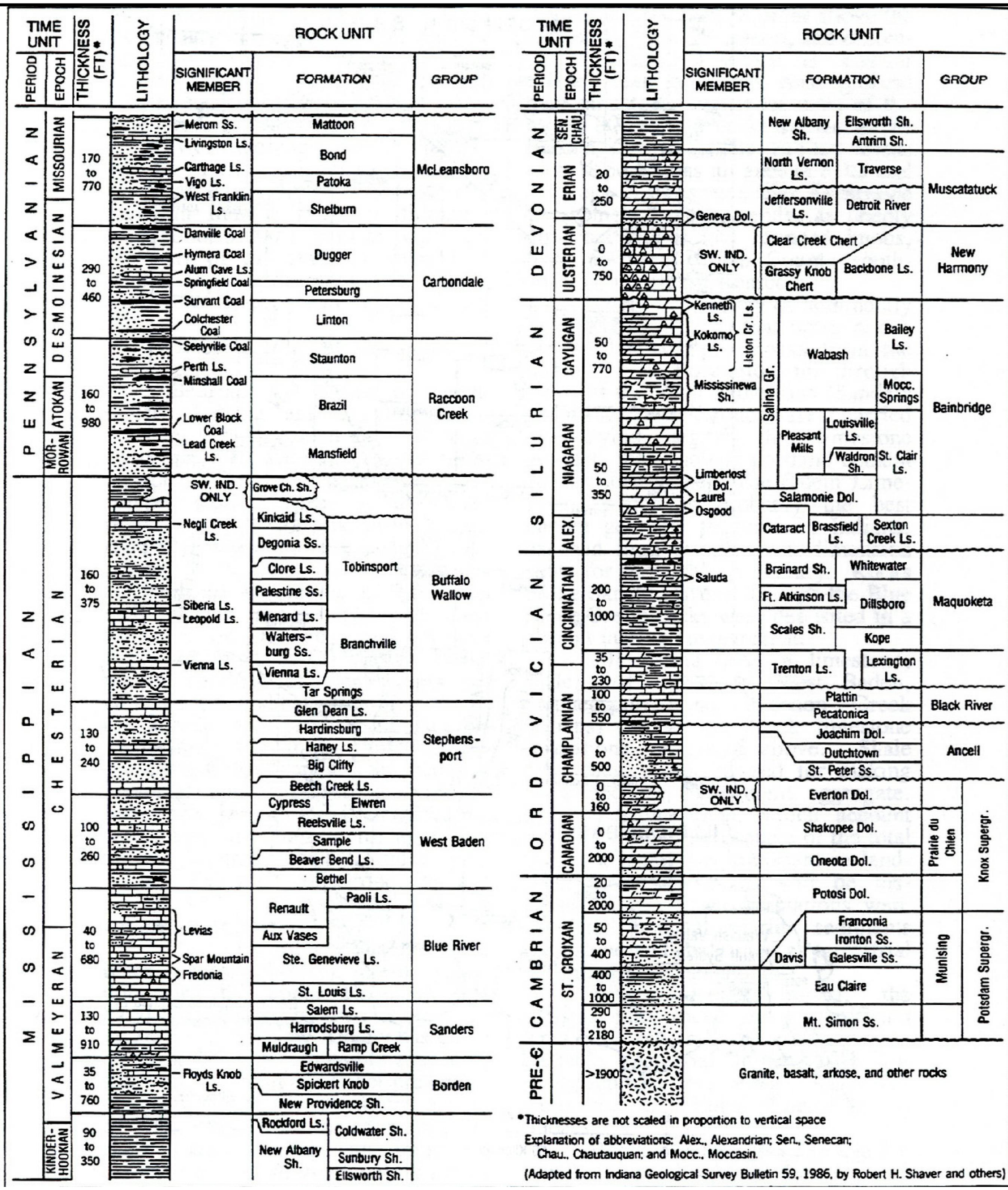


DRAFT

figure 3.3

BEDROCK GEOLOGY OF INDIANA
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

SOURCE: CAMP AND RICHARDSON, 1999



DRAFT

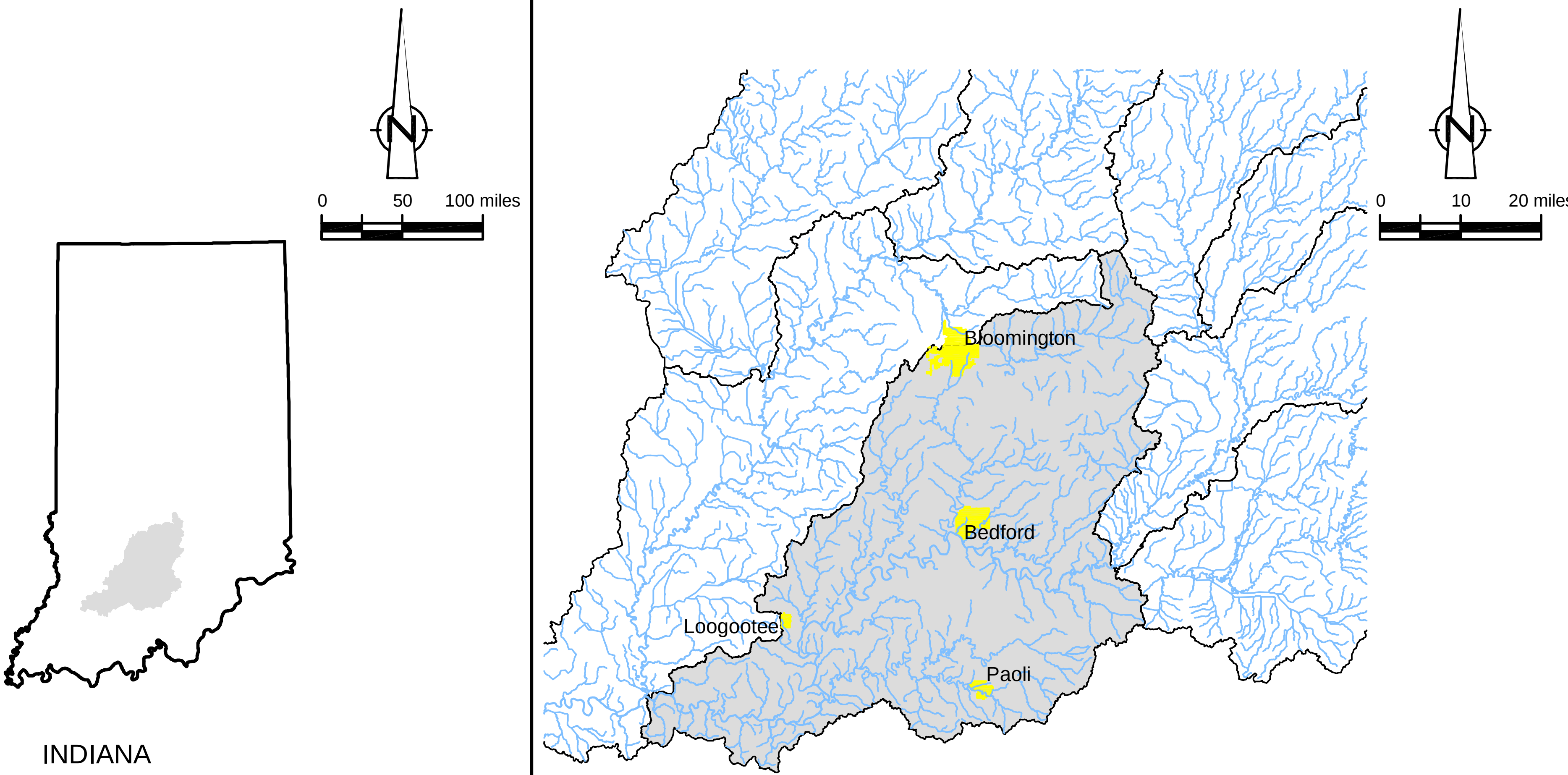
figure 3.4

GENERALIZED STRATIGRAPHIC COLUMN
FOR PALEOZOIC ROCKS IN INDIANA
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

CRA

SOURCE: HILL, UNDATED

13968-00(253)GN-WA010 DEC 12/2007



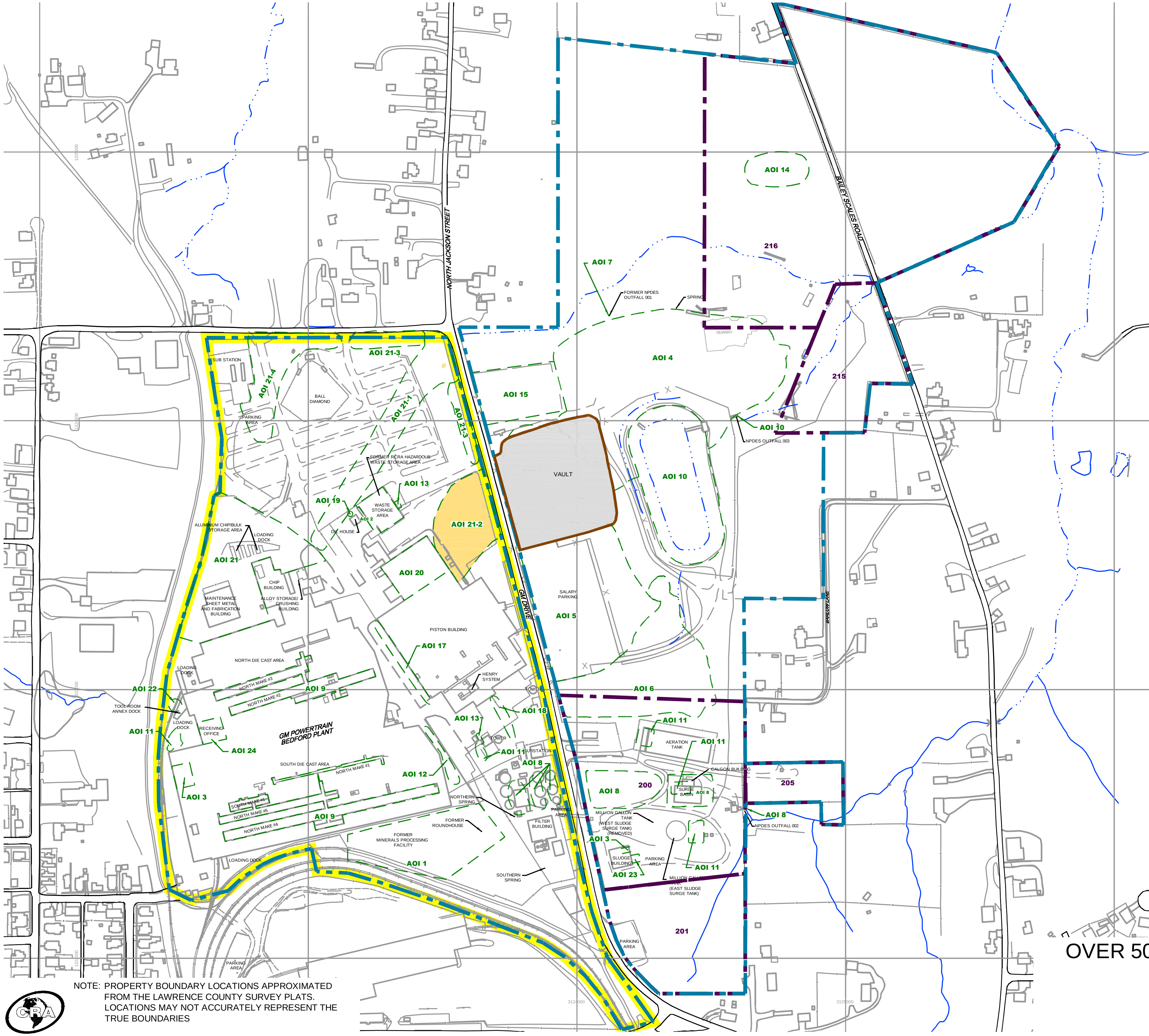
SOURCE: SOURCE: INDIANA GEOLOGICAL SURVEY, INDIANA DEPARTMENT OF TRANSPORTATION

DRAFT

figure 3.5

LOWER EAST FORK WHITE RIVER DRAINAGE BASIN
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA011 DEC 12/2007



NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

0 200 400ft

LEGEND

- AOI BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- WEST PLANT AREA
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- AREA OF INTEREST IN 21-1 AND 21-2

AOI SUMMARY

AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 4	Former North Disposal Area
AOI 5	Former East Sand Disposal Area
AOI 6	Former Sludge Disposal and Fire Training Area
AOI 7	Former North Lagoon and Outfall 001
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 10	Existing Stormwater Lagoon and Outfall 003
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 14	McBride Cows Disposal Area
AOI 15	Former Equipment Storage Area
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 23	Area Affected by the 1996 Wastewater Treatment Filter Cake Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release

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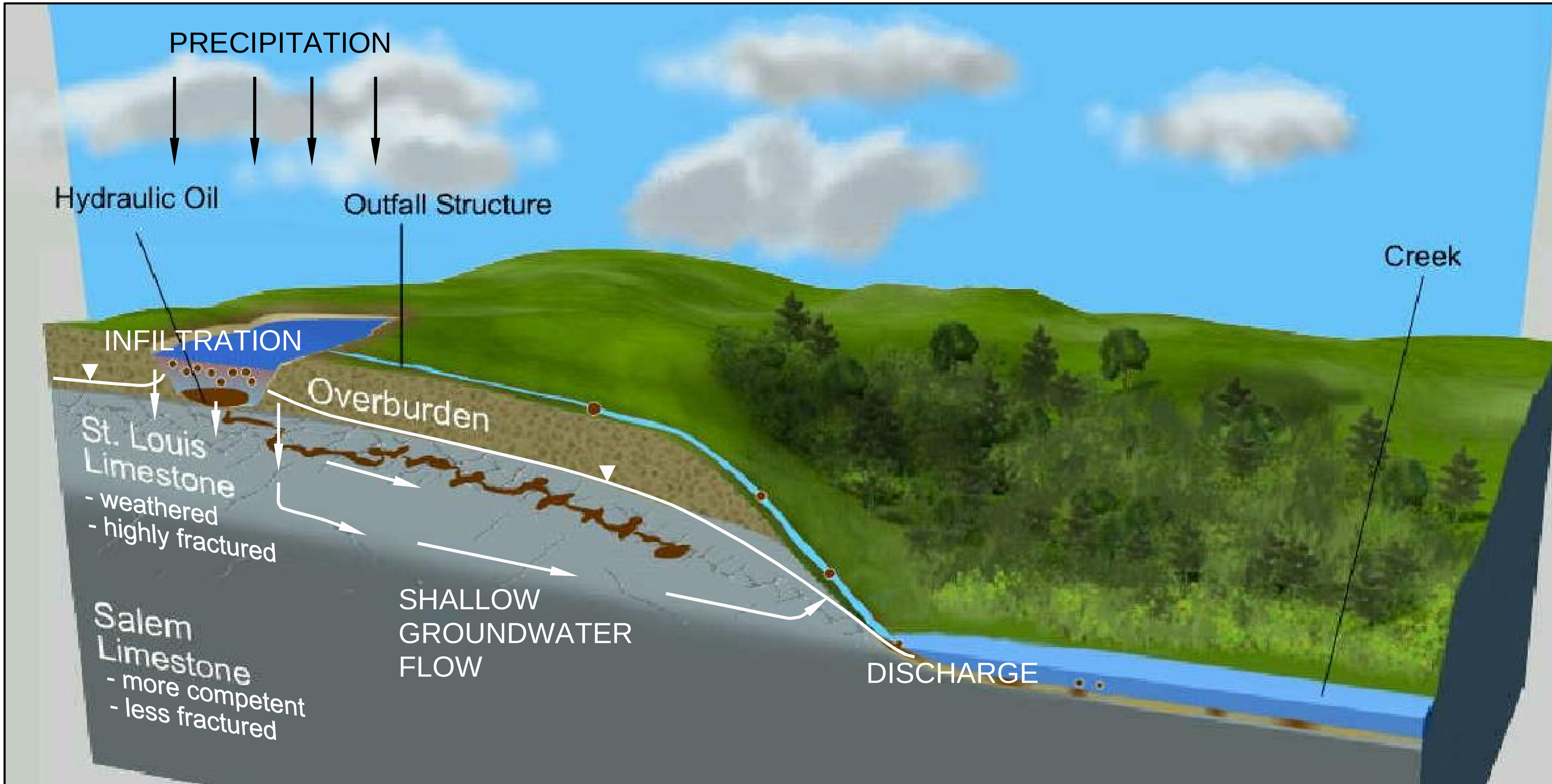
figure 3.6

WEST PLANT AREA AND AOI LOCATIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA012 DEC 12/2007



NOTE:
REPRESENTATIVE OF HISTORICAL CONDITION.

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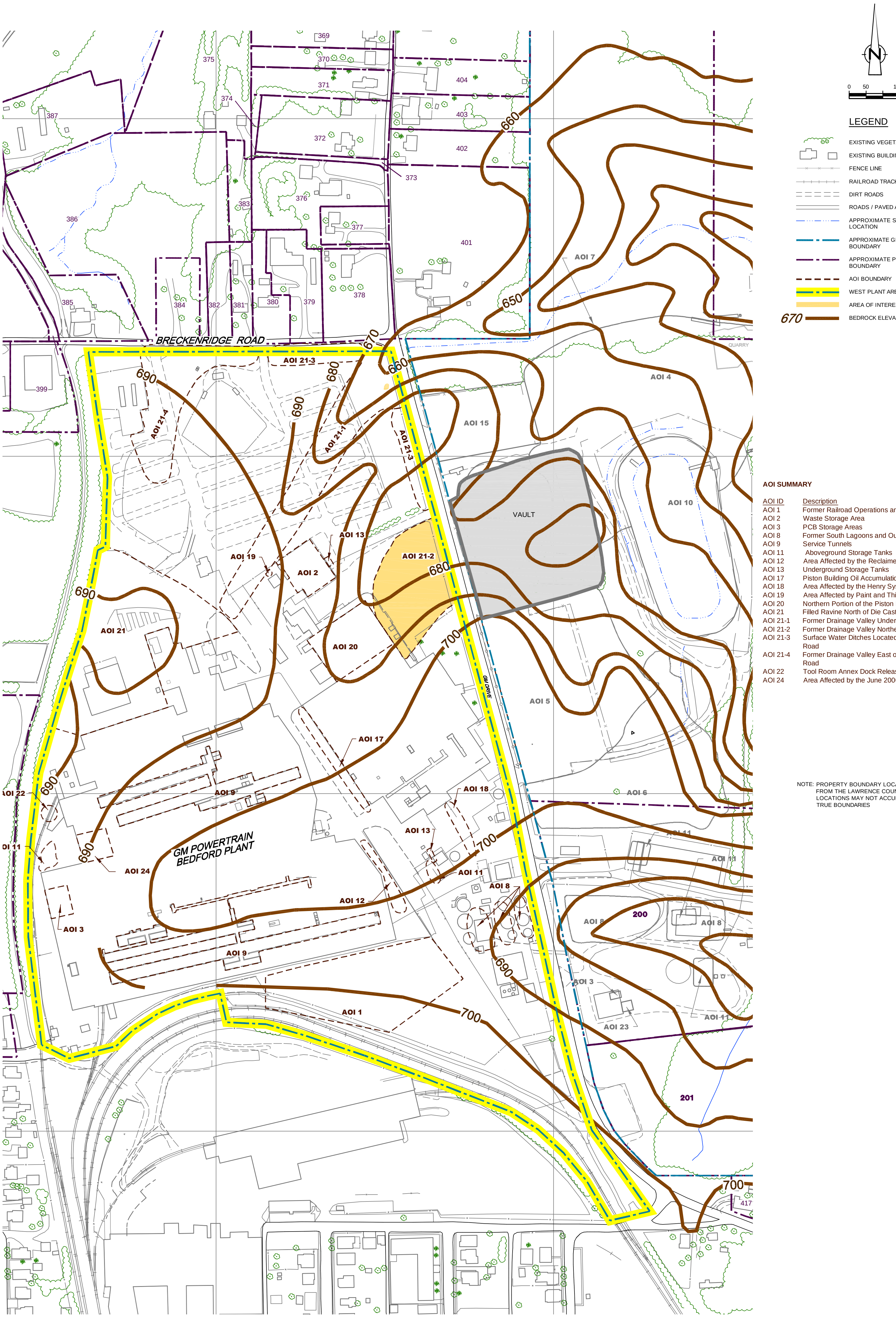
figure 3.7

OVERBURDEN AND SHALLOW BEDROCK CONCEPTUAL SITE MODEL FOR HISTORIC MIGRATION OF OIL AND SHALLOW GROUNDWATER FLOW
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA013 DEC 12/2007



LEGEND

- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE GM PROPERTY BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- AOI BOUNDARY
- WEST PLANT AREA
- AREA OF INTEREST IN 21-1 AND 21-2
- 670 BEDROCK ELEVATION CONTOUR (ft AMSL)

AOI SUMMARY

AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release

NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAFT

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA

BEDROCK
TOPOGRAPHY

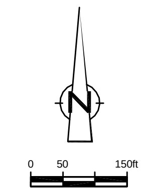
CONESTOGA-ROVERS & ASSOCIATES

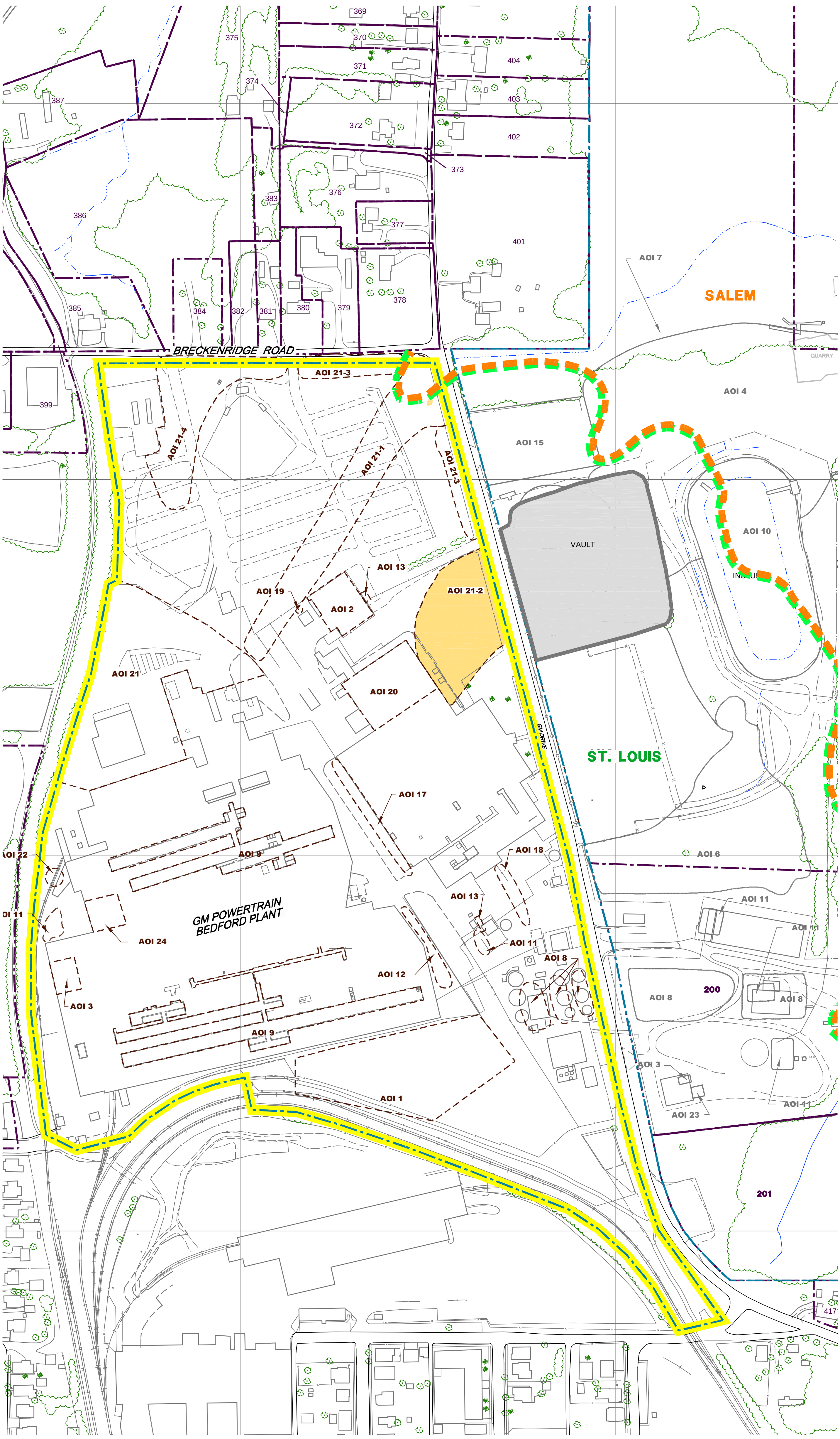
Source Reference:
BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

Project Manager:	Reviewed By:	Date:
J.M.	D.C.	MAY 2006

Scale:	Project Nº:	Report Nº:	Drawing Nº:
AS SHOWN	13968-00	253	figure 3.8

13968-00(253)GN-WA014 DEC 12/2007





LEGEND

- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE GM PROPERTY BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- AOI BOUNDARY
- WEST PLANT AREA
- AREA OF INTEREST IN 21-1 AND 21-2
- APPROXIMATE BEDROCK FORMATION CONTACT GREEN INDICATES ST. LOUIS FORMATIOM
- ORANGE INDICATES SALEM FORMATION

AOI SUMMARY

AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release

NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAFT

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA

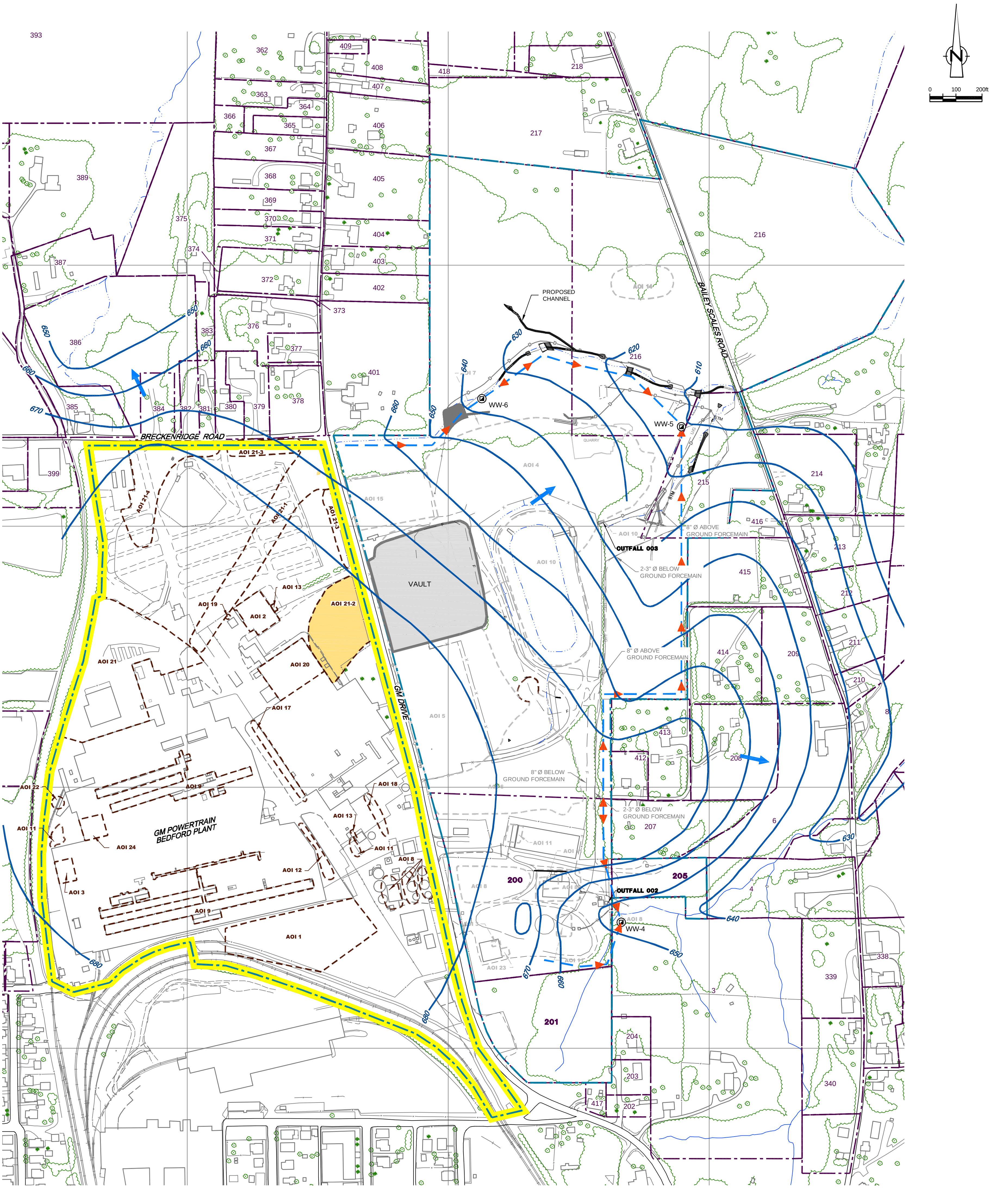
APPROXIMATE BEDROCK
FORMATION CONTACT LOCATIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

Project Manager:	Reviewed By:	Date:	
J.M.	P.G.	MAY 2006	
Scale:	Project Nº:	Report Nº:	Drawing Nº:
AS SHOWN	13968-00	253	figure 3.9

13968-00(253)GN-WA015 DEC 12/2007



LEGEND

	EXISTING VEGETATION
	EXISTING BUILDINGS
	FENCE LINE
	RAILROAD TRACKS
	DIRT ROADS
	ROADS / PAVED AREAS
	APPROXIMATE SURFACE WATER LOCATION
	APPROXIMATE GM PROPERTY BOUNDARY
	APPROXIMATE PROPERTY BOUNDARY
	AOI BOUNDARY
	WEST PLANT AREA
	AREA OF INTEREST IN 21-1 AND 21-2
670	SHALLOW GROUNDWATER FLOW CONTOUR (ft AMSL) (JUNE 20-22, 2006)
	APPROXIMATE DIRECTION OF GROUDWATER FLOW
	EXISTING SSC GRAVITY DRAIN
STM	PROPOSED STORM SEWER
F	PROPOSED FORCEMAIN
	PROPOSED GROUNDWATER COLLECTION TRENCH
WW	PROPOSED WET WELL
	PROPOSED GROUNDWATER COLLECTION TRENCH FLOW DIRECTION

AOI SUMMARY

AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release

NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAFT

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA

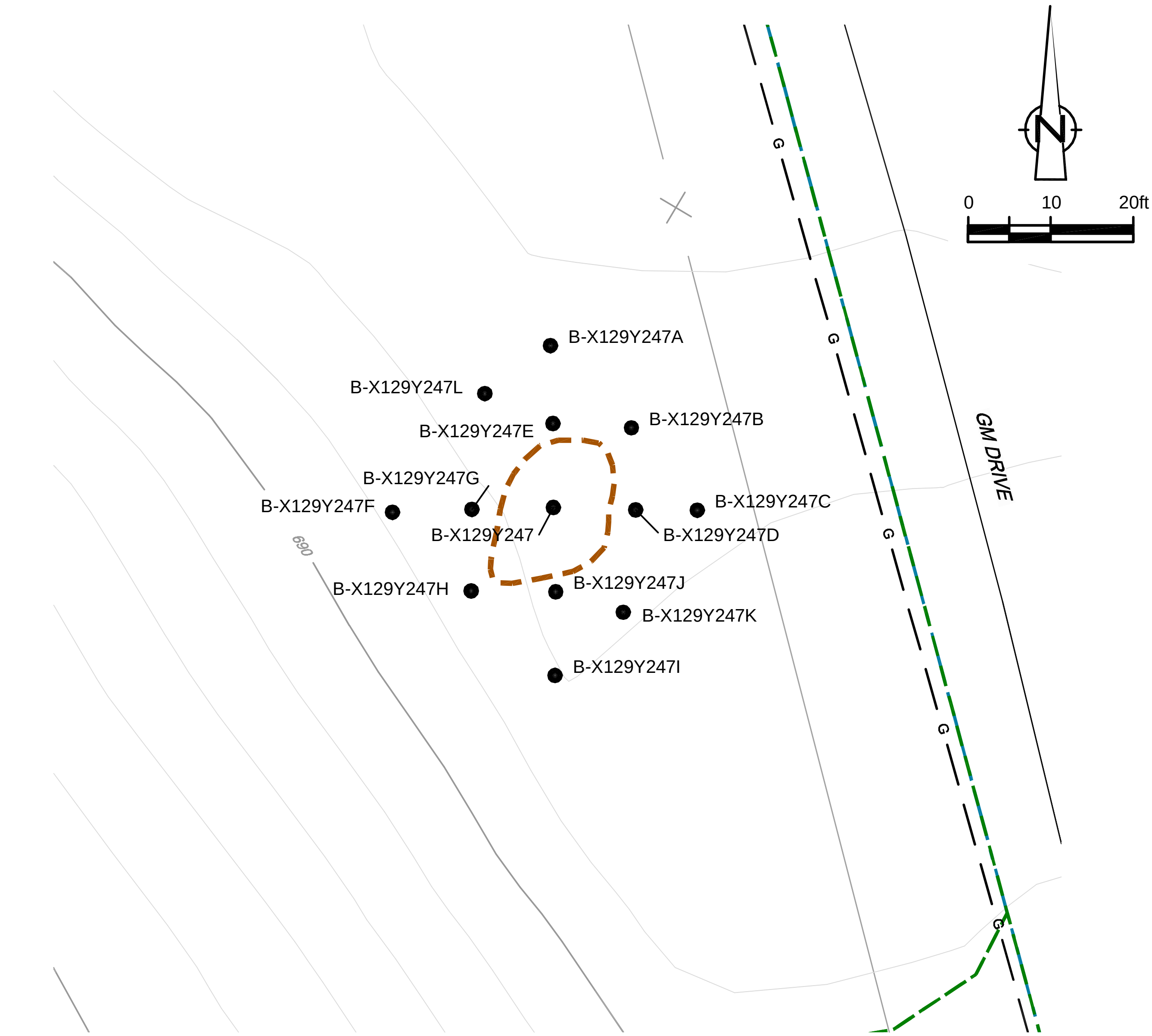
SHALLOW GROUNDWATER TABLE CONTOURS AND FLOW DIRECTIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

Project Manager:	Reviewed By:	Date:	
J.M.	P.G.	MAY 2006	
Scale: AS SHOWN	Project Nº: 13968-00	Report Nº: 253	Drawing Nº: figure 3.10

13968-00(253)GN-WA016 DEC 12/2007



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2005

LEGEND

- AOI BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE LOCATION OF EXISTING GAS LINE
- SOIL SAMPLE LOCATION
- LIMITS OF EXCAVATION (TO 2ft BGS)

AOI SUMMARY

AOI ID Description
AOI 21 Filled Ravine North of Die Cast Building

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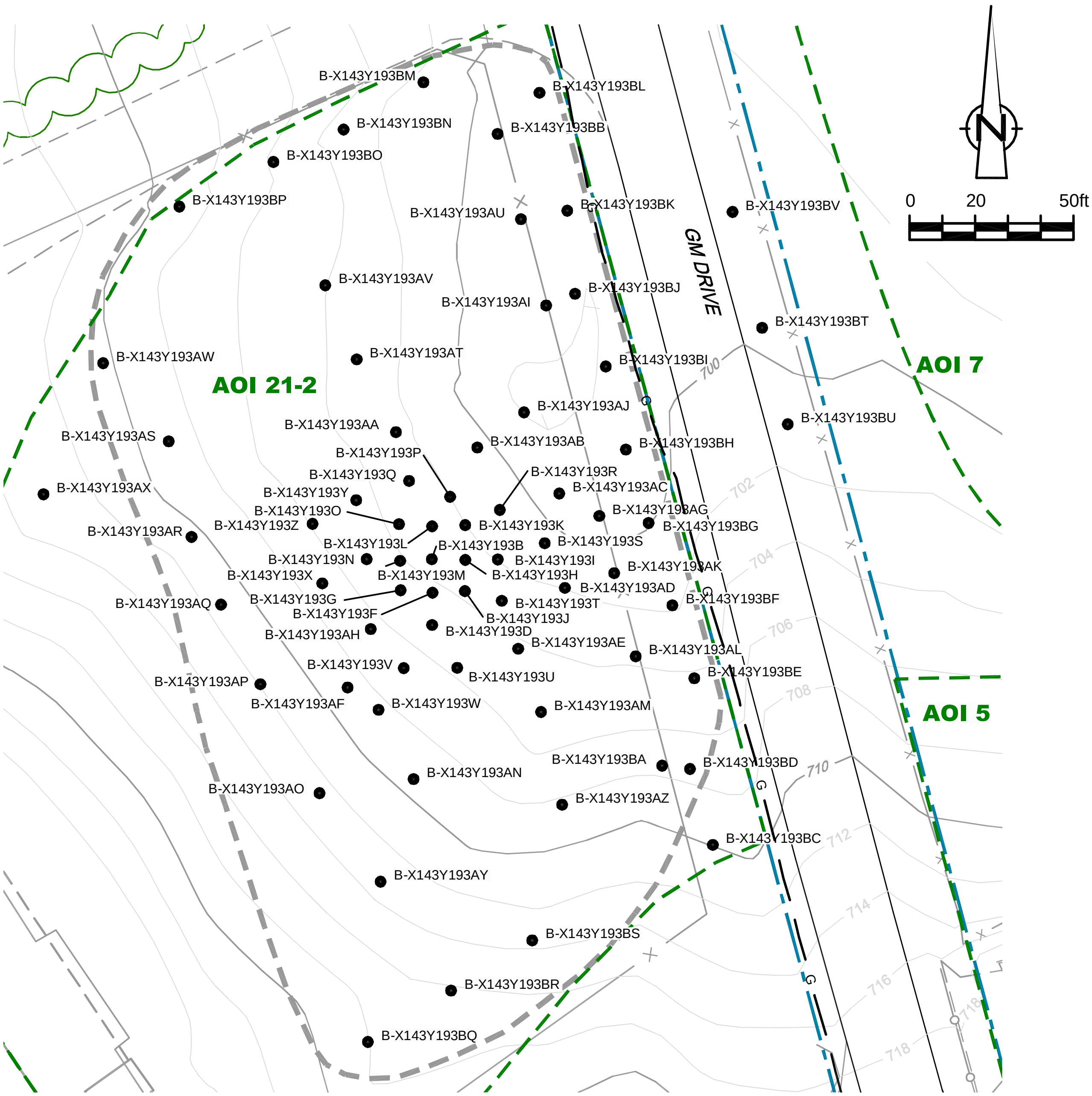
figure 3.11

AOI 21-1 BOREHOLE LOCATIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA017 DEC 12/2007



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2005

LEGEND

green dashed line	AOI BOUNDARY	●	SOIL SAMPLE LOCATION
blue dash-dot line	APPROXIMATE GM PROPERTY BOUNDARY	grey heavy dashed line	LIMITS OF PROPOSED COVER SYSTEM
blue dash-dot-dot line	STREAMS		
line with x marks	FENCE LINE		
line with tick marks	RAILROAD TRACKS		
double dashed line	DIRT ROADS		
double solid line	ROADS / PAVED AREAS		
dashed line with G	GAS LINE (SURVEYED)		

AOI SUMMARY

AOI ID	Description
AOI 5	Former East Sand Disposal Area
AOI 7	Former North Lagoon and Outfall 001
AOI 21	Filled Ravine North of Die Cast Building

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figure 3.12

AOI 21-2 BOREHOLE LOCATIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

CRA

13968-00(253)GN-WA018 DEC 12/2007

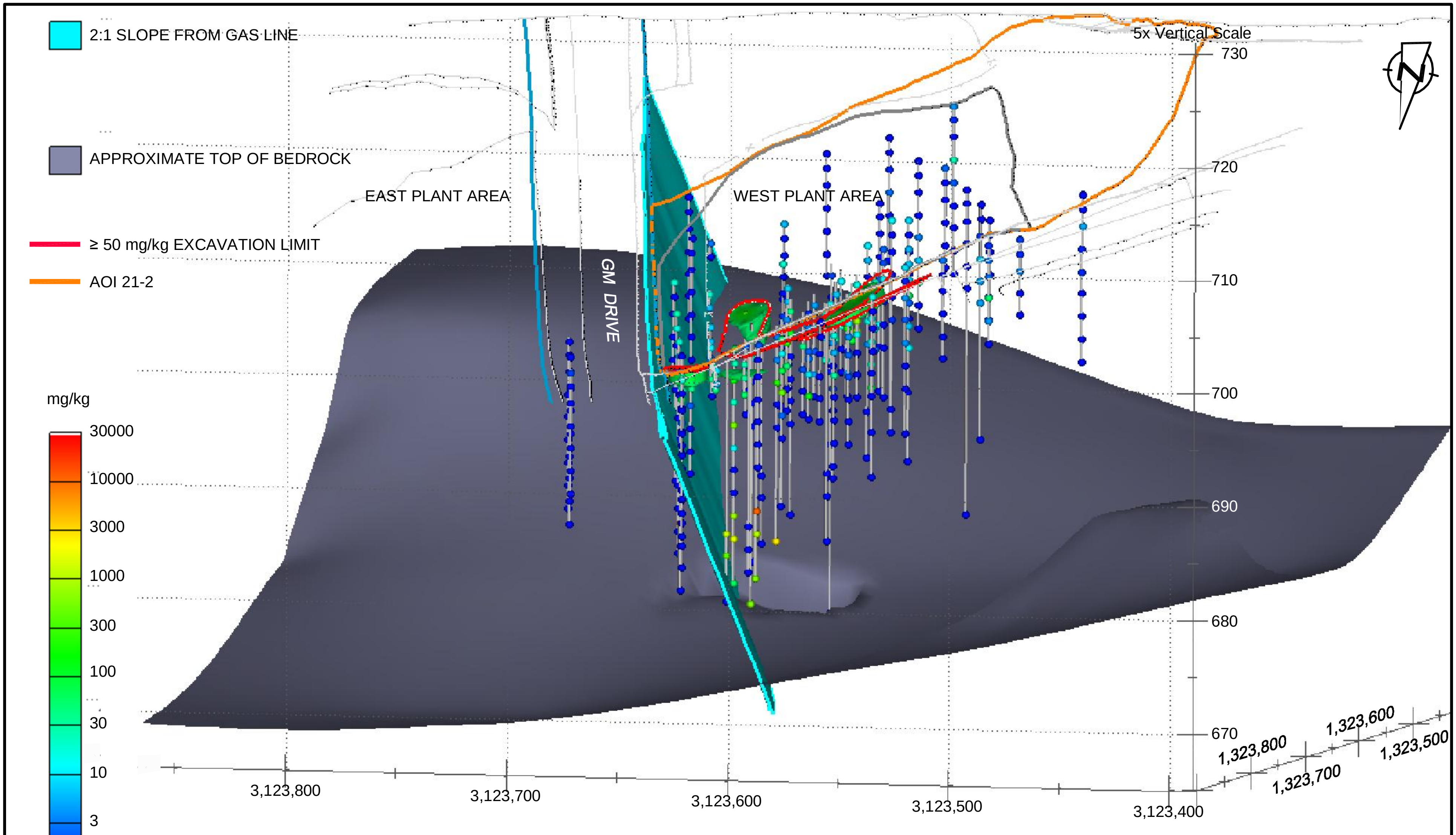

figure 3.13.1

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 0 - 2 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

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13968-00(253)GN-WA026 DEC 14/2007

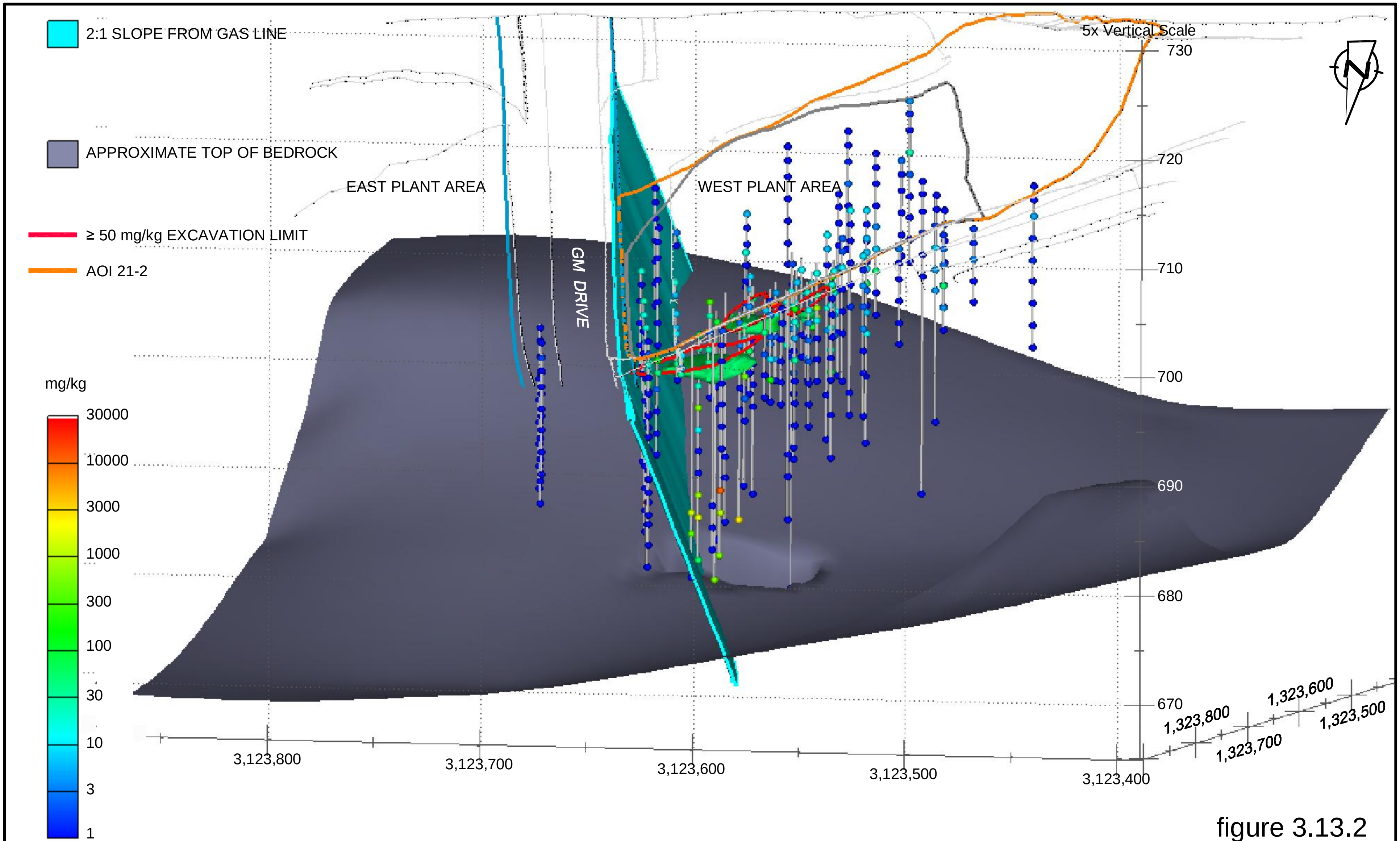

figure 3.13.2

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 2 - 4 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

13968-00(253)GN-WA026 DEC 14/2007

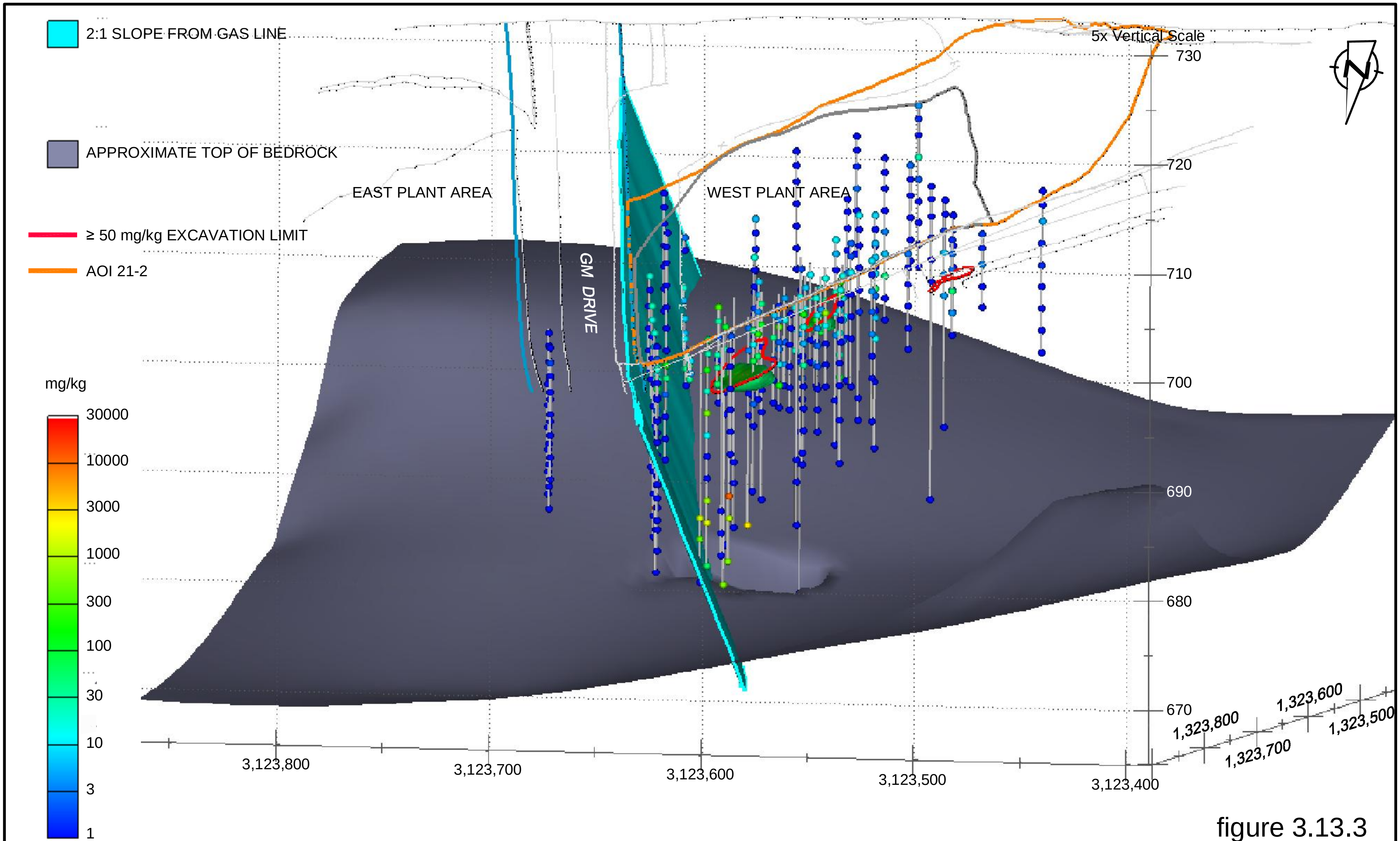

figure 3.13.3

DRAFT

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 4 - 6 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA026 DEC 14/2007

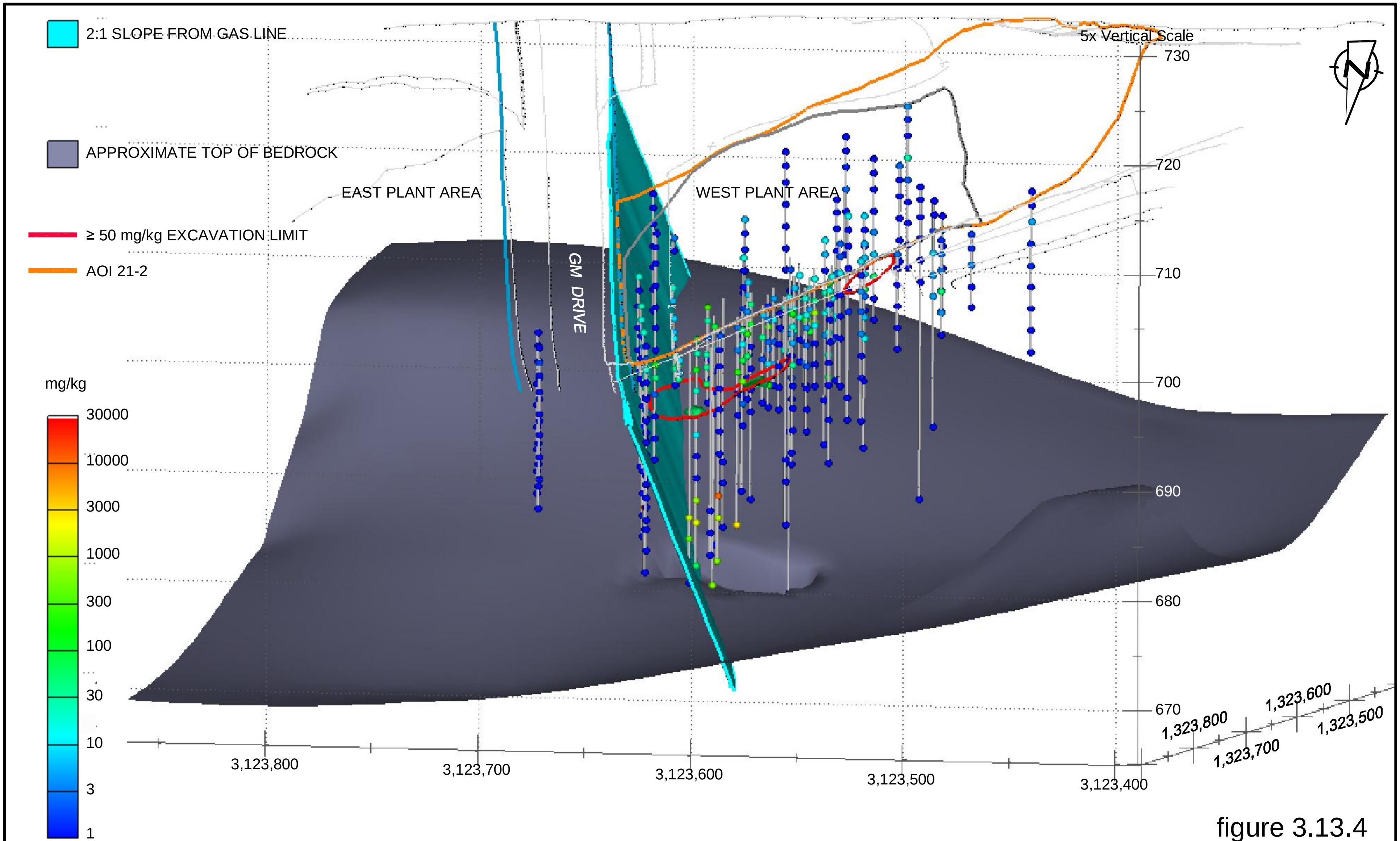

figure 3.13.4

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 6 - 8 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

CRA

13968-00(253)GN-WA026 DEC 14/2007

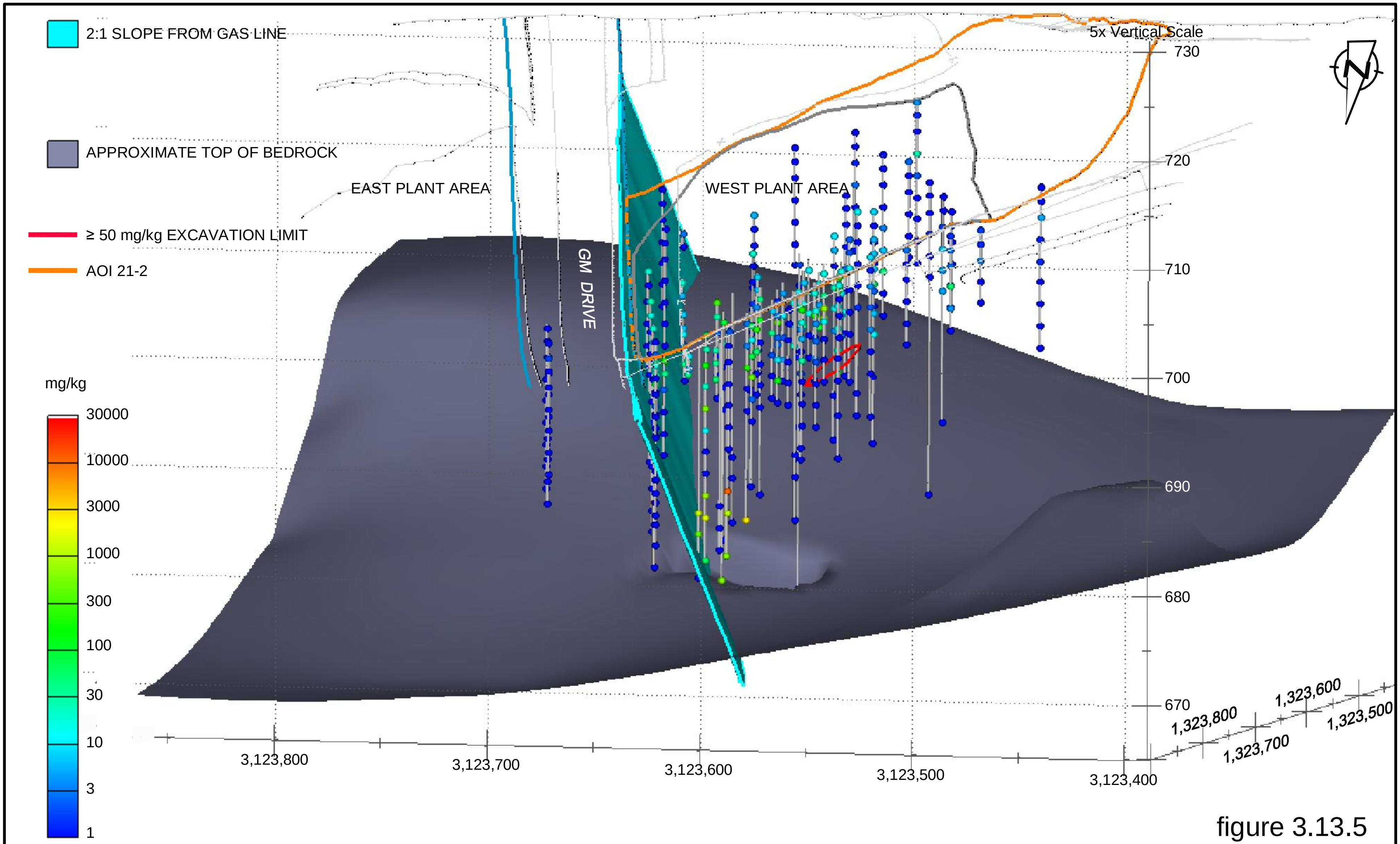

figure 3.13.5

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 8 - 10 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

13968-00(253)GN-WA027 DEC 14/2007

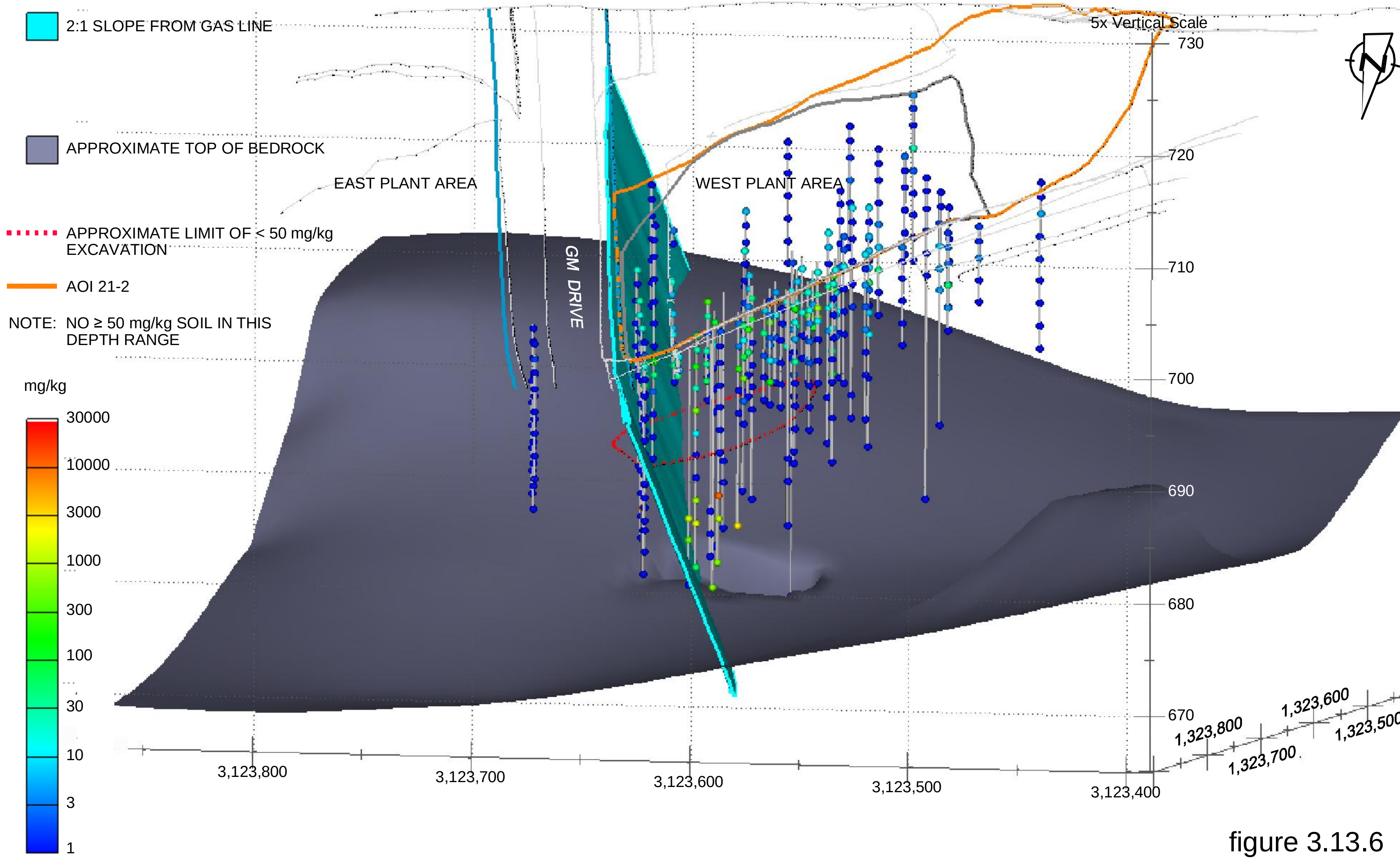

figure 3.13.6

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 10 - 12 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

CRA

13968-00(253)GN-WA027 DEC 14/2007

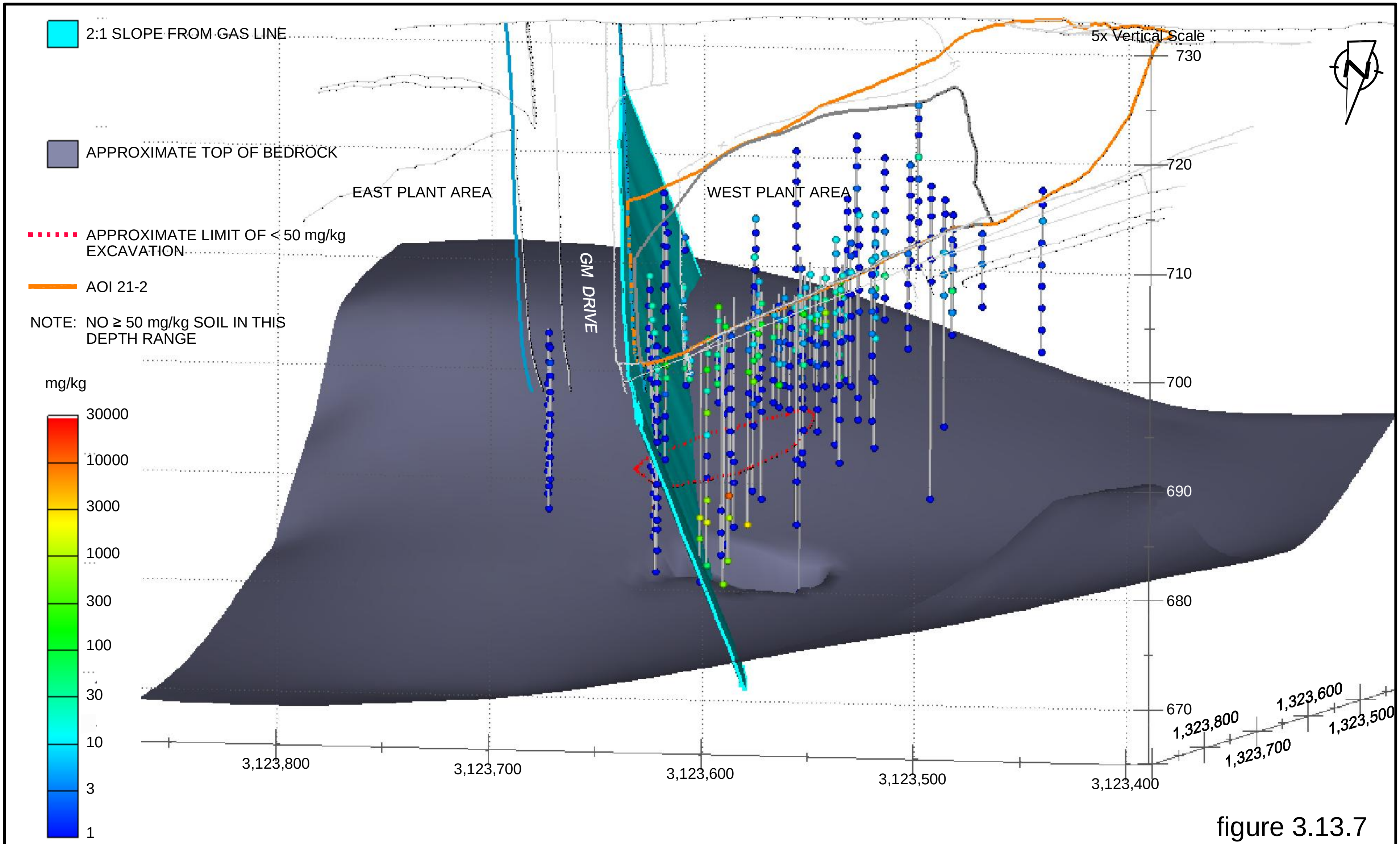

figure 3.13.7

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 12 - 14 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

CRA

13968-00(253)GN-WA027 DEC 14/2007

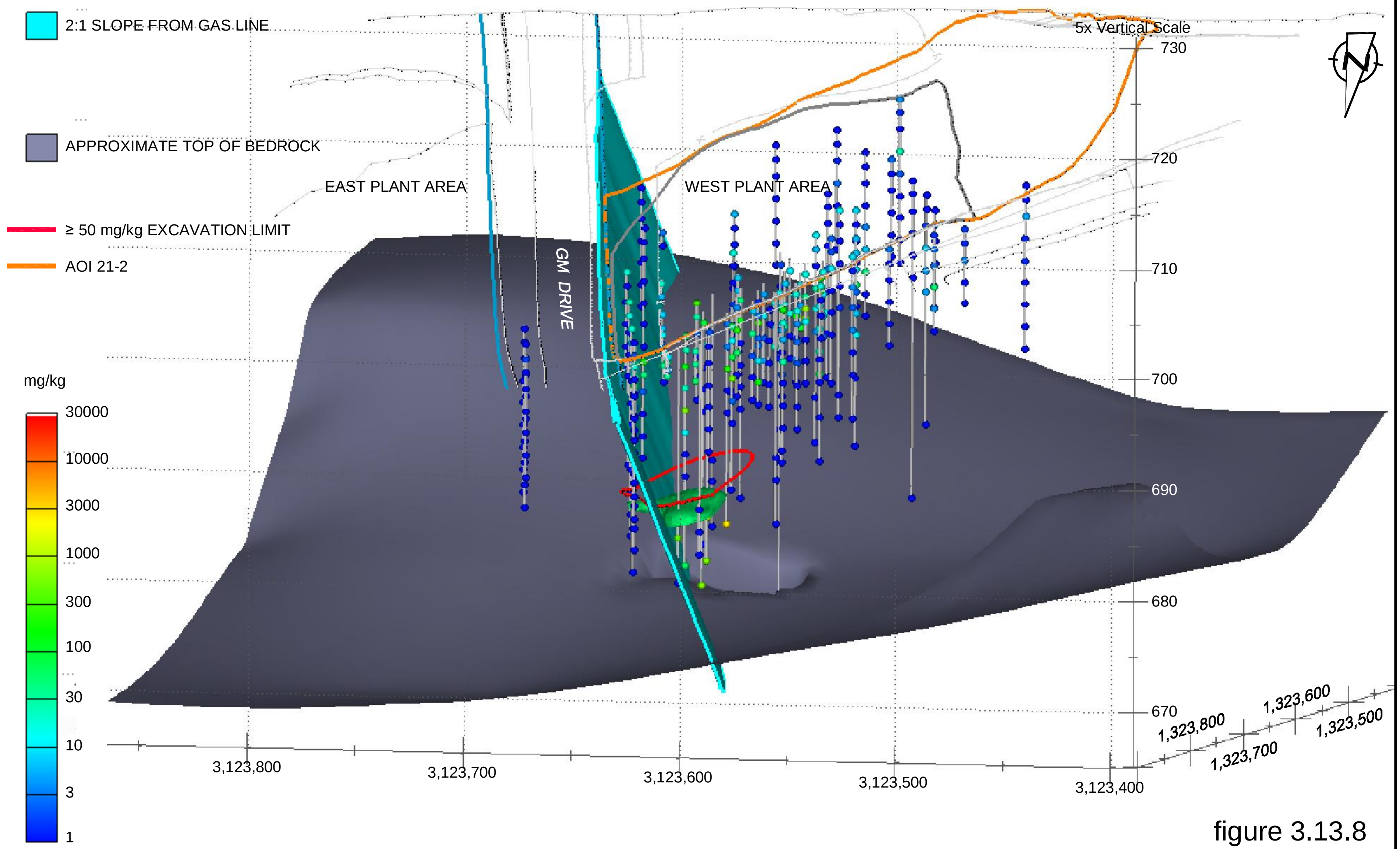

figure 3.13.8

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 14 - 16 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

CRA

13968-00(253)GN-WA027 DEC 14/2007

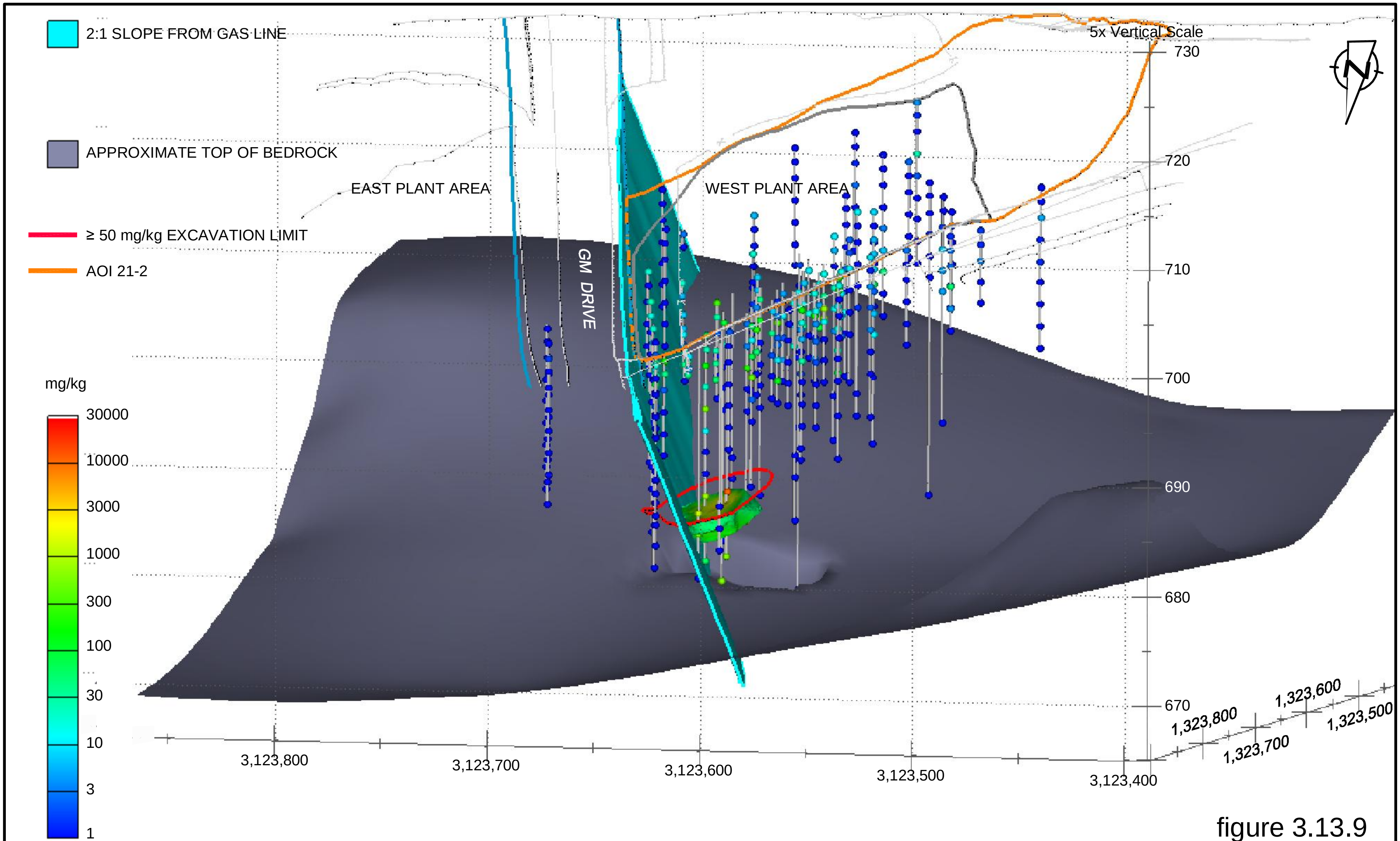

figure 3.13.9

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 16 - 18 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

13968-00(253)GN-WA028 DEC 14/2007

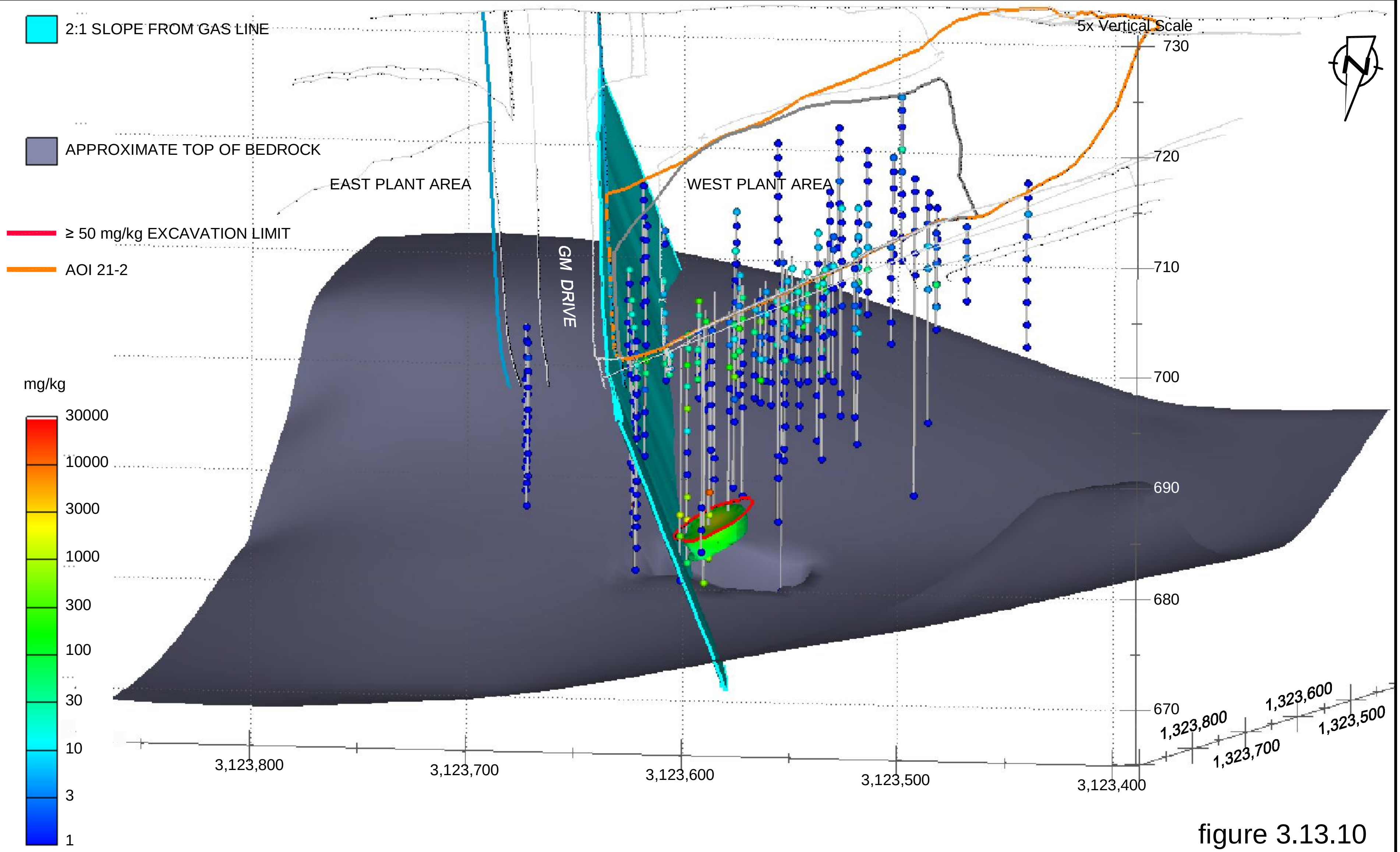

figure 3.13.10

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 18 - 20 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

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CRA

13968-00(253)GN-WA028 DEC 14/2007

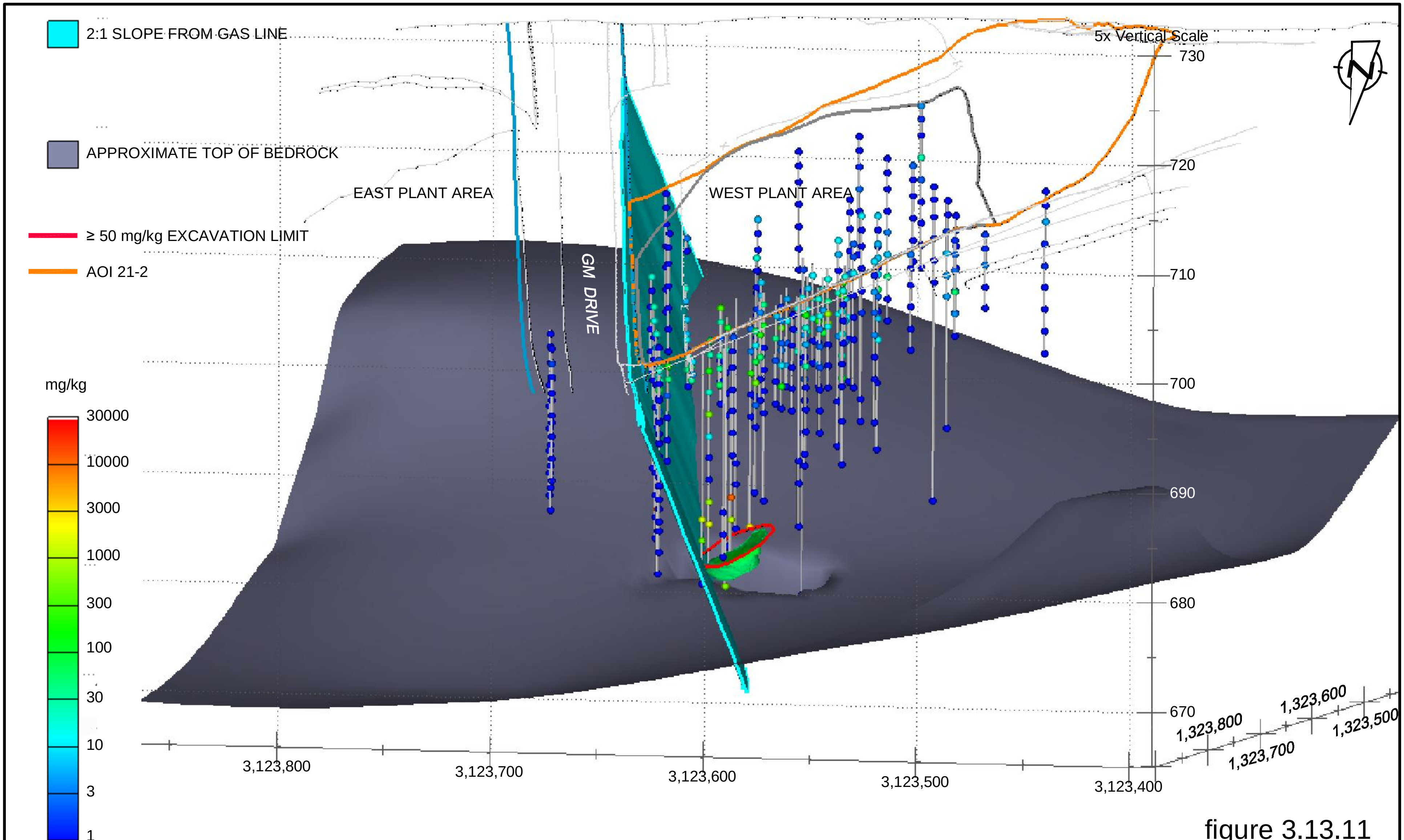

figure 3.13.11

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 20 - 22 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

DRAFT

CRA

13968-00(253)GN-WA028 DEC 14/2007

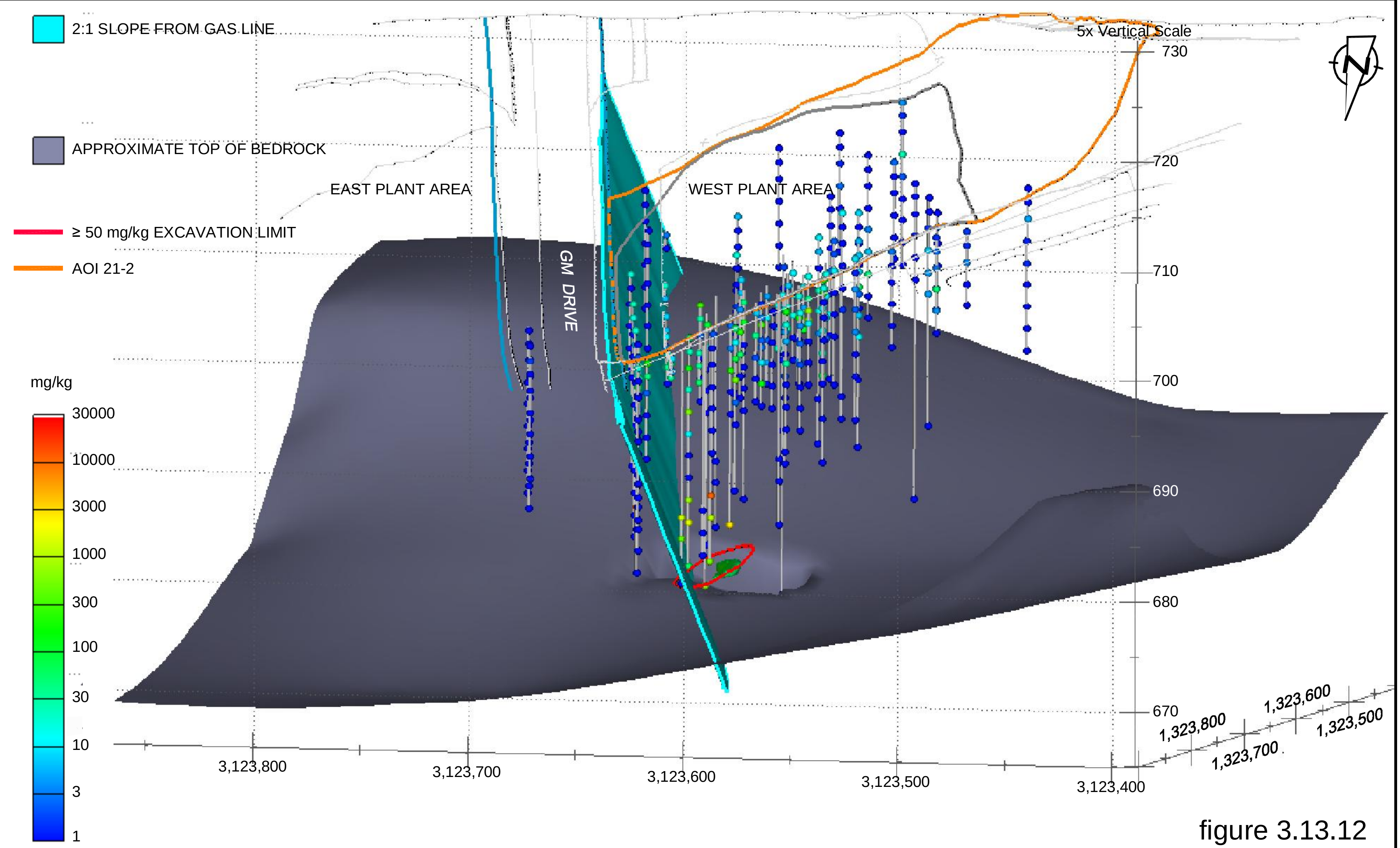

figure 3.13.12

3D ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 22 - 24 FEET BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

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13968-00(253)GN-WA028 DEC 14/2007

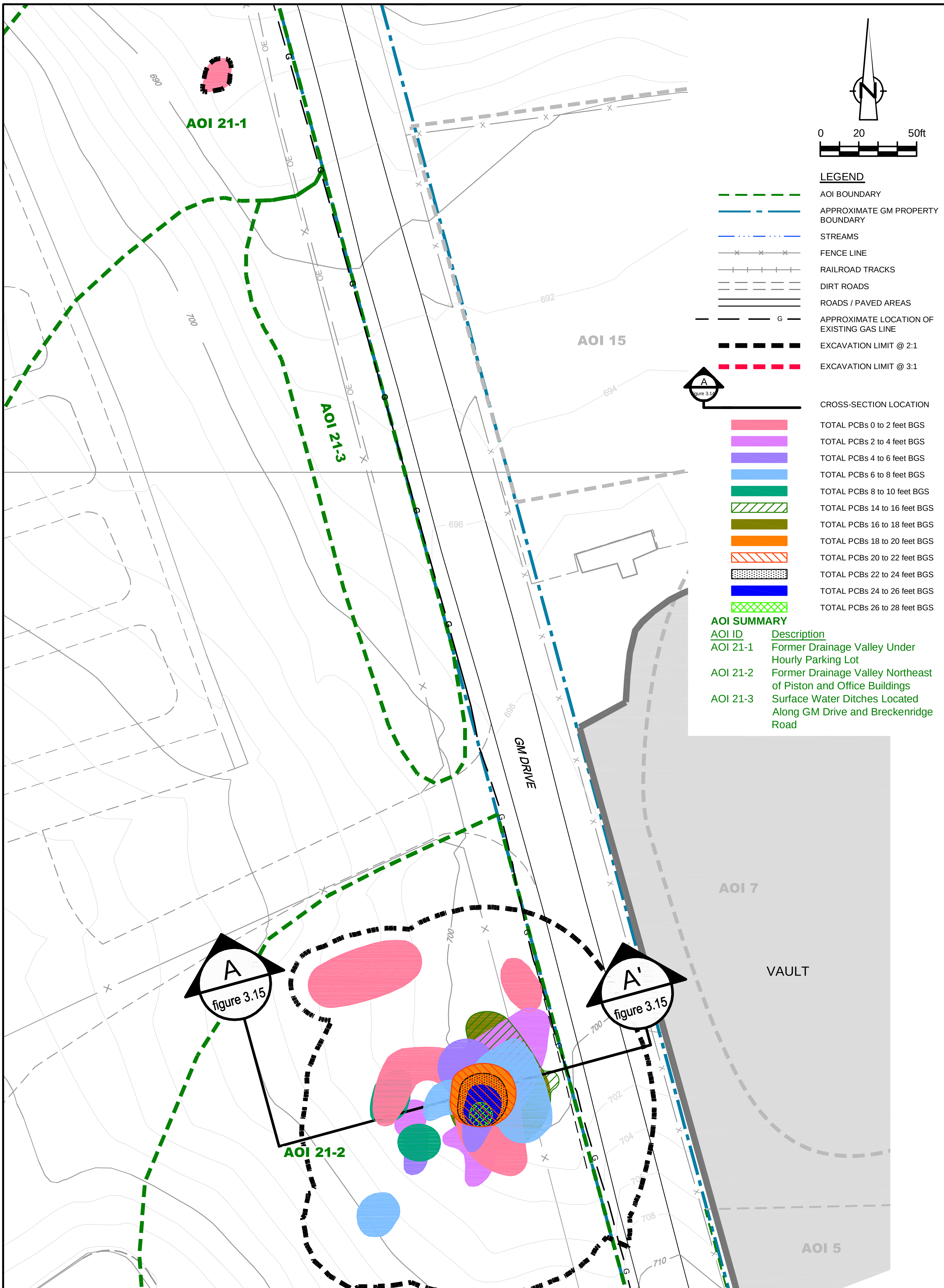


figure 3.14

SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2005

DRAFT

ISOCONCENTRATIONS PCBs ≥ 50 mg/kg - 0-28 ft BGS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR
WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA021 APR 08/2008

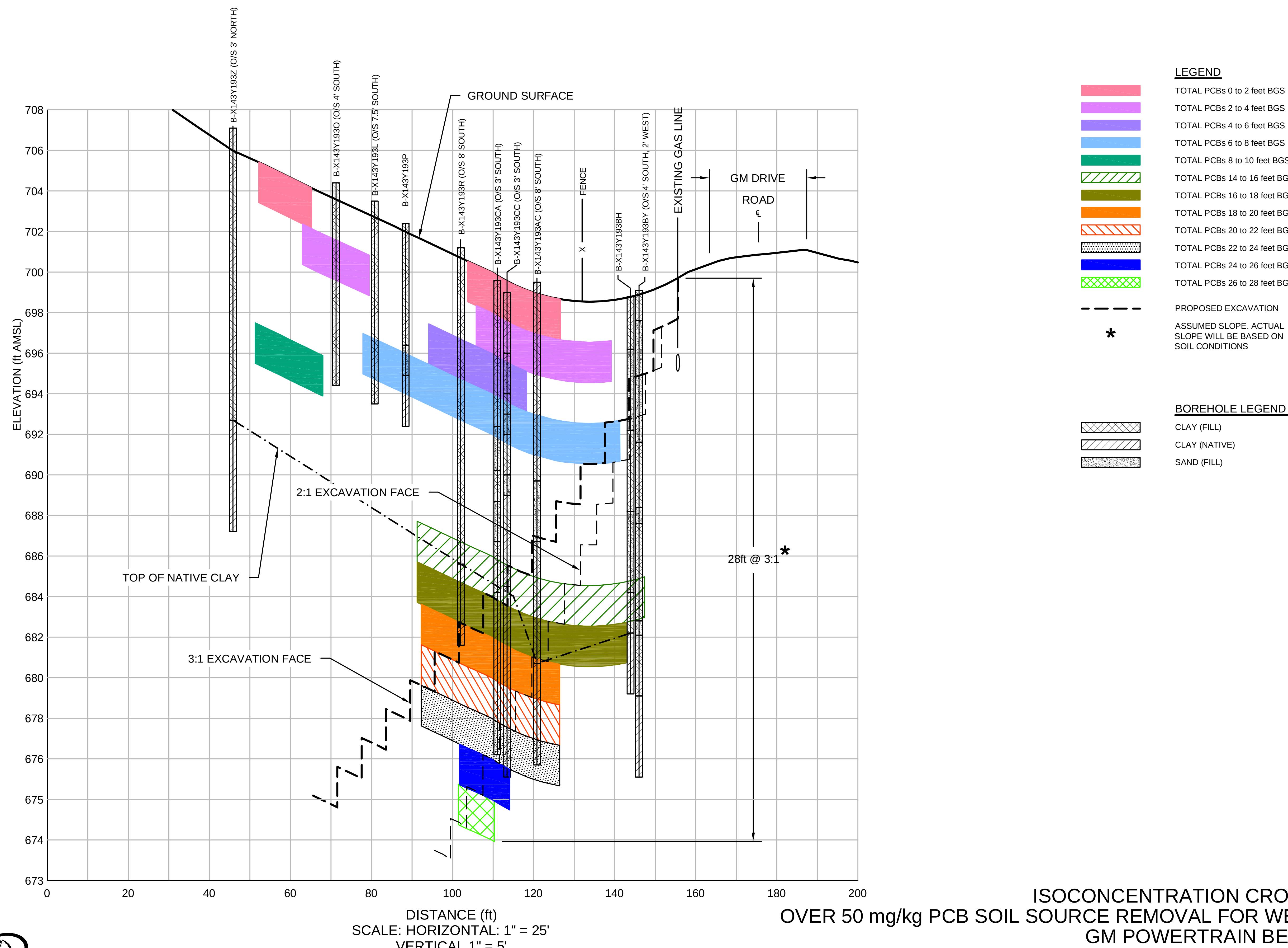
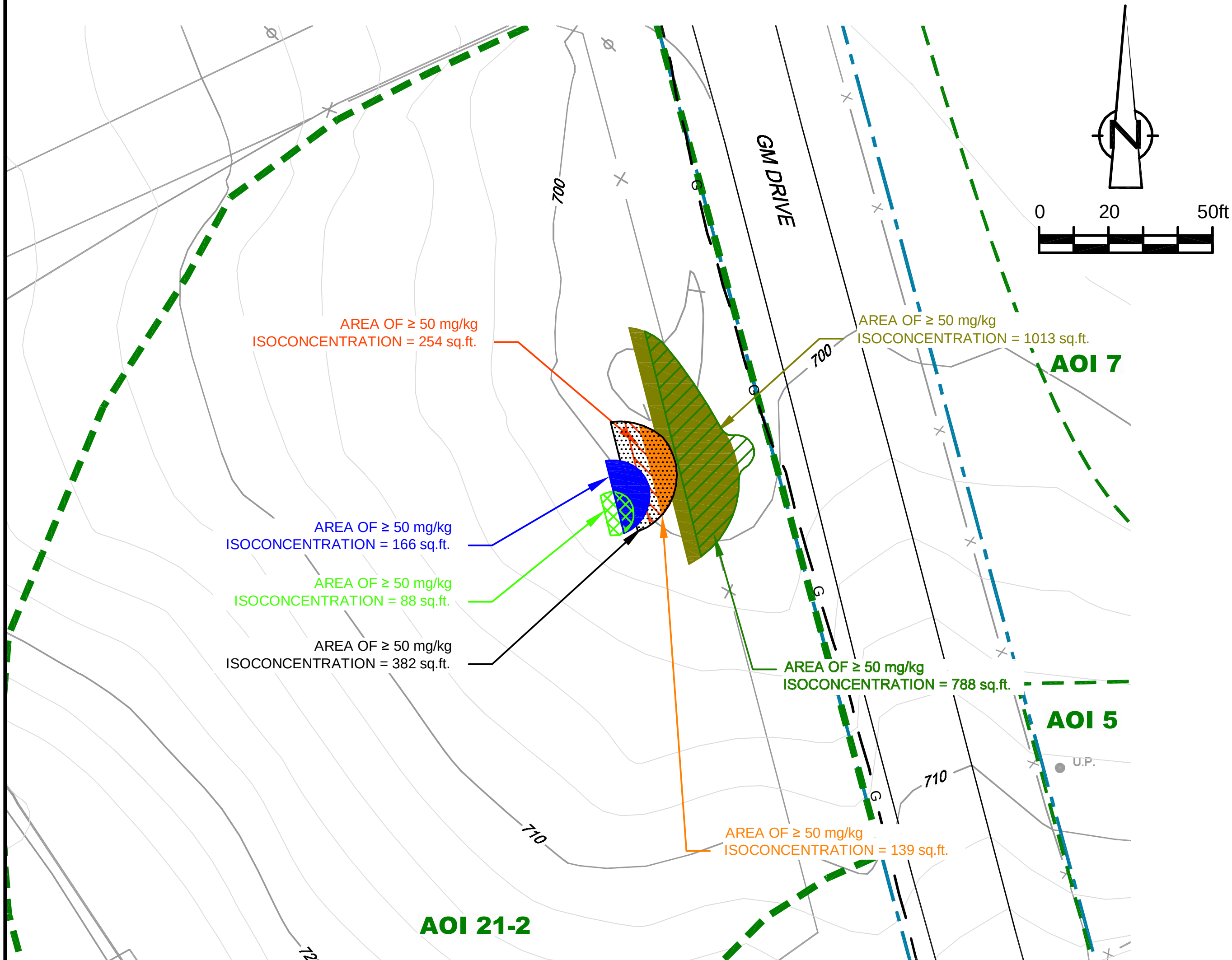


figure 3.15

ISOCONCENTRATION CROSS SECTION A-A'
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2005

LEGEND

AOI BOUNDARY	TOTAL PCBs 0 to 2 feet BGS
APPROXIMATE GM PROPERTY BOUNDARY	TOTAL PCBs 2 to 4 feet BGS
STREAMS	TOTAL PCBs 4 to 6 feet BGS
FENCE LINE	TOTAL PCBs 6 to 8 feet BGS
RAILROAD TRACKS	TOTAL PCBs 8 to 10 feet BGS
DIRT ROADS	TOTAL PCBs 14 to 16 feet BGS
ROADS / PAVED AREAS	TOTAL PCBs 16 to 18 feet BGS
GAS LINE (SURVEYED)	TOTAL PCBs 18 to 20 feet BGS
	TOTAL PCBs 20 to 22 feet BGS
	TOTAL PCBs 22 to 24 feet BGS
	TOTAL PCBs 24 to 26 feet BGS
	TOTAL PCBs 26 to 28 feet BGS

AOI SUMMARY

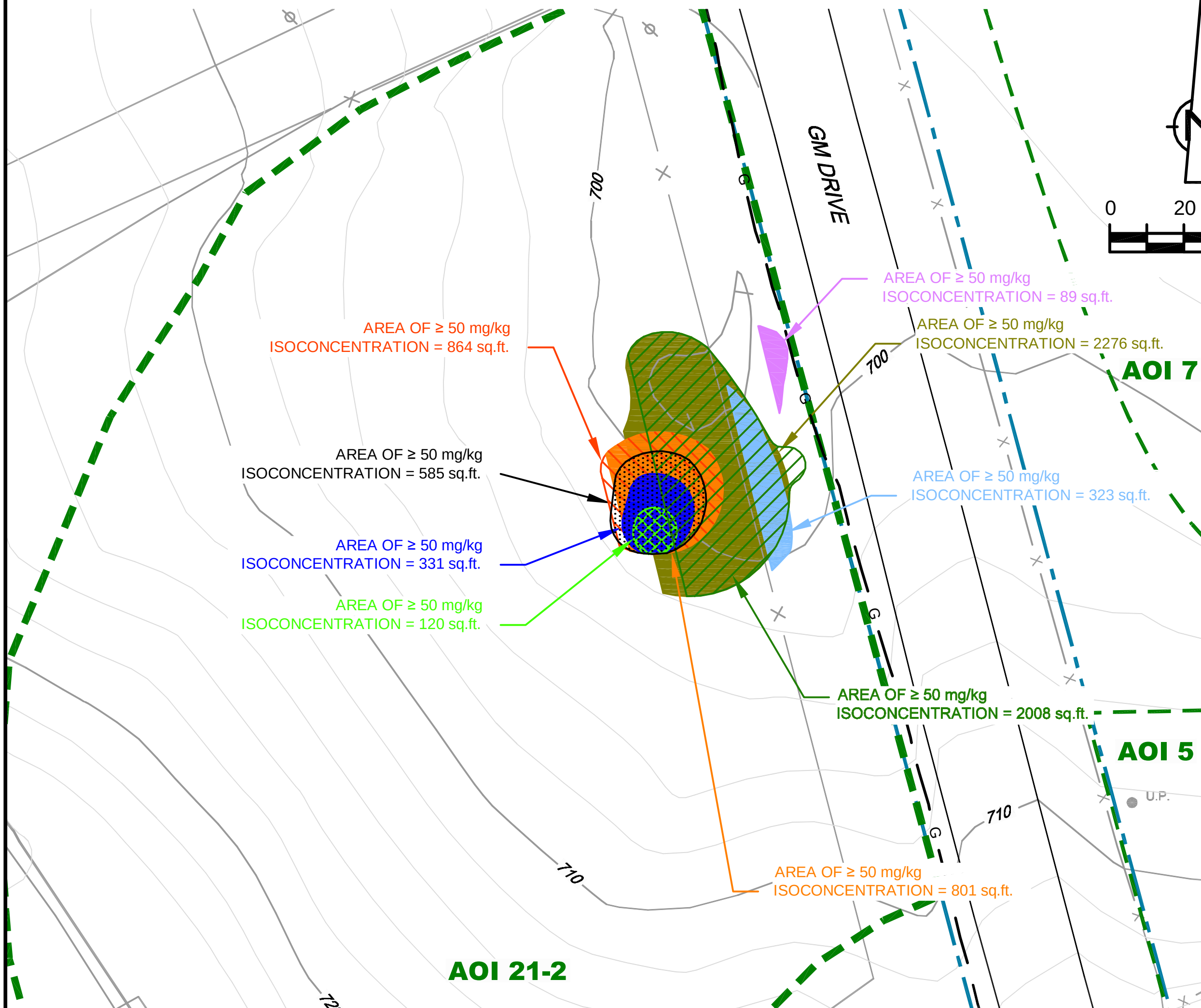
AOI ID	Description
AOI 5	Former East Sand Disposal Area
AOI 7	Former North Lagoon and Outfall 001
AOI 21	Filled Ravine North of Die Cast Building

DRAFT

figure 3.16

POTENTIAL AREAS NOT PRACTICAL TO EXCAVATE - 2:1 SLOPE
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA004 APR 08/2008



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2005

LEGEND

- AOI BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- GAS LINE (SURVEYED)

- TOTAL PCBs 0 to 2 feet BGS
- TOTAL PCBs 2 to 4 feet BGS
- TOTAL PCBs 4 to 6 feet BGS
- TOTAL PCBs 6 to 8 feet BGS
- TOTAL PCBs 8 to 10 feet BGS
- TOTAL PCBs 14 to 16 feet BGS
- TOTAL PCBs 16 to 18 feet BGS
- TOTAL PCBs 18 to 20 feet BGS
- TOTAL PCBs 20 to 22 feet BGS
- TOTAL PCBs 22 to 24 feet BGS
- TOTAL PCBs 24 to 26 feet BGS
- TOTAL PCBs 26 to 28 feet BGS

AOI SUMMARY

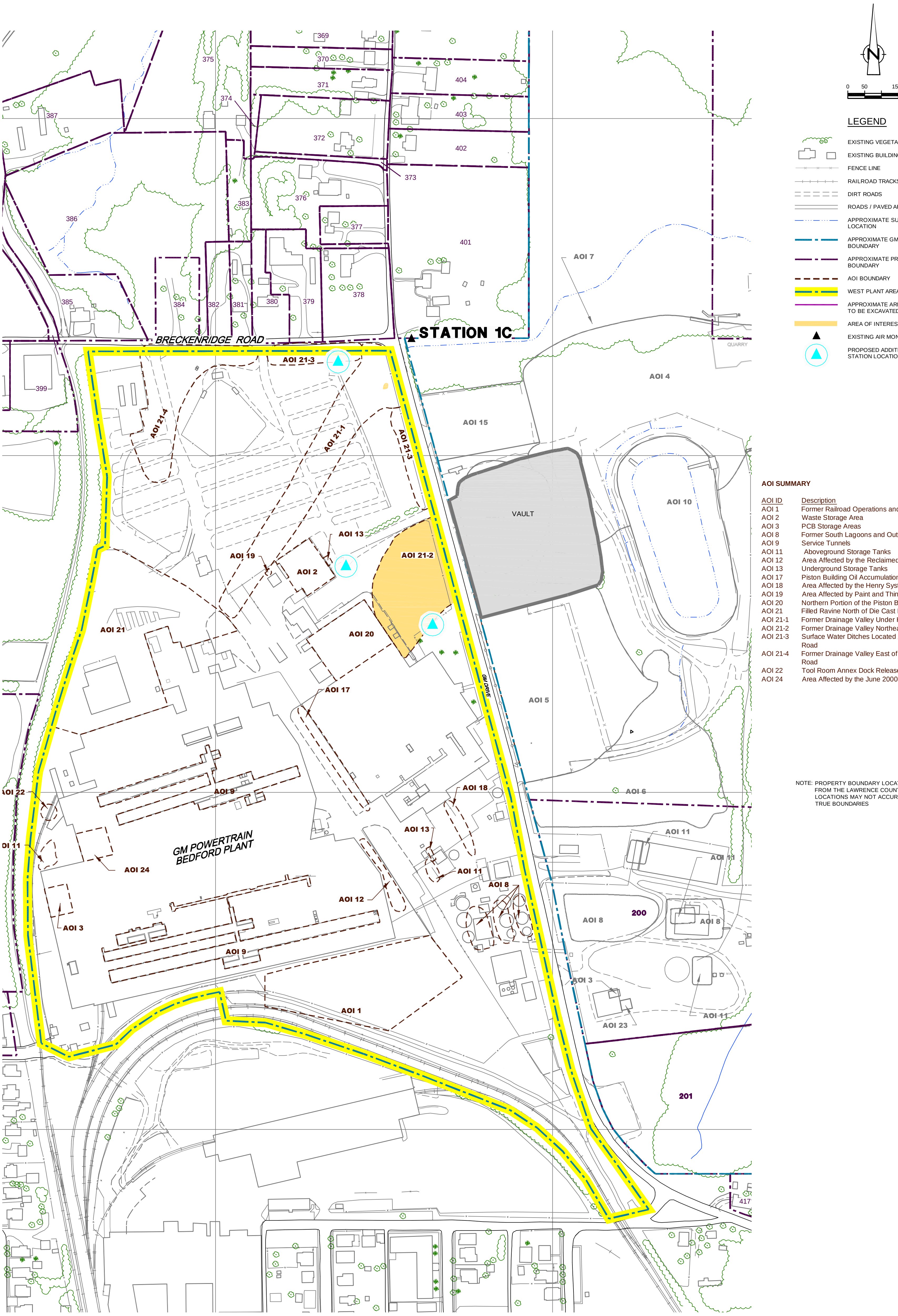
AOI ID	Description
AOI 5	Former East Sand Disposal Area
AOI 7	Former North Lagoon and Outfall 001
AOI 21	Filled Ravine North of Die Cast Building

DRAFT

figure 3.17

POTENTIAL AREAS NOT PRACTICAL TO EXCAVATE - 3:1 SLOPE
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

CRA



LEGEND

- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE GM PROPERTY BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- AOI BOUNDARY
- WEST PLANT AREA
- APPROXIMATE AREAS OF ≥ 50 mg/kg PCBs TO BE EXCAVATED
- AREA OF INTEREST IN 21-1 AND 21-2
- EXISTING AIR MONITORING STATION LOCATION
- PROPOSED ADDITIONAL AIR MONITORING STATION LOCATION

AOI SUMMARY

AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release

NOTE: PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES

Nº	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAFT

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA

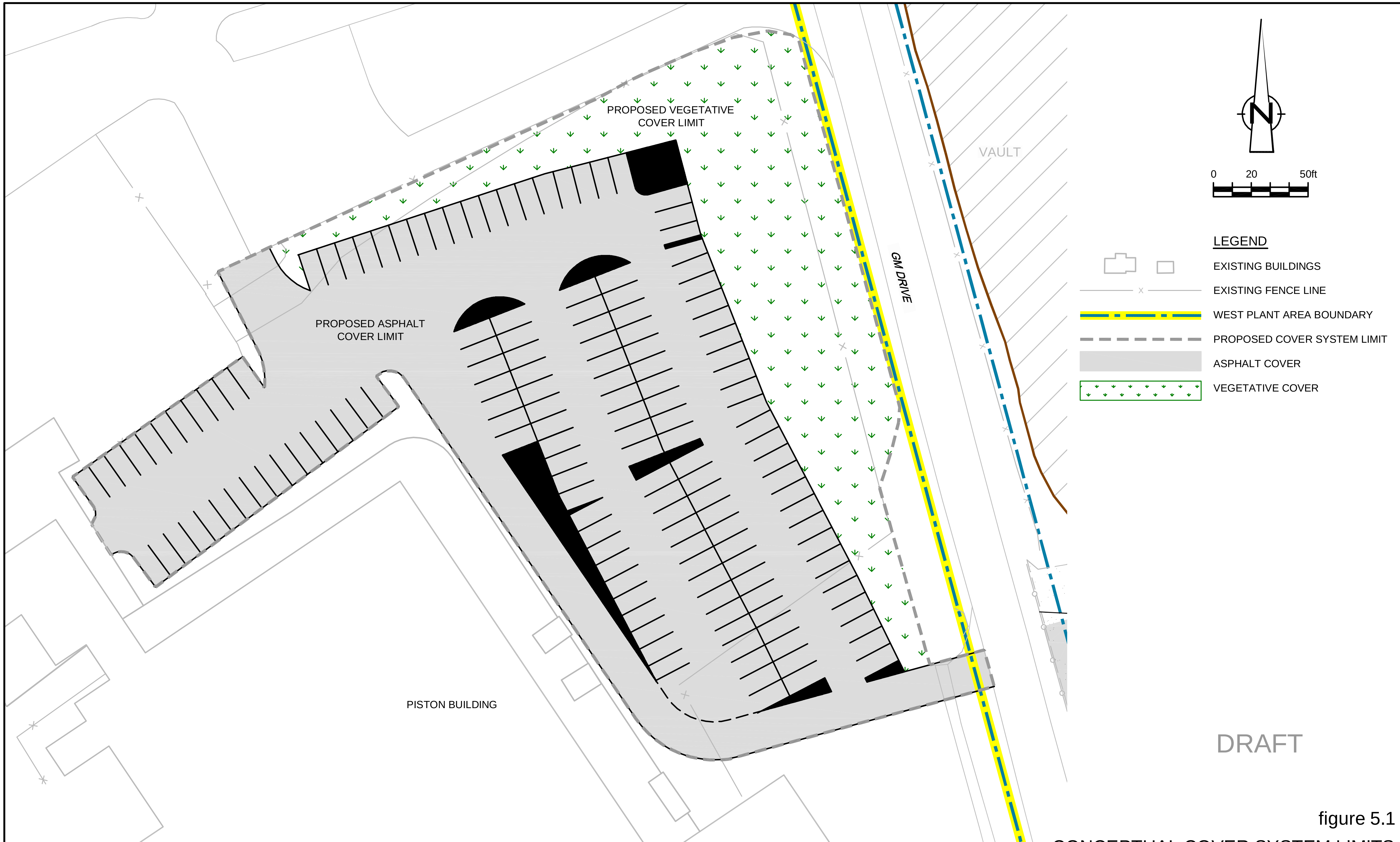
AIR MONITORING
STATION LOCATIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

Project Manager: J.M.	Reviewed By: P.G.	Date: MAY 2006	
Scale: AS SHOWN	Project Nº: 13968-00	Report Nº: 253	Drawing Nº: figure 4.1

13968-00(253)GN-WA020 DEC 12/2007



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.
AND CRA SURVEYS 2002 - 2006

figure 5.1

CONCEPTUAL COVER SYSTEM LIMITS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA023 DEC 12/2007

TABLE 3.1

AOI 21 AREA 1 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*
Sample Location:		*B-X129Y247*	*B-X129Y247*	*B-X129Y247A*	*B-X129Y247A*	*B-X129Y247A*	*B-X129Y247B*	*B-X129Y247B*	*B-X129Y247B*	*B-X129Y247B*	*B-X129Y247C*	*B-X129Y247C*	*B-X129Y247C*	*B-X129Y247D*
Sample ID:		*S-041404-JC-063*	*S-041404-JC-064*	*S-102504-JC-285*	*S-102504-JC-286*	*S-102504-JC-287*	*S-102504-JC-290*	*S-102504-JC-291*	*S-102504-JC-292*	*S-102504-JC-293*	*S-102504-JC-296*	*S-102504-JC-297*	*S-102504-JC-298*	*S-102504-JC-302*
Sample Date:		*4/14/2004*	*4/14/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*
Sample Depth:		*(0-2) ft*	*(6-8) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	19 U	0.042 U	0.04 U	0.036 UJ	0.04 U	0.2 U	0.038 U	0.075 U	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
Aroclor-1221 (PCB-1221)	mg/kg	19 U	0.042 U	0.04 U	0.036 UJ	0.04 U	0.2 U	0.038 U	0.075 U	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
Aroclor-1232 (PCB-1232)	mg/kg	19 U	0.042 U	0.04 U	0.036 UJ	0.04 U	0.2 U	0.038 U	0.075 U	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
Aroclor-1242 (PCB-1242)	mg/kg	19 U	0.042 U	0.04 U	0.036 UJ	0.04 U	0.2 U	0.038 U	0.075 U	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
Aroclor-1248 (PCB-1248)	mg/kg	19 U	0.042 U	0.04 U	0.036 UJ	0.04 U	0.2 U	0.038 U	0.075 U	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
Aroclor-1254 (PCB-1254)	mg/kg	67	0.042 U	0.22	0.036 UJ	0.04 U	0.85	0.26	0.075 U	0.044 U	1.4	0.04 U	0.042 U	0.074
Aroclor-1260 (PCB-1260)	mg/kg	19 U	0.042 U	0.04 U	0.0094 J	0.04 U	0.2 U	0.038 U	0.28	0.044 U	0.19 U	0.04 U	0.042 U	0.04 U
General Chemistry														
Total Solids	%	86.8	78.3	81.8	92.7	83.0	84.3	86.9	88.2	74.6	86.8	83.1	78.3	82.2

TABLE 3.1

AOI 21 AREA 1 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*
Sample Location:		*B-X129Y247D*	*B-X129Y247D*	*B-X129Y247E*	*B-X129Y247E*	*B-X129Y247E*	*B-X129Y247F*	*B-X129Y247F*	*B-X129Y247F*	*B-X129Y247G*	*B-X129Y247G*	*B-X129Y247G*	*B-X129Y247G*	*B-X129Y247G*
Sample ID:		*S-102504-JC-303*	*S-102504-JC-304*	*S-102504-JC-307*	*S-102504-JC-308*	*S-102504-JC-309*	*S-102504-JC-313*	*S-102504-JC-314*	*S-102504-JC-315*	*S-102504-JC-317*	*S-102504-JC-318*	*S-102504-JC-319*	*S-102504-JC-320*	*S-102504-JC-321*
Sample Date:		*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*	*10/25/2004*
Sample Depth:		*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.077 U	0.042 U	0.039 U	0.036 U	0.043 U	0.079 U	0.071 U	0.07 U	0.076 U	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1221 (PCB-1221)	mg/kg	0.077 U	0.042 U	0.039 U	0.036 U	0.043 U	0.079 U	0.071 U	0.07 U	0.076 U	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1232 (PCB-1232)	mg/kg	0.077 U	0.042 U	0.039 U	0.036 U	0.043 U	0.079 U	0.071 U	0.07 U	0.076 U	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1242 (PCB-1242)	mg/kg	0.077 U	0.042 U	0.039 U	0.036 U	0.043 U	0.079 U	0.071 U	0.07 U	0.076 U	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1248 (PCB-1248)	mg/kg	0.077 U	0.042 U	0.039 U	0.036 U	0.043 U	0.7	0.071 U	0.07 U	0.076 U	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1254 (PCB-1254)	mg/kg	0.66	0.042 U	0.084	0.036 U	0.043 U	0.079 U	0.071 U	0.07 U	0.6	0.073 U	0.037 U	0.039 U	0.042 U
Aroclor-1260 (PCB-1260)	mg/kg	0.077 U	0.042 U	0.039 U	0.16	0.043 U	0.18	0.23	0.34	0.076 U	0.55	0.11	0.039 U	0.042 U
General Chemistry														
Total Solids	%	85.9	77.8	84.0	91.8	76.6	83.8	92.3	93.9	87.1	90.8	89.1	85.5	77.9

TABLE 3.1

AOI 21 AREA 1 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*	*A021-1*
Sample Location:		*B-X129Y247G*	*B-X129Y247H*	*B-X129Y247H*	*B-X129Y247H*	*B-X129Y247H*	*B-X129Y247I*	*B-X129Y247I*	*B-X129Y247I*	*B-X129Y247J*	*B-X129Y247J*	*B-X129Y247J*	*B-X129Y247K*	*B-X129Y247K*
Sample ID:		*S-102504-JC-322*	*S-102604-JC-323*	*S-102604-JC-324*	*S-102604-JC-325*	*S-102604-JC-326*	*S-102604-JC-329*	*S-102604-JC-330*	*S-102604-JC-331*	*S-102604-JC-334*	*S-102604-JC-335*	*S-102604-JC-336*	*S-102604-JC-339*	*S-102604-JC-340*
Sample Date:		*10/25/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*	*10/26/2004*
Sample Depth:		*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.042 U	0.076 U	0.071 U	0.072 U	0.041 U	0.038 U	0.037 U	0.041 U	0.078 U	0.073 U	0.042 U	0.19 U	0.19 U
Aroclor-1221 (PCB-1221)	mg/kg	0.042 U	0.076 U	0.071 U	0.072 U	0.041 U	0.038 U	0.037 U	0.041 U	0.078 U	0.073 U	0.042 U	0.19 U	0.19 U
Aroclor-1232 (PCB-1232)	mg/kg	0.042 U	0.076 U	0.071 U	0.072 U	0.041 U	0.038 U	0.037 U	0.041 U	0.078 U	0.073 U	0.042 U	0.19 U	0.19 U
Aroclor-1242 (PCB-1242)	mg/kg	0.023 J	0.076 U	0.071 U	0.072 U	0.041 U	0.038 U	0.037 U	0.041 U	0.078 U	0.073 U	0.042 U	0.19 U	0.19 U
Aroclor-1248 (PCB-1248)	mg/kg	0.042 U	0.43	0.071 U	0.072 U	0.041 U	0.038 U	0.037 U	0.041 U	0.078 U	0.073 U	0.042 U	0.19 U	0.19 U
Aroclor-1254 (PCB-1254)	mg/kg	0.042 U	0.076 U	0.34	0.39	0.041 U	0.2	0.037 U	0.041 U	0.86	0.073 U	0.042 U	1	1.1
Aroclor-1260 (PCB-1260)	mg/kg	0.042 U	0.22	0.071 U	0.072 U	0.057	0.038 U	0.18	0.041 U	0.078 U	0.14	0.042 U	0.19 U	0.19 U
General Chemistry														
Total Solids	%	78.0	87.0	92.6	92.0	81.0	86.3	90.0	80.7	84.8	90.9	78.3	87.3	84.7

TABLE 3.1

**AOI 21 AREA 1 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA**

Sample Area:		***A021-1***	***A021-1***	***A021-1***	***A021-1***	***A021-1***	***A021-1***
Sample Location:		***B-X129Y247K***	***B-X129Y247K***	***B-X129Y247L***	***B-X129Y247L***	***B-X129Y247L***	***B-X129Y247L***
Sample ID:		***S-102604-JC-341***	***S-102604-JC-342***	***S-102604-JC-345***	***S-102604-JC-346***	***S-102604-JC-347***	***S-102604-JC-348***
Sample Date:		***10/26/2004***	***10/26/2004***	***10/26/2004***	***10/26/2004***	***10/26/2004***	***10/26/2004***
Sample Depth:		***(2-4) ft***	***(4-6) ft***	***(0-2) ft***	***(2-4) ft***	***(4-6) ft***	***(6-8) ft***
		(Duplicate)	***(orig)***	***(orig)***	***(orig)***	***(orig)***	***(orig)***
Parameters	***Units***						
PCBs							
Aroclor-1016 (PCB-1016)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.039 U
Aroclor-1221 (PCB-1221)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.039 U
Aroclor-1232 (PCB-1232)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.039 U
Aroclor-1242 (PCB-1242)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.039 U
Aroclor-1248 (PCB-1248)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.5
Aroclor-1254 (PCB-1254)	mg/kg	0.89	0.1 J	0.81	2.1	0.039 U	0.039 U
Aroclor-1260 (PCB-1260)	mg/kg	0.19 U	0.19 U	0.081 U	0.36 U	0.039 U	0.039 U
General Chemistry							
Total Solids	%	87.8	87.4	81.0	92.2	85.5	83.7

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AA*	*B-X143Y193AB*	*B-X143Y193AB*	*B-X143Y193AB*	*B-X143Y193AB*	*B-X143Y193AB*
Sample ID:		*S-112204-DD-690*	*S-112204-DD-691*	*S-112204-DD-692*	*S-112204-DD-693*	*S-112204-DD-694*	*S-112204-DD-695*	*S-112204-DD-696*	*S-112204-DD-697*	*S-112304-DD-698*	*S-112304-DD-699*	*S-112304-DD-700*	*S-112304-DD-701*	*S-112304-DD-702*
Sample Date:		*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*
Sample Depth:		*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	20 U	2.1 U	0.8 U	3.7 U	0.041 U	0.04 U	0.042 U	0.043 U	8.1 U	8.1 U	1.9 U	20 U	80 U
Aroclor-1221 (PCB-1221)	mg/kg	20 U	2.1 U	0.8 U	3.7 U	0.041 U	0.04 U	0.042 U	0.043 U	8.1 U	8.1 U	1.9 U	20 U	80 U
Aroclor-1232 (PCB-1232)	mg/kg	20 U	2.1 U	0.8 U	3.7 U	0.041 U	0.04 U	0.042 U	0.043 U	8.1 U	8.1 U	1.9 U	20 U	80 U
Aroclor-1242 (PCB-1242)	mg/kg	20 U	2.1 U	0.8 U	26	0.034 J	0.04 U	0.042 U	0.043 U	8.1 U	8.1 U	1.9 U	20 U	80 U
Aroclor-1248 (PCB-1248)	mg/kg	130	15	5.1	3.7 U	0.041 U	0.04 U	0.0086 J	0.043 U	54	32	9.9	77	440
Aroclor-1254 (PCB-1254)	mg/kg	20 U	2.1 U	0.8 U	3.7 U	0.041 U	0.04 U	0.042 U	0.043 U	8.1 U	8.1 U	1.9 U	20 U	80 U
Aroclor-1260 (PCB-1260)	mg/kg	20	2.3	0.62 J	3.5 J	0.041 U	0.04 U	0.042 U	0.043 U	8 J	4.9 J	1.4 J	20 U	37 J
General Chemistry														
Total Solids	%	80.6	80.1	82.4	88.7	80.5	81.6	78.7	77.3	81.5	81.7	87.1	83.8	82.9

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AT*	*B-X143Y193AT*	*B-X143Y193AT*	*B-X143Y193AT*	*B-X143Y193AT*	*B-X143Y193AU*	*B-X143Y193AU*	*B-X143Y193AV*	*B-X143Y193AV*	*B-X143Y193AV*	*B-X143Y193AV*	*B-X143Y193AV*	*B-X143Y193AV*
Sample ID:		*S-120804-KMV-849*	*S-120804-KMV-850*	*S-120804-KMV-851*	*S-120804-KMV-852*	*S-120804-KMV-853*	*S-121604-KMV-891*	*S-121604-KMV-892*	*S-122104-JC-912*	*S-122104-JC-913*	*S-122104-JC-914*	*S-122104-JC-915*	*S-122104-JC-916*	*S-122104-JC-917*
Sample Date:		*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/16/2004*	*12/16/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*
Sample Depth:		*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-0.5) ft*	*(1-2) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.38 U	0.81 U	0.045 U	0.043 U	0.043 U	2.2 U	4.1 U	77 U	2 U	0.042 U	0.042 U	0.041 U	0.044 U
Aroclor-1221 (PCB-1221)	mg/kg	0.38 U	0.81 U	0.045 U	0.043 U	0.043 U	2.2 U	4.1 U	77 U	2 U	0.042 U	0.042 U	0.041 U	0.044 U
Aroclor-1232 (PCB-1232)	mg/kg	0.38 U	0.81 U	0.045 U	0.043 U	0.043 U	2.2 U	4.1 U	77 U	2 U	0.042 U	0.042 U	0.041 U	0.044 U
Aroclor-1242 (PCB-1242)	mg/kg	0.38 U	0.81 U	0.045 U	0.043 U	0.043 U	2.2 U	4.1 U	77 U	2 U	0.042 U	0.042 U	0.041 U	0.044 U
Aroclor-1248 (PCB-1248)	mg/kg	2.3	0.81 U	0.038 J	0.043 U	0.023 J	27	28	690	10	0.014 J	0.039 J	0.0088 J	0.044 U
Aroclor-1254 (PCB-1254)	mg/kg	0.38 U	2	0.045 U	0.043 U	0.043 U	2.2 U	4.1 U	77 U	2 U	0.042 U	0.042 U	0.041 U	0.044 U
Aroclor-1260 (PCB-1260)	mg/kg	0.35 J	0.81 U	0.045 U	0.043 U	0.043 U	6.4	6.1	69 J	1.7 J	0.042 U	0.042 U	0.041 U	0.044 U
General Chemistry														
Total Solids	%	86.8	81.6	73.7	76.8	76.3	74.0	80.4	85.6	81.0	78.7	77.7	80.9	75.5

TABLE 3.2

**AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA**

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AB*	*B-X143Y193AB*	*B-X143Y193AB*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AC*
Sample ID:		*S-112304-DD-703*	*S-112304-DD-704*	*S-112304-DD-707*	*S-112904-DD-740*	*S-112904-DD-741*	*S-112904-DD-750*	*S-112904-DD-751*	*S-112904-DD-742*	*S-112904-DD-743*	*S-112904-DD-744*	*S-112904-DD-745*	*S-112904-DD-746*	*S-112904-DD-747*
Sample Date:		*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*	*11/29/2004*
Sample Depth:		*(6-8) ft*	*(8-10) ft*	*(14-16) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(16-18) ft*	*(20-22) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.41 U	0.042 U	0.042 UJ	4.2 U	8.3 U	220 UJ	7.8 UJ	3.8 U	20 U	3.8 U	81 U	2.1 U	0.039 UJ
Aroclor-1221 (PCB-1221)	mg/kg	0.41 U	0.042 U	0.042 UJ	4.2 U	8.3 U	220 UJ	7.8 UJ	3.8 U	20 U	3.8 U	81 U	2.1 U	0.039 UJ
Aroclor-1232 (PCB-1232)	mg/kg	0.41 U	0.042 U	0.042 UJ	4.2 U	8.3 U	220 UJ	7.8 UJ	3.8 U	20 U	3.8 U	81 U	2.1 U	0.039 UJ
Aroclor-1242 (PCB-1242)	mg/kg	0.41 U	0.042 U	0.042 UJ	4.2 U	8.3 U	1400 J	52 J	3.8 U	130	20	570	11	0.24 J
Aroclor-1248 (PCB-1248)	mg/kg	2.5	0.052	0.042 UJ	34	48	220 UJ	7.8 UJ	23	20 U	3.8 U	81 U	2.1 U	0.039 UJ
Aroclor-1254 (PCB-1254)	mg/kg	0.41 U	0.042 U	0.042 UJ	4.2 U	8.3 U	220 UJ	7.8 UJ	3.8 U	20 U	3.8 U	81 U	2.1 U	0.039 UJ
Aroclor-1260 (PCB-1260)	mg/kg	0.14 J	0.042 U	0.042 UJ	5.7	8.6	190 J	8.1 J	3 J	11 J	1.6 J	81 U	1 J	0.032 J
General Chemistry														
Total Solids	%	81.0	78.5	78.4	78.9	79.2	74.8	84.5	87.2	82.9	86.3	81.7	77.7	83.9

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AW*	*B-X143Y193AW*	*B-X143Y193AW*	*B-X143Y193AW*	*B-X143Y193AW*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*
Sample ID:		*S-122104-JC-918*	*S-122104-JC-919*	*S-122104-JC-920*	*S-122104-JC-921*	*S-122104-JC-922*	*S-122104-JC-923*	*S-122104-JC-924*	*S-122104-JC-925*	*S-122104-JC-926*	*S-122104-JC-927*	*S-122104-JC-928*	*S-122104-JC-929*	*S-122104-JC-930*
Sample Date:		*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*
Sample Depth:		*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.2 U	0.19 U	0.36 U	0.042 U	0.045 U	0.039 U	0.039 U	0.39 U	0.78 U	0.078 U	0.19 U	0.19 U	0.081 U
Aroclor-1221 (PCB-1221)	mg/kg	0.2 U	0.19 U	0.36 U	0.042 U	0.045 U	0.039 U	0.039 U	0.39 U	0.78 U	0.078 U	0.19 U	0.19 U	0.081 U
Aroclor-1232 (PCB-1232)	mg/kg	0.2 U	0.19 U	0.36 U	0.042 U	0.045 U	0.039 U	0.039 U	0.39 U	0.78 U	0.078 U	0.19 U	0.19 U	0.081 U
Aroclor-1242 (PCB-1242)	mg/kg	0.2 U	0.19 U	0.36 U	0.042 U	0.045 U	0.039 U	0.039 U	0.39 U	0.78 U	0.078 U	0.19 U	0.19 U	0.081 U
Aroclor-1248 (PCB-1248)	mg/kg	1.4	1.1	3	0.042	0.018 J	0.21	0.11	4.5	5.9	1.2	1.3	0.6	0.081 U
Aroclor-1254 (PCB-1254)	mg/kg	0.2 U	0.19 U	0.36 U	0.042 U	0.045 U	0.039 U	0.039 U	0.39 U	0.78 U	0.078 U	0.19 U	0.19 U	0.081 U
Aroclor-1260 (PCB-1260)	mg/kg	0.25	0.26	0.51	0.042 U	0.045 U	0.12	0.056	0.39 U	0.78 U	0.098	0.11 J	0.19 U	0.081 U
General Chemistry														
Total Solids	%	82.8	87.5	91.3	79.4	73.1	84.9	85.5	85.3	84.7	84.9	85.2	84.8	81.9

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AC*	*B-X143Y193AC*	*B-X143Y193AD*	*B-X143Y193AD*	*B-X143Y193AD*	*B-X143Y193AD*	*B-X143Y193AD*	*B-X143Y193AD*	*B-X143Y193AE*	*B-X143Y193AE*	*B-X143Y193AE*	*B-X143Y193AE*	*B-X143Y193AE*
Sample ID:		*S-112904-DD-748*	*S-112904-DD-749*	*S-112304-DD-708*	*S-112304-DD-709*	*S-112304-DD-710*	*S-112304-DD-711*	*S-112304-DD-712*	*S-112304-DD-713*	*S-112304-DD-731*	*S-112304-DD-732*	*S-112304-DD-733*	*S-112304-DD-734*	*S-112304-DD-735*
Sample Date:		*11/29/2004*	*11/29/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*
Sample Depth:		*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.043 UJ	210 UJ	34 U	3.8 U	0.38 U	0.04 U	0.041 U	0.037 U	0.84 U	0.77 U	0.2 U	0.04 U	0.2 U
Aroclor-1221 (PCB-1221)	mg/kg	0.043 UJ	210 UJ	34 U	3.8 U	0.38 U	0.04 U	0.041 U	0.037 U	0.84 U	0.77 U	0.2 U	0.04 U	0.2 U
Aroclor-1232 (PCB-1232)	mg/kg	0.043 UJ	210 UJ	34 U	3.8 U	0.38 U	0.04 U	0.041 U	0.037 U	0.84 U	0.77 U	0.2 U	0.04 U	0.2 U
Aroclor-1242 (PCB-1242)	mg/kg	0.043 UJ	690 J	34 U	3.8 U	0.38 U	0.04 U	0.041 U	0.037 U	0.84 U	0.77 U	0.2 U	0.04 U	0.2 U
Aroclor-1248 (PCB-1248)	mg/kg	0.04 J	210 UJ	270	27	2.1	0.17	0.014 J	0.0084 J	6.7	6.2	1.1	0.23	0.94
Aroclor-1254 (PCB-1254)	mg/kg	0.043 UJ	210 UJ	34 U	3.8 U	0.38 U	0.04 U	0.041 U	0.037 U	0.84 U	0.77 U	0.2 U	0.04 U	0.2 U
Aroclor-1260 (PCB-1260)	mg/kg	0.043 UJ	110 J	36	3.4 J	0.21 J	0.038 J	0.041 U	0.037 U	1.4	0.69 J	0.17 J	0.025 J	0.2 U
General Chemistry														
Total Solids	%	77.1	80.3	96.3	85.9	87.7	81.8	80.8	88.0	79.0	85.8	84.1	82.6	81.3

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AX*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AY*	*B-X143Y193AZ*
Sample ID:		*S-122104-JC-931*	*S-122104-JC-932*	*S-122104-JC-933*	*S-122104-JC-903*	*S-122104-JC-904*	*S-122104-JC-905*	*S-122104-JC-906*	*S-122104-JC-907*	*S-122104-JC-908*	*S-122104-JC-909*	*S-122104-JC-910*	*S-122104-JC-911*	*S-121604-KMV-895*
Sample Date:		*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/21/2004*	*12/16/2004*
Sample Depth:		*(12-14) ft*	*(14-16) ft*	*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.043 U	0.042 U	0.042 U	0.039 U	0.077 U	0.04 U	0.077 U	0.38 U	0.77 U	3.6 U	0.21 U	0.044 U	0.73 U
Aroclor-1221 (PCB-1221)	mg/kg	0.043 U	0.042 U	0.042 U	0.039 U	0.077 U	0.04 U	0.077 U	0.38 U	0.77 U	3.6 U	0.21 U	0.044 U	0.73 U
Aroclor-1232 (PCB-1232)	mg/kg	0.043 U	0.042 U	0.042 U	0.039 U	0.077 U	0.04 U	0.077 U	0.38 U	0.77 U	3.6 U	0.21 U	0.044 U	0.73 U
Aroclor-1242 (PCB-1242)	mg/kg	0.043 U	0.042 U	0.042 U	0.039 U	0.077 U	0.04 U	0.077 U	0.38 U	0.77 U	3.6 U	0.21 U	0.044 U	0.73 U
Aroclor-1248 (PCB-1248)	mg/kg	0.0063 J	0.0089 J	0.042 U	0.093	0.62	0.25	0.55	3.1	6	37	0.56	0.027 J	4.6
Aroclor-1254 (PCB-1254)	mg/kg	0.043 U	0.042 U	0.042 U	0.039 U	0.077 U	0.04 U	0.077 U	0.38 U	0.77 U	3.6 U	0.21 U	0.044 U	0.73 U
Aroclor-1260 (PCB-1260)	mg/kg	0.043 U	0.042 U	0.042 U	0.042	0.12	0.028 J	0.069 J	0.38	0.73 J	6.2	0.15 J	0.044 U	1.6
General Chemistry														
Total Solids	%	77.5	77.7	78.1	84.6	86.1	82.6	86.2	87.0	86.2	91.2	80.4	74.7	90.3

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AE*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AF*	*B-X143Y193AG*	*B-X143Y193AG*	*B-X143Y193AG*	*B-X143Y193AG*	*B-X143Y193AH*
Sample ID:		*S-112304-DD-736*	*S-112304-DD-717*	*S-112304-DD-718*	*S-112304-DD-719*	*S-112304-DD-720*	*S-112304-DD-721*	*S-112304-DD-722*	*S-112304-DD-723*	*S-113004-DD-752*	*S-113004-DD-753*	*S-113004-DD-754*	*S-113004-DD-755*	*S-113004-DD-756*
Sample Date:		*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/23/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*
Sample Depth:		*(8-10) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.04 U	0.83 U	0.87 U	0.078 U	0.078 U	0.04 U	7.7 U	0.19 U	2 U	2 U	0.77 U	3.9 U	0.73 U
Aroclor-1221 (PCB-1221)	mg/kg	0.04 U	0.83 U	0.87 U	0.078 U	0.078 U	0.04 U	7.7 U	0.19 U	2 U	2 U	0.77 U	3.9 U	0.73 U
Aroclor-1232 (PCB-1232)	mg/kg	0.04 U	0.83 U	0.87 U	0.078 U	0.078 U	0.04 U	7.7 U	0.19 U	2 U	2 U	0.77 U	3.9 U	0.73 U
Aroclor-1242 (PCB-1242)	mg/kg	0.04 U	0.83 U	0.87 U	0.078 U	0.078 U	0.04 U	64	0.38	2 U	2 U	0.77 U	3.9 U	0.73 U
Aroclor-1248 (PCB-1248)	mg/kg	0.105 U	6.9	6.9	0.35	0.52	0.21	7.7 U	0.19 U	9.3	11	4.3	19	4.1
Aroclor-1254 (PCB-1254)	mg/kg	0.04 U	0.83 U	0.87 U	0.078 U	0.078 U	0.04 U	7.7 U	0.19 U	2 U	2 U	0.77 U	3.9 U	0.73 U
Aroclor-1260 (PCB-1260)	mg/kg	0.04 U	1.8	1.6	0.059 J	0.094	0.04 U	7.7 U	0.19 U	1.4 J	1.5 J	0.77 U	4.4	0.94
General Chemistry														
Total Solids	%	81.6	79.4	75.6	85.0	84.1	83.0	86.1	84.9	84.4	81.4	85.2	83.7	90.4

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193AZ*	*B-X143Y193B*	*B-X143Y193B*	*B-X143Y193B*	*B-X143Y193BA*	*B-X143Y193BA*	*B-X143Y193BB*
Sample ID:		*S-121604-KMV-896*	*S-121604-KMV-897*	*S-121604-KMV-898*	*S-121604-KMV-899*	*S-121604-KMV-900*	*S-121604-KMV-901*	*S-121604-KMV-902*	*S-040704-JC-047*	*S-040704-JC-048*	*S-040704-JC-049*	*S-121604-KMV-893*	*S-121604-KMV-894*	*S-122204-JC-934*
Sample Date:		*12/16/2004*	*12/16/2004*	*12/16/2004*	*12/16/2004*	*12/16/2004*	*12/16/2004*	*12/16/2004*	*4/7/2004*	*4/7/2004*	*4/7/2004*	*12/16/2004*	*12/16/2004*	*12/22/2004*
Sample Depth:		*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-2) ft*	*(6-8) ft*	*(27-29.4) ft*	*(0-0.5) ft*	*(1-2) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.19 U	0.2 U	0.21 U	0.43 U	0.082 U	0.041 U	0.044 U	1.9 U	0.19 U	0.041 U	0.2 U	0.042 U	2.1 U
Aroclor-1221 (PCB-1221)	mg/kg	0.19 U	0.2 U	0.21 U	0.43 U	0.082 U	0.041 U	0.044 U	1.9 U	0.19 U	0.041 U	0.2 U	0.042 U	2.1 U
Aroclor-1232 (PCB-1232)	mg/kg	0.19 U	0.2 U	0.21 U	0.43 U	0.082 U	0.041 U	0.044 U	1.9 U	0.19 U	0.041 U	0.2 U	0.042 U	2.1 U
Aroclor-1242 (PCB-1242)	mg/kg	0.19 U	0.2 U	0.21 U	0.43 U	0.082 U	0.041 U	0.044 U	1.9 U	0.19 U	0.041 U	0.2 U	0.042 U	2.1 U
Aroclor-1248 (PCB-1248)	mg/kg	0.75	0.77	0.64	1.6	0.79	0.0081 J	0.013 J	13	1.1	0.012 J	1.9	0.017 J	7.9
Aroclor-1254 (PCB-1254)	mg/kg	0.19 U	0.2 U	0.21 U	0.43 U	0.082 U	0.041 U	0.044 U	1.9 U	0.19 U	0.041 U	0.2 U	0.042 U	2.1 U
Aroclor-1260 (PCB-1260)	mg/kg	0.35	0.36	0.11 J	0.37 J	0.21	0.041 U	0.044 U	1.9 U	0.093 J	0.041 U	1.1	0.042 U	1.3 J
General Chemistry														
Total Solids	%	84.8	82.8	79.3	76.8	80.7	80.6	75.0	85.3	86.3	79.9	83.4	78.3	80.3

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AH*	*B-X143Y193AI*	*B-X143Y193AI*	*B-X143Y193AI*	*B-X143Y193AJ*	*B-X143Y193AJ*
Sample ID:		*S-113004-DD-757*	*S-113004-DD-758*	*S-113004-DD-759*	*S-113004-DD-760*	*S-113004-DD-761*	*S-113004-DD-762*	*S-120104-DD-771*	*S-120804-KMV-854*	*S-120804-KMV-855*	*S-120804-KMV-856*	*S-120904-KMV-857*	*S-120904-KMV-858*
Sample Date:		*11/30/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*	*11/30/2004*	*12/1/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/9/2004*	*12/9/2004*
Sample Depth:		*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(12.5-14.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(0-0.5) ft*	*(1-2) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	2 U	0.39 U	2 U	0.041 U	0.08 U	0.2 U	0.042 U	4.2 U	4 U	0.042 U	4 U	19 U
Aroclor-1221 (PCB-1221)	mg/kg	2 U	0.39 U	2 U	0.041 U	0.08 U	0.2 U	0.042 U	4.2 U	4 U	0.042 U	4 U	19 U
Aroclor-1232 (PCB-1232)	mg/kg	2 U	0.39 U	2 U	0.041 U	0.08 U	0.2 U	0.042 U	4.2 U	4 U	0.042 U	4 U	19 U
Aroclor-1242 (PCB-1242)	mg/kg	2 U	0.39 U	2 U	0.041 U	0.08 U	0.67	0.042 U	4.2 U	4 U	0.042 U	4 U	19 U
Aroclor-1248 (PCB-1248)	mg/kg	11	2	11	0.087	0.45	0.2 U	0.011 J	18	32	0.28	23 J	36 J
Aroclor-1254 (PCB-1254)	mg/kg	2 U	0.39 U	2 U	0.041 U	0.08 U	0.2 U	0.042 U	4.2 U	4 U	0.042 U	4 U	19 U
Aroclor-1260 (PCB-1260)	mg/kg	2 U	0.39 U	2 U	0.016 J	0.08 U	0.088 J	0.042 U	3.2 J	6.6	0.08	4.1 J	19 U
General Chemistry													
Total Solids	%	82.7	84.6	82.8	81.1	82.5	83.0	78.2	78.7	83.5	78.2	83.2	85.1

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BB*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BC*	*B-X143Y193BD*	*B-X143Y193BD*	*B-X143Y193BD*	*B-X143Y193BD*
Sample ID:		*S-122204-JC-935*	*S-011905-KMV-895*	*S-011905-KMV-896*	*S-011905-KMV-897*	*S-011905-KMV-898*	*S-011905-KMV-899*	*S-011905-KMV-900*	*S-011905-KMV-901*	*S-011905-KMV-902*	*S-011905-KMV-903*	*S-011905-KMV-904*	*S-011905-KMV-905*
Sample Date:		*12/22/2004*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*
Sample Depth:		*(1-2) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.82 U	0.045 U	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.047 U	0.04 U	0.039 U	0.04 U
Aroclor-1221 (PCB-1221)	mg/kg	0.82 U	0.045 U	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.047 U	0.04 U	0.039 U	0.04 U
Aroclor-1232 (PCB-1232)	mg/kg	0.82 U	0.045 U	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.047 U	0.04 U	0.039 U	0.04 U
Aroclor-1242 (PCB-1242)	mg/kg	0.82 U	0.045 U	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.047 U	0.04 U	0.039 U	0.04 U
Aroclor-1248 (PCB-1248)	mg/kg	4.4	0.062 J	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.1 J	0.04 U	0.039 U	0.04 U
Aroclor-1254 (PCB-1254)	mg/kg	0.82 U	0.045 U	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.047 U	0.04 U	0.039 U	0.04 U
Aroclor-1260 (PCB-1260)	mg/kg	0.74 J	0.052 J	0.04 U	0.039 U	0.038 U	0.042 U	0.045 U	0.042 U	0.044 J	0.04 U	0.039 U	0.04 U
General Chemistry													
Total Solids	%	80.6	73.7	82.4	85.6	86.6	78.7	72.7	77.7	70.1	82.8	84.3	82.8

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AJ*	*B-X143Y193AK*	*B-X143Y193AK*	*B-X143Y193AK*	*B-X143Y193AL*	*B-X143Y193AL*	*B-X143Y193AM*	*B-X143Y193AM*	*B-X143Y193AM*	*B-X143Y193AM*	*B-X143Y193AM*	*B-X143Y193AM*
Sample ID:		*S-120904-KMV-859*	*S-120904-KMV-860*	*S-120904-KMV-861*	*S-120904-KMV-862*	*S-120904-KMV-863*	*S-120904-KMV-864*	*S-120904-KMV-865*	*S-120904-KMV-866*	*S-120904-KMV-867*	*S-120904-KMV-868*	*S-120904-KMV-869*	*S-120904-KMV-870*
Sample Date:		*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*
Sample Depth:		*(2-4) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(0-0.5) ft*	*(1-2) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	20 U	2 U	1.9 U	0.36 U	4.3 U	3.8 U	3.7 U	0.2 U	0.079 U	0.39 U	0.039 U	0.041 U
Aroclor-1221 (PCB-1221)	mg/kg	20 U	2 U	1.9 U	0.36 U	4.3 U	3.8 U	3.7 U	0.2 U	0.079 U	0.39 U	0.039 U	0.041 U
Aroclor-1232 (PCB-1232)	mg/kg	20 U	2 U	1.9 U	0.36 U	4.3 U	3.8 U	3.7 U	0.2 U	0.079 U	0.39 U	0.039 U	0.041 U
Aroclor-1242 (PCB-1242)	mg/kg	20 U	2 U	1.9 U	0.36 U	4.3 U	3.8 U	3.7 U	0.2 U	0.079 U	0.39 U	0.039 U	0.041 U
Aroclor-1248 (PCB-1248)	mg/kg	46 J	7 J	5.8 J	2.4 J	17 J	6.2 J	16 J	0.58 J	0.2 J	1.4 J	0.16 J	0.11 J
Aroclor-1254 (PCB-1254)	mg/kg	20 U	2 U	1.9 U	0.36 U	4.3 U	3.8 U	3.7 U	0.2 U	0.079 U	0.39 U	0.039 U	0.041 U
Aroclor-1260 (PCB-1260)	mg/kg	9 J	0.97 J	0.63 J	0.28 J	2.5 J	3.8 U	2 J	0.071 J	0.028 J	0.17 J	0.039 U	0.018 J
General Chemistry													
Total Solids	%	80.7	83.1	84.9	90.8	76.1	87.2	88.1	81.5	83.8	85.4	83.8	80.1

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BD*	*B-X143Y193BD*	*B-X143Y193BD*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*	*B-X143Y193BE*
Sample ID:		*S-011905-KMV-906*	*S-011905-KMV-907*	*S-011905-KMV-908*	*S-011905-KMV-918*	*S-011905-KMV-919*	*S-011905-KMV-920*	*S-011905-KMV-921*	*S-011905-KMV-922*	*S-011905-KMV-923*	*S-011905-KMV-924*	*S-011905-KMV-925*	*S-011905-KMV-926*
Sample Date:		*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*
Sample Depth:		*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.043 U	0.042 U	0.044 U	2.4 U	0.039 U	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
Aroclor-1221 (PCB-1221)	mg/kg	0.043 U	0.042 U	0.044 U	2.4 U	0.039 U	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
Aroclor-1232 (PCB-1232)	mg/kg	0.043 U	0.042 U	0.044 U	2.4 U	0.039 U	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
Aroclor-1242 (PCB-1242)	mg/kg	0.043 U	0.042 U	0.044 U	2.4 U	0.039 U	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
Aroclor-1248 (PCB-1248)	mg/kg	0.043 U	0.042 U	0.044 U	15	0.16	0.042 U	0.043 U	0.046 U	0.0077 J	0.041 U	0.046 U	0.043 U
Aroclor-1254 (PCB-1254)	mg/kg	0.043 U	0.042 U	0.044 U	2.4 U	0.039 U	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
Aroclor-1260 (PCB-1260)	mg/kg	0.043 U	0.042 U	0.044 U	2.7	0.041	0.042 U	0.043 U	0.046 U	0.042 U	0.041 U	0.046 U	0.043 U
General Chemistry													
Total Solids	%	76.6	79.1	74.4	68.5	83.7	79.0	76.6	72.5	77.7	80.6	72.5	75.9

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AM*	*B-X143Y193AM*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*	*B-X143Y193AN*
Sample ID:		*S-120904-KMV-871*	*S-120904-KMV-873*	*S-120904-KMV-875*	*S-120904-KMV-876*	*S-120904-KMV-877*	*S-120904-KMV-878*	*S-120904-KMV-879*	*S-120904-KMV-880*	*S-120904-KMV-881*	*S-120904-KMV-882*	*S-120904-KMV-884*	*S-120904-KMV-885*
Sample Date:		*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*	*12/9/2004*
Sample Depth:		*(8-10) ft*	*(12-14) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(16-18) ft*	*(16-18) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.04 U	0.041 UJ	0.078 U	0.04 U	0.04 U	0.04 U	0.39 U	0.21 U	4 U	0.08 U	0.043 U	0.041 U
Aroclor-1221 (PCB-1221)	mg/kg	0.04 U	0.041 UJ	0.078 U	0.04 U	0.04 U	0.04 U	0.39 U	0.21 U	4 U	0.08 U	0.043 U	0.041 U
Aroclor-1232 (PCB-1232)	mg/kg	0.04 U	0.041 UJ	0.078 U	0.04 U	0.04 U	0.04 U	0.39 U	0.21 U	4 U	0.08 U	0.043 U	0.041 U
Aroclor-1242 (PCB-1242)	mg/kg	0.04 U	0.041 UJ	0.078 U	0.04 U	0.04 U	0.04 U	0.39 U	0.21 U	4 U	0.08 U	0.043 U	0.041 U
Aroclor-1248 (PCB-1248)	mg/kg	0.014 J	0.0091 J	0.25 J	0.046 J	0.034 J	0.12 J	2.1	0.64	12	0.24	0.043 U	0.041 U
Aroclor-1254 (PCB-1254)	mg/kg	0.04 U	0.041 UJ	0.078 U	0.04 U	0.04 U	0.04 U	0.39 U	0.21 U	4 U	0.08 U	0.043 U	0.041 U
Aroclor-1260 (PCB-1260)	mg/kg	0.04 U	0.041 UJ	0.077 J	0.013 J	0.04 U	0.015 J	0.24 J	0.1 J	1.4 J	0.067 J	0.043 U	0.041 U
General Chemistry													
Total Solids	%	81.7	79.7	84.3	82.0	82.8	81.8	84.1	79.0	82.4	82.3	76.5	79.6

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BF*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*
Sample ID:		*S-011905-KMV-909*	*S-011905-KMV-910*	*S-011905-KMV-911*	*S-011905-KMV-912*	*S-011905-KMV-913*	*S-011905-KMV-914*	*S-011905-KMV-915*	*S-011905-KMV-916*	*S-011905-KMV-917*	*S-011905-KMV-927*	*S-011905-KMV-937*	*S-011905-KMV-938*
Sample Date:		*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*
Sample Depth:		*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(14-16) ft*	*(0-0.5) ft*	*(16-18) ft*	*(18-20) ft*
		(orig)	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	4 U	4 U	3.8 U	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	4.1 U	0.04 U	0.041 U
Aroclor-1221 (PCB-1221)	mg/kg	4 U	4 U	3.8 U	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	4.1 U	0.04 U	0.041 U
Aroclor-1232 (PCB-1232)	mg/kg	4 U	4 U	3.8 U	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	4.1 U	0.04 U	0.041 U
Aroclor-1242 (PCB-1242)	mg/kg	4 U	4 U	3.8 U	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	4.1 U	0.04 U	0.041 U
Aroclor-1248 (PCB-1248)	mg/kg	20 J	24 J	15 J	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	17	0.04 U	0.041 U
Aroclor-1254 (PCB-1254)	mg/kg	4 U	4 U	3.8 U	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	4.1 U	0.04 U	0.041 U
Aroclor-1260 (PCB-1260)	mg/kg	3.7 J	3.6 J	1.4 J	0.039 U	0.044 U	0.044 U	0.042 U	0.04 U	0.042 U	2.6 J	0.04 U	0.041 U
General Chemistry													
Total Solids	%	82.5	83.0	86.3	83.7	74.2	75.6	78.6	82.5	78.7	80.9	81.9	81.3

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AO*	*B-X143Y193AO*	*B-X143Y193AO*	*B-X143Y193AO*	*B-X143Y193AO*	*B-X143Y193AO*	*B-X143Y193AP*	*B-X143Y193AP*	*B-X143Y193AP*	*B-X143Y193AP*	*B-X143Y193AP*	*B-X143Y193AP*
Sample ID:		*S-120604-KMV-785*	*S-120604-KMV-786*	*S-120604-KMV-787*	*S-120604-KMV-788*	*S-120604-KMV-789*	*S-120604-KMV-790*	*S-120704-KMV-798*	*S-120704-KMV-799*	*S-120704-KMV-800*	*S-120704-KMV-801*	*S-120704-KMV-802*	*S-120704-KMV-803*
Sample Date:		*12/6/2004*	*12/6/2004*	*12/6/2004*	*12/6/2004*	*12/6/2004*	*12/6/2004*	*12/7/2004*	*12/7/2004*	*12/7/2004*	*12/7/2004*	*12/7/2004*	*12/7/2004*
Sample Depth:		*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.23 U	0.077 U	0.04 U	0.041 U	0.078 U	0.2 U	0.079 U	0.076 U	0.04 U	0.2 U	0.041 U	0.2 U
Aroclor-1221 (PCB-1221)	mg/kg	0.23 U	0.077 U	0.04 U	0.041 U	0.078 U	0.2 U	0.079 U	0.076 U	0.04 U	0.2 U	0.041 U	0.2 U
Aroclor-1232 (PCB-1232)	mg/kg	0.23 U	0.077 U	0.04 U	0.041 U	0.078 U	0.2 U	0.079 U	0.076 U	0.04 U	0.2 U	0.041 U	0.2 U
Aroclor-1242 (PCB-1242)	mg/kg	0.23 U	0.077 U	0.04 U	0.041 U	0.078 U	0.2 U	0.079 U	0.076 U	0.04 U	0.2 U	0.041 U	0.2 U
Aroclor-1248 (PCB-1248)	mg/kg	2.2	0.62	0.15	0.17	0.83	0.82	0.49	0.44	0.25 J	1.3	0.25	0.92
Aroclor-1254 (PCB-1254)	mg/kg	0.23 U	0.077 U	0.04 U	0.041 U	0.078 U	0.2 U	0.079 U	0.076 U	0.04 U	0.2 U	0.041 U	0.2 U
Aroclor-1260 (PCB-1260)	mg/kg	0.49	0.11	0.035 J	0.029 J	0.082	0.094 J	0.11	0.059 J	0.033 J	0.2	0.025 J	0.069 J
General Chemistry													
Total Solids	%	72.5	86.2	83.4	80.6	84.3	84.3	83.3	86.8	81.9	81.1	80.8	84.1

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BG*	*B-X143Y193BH*	*B-X143Y193BH*
Sample ID:		*S-011905-KMV-939*	*S-011905-KMV-928*	*S-011905-KMV-929*	*S-011905-KMV-930*	*S-011905-KMV-931*	*S-011905-KMV-932*	*S-011905-KMV-933*	*S-011905-KMV-934*	*S-011905-KMV-935*	*S-011905-KMV-936*	*S-011905-KMV-940*	*S-011905-KMV-950*
Sample Date:		*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*
Sample Depth:		*(18-20) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*	*(16-18) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.041 U	0.78 U	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.19 U	0.043 U
Aroclor-1221 (PCB-1221)	mg/kg	0.041 U	0.78 U	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.19 U	0.043 U
Aroclor-1232 (PCB-1232)	mg/kg	0.041 U	0.78 U	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.19 U	0.043 U
Aroclor-1242 (PCB-1242)	mg/kg	0.041 U	0.78 U	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.19 U	0.043 U
Aroclor-1248 (PCB-1248)	mg/kg	0.041 U	4.9	0.01 J	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.61	0.043 U
Aroclor-1254 (PCB-1254)	mg/kg	0.041 U	0.78 U	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.19 U	0.043 U
Aroclor-1260 (PCB-1260)	mg/kg	0.041 U	0.55 J	0.044 U	0.045 U	0.044 U	0.045 U	0.04 U	0.044 U	0.043 U	0.041 U	0.097 J	0.043 U
General Chemistry													
Total Solids	%	80.9	85.1	74.3	73.5	74.5	73.2	81.6	75.1	76.8	80.2	84.9	76.7

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AP*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AQ*	*B-X143Y193AR*	*B-X143Y193AR*	*B-X143Y193AR*
Sample ID:		*S-120704-KMV-813*	*S-120804-KMV-815*	*S-120804-KMV-829*	*S-120804-KMV-816*	*S-120804-KMV-817*	*S-120804-KMV-818*	*S-120804-KMV-819*	*S-120804-KMV-820*	*S-120804-KMV-827*	*S-120804-KMV-830*	*S-120804-KMV-831*	*S-120804-KMV-832*
Sample Date:		*12/7/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*
Sample Depth:		*(28-30) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(20-22) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.04 U	0.086 U	0.2 U	0.038 U	0.37 U	0.8 U	0.81 U	0.83 U	0.044 U	0.073 U	0.19 U	0.075 U
Aroclor-1221 (PCB-1221)	mg/kg	0.04 U	0.086 U	0.2 U	0.038 U	0.37 U	0.8 U	0.81 U	0.83 U	0.044 U	0.073 U	0.19 U	0.075 U
Aroclor-1232 (PCB-1232)	mg/kg	0.04 U	0.086 U	0.2 U	0.038 U	0.37 U	0.8 U	0.81 U	0.83 U	0.044 U	0.073 U	0.19 U	0.075 U
Aroclor-1242 (PCB-1242)	mg/kg	0.04 U	0.086 U	0.2 U	0.038 U	0.37 U	0.8 U	0.81 U	0.83 U	0.044 U	0.073 U	0.19 U	0.075 U
Aroclor-1248 (PCB-1248)	mg/kg	0.0089 J	0.65	1	0.23 J	1.6	6.8	4.6	4.8	0.044 U	0.55	1.4	0.69
Aroclor-1254 (PCB-1254)	mg/kg	0.04 U	0.086 U	0.2 U	0.038 U	0.37 U	0.8 U	0.81 U	0.83 U	0.044 U	0.073 U	0.19 U	0.075 U
Aroclor-1260 (PCB-1260)	mg/kg	0.04 U	0.12	0.16 J	0.029 J	0.13 J	0.35 J	0.81 U	0.83 U	0.044 U	0.11	0.26	0.058 J
General Chemistry													
Total Solids	%	82.0	76.7	83.6	86.9	88.7	82.3	81.8	79.2	74.2	90.6	88.0	87.5

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BH*	*B-X143Y193BI*	*B-X143Y193BI*
Sample ID:		*S-011905-KMV-951*	*S-011905-KMV-941*	*S-011905-KMV-942*	*S-011905-KMV-943*	*S-011905-KMV-944*	*S-011905-KMV-945*	*S-011905-KMV-946*	*S-011905-KMV-947*	*S-011905-KMV-948*	*S-011905-KMV-949*	*S-012005-KMV-952*	*S-012005-KMV-953*
Sample Date:		*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/19/2005*	*1/20/2005*	*1/20/2005*
Sample Depth:		*(18-20) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(Duplicate)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.042 U	2 U	3.8 U	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.39 U	0.38 U
Aroclor-1221 (PCB-1221)	mg/kg	0.042 U	2 U	3.8 U	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.39 U	0.38 U
Aroclor-1232 (PCB-1232)	mg/kg	0.042 U	2 U	3.8 U	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.39 U	0.38 U
Aroclor-1242 (PCB-1242)	mg/kg	0.042 U	2 U	3.8 U	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.39 U	0.38 U
Aroclor-1248 (PCB-1248)	mg/kg	0.042 U	11	17	0.03 J	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	1.7	2.2
Aroclor-1254 (PCB-1254)	mg/kg	0.042 U	2 U	3.8 U	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.39 U	0.38 U
Aroclor-1260 (PCB-1260)	mg/kg	0.042 U	1.3 J	3.4 J	0.038 U	0.043 U	0.046 U	0.041 U	0.043 U	0.043 U	0.043 U	0.33 J	0.31 J
General Chemistry													
Total Solids	%	79.1	81.1	87.1	87.1	75.9	71.2	80.4	75.9	76.1	76.9	84.0	88.0

TABLE 3.2

**AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA**

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193AR*	*B-X143Y193AR*	*B-X143Y193AR*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AS*	*B-X143Y193AT*	*B-X143Y193AT*
Sample ID:		*S-120804-KMV-833*	*S-120804-KMV-834*	*S-120804-KMV-835*	*S-120804-KMV-839*	*S-120804-KMV-840*	*S-120804-KMV-841*	*S-120804-KMV-842*	*S-120804-KMV-843*	*S-120804-KMV-844*	*S-120804-KMV-845*	*S-120804-KMV-847*	*S-120804-KMV-848*
Sample Date:		*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*	*12/8/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.078 U	0.19 U	0.2 U	0.076 U	0.37 U	0.38 U	0.37 U	7.9 U	0.4 U	0.04 U	3.9 U	0.38 U
Aroclor-1221 (PCB-1221)	mg/kg	0.078 U	0.19 U	0.2 U	0.076 U	0.37 U	0.38 U	0.37 U	7.9 U	0.4 U	0.04 U	3.9 U	0.38 U
Aroclor-1232 (PCB-1232)	mg/kg	0.078 U	0.19 U	0.2 U	0.076 U	0.37 U	0.38 U	0.37 U	7.9 U	0.4 U	0.04 U	3.9 U	0.38 U
Aroclor-1242 (PCB-1242)	mg/kg	0.078 U	0.19 U	0.2 U	0.076 U	0.37 U	0.38 U	0.37 U	7.9 U	0.4 U	0.04 U	3.9 U	0.38 U
Aroclor-1248 (PCB-1248)	mg/kg	0.71	1.2	1.1	1.2 J	2.3	2.6	2.6	46	3.8	0.04 U	13	3.5
Aroclor-1254 (PCB-1254)	mg/kg	0.078 U	0.19 U	0.2 U	0.076 U	0.37 U	0.38 U	0.37 U	7.9 U	0.4 U	0.04 U	3.9 U	0.38 U
Aroclor-1260 (PCB-1260)	mg/kg	0.042 J	0.11 J	0.2 U	0.31 J	0.32 J	0.36 J	0.26 J	4.8 J	0.39 J	0.04 U	1.7 J	0.55
General Chemistry													
Total Solids	%	84.1	85.4	80.6	86.7	88.2	87.6	88.2	83.1	82.9	81.5	84.4	87.0

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BI*	*B-X143Y193BJ*	*B-X143Y193BJ*	*B-X143Y193BJ*
Sample ID:		*S-012005-KMV-954*	*S-012005-KMV-955*	*S-012005-KMV-956*	*S-012005-KMV-957*	*S-012005-KMV-958*	*S-012005-KMV-959*	*S-012005-KMV-960*	*S-012005-KMV-961*	*S-012005-KMV-962*	*S-012005-KMV-963*	*S-012005-KMV-964*	*S-012005-KMV-965*
Sample Date:		*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*
Sample Depth:		*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*	*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	2 U	20 U	0.43 U	0.041 U	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	39 U	8.2 U	0.43 U
Aroclor-1221 (PCB-1221)	mg/kg	2 U	20 U	0.43 U	0.041 U	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	39 U	8.2 U	0.43 U
Aroclor-1232 (PCB-1232)	mg/kg	2 U	20 U	0.43 U	0.041 U	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	39 U	8.2 U	0.43 U
Aroclor-1242 (PCB-1242)	mg/kg	2 U	20 U	0.43 U	0.041 U	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	39 U	8.2 U	0.43 U
Aroclor-1248 (PCB-1248)	mg/kg	8.1	52	2.6	0.052	0.013 J	0.0097 J	0.02 J	0.0079 J	0.018 J	150	35	2
Aroclor-1254 (PCB-1254)	mg/kg	2 U	20 U	0.43 U	0.041 U	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	39 U	8.2 U	0.43 U
Aroclor-1260 (PCB-1260)	mg/kg	2.3	12 J	0.16 J	0.013 J	0.041 U	0.045 U	0.043 U	0.041 U	0.041 U	22 J	5.1 J	0.38 J
General Chemistry													
Total Solids	%	82.5	84.4	77.0	80.1	80.7	73.9	76.5	79.7	79.7	83.9	80.1	76.6

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BJ*	*B-X143Y193BJ*	*B-X143Y193BJ*	*B-X143Y193BJ*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BK*	*B-X143Y193BL*
Sample ID:		*S-012005-KMV-966*	*S-012005-KMV-967*	*S-012005-KMV-968*	*S-012005-KMV-969*	*S-012005-KMV-970*	*S-012005-KMV-971*	*S-012005-KMV-972*	*S-012005-KMV-973*	*S-012005-KMV-974*	*S-012005-KMV-975*	*S-012005-KMV-976*	*S-012005-KMV-977*	*S-012005-KMV-978*
Sample Date:		*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*
Sample Depth:		*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-0.5) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.43 U	0.042 U	0.044 U	0.042 U	8.1 U	8.1 U	0.086 U	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	2 U
Aroclor-1221 (PCB-1221)	mg/kg	0.43 U	0.042 U	0.044 U	0.042 U	8.1 U	8.1 U	0.086 U	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	2 U
Aroclor-1232 (PCB-1232)	mg/kg	0.43 U	0.042 U	0.044 U	0.042 U	8.1 U	8.1 U	0.086 U	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	2 U
Aroclor-1242 (PCB-1242)	mg/kg	0.43 U	0.042 U	0.044 U	0.042 U	8.1 U	8.1 U	0.086 U	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	2 U
Aroclor-1248 (PCB-1248)	mg/kg	2.1	0.1	0.036 J	0.019 J	35	25	0.52	0.01 J	0.042 U	0.042 U	0.04 U	0.041 U	15
Aroclor-1254 (PCB-1254)	mg/kg	0.43 U	0.042 U	0.044 U	0.042 U	8.1 U	8.1 U	0.086 U	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	2 U
Aroclor-1260 (PCB-1260)	mg/kg	0.44	0.018 J	0.044 U	0.042 U	5.2 J	4.3 J	0.1	0.04 U	0.042 U	0.042 U	0.04 U	0.041 U	3
General Chemistry														
Total Solids	%	76.4	78.2	75.7	78.3	81.8	81.7	76.6	83.5	78.7	78.0	81.8	79.5	82.9

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193I*	*B-X143Y193I*	*B-X143Y193I*	*B-X143Y193J*	*B-X143Y193J*	*B-X143Y193J*	*B-X143Y193J*	*B-X143Y193J*	*B-X143Y193J*	*B-X143Y193K*	*B-X143Y193K*	*B-X143Y193K*	*B-X143Y193K*
Sample ID:		*S-102704-JC-375*	*S-102704-JC-376*	*S-102704-JC-377*	*S-102704-JC-378*	*S-102704-JC-379*	*S-102704-JC-380*	*S-102704-JC-381*	*S-102704-JC-382*	*S-102704-JC-383*	*S-102704-JC-384*	*S-102704-JC-385*	*S-102704-JC-386*	*S-102704-JC-387*
Sample Date:		*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	4 U	0.04 UJ	0.04 UJ	0.38 U	0.8 U	0.19 U	0.37 U	0.4 UJ	0.041 UJ	0.77 U	3.9 U	0.24 U	0.041 UJ
Aroclor-1221 (PCB-1221)	mg/kg	4 U	0.04 UJ	0.04 UJ	0.38 U	0.8 U	0.19 U	0.37 U	0.4 UJ	0.041 UJ	0.77 U	3.9 U	0.24 U	0.041 UJ
Aroclor-1232 (PCB-1232)	mg/kg	4 U	0.04 UJ	0.04 UJ	0.38 U	0.8 U	0.19 U	0.37 U	0.4 UJ	0.041 UJ	0.77 U	3.9 U	0.24 U	0.041 UJ
Aroclor-1242 (PCB-1242)	mg/kg	4 U	0.73	0.04 UJ	0.38 U	0.8 U	0.19 U	0.37 U	4.2	0.041 UJ	0.77 U	3.9 U	0.24 U	0.18
Aroclor-1248 (PCB-1248)	mg/kg	49	0.04 UJ	0.04 UJ	4.5	10	1.1	2.7	0.4 UJ	0.041 UJ	6.6	38	1.9	0.041 UJ
Aroclor-1254 (PCB-1254)	mg/kg	4 U	0.04 UJ	0.04 UJ	0.38 U	0.8 U	0.19 U	0.37 U	0.4 UJ	0.041 UJ	0.77 U	3.9 U	0.24 U	0.041 UJ
Aroclor-1260 (PCB-1260)	mg/kg	3.7 J	0.029 J	0.04 UJ	0.4	0.89	0.26	0.47	0.27 J	0.041 UJ	0.48 J	2.5 J	0.1 J	0.032 J
General Chemistry														
Total Solids	%	82.0	83.3	82.6	87.6	82.8	89.0	89.8	83.4	80.1	85.6	85.3	69.1	80.7

TABLE 3.2

**AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA**

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BL*	*B-X143Y193BL*	*B-X143Y193BL*	*B-X143Y193BL*	*B-X143Y193BL*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*	*B-X143Y193BM*
Sample ID:		*S-012005-KMV-979*	*S-012005-KMV-980*	*S-012005-KMV-981*	*S-012005-KMV-982*	*S-012005-KMV-983*	*S-012405-KMV-984*	*S-012405-KMV-985*	*S-012405-KMV-986*	*S-012405-KMV-987*	*S-012405-KMV-988*	*S-012405-KMV-989*	*S-012405-KMV-990*	*S-012405-KMV-991*
Sample Date:		*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/20/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*
Sample Depth:		*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(6-8) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.04 U	0.042 U	0.04 U	0.044 U	0.045 U	0.41 U	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1221 (PCB-1221)	mg/kg	0.04 U	0.042 U	0.04 U	0.044 U	0.045 U	0.41 U	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1232 (PCB-1232)	mg/kg	0.04 U	0.042 U	0.04 U	0.044 U	0.045 U	0.41 U	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1242 (PCB-1242)	mg/kg	0.04 U	0.042 U	0.04 U	0.044 U	0.045 U	0.41 U	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1248 (PCB-1248)	mg/kg	0.1	0.042 U	0.0066 J	0.0096 J	0.013 J	2.1	0.24	0.081	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1254 (PCB-1254)	mg/kg	0.04 U	0.042 U	0.04 U	0.044 U	0.045 U	0.41 U	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
Aroclor-1260 (PCB-1260)	mg/kg	0.026 J	0.042 U	0.04 U	0.044 U	0.045 U	0.13 J	0.043 U	0.043 U	0.044 U	0.042 U	0.042 U	0.043 U	0.041 U
General Chemistry														
Total Solids	%	82.3	78.2	82.7	74.5	73.3	81.1	77.0	76.7	75.5	77.9	78.7	77.0	81.3

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193K*	*B-X143Y193L*	*B-X143Y193L*	*B-X143Y193L*	*B-X143Y193M*	*B-X143Y193M*	*B-X143Y193M*	*B-X143Y193M*	*B-X143Y193N*	*B-X143Y193N*	*B-X143Y193N*	*B-X143Y193N*	*B-X143Y193O*
Sample ID:		*S-102704-JC-388*	*S-102704-JC-389*	*S-102704-JC-390*	*S-102704-JC-391*	*S-102704-JC-394*	*S-102704-JC-395*	*S-102704-JC-396*	*S-102704-JC-397*	*S-102804-JC-400*	*S-102804-JC-401*	*S-102804-JC-402*	*S-102804-JC-403*	*S-102804-JC-404*
Sample Date:		*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*
Sample Depth:		*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(0-2) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.041 UJ	0.76 U	0.8 U	2 U	1.8 U	0.78 U	0.38 U	7.8 U	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8 U
Aroclor-1221 (PCB-1221)	mg/kg	0.041 UJ	0.76 U	0.8 U	2 U	1.8 U	0.78 U	0.38 U	7.8 U	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8 U
Aroclor-1232 (PCB-1232)	mg/kg	0.041 UJ	0.76 U	0.8 U	2 U	1.8 U	0.78 U	0.38 U	7.8 U	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8 U
Aroclor-1242 (PCB-1242)	mg/kg	0.041 UJ	0.76 U	0.8 U	2 U	1.8 U	0.78 U	0.38 U	89	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8 U
Aroclor-1248 (PCB-1248)	mg/kg	0.041 UJ	12	6	19	12	6.7	2.2	7.8 U	15	9.6	7	2.9	15
Aroclor-1254 (PCB-1254)	mg/kg	0.041 UJ	0.76 U	0.8 U	2 U	1.8 U	0.78 U	0.38 U	7.8 U	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8 U
Aroclor-1260 (PCB-1260)	mg/kg	0.041 UJ	1.2	0.64 J	1.3 J	0.92 J	0.43 J	0.38 U	4.6 J	1.9 U	0.79 U	0.83 U	0.2 UJ	1.8
General Chemistry														
Total Solids	%	81.2	86.6	82.8	83.3	91.2	84.9	86.4	84.3	84.8	83.4	79.7	82.4	90.3

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BN*	*B-X143Y193BN*	*B-X143Y193BN*	*B-X143Y193BN*	*B-X143Y193BN*	*B-X143Y193BN*	*B-X143Y193BO*	*B-X143Y193BO*	*B-X143Y193BO*	*B-X143Y193BO*	*B-X143Y193BO*	*B-X143Y193BO*	*B-X143Y193BP*
Sample ID:		*S-012405-KMV-992*	*S-012405-KMV-993*	*S-012405-KMV-994*	*S-012405-KMV-995*	*S-012405-KMV-996*	*S-012405-KMV-997*	*S-012405-KMV-998*	*S-012405-KMV-999*	*S-012405-KMV-1000*	*S-012405-KMV-1001*	*S-012405-KMV-1002*	*S-012405-KMV-1003*	*S-012405-KMV-1004*
Sample Date:		*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*
Sample Depth:		*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	0.089 U	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	2.1 U	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.38 U
Aroclor-1221 (PCB-1221)	mg/kg	0.089 U	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	2.1 U	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.38 U
Aroclor-1232 (PCB-1232)	mg/kg	0.089 U	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	2.1 U	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.38 U
Aroclor-1242 (PCB-1242)	mg/kg	0.089 U	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	2.1 U	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.38 U
Aroclor-1248 (PCB-1248)	mg/kg	0.53	0.04 U	0.012 J	0.044 U	0.043 U	0.042 U	14	0.062	0.043 U	0.044 U	0.039 U	0.039 U	2.7
Aroclor-1254 (PCB-1254)	mg/kg	0.089 U	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	2.1 U	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.38 U
Aroclor-1260 (PCB-1260)	mg/kg	0.092	0.04 U	0.045 U	0.044 U	0.043 U	0.042 U	1.5 J	0.041 U	0.043 U	0.044 U	0.039 U	0.039 U	0.39
General Chemistry														
Total Solids	%	74.5	81.5	73.9	75.8	77.1	78.2	78.4	80.3	76.2	75.6	85.4	84.5	85.8

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193O*	*B-X143Y193O*	*B-X143Y193O*	*B-X143Y193O*	*B-X143Y193O*	*B-X143Y193P*	*B-X143Y193P*	*B-X143Y193P*	*B-X143Y193P*	*B-X143Y193P*	*B-X143Y193P*	*B-X143Y193Q*	*B-X143Y193Q*
Sample ID:		*S-102804-JC-405*	*S-102804-JC-406*	*S-102804-JC-407*	*S-102804-JC-408*	*S-102804-JC-409*	*S-102804-JC-410*	*S-102804-JC-411*	*S-102804-JC-412*	*S-102804-JC-413*	*S-102804-JC-414*	*S-102804-JC-415*	*S-111604-KMV-586*	*S-111604-KMV-587*
Sample Date:		*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*10/28/2004*	*11/16/2004*	*11/16/2004*
Sample Depth:		*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(8-10) ft*	*(0-2) ft*	*(2-4) ft*
		(orig)	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*													
PCBs														
Aroclor-1016 (PCB-1016)	mg/kg	1.9 U	39 U	0.2 U	0.4 UJ	0.041 UJ	0.38 U	0.19 U	0.78 U	19 UJ	0.041 UJ	0.04 UJ	1.9 U	0.77 U
Aroclor-1221 (PCB-1221)	mg/kg	1.9 U	39 U	0.2 U	0.4 UJ	0.041 UJ	0.38 U	0.19 U	0.78 U	19 UJ	0.041 UJ	0.04 UJ	1.9 U	0.77 U
Aroclor-1232 (PCB-1232)	mg/kg	1.9 U	39 U	0.2 U	0.4 UJ	0.041 UJ	0.38 U	0.19 U	0.78 U	19 UJ	0.041 UJ	0.04 UJ	1.9 U	0.77 U
Aroclor-1242 (PCB-1242)	mg/kg	1.9 U	39 U	0.2 U	0.4 UJ	0.048	0.38 U	0.19 U	0.78 U	130	0.015 J	0.016 J	1.9 U	0.77 U
Aroclor-1248 (PCB-1248)	mg/kg	18	300	1.2	3.8	0.041 UJ	3.2	2.3	9.2	19 UJ	0.041 UJ	0.04 UJ	17	4.7
Aroclor-1254 (PCB-1254)	mg/kg	1.9 U	39 U	0.2 U	0.4 UJ	0.041 UJ	0.38 U	0.19 U	0.78 U	19 UJ	0.041 UJ	0.04 UJ	1.9 U	0.77 U
Aroclor-1260 (PCB-1260)	mg/kg	1.6 J	39	0.085 J	0.4 UJ	0.041 UJ	0.3 J	0.17 J	1	10 J	0.041 UJ	0.04 UJ	1.9 U	0.77 U
General Chemistry														
Total Solids	%	85.8	85.5	81.0	82.9	81.0	86.6	86.3	84.6	85.2	80.8	81.8	88.2	85.2

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BP*	*B-X143Y193BP*	*B-X143Y193BP*	*B-X143Y193BP*	*B-X143Y193BP*	*B-X143Y193BP*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*
Sample ID:		*S-012405-KMV-1005*	*S-012405-KMV-1006*	*S-012405-KMV-1007*	*S-012405-KMV-1008*	*S-012405-KMV-1009*	*S-012405-KMV-1010*	*S-012505-KMV-1011*	*S-012505-KMV-1012*	*S-012505-KMV-1013*	*S-012505-KMV-1014*	*S-012505-KMV-1015*	*S-012505-KMV-1016*
Sample Date:		*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/24/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*
Sample Depth:		*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(orig)	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.043 UJ	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.39 U	0.2 U	0.2 U	3.9 U	0.2 U	0.043 UJ
Aroclor-1221 (PCB-1221)	mg/kg	0.043 UJ	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.39 U	0.2 U	0.2 U	3.9 U	0.2 U	0.043 UJ
Aroclor-1232 (PCB-1232)	mg/kg	0.043 UJ	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.39 U	0.2 U	0.2 U	3.9 U	0.2 U	0.043 UJ
Aroclor-1242 (PCB-1242)	mg/kg	0.043 UJ	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.39 U	0.2 U	0.2 U	3.9 U	0.2 U	0.043 UJ
Aroclor-1248 (PCB-1248)	mg/kg	0.4 J	0.086	0.043 U	0.043 U	0.041 U	0.042 U	3.8	1.2	0.6	24	2	0.043 UJ
Aroclor-1254 (PCB-1254)	mg/kg	0.043 UJ	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.39 U	0.2 U	0.2 U	3.9 U	0.2 U	0.043 UJ
Aroclor-1260 (PCB-1260)	mg/kg	0.029 J	0.042 U	0.043 U	0.043 U	0.041 U	0.042 U	0.44	0.19 J	0.11 J	1.5 J	0.27	0.043 UJ
General Chemistry													
Total Solids	%	76.2	77.9	76.6	76.0	80.0	78.0	84.4	83.6	84.4	83.7	83.0	77.4

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193Q*	*B-X143Y193Q*	*B-X143Y193Q*	*B-X143Y193Q*	*B-X143Y193R*	*B-X143Y193R*	*B-X143Y193R*	*B-X143Y193R*	*B-X143Y193R*	*B-X143Y193R*	*B-X143Y193S*	*B-X143Y193S*
Sample ID:		*S-111604-KMV-588*	*S-111604-KMV-589*	*S-111604-KMV-590*	*S-111604-KMV-603*	*S-111604-KMV-591*	*S-111604-KMV-592*	*S-111604-KMV-593*	*S-111604-KMV-594*	*S-111604-KMV-595*	*S-111604-KMV-600*	*S-111704-DD-604*	*S-111704-DD-605*
Sample Date:		*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/16/2004*	*11/17/2004*	*11/17/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(14-16) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(18-20) ft*	*(0-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.039 U	0.4 U	0.04 U	0.045 U	0.39 U	0.39 U	21 U	0.04 U	0.041 U	430 U	20 U	3.8 U
Aroclor-1221 (PCB-1221)	mg/kg	0.039 U	0.4 U	0.04 U	0.045 U	0.39 U	0.39 U	21 U	0.04 U	0.041 U	430 U	20 U	3.8 U
Aroclor-1232 (PCB-1232)	mg/kg	0.039 U	0.4 U	0.04 U	0.045 U	0.39 U	0.39 U	21 U	0.04 U	0.041 U	430 U	20 U	3.8 U
Aroclor-1242 (PCB-1242)	mg/kg	0.039 U	0.4 U	0.04 U	0.037 J	0.39 U	3.2	21 U	0.16	0.041 U	2400	20 U	3.8 U
Aroclor-1248 (PCB-1248)	mg/kg	0.37	2.2	0.032 J	0.045 U	2.7	0.39 U	220	0.04 U	0.032 J	430 U	83	21
Aroclor-1254 (PCB-1254)	mg/kg	0.039 U	0.4 U	0.04 U	0.045 U	0.39 U	0.39 U	21 U	0.04 U	0.041 U	430 U	20 U	3.8 U
Aroclor-1260 (PCB-1260)	mg/kg	0.039 U	0.4 U	0.04 U	0.045 U	0.3 J	0.33 J	21 U	0.04 U	0.041 U	370 J	10 J	1.5 J
General Chemistry													
Total Solids	%	83.8	82.7	82.4	73.9	84.5	85.0	79.7	82.8	79.9	77.2	84.2	86.5

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BQ*	*B-X143Y193BR*	*B-X143Y193BR*	*B-X143Y193BR*	*B-X143Y193BR*	*B-X143Y193BR*	*B-X143Y193BR*	*B-X143Y193BS*	*B-X143Y193BS*
Sample ID:		*S-012505-KMV-1017*	*S-012505-KMV-1018*	*S-012505-KMV-1019*	*S-012505-KMV-1020*	*S-012505-KMV-1021*	*S-012505-KMV-1022*	*S-012505-KMV-1023*	*S-012505-KMV-1024*	*S-012505-KMV-1025*	*S-012505-KMV-1026*	*S-012505-KMV-1027*	*S-012505-KMV-1028*
Sample Date:		*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*
Sample Depth:		*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(10-12) ft*	*(0-0.5) ft*	*(1-2) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.19 U	0.39 U	0.042 U	0.045 UJ	0.041 U	0.039 U
Aroclor-1221 (PCB-1221)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.19 U	0.39 U	0.042 U	0.045 UJ	0.041 U	0.039 U
Aroclor-1232 (PCB-1232)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.19 U	0.39 U	0.042 U	0.045 UJ	0.041 U	0.039 U
Aroclor-1242 (PCB-1242)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.19 U	0.39 U	0.042 U	0.045 UJ	0.041 U	0.039 U
Aroclor-1248 (PCB-1248)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	1	2.4	0.1	0.045 UJ	0.21	0.059
Aroclor-1254 (PCB-1254)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.19 U	0.39 U	0.042 U	0.045 UJ	0.041 U	0.039 U
Aroclor-1260 (PCB-1260)	mg/kg	0.041 UJ	0.042 UJ	0.042 UJ	0.041 UJ	0.044 UJ	0.04 UJ	0.29	0.43	0.016 J	0.045 UJ	0.06	0.024 J
General Chemistry													
Total Solids	%	81.3	78.9	77.7	80.2	74.9	83.1	84.7	84.4	78.9	73.4	80.4	84.2

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193S*	*B-X143Y193S*	*B-X143Y193S*	*B-X143Y193S*	*B-X143Y193S*	*B-X143Y193T*	*B-X143Y193T*	*B-X143Y193T*	*B-X143Y193T*	*B-X143Y193T*	*B-X143Y193T*	*B-X143Y193T*
Sample ID:		*S-111704-DD-606*	*S-111704-DD-607*	*S-111704-DD-608*	*S-111704-DD-609*	*S-111704-DD-614*	*S-111704-DD-615*	*S-111704-DD-616*	*S-111704-DD-617*	*S-111704-DD-618*	*S-111704-DD-619*	*S-111704-DD-620*	*S-111704-DD-623*
Sample Date:		*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*
Sample Depth:		*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(20-22) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(18-20) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	3.8 U	0.079 U	0.042 U	0.041 U	0.042 U	7.9 U	19 U	0.19 U	0.039 U	0.041 U	0.041 U	0.044 U
Aroclor-1221 (PCB-1221)	mg/kg	3.8 U	0.079 U	0.042 U	0.041 U	0.042 U	7.9 U	19 U	0.19 U	0.039 U	0.041 U	0.041 U	0.044 U
Aroclor-1232 (PCB-1232)	mg/kg	3.8 U	0.079 U	0.042 U	0.041 U	0.042 U	7.9 U	19 U	0.19 U	0.039 U	0.041 U	0.041 U	0.044 U
Aroclor-1242 (PCB-1242)	mg/kg	3.8 U	0.079 U	0.042 U	0.041 U	0.042 U	7.9 U	19 U	0.19 U	0.039 U	0.041 U	0.041 U	0.044 U
Aroclor-1248 (PCB-1248)	mg/kg	27	0.48	0.13	0.069	0.042 U	40	110	0.92	0.029 J	0.012 J	0.041 U	0.044 U
Aroclor-1254 (PCB-1254)	mg/kg	3.8 U	0.079 U	0.042 U	0.041 U	0.042 U	7.9 U	19 U	0.19 U	0.039 U	0.041 U	0.041 U	0.044 U
Aroclor-1260 (PCB-1260)	mg/kg	1.6 J	0.035 J	0.042 U	0.041 U	0.042 U	2.1 J	5.4 J	0.15 J	0.039 U	0.041 U	0.041 U	0.044 U
General Chemistry													
Total Solids	%	86.3	83.1	78.5	80.8	79.1	83.4	87.5	88.5	85.5	81.1	80.0	75.4

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BS*	*B-X143Y193BS*	*B-X143Y193BS*	*B-X143Y193BS*	*B-X143Y193BS*	*B-X143Y193BS*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*
Sample ID:		*S-012505-KMV-1029*	*S-012505-KMV-1030*	*S-012505-KMV-1031*	*S-012505-KMV-1032*	*S-012505-KMV-1033*	*S-012505-KMV-1034*	*S-012505-KMV-1035*	*S-012505-KMV-1036*	*S-012505-KMV-1037*	*S-012505-KMV-1038*	*S-012505-KMV-1039*	*S-012505-KMV-1040*
Sample Date:		*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*
Sample Depth:		*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.18 U	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
Aroclor-1221 (PCB-1221)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.18 U	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
Aroclor-1232 (PCB-1232)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.18 U	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
Aroclor-1242 (PCB-1242)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.18 U	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
Aroclor-1248 (PCB-1248)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.8	0.014 J	0.014 J	0.043 U	0.042 U	0.04 U
Aroclor-1254 (PCB-1254)	mg/kg	0.015 J	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.18 U	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
Aroclor-1260 (PCB-1260)	mg/kg	0.041 U	0.041 U	0.041 U	0.042 U	0.04 U	0.042 U	0.09 J	0.04 U	0.042 U	0.043 U	0.042 U	0.04 U
General Chemistry													
Total Solids	%	80.1	81.3	81.3	78.4	82.4	77.7	90.4	82.5	77.9	77.1	78.5	82.4

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193U*	*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193V*
Sample ID:		*S-111704-DD-624*	*S-111704-DD-625*	*S-111704-DD-630*	*S-111704-DD-626*	*S-111704-DD-627*	*S-111704-DD-628*	*S-111704-DD-632*	*S-111704-DD-633*	*S-111804-DD-646*	*S-111804-DD-647*	*S-111804-DD-648*	*S-111804-DD-649*
Sample Date:		*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/17/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*
Sample Depth:		*(0-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(15-17) ft*	*(18-20) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.38 U	0.4 U	0.04 U	0.41 U	0.039 U	0.04 U	0.043 U	0.044 U	0.86 U	0.78 U	0.2 U	8 U
Aroclor-1221 (PCB-1221)	mg/kg	0.38 U	0.4 U	0.04 U	0.41 U	0.039 U	0.04 U	0.043 U	0.044 U	0.86 U	0.78 U	0.2 U	8 U
Aroclor-1232 (PCB-1232)	mg/kg	0.38 U	0.4 U	0.04 U	0.41 U	0.039 U	0.04 U	0.043 U	0.044 U	0.86 U	0.78 U	0.2 U	8 U
Aroclor-1242 (PCB-1242)	mg/kg	0.38 U	0.4 U	0.04 U	0.41 U	0.039 U	0.04 U	0.043 U	0.044 U	0.86 U	0.78 U	0.2 U	28
Aroclor-1248 (PCB-1248)	mg/kg	1.7	1.3	0.26	3	0.051	0.43	0.0081 J	0.044 U	9	5.2	0.84	8 U
Aroclor-1254 (PCB-1254)	mg/kg	0.38 U	0.4 U	0.04 U	0.41 U	0.039 U	0.04 U	0.043 U	0.044 U	0.86 U	0.78 U	0.2 U	8 U
Aroclor-1260 (PCB-1260)	mg/kg	0.16 J	0.12 J	0.023 J	0.41 U	0.039 U	0.069	0.043 U	0.044 U	1.8	0.58 J	0.2 U	8 U
General Chemistry													
Total Solids	%	87.1	82.6	82.2	81.2	85.3	82.3	76.9	74.9	76.8	84.5	83.8	82.6

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BT*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*	*B-X143Y193BU*
Sample ID:		*S-012505-KMV-1041*	*S-012505-KMV-1042*	*S-012505-KMV-1043*	*S-012505-KMV-1044*	*S-012505-KMV-1045*	*S-012505-KMV-1046*	*S-012505-KMV-1047*	*S-012505-KMV-1048*	*S-012505-KMV-1049*	*S-012505-KMV-1050*	*S-012505-KMV-1051*	*S-012505-KMV-1052*
Sample Date:		*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*
Sample Depth:		*(8-10) ft*	*(10-12) ft*	*(12-14) ft*	*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(12-14) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.083 U	0.035 U	0.043 U	0.046 U	0.043 U
Aroclor-1221 (PCB-1221)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.083 U	0.035 U	0.043 U	0.046 U	0.043 U
Aroclor-1232 (PCB-1232)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.083 U	0.035 U	0.043 U	0.046 U	0.043 U
Aroclor-1242 (PCB-1242)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.083 U	0.035 U	0.043 U	0.046 U	0.043 U
Aroclor-1248 (PCB-1248)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.025 J	0.043 U	0.044 U	0.52	0.035 U	0.018 J	0.046 U	0.043 U
Aroclor-1254 (PCB-1254)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.083 U	0.035 U	0.043 U	0.046 U	0.043 U
Aroclor-1260 (PCB-1260)	mg/kg	0.039 U	0.039 U	0.045 U	0.042 U	0.041 UJ	0.043 U	0.044 U	0.024 J	0.035 U	0.043 U	0.046 U	0.043 U
General Chemistry													
Total Solids	%	85.4	84.1	73.7	78.1	81.3	76.3	75.1	79.3	93.7	77.4	72.4	76.4

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193V*	*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193W*
Sample ID:		*S-111804-DD-650*	*S-111804-DD-651*	*S-111804-DD-652*	*S-111804-DD-655*	*S-111804-DD-657*	*S-111804-DD-634*	*S-111804-DD-635*	*S-111804-DD-636*	*S-111804-DD-637*	*S-111804-DD-638*	*S-111804-DD-639*	*S-111804-DD-640*
Sample Date:		*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(14-16) ft*	*(18-20) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(Duplicate)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	4 U	2 U	0.79 U	0.04 U	0.042 U	0.85 U	0.038 U	0.039 U	0.041 U	0.041 U	0.04 U	0.19 U
Aroclor-1221 (PCB-1221)	mg/kg	4 U	2 U	0.79 U	0.04 U	0.042 U	0.85 U	0.038 U	0.039 U	0.041 U	0.041 U	0.04 U	0.19 U
Aroclor-1232 (PCB-1232)	mg/kg	4 U	2 U	0.79 U	0.04 U	0.042 U	0.85 U	0.038 U	0.039 U	0.041 U	0.041 U	0.04 U	0.19 U
Aroclor-1242 (PCB-1242)	mg/kg	17	15	0.79 U	0.04 U	0.042 U	0.85 U	0.038 U	0.039 U	0.041 U	0.041 U	0.04 U	0.19 U
Aroclor-1248 (PCB-1248)	mg/kg	4 U	2 U	4	0.17	0.042 U	9.7	0.24	0.26	0.09	0.031 J	0.0089 J	1.4
Aroclor-1254 (PCB-1254)	mg/kg	4 U	2 U	0.79 U	0.04 U	0.042 U	0.85 U	0.038 U	0.039 U	0.041 U	0.041 U	0.04 U	0.19 U
Aroclor-1260 (PCB-1260)	mg/kg	4 U	2 U	0.79 U	0.04 U	0.042 U	1.9	0.038	0.029 J	0.03 J	0.041 U	0.04 U	0.14 J
General Chemistry													
Total Solids	%	82.7	83.4	83.4	82.0	78.8	77.5	86.0	85.2	81.1	81.3	81.9	86.4

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193BU*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193BV*	*B-X143Y193D*	*B-X143Y193D*	*B-X143Y193D*
Sample ID:		*S-012505-KMV-1053*	*S-012505-KMV-1054*	*S-012505-KMV-1055*	*S-012505-KMV-1056*	*S-012505-KMV-1057*	*S-012505-KMV-1058*	*S-012505-KMV-1059*	*S-012505-KMV-1060*	*S-012505-KMV-1061*	*S-102604-JC-350*	*S-102604-JC-351*	*S-102604-JC-352*
Sample Date:		*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*1/25/2005*	*10/26/2004*	*10/26/2004*	*10/26/2004*
Sample Depth:		*(14-16) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(10-12) ft*	*(0-2) ft*	*(2-4) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(Duplicate)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	0.82 U	0.38 U	1.9 U
Aroclor-1221 (PCB-1221)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	0.82 U	0.38 U	1.9 U
Aroclor-1232 (PCB-1232)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	0.82 U	0.38 U	1.9 U
Aroclor-1242 (PCB-1242)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	0.82 U	0.38 U	1.9 U
Aroclor-1248 (PCB-1248)	mg/kg	0.0068 J	1.8	0.011 J	0.0069 J	0.042 U	0.042 U	0.038 U	0.0082 J	0.044 U	10	3.4	16
Aroclor-1254 (PCB-1254)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	0.82 U	0.38 U	1.9 U
Aroclor-1260 (PCB-1260)	mg/kg	0.045 U	0.35 U	0.039 U	0.042 U	0.042 U	0.042 U	0.038 U	0.045 U	0.044 U	1	0.27 J	1.4 J
General Chemistry													
Total Solids	%	72.9	94.2	84.8	79.4	78.9	77.7	86.7	73.7	75.3	80.5	86.5	85.6

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193W*	*B-X143Y193W*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193X*	*B-X143Y193Y*
Sample ID:		*S-111804-DD-644*	*S-111804-DD-645*	*S-111804-DD-658*	*S-111804-DD-659*	*S-111804-DD-660*	*S-111804-DD-661*	*S-111804-DD-662*	*S-111804-DD-663*	*S-111804-DD-664*	*S-111804-DD-666*	*S-111804-DD-669*	*S-111904-DD-670*
Sample Date:		*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/18/2004*	*11/19/2004*
Sample Depth:		*(16-18) ft*	*(18-20) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(8-10) ft*	*(12-14) ft*	*(18-20) ft*	*(0-0.5) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	0.041 U	0.045 U	0.42 U	0.39 U	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.041 U	0.044 U	20 U
Aroclor-1221 (PCB-1221)	mg/kg	0.041 U	0.045 U	0.42 U	0.39 U	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.041 U	0.044 U	20 U
Aroclor-1232 (PCB-1232)	mg/kg	0.041 U	0.045 U	0.42 U	0.39 U	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.041 U	0.044 U	20 U
Aroclor-1242 (PCB-1242)	mg/kg	0.041 U	0.045 U	0.42 U	0.39 U	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.2	0.044 U	20 U
Aroclor-1248 (PCB-1248)	mg/kg	0.041 U	0.045 U	4.8	5.3	9	2.6	6.8	10	13	0.041 U	0.044 U	140
Aroclor-1254 (PCB-1254)	mg/kg	0.041 U	0.045 U	0.42 U	0.39 U	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.041 U	0.044 U	20 U
Aroclor-1260 (PCB-1260)	mg/kg	0.041 U	0.045 U	1.3	1.4	0.79 U	0.21 U	0.41 U	0.8 U	0.79 U	0.041 U	0.044 U	24
General Chemistry													
Total Solids	%	80.5	73.0	78.3	84.3	83.9	80.4	81.1	82.5	83.1	80.2	75.1	83.4

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193D*	*B-X143Y193D*	*B-X143Y193D*	*B-X143Y193F*	*B-X143Y193F*	*B-X143Y193F*	*B-X143Y193G*	*B-X143Y193G*	*B-X143Y193G*	*B-X143Y193G*	*B-X143Y193G*	*B-X143Y193G*
Sample ID:		*S-102604-JC-353*	*S-102604-JC-354*	*S-102604-JC-355*	*S-102704-JC-356*	*S-102704-JC-357*	*S-102704-JC-358*	*S-102704-JC-361*	*S-102704-JC-362*	*S-102704-JC-363*	*S-102704-JC-364*	*S-102704-JC-365*	*S-102704-JC-366*
Sample Date:		*10/26/2004*	*10/26/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	2 U	0.037 UJ	0.04 UJ	0.75 U	1.9 U	4 U	1.9 U	3.9 U	40 U	40 U	0.04 UJ	0.042 UJ
Aroclor-1221 (PCB-1221)	mg/kg	2 U	0.037 UJ	0.04 UJ	0.75 U	1.9 U	4 U	1.9 U	3.9 U	40 U	40 U	0.04 UJ	0.042 UJ
Aroclor-1232 (PCB-1232)	mg/kg	2 U	0.037 UJ	0.04 UJ	0.75 U	1.9 U	4 U	1.9 U	3.9 U	40 U	40 U	0.04 UJ	0.042 UJ
Aroclor-1242 (PCB-1242)	mg/kg	2 U	0.15	0.26	0.75 U	1.9 U	33	1.9 U	3.9 U	40 U	40 U	0.32	0.042 UJ
Aroclor-1248 (PCB-1248)	mg/kg	16	0.037 UJ	0.04 UJ	6.8	13	4 U	14	36	770	590	0.04 UJ	0.14
Aroclor-1254 (PCB-1254)	mg/kg	2 U	0.037 UJ	0.04 UJ	0.75 U	1.9 U	4 U	1.9 U	3.9 U	40 U	40 U	0.04 UJ	0.042 UJ
Aroclor-1260 (PCB-1260)	mg/kg	2 U	0.025 J	0.018 J	0.61 J	0.92 J	1.8 J	1 J	3.9 U	62	42	0.065	0.012 J
General Chemistry													
Total Solids	%	83.2	88.3	81.8	87.6	86.5	81.8	86.2	84.8	82.4	83.1	82.8	79.4

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Y*	*B-X143Y193Z*	*B-X143Y193Z*	*B-X143Y193Z*	*B-X143Y193Z*
Sample ID:		*S-111904-DD-671*	*S-111904-DD-672*	*S-111904-DD-675*	*S-111904-DD-673*	*S-111904-DD-674*	*S-111904-DD-676*	*S-111904-DD-678*	*S-111904-DD-679*	*S-112204-DD-680*	*S-112204-DD-689*	*S-112204-DD-681*	*S-112204-DD-682*
Sample Date:		*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/19/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*
Sample Depth:		*(1-2) ft*	*(2-4) ft*	*(2-4) ft*	*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(12-14) ft*	*(16-18) ft*	*(0-0.5) ft*	*(0-0.5) ft*	*(1-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*												
PCBs													
Aroclor-1016 (PCB-1016)	mg/kg	19 U	0.8 U	2 U	2 U	3.9 U	8.2 U	0.083 U	0.044 U	0.4 U	1.9 U	0.19 U	0.39 U
Aroclor-1221 (PCB-1221)	mg/kg	19 U	0.8 U	2 U	2 U	3.9 U	8.2 U	0.083 U	0.044 U	0.4 U	1.9 U	0.19 U	0.39 U
Aroclor-1232 (PCB-1232)	mg/kg	19 U	0.8 U	2 U	2 U	3.9 U	8.2 U	0.083 U	0.044 U	0.4 U	1.9 U	0.19 U	0.39 U
Aroclor-1242 (PCB-1242)	mg/kg	19 U	0.8 U	2 U	2 U	3.9 U	8.2 U	0.12	0.044 U	0.4 U	1.9 U	0.19 U	0.39 U
Aroclor-1248 (PCB-1248)	mg/kg	170	5.4	16	13	19	71	0.083 U	0.044 U	5	10	1.3	4.4
Aroclor-1254 (PCB-1254)	mg/kg	19 U	0.8 U	2 U	2 U	3.9 U	8.2 U	0.083 U	0.044 U	0.4 U	1.9 U	0.19 U	0.39 U
Aroclor-1260 (PCB-1260)	mg/kg	28	0.56 J	2 U	0.73 J	1.7 J	3 J	0.083 U	0.044 U	1.1	2.5	0.19 U	0.39 U
General Chemistry													
Total Solids	%	86.7	82.1	84.2	81.2	85.4	80.5	79.5	75.5	82.4	84.9	86.0	85.5

TABLE 3.2

AOI 21 AREA 2 SOIL ANALYTICAL RESULTS SUMMARY
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193H*	*B-X143Y193H*	*B-X143Y193H*	*B-X143Y193H*	*B-X143Y193I*	*B-X143Y193I*
Sample ID:		*S-102704-JC-367*	*S-102704-JC-368*	*S-102704-JC-369*	*S-102704-JC-370*	*S-102704-JC-373*	*S-102704-JC-374*
Sample Date:		*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*	*10/27/2004*
Sample Depth:		*(0-2) ft*	*(2-4) ft*	*(4-6) ft*	*(4-6) ft*	*(0-2) ft*	*(2-4) ft*
		(orig)	*(orig)*	*(orig)*	*(Duplicate)*	*(orig)*	*(orig)*
Parameters	*Units*						
PCBs							
Aroclor-1016 (PCB-1016)	mg/kg	0.19 U	20 U	0.39 U	0.44 U	0.38 U	19 U
Aroclor-1221 (PCB-1221)	mg/kg	0.19 U	20 U	0.39 U	0.44 U	0.38 U	19 U
Aroclor-1232 (PCB-1232)	mg/kg	0.19 U	20 U	0.39 U	0.44 U	0.38 U	19 U
Aroclor-1242 (PCB-1242)	mg/kg	0.19 U	20 U	0.39 U	0.44 U	0.38 U	19 U
Aroclor-1248 (PCB-1248)	mg/kg	1.1	350	3.8	1.5	3.6	200
Aroclor-1254 (PCB-1254)	mg/kg	0.19 U	20 U	0.39 U	0.44 U	0.38 U	19 U
Aroclor-1260 (PCB-1260)	mg/kg	0.29	14 J	0.38 J	0.26 J	0.46	21
General Chemistry							
Total Solids	%	85.5	84.1	84.3	75.2	85.9	86.5

Sample Area:		*A021-2*	*A021-2*	*A021-2*	*A021-2*	*A021-2*
Sample Location:		*B-X143Y193Z*	*B-X143Y193Z*	*B-X143Y193Z*	*B-X143Y193Z*	*B-X143Y193Z*
Sample ID:		*S-112204-DD-683*	*S-112204-DD-684*	*S-112204-DD-685*	*S-112204-DD-686*	*S-112204-DD-688*
Sample Date:		*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*	*11/22/2004*
Sample Depth:		*(4-6) ft*	*(6-8) ft*	*(8-10) ft*	*(10-12) ft*	*(14-16) ft*
		(orig)	*(orig)*	*(orig)*	*(orig)*	*(orig)*
Parameters	*Units*					
PCBs						
Aroclor-1016 (PCB-1016)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
Aroclor-1221 (PCB-1221)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
Aroclor-1232 (PCB-1232)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
Aroclor-1242 (PCB-1242)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
Aroclor-1248 (PCB-1248)	mg/kg	2.4	3.9	0.084	0.023 J	0.012 J
Aroclor-1254 (PCB-1254)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
Aroclor-1260 (PCB-1260)	mg/kg	0.41 U	0.4 U	0.039 U	0.04 U	0.043 U
General Chemistry						
Total Solids	%	81.5	81.7	84.2	82.5	77.2

TABLE 4.1

AIR MONITORING SUMMARY - 24-HOUR (LONG TERM)
WEST PLANT AREA SOIL REMOVAL
GENERAL MOTORS POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Excavation Areas	*Parameters*	*Duration of Monitoring*	*Air Monitoring Locations*	*Air Monitoring Frequency*
Soil Removal Area	Compound Specific PCBs	Duration of the over 50 mg/kg PCB soil removal portion of the IM	Four locations around perimeter of the West Plant Area Construction Zone Station 1C	At least 3 times per week Daily whenever work is done
Soil Removal Area	Compound Specific TSPs	Duration of the over 50 mg/kg PCB soil removal portion of the IM	Four locations around perimeter of the West Plant Area Construction Zone	Daily

Notes:
1) PCB air monitoring program will be re-evaluated after one month of data is collected.
2) TSP samples will be collected with high volume samplers or real-time monitoring units as specified in the March 9, 2006 proposed modification to the AAQMP letter to U.S. EPA.
PCBs - Polychlorinated Biphenyls
TSPs - Total Suspended Particulates

APPENDIX A

EAST PLANT AREA AND NORTHERN TRIBUTARY 40 CFR 761.61 (C) APPROVAL

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

OCT 26 2006

REPLY TO THE ATTENTION OF:

D-8J

Cheryl R. Hiatt, Project Manager
General Motors Corporation
Worldwide Facilities Group Remediation Team
2000 Centerpoint Parkway (483-520-190)
Pontiac, Michigan 48341-3147

Re: Toxic Substances Control Act Approval to Dispose of Polychlorinated Biphenyls

Dear Ms. Hiatt:

Enclosed is the Toxic Substances Control Act (TSCA) Risk-Based Approval to Dispose of Polychlorinated Biphenyls (PCBs). This Approval is issued pursuant to 40 CFR § 761.61(c) of the Federal PCB regulations for the disposal of PCB contaminated waste in the PCB disposal facility (vault) located in the former north stormwater basin at the East Plant Area of General Motors Corporation's (GM) Bedford, Indiana facility (Site).

We are granting this Approval based on our finding that the disposal of PCBs in the vault is in compliance with the conditions in the enclosed Approval and does not pose an unreasonable risk of injury to health or the environment. This Approval is effective today and is based on our review of the East Plant Area Vault Design Report (application), the Vault Development Plan, supplemental information that you submitted in support of your application, and all of the other site-specific factors and information that you submitted as part of the East Plant Area Interim Measure.

This Approval is solely for the disposal of the following PCB contaminated material in the vault, as identified in the conditions of the enclosed approval. No other PCB contaminated material may be disposed of in the vault.

1. Approximately 110,000 cubic yards of PCB contaminated soil and incidental debris from the excavation of 50 ppm and over PCB contaminated fill or overburden soil within the East Plant Area of the Site.

2. 50 ppm and over PCB contaminated material from the northern tributary fill area excavation.

3. Sediments collected from the wheel wash operation.

4. Imported granular material originally used for access road construction but which has contacted PCB contaminated fill or soil excavated from the East Plant Area.

The Approval does not relieve GM from the responsibility to comply with all applicable provisions of TSCA and the Federal PCB regulations or any other applicable Federal, state or local regulations.

If you have any questions regarding this approval, please contact Jean Greensley, of my staff, at (312) 353-1171.

Sincerely,

Bruce F. Sypniewski, Deputy Director
Waste, Pesticides and Toxics Division

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

IN THE MATTER OF: General Motors Powertrain Bedford Facility 105 GM Drive Bedford, Indiana 47421-1558 Corporate Address: General Motors Corporation Worldwide Facilities Group Remediation Team 2000 Centerpoint Parkway Pontiac, Michigan 48341-3147 **PERMITTEE**	)	**RISK-BASED APPROVAL TO DISPOSE OF POLYCHLORINATED BIPHENYLS (PCBs) ISSUED PURSUANT TO 40 CFR § 761.61(c)**

AUTHORITY

This risk-based disposal approval (Approval) is issued pursuant to Section 6(e)(1) of the Toxic Substances Control Act (TSCA) of 1976, Public Law No. 94-469, 15 U.S.C. § 2605(e)(1), and the Federal PCB regulations promulgated thereunder, 40 CFR § 761.61(c).

Any and all information required to be maintained under or submitted pursuant to this Approval is not subject to the requirements of the Paperwork Reduction Act of 1980, 44 U.S.C. § 3501, et seq., because such information is collected by the United States Environmental Protection Agency (U.S. EPA or Agency), Region 5 from the Permittee for the purpose of assuring compliance with this Approval.

EFFECTIVE DATES

This Approval is effective upon the signature of the Director of the Waste, Pesticides and Toxics Division, U.S. EPA, Region 5. On that date, the issuance of this Approval shall be considered a final Agency action.

BACKGROUND

Section 6(e)(l)(A) of TSCA requires that the U.S. EPA promulgate rules for the disposal of PCBs. The rules implementing Section 6(e)(l)(A) were published in the Federal Register on February 17, 1978, (43 Fed. Reg. 7150), recodified in the Federal Register on May 6, 1982, (47 Fed. Reg. 19527), and modified in the Federal Register of June 29, 1998. Those rules require, among other things, that various types of PCBs be disposed of in U.S. EPA-approved disposal facilities. The February 17, 1978 Federal Register also designated the Regional Administrator as the approval authority for PCB disposal facilities. On June 5, 2001, the U.S. EPA delegated, among other things, the authority to approve or deny permit applications to operate PCB storage and disposal facilities from the Regional Administrator to the Director of the Waste, Pesticides and Toxics Division. This Approval is based on the Federal PCB regulations at 40 CFR § 761.61(c).

On October 17, 2005, General Motors (Permitee), as owner of the General Motors Powertrain Bedford, Indiana Facility (Site) and operator of the proposed PCB disposal facility (vault), submitted an East Plant Area Vault Design Report (application) to the U.S. EPA for approval under 40 CFR § 761.61(c) to dispose of PCB contaminated waste generated from the clean up of PCB contaminated soil at the Site. On June 16, 2006, the Permitee submitted a revised East Plant Area Vault Design Report (revised application) to U.S. EPA. The vault that is the subject of this Approval has been constructed in the former north stormwater basin (AOI 7) that is no longer in service. The vault is located in the East Plant Area of the Site which is east of GM Drive, west of the existing Stormwater Lagoon and between a General Motors (GM) owned parking lot referred to as the Zipp Trucking parking lot to the north and the East Plant parking lot to the south (Figure 1.3, Vault Application).

FINDINGS

1. The Site is an approximately 152.5 acre property located at 105 GM Drive in Bedford, Indiana 47421-1558. The property is located on either side of GM Drive and extends north along Bailey Scales Road (Figure 1.2, Vault Application).

2. The coordinates for the Site are latitude North 38° 52' 54" and longitude West 86° 28' 52".

3. The Site is zoned and used for industrial purposes.

4. The Permittee's mailing address and physical address is: General Motors Corporation, Worldwide Facilities Group Remediation Team, 2000 Centerpoint Parkway, Pontiac, Michigan 48341-3146.

5. The East Plant Area is east of GM Drive and west of Bailey Scales Road (Figure 1.3, Vault Application).

6. The Site stratigraphy, from top to bottom, is:

   a. Variable thicknesses of overburden materials consisting of foundry sand fill, clay and silt.

   b. The St. Louis Formation which is a limestone that is highly weathered and fractured near the surface, with the degree of weathering decreasing with depth. The formation is about 25 feet thick in the area of the vault.

   c. The Salem Limestone which is 70 to 80 feet thick. The Salem Limestone formation is generally less weathered and fractured than the St. Louis Formation. The weathering and fractures are evident at the erosional rock surface but the formation becomes more homogeneous with depth.

7. Borings drilled into the bedrock at the Site, along with optical televiewer logs, indicate that the shallow bedrock contains solution enhanced features (epikarst) and that the deeper bedrock lacks significant amounts of weathering and fractures and has a lower overall hydraulic conductivity (January 20, 2006 Technical Memorandum by Dr. B.H. Kueper titled Site Conceptual Model Contaminant Migration, GM Powertrain Bedford Facility, Bedford, Indiana).

8. Regionally, the area is characterized by sinkholes that are five to ten miles west of the Site and caves that are between one to five miles of the Site. None of these features are evident in the area of the vault.

9. The vault has been constructed in the former north stormwater basin (AOI 7) which is no longer in service.

10. The bedrock exposed in the excavation of the former north stormwater basin showed the following:

    a. Subaerial dissolution and epikarst development on the surface of the bedrock.

    b. A 2 x 2 foot void in the southeast corner of the excavation.

    c. A clay-filled vertical fracture in the northeast corner of the excavation within the St. Louis Formation.

11. Geophysical investigation of the bedrock and the void showed the following:

    a. No indication that there was any continuation of the void at depth or that the void extended laterally beyond the bounding lines 240E and 260E (Figure 2.2, Comments – Technical Memorandum Regarding U.S. EPA Comments on October 14, 2005 Geophysics Memorandum East Plant Area Vault Design Report [October 17, 2005]).

    b. No additional voids of significance in the footprint of the vault.

    c. The clay in the vertical fracture was excavated and the fracture was found to be only 12 to 18 inches deep and above the groundwater elevation at the Site.

12. The fracture, as well as another fracture, was bridged with larger diameter rock and covered with concrete to eliminate any potential for settlement.

13. A gravel underdrain was placed on the bedrock surface of the excavated stormwater basin to eliminate any potential for piping of the clay liner into bedrock voids in the epikarst through seasonal groundwater fluctuation or leakage through the bottom liner system.

14. Regionally, groundwater resources are found along the valley of major streams and within a thick Mississippian carbonate aquifer system.

15. The hydrogeology at the East Plant Area is as follows:

    a. Shallow groundwater flow through the unconsolidated overburden material and the upper fractured and weathered bedrock.

    b. Recharge to the aquifer through the overburden material and directly into the bedrock where it is exposed.

    c. Discharge of the shallow bedrock groundwater occurs through springs and seeps in topographically low areas such as creeks and ditches.

    d. Surface runoff is primarily to the east and northeast in small valleys which are tributaries of Bailey's Branch of Pleasant Run Creek. Surface runoff to the west of the facility is minimal.

16. The water table occurs at depths of 5 to 15 feet below ground surface.

17. There are domestic wells within the vicinity of the Site but none are used for drinking water.

18. The vault is not in the 100 year floodplain.

19. The vault has been constructed with the following features:

    a. An underdrain consisting of a minimum of six inches of gravel, perforated high density polyethylene (HDPE) collection pipes and an eight ounce non-woven, needle punched geotextile with three oil seep collection pipes and sumps (Drawing C-02, Vault Application).

    b. A primary 60 mil textured HDPE synthetic membrane liner and a secondary 60 mil thick low level density polyethylene (LLDPE) liner each of which exceeds the 30 mil thickness specified in the TSCA Chemical Waste Landfill regulations at 40 CFR § 761.75 for a landfill that is not located on a clay pan.

    c. A primary and secondary liner each comprised of 12 inches of re-compacted clay and a Geocomposite Clay Liner (GCL). Twelve inches of re-compacted clay and the GCL is an acceptable substitute for the 36 inches of re-compacted clay which is the TSCA Chemical Waste Landfill minimum requirement (40 CFR § 761.75). The hydraulic conductivity of the clay and the GCL meet the required hydraulic conductivity of 10^{-7} cm/sec.

    d. A compound leachate collection system that consists of a primary leachate collection system and a secondary leak detection system. The primary leachate collection system consists of 6 inch HDPE perforated piping installed within 12 inches of ½ inch diameter gravel. The secondary leak detection system consists of a geocomposite drainage net placed between the 12 inches of clay in the primary liner and the LLDPE liner with geotextile fabric on either side of the geonet. The compound leachate collection system meets the requirements for a TSCA Chemical Waste Landfill under 40 CFR § 761.75.

    e. A secondary LLDPE liner above the secondary clay/GCL liner and below the secondary leachate collection system. Above this is the primary clay/GCL liner overlain by the HDPE liner and the primary leachate collection system. The underdrain is below this double liner/double leachate collection system.

20. When the vault is filled, it will be covered with a cap constructed of 24 inches of compacted clay, a 60 mil textured flexible membrane liner (fml), a geonet, 18 inches of cover fill, 6 inches of top soil and a vegetative cover.

21. The vault will have a maximum capacity of approximately 135,000 cubic yards based on 4H:1V slopes on the cap.

22. Disposal in the vault involves the following:

   a. Placement of approximately 110,000 cubic yards of PCB contaminated soil and incidental debris from the excavation of 50 ppm and over PCB contaminated fill or overburden soil within the East Plant Area of the Site into the vault including:

      i. Material from the staging pad immediately north of the storm water pond, which will be placed into the vault first.

      ii. Material from the east parking lot, currently staged in Grading Area 4, which will be placed into the vault second.

      iii. Material from the Phase I excavation in the Zipp Trucking parking lot.

      iv. 50 ppm and over PCB contaminated material that will be excavated from the east parking lot.

      v. 50 ppm and over PCB contaminated material excavated from AOI 4.

   b. Placement in the vault of 50 ppm and over PCB contaminated material from the northern tributary fill area excavation.

   c. Placement in the vault of sediments collected from the wheel wash operation.

   d. Placement in the vault of imported granular material originally used for access road construction but which has contacted PCB contaminated fill or soil excavated from the East Plant Area.

23. The leachate from the collection system and the leak detection system and the water from the underdrain will be treated at the temporary water treatment facility under requirements established under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) until the new water treatment system is operational when it will be discharged under a National Pollutant Discharge Elimination System (NPDES) Permit.

24. While the vault is actively operating and accepting PCB contaminated material, the Permittee will maintain an operating log that contains the following information:

      i. Source (i.e., location) of excavated material.

      ii. Estimated quantity (volume and/or weight) of excavated material.

      iii. The estimated volume of excavated material disposed of in the vault on a daily basis.

25. The Permittee has filed the document, "Notification of PCB Waste Activity," Form 7710-53 (12-89) and has received the U.S. EPA identification number IND 006036099.

CONDITIONS OF APPROVAL

SCOPE OF WORK

1. The Permittee can dispose of the following PCB contaminated waste in the vault located at latitude North 38° 52' 54" and longitude West 86° 28' 52": approximately 110,000 cubic yards of PCB contaminated soil generated from the excavation of 50 ppm and over PCB contaminated soil within the East Plant Area of the Site, PCB contaminated soil generated from the excavation of 50 ppm and over PCB contaminated soil from the northern tributary, sediments collected from the wheel wash operation and imported granular material originally used for access road construction but which has contacted PCB contaminated fill or soils excavated from the East Plant Area.

2. The leachate from the leachate collection system and the leak detection system, the water from the underdrain and groundwater from the groundwater collection trench must be treated at the temporary water treatment facility until the permanent water treatment facility is operational. Water released from the temporary water treatment facility must be discharged under requirements established under CERCLA. Water released from the permanent water treatment facility must be discharged under a NPDES Permit.

WASTE PLACEMENT

3. The PCB contaminated waste placed in the vault must be capable of attaining sufficient strength to prevent subsidence, ponding on the waste or on the cap, and slope movement, i.e., creep.

4. All vehicles delivering waste to the vault must be washed before entering the public road. Waste water generated from truck washing activities must be collected and treated for disposal.

5. If a truck leaves an exclusion zone or switches use to a material other than PCB contaminated waste, it must be decontaminated.

UNDERDRAIN WATER MONITORING AND DISPOSAL

6. The level of water in the underdrain must be monitored daily and any accumulation must be discharged to the temporary water treatment facility. The Permittee can propose an alternate schedule once the permanent water treatment facility is operational.

7. The level of water in the underdrain must be maintained at less than one foot. Should the level increase beyond one foot in response to a storm event, accumulated water must be removed for treatment at the maximum achievable removal rate until the level is reduced to below one foot.

LEACHATE AND LEAK DETECTION SYSTEM WATER MONITORING AND DISPOSAL

8. While the vault is open and receiving PCB contaminated material, the Permittee must sample the leachate and the leak detection system water monthly for PCBs before it is sent to the temporary water treatment facility. This same schedule will apply once the leachate and leak detection water is sent to the permanent water treatment facility.

9. After closure of the vault, the Permittee may submit an alternate leachate and leak detection monitoring schedule, as part of the East Plant Area long-term monitoring plan, for U.S. EPA, Region 5 review and approval.

10. The leachate and leak detection system water must be managed in accordance with the following TSCA leachate management policy:

    a. Leachate and leak detection water whose PCB content is equal to or greater than 50 ppm PCBs is PCB waste and must be treated or disposed of in accordance with the PCB regulations.

    b. Leachate and leak detection water with PCB concentrations from 1 ppm to, but not including, 50 ppm is TSCA reportable material that must be managed in compliance with the U.S. EPA CERCLA order or a NPDES permit.

    c. Leachate and leak detection water with a PCB concentration of less than 1 ppm must be managed in compliance with the U.S. EPA CERCLA order or a NPDES permit.

11. Leachate samples must be tested for

    a. PCBs

    b. pH

    c. Specific Conductance

    d. Chlorinated Organics identified in Table 1 (attached) and analyzed according to Method 8260B.

    e. Physicochemical characteristics necessary to characterize the leachate for treatment in the temporary and permanent water treatment facility.

12. The secondary leak detection system must be monitored for:

    a. Quantity of water

    b. PCBs

c. Sufficient physiochemical characteristics of the water produced in order to determine whether a leak of the membrane has occurred and to characterize the water for treatment in the temporary and permanent water treatment facility.

13. While the vault is open and receiving PCB contaminated material, the Permittee must monitor the water level over the primary liner to ensure that it does not exceed one foot. Should the level increase beyond one foot in response to a storm event, accumulated water shall be removed for treatment at the maximum achievable removal rate until the level is reduced below one foot. The maximum water elevation must be recorded monthly and reported annually.

14. After closure of the vault, the Permittee may submit an alternate schedule for monitoring the water level over the primary liner, as part of the East Plant Area long-term monitoring plan, for U.S. EPA, Region 5 review and approval.

GROUNDWATER MONITORING

15. The Permittee must construct a groundwater collection trench around the perimeter of the East Plant Area. If the trench is not constructed, the U.S. EPA may terminate this Approval and might require the PCB waste to be removed from the vault and disposed of at a facility permitted to accept this waste.

16. The construction and monitoring schedule for the perimeter groundwater collection trench must be submitted to the U.S. EPA, Region 5 for review and approval.

17. Groundwater, including background samples, must be monitored for:

    a. PCBs

    b. pH

    c. Specific Conductance

    d. Chlorinated Organics identified in Table 1 (attached) and analyzed according to Method 8260B.

18. The groundwater must be treated at the temporary or permanent water treatment facility and discharged in compliance with the U.S. EPA CERCLA order or a NPDES permit.

SPILL CLEANUP

19. Cleanup of onsite PCB spills which are outside of the Exclusion Zones established in accordance with the Site Health and Safety Plan must begin upon discovery by the Permittee. These spills must be cleaned up in accordance with 40 CFR Part 761, Subpart G, PCB Spill Cleanup Policy, or 40 CFR § 761.61, PCB Remediation Waste, as applicable. PCB spills on public roads must be cleaned up in accordance with 40 CFR Part 761,

Subpart G, PCB Spill Cleanup Policy. The cleanup standards in the PCB Spill Cleanup Policy may only be applied for spills of PCBs that are less than 72 hours old.

20. Any debris or solid wastes generated as a result of cleanup or decontamination of a PCB spill or release may be disposed of in the vault.

AMBIENT AIR MONITORING

21. While the vault is open and accepting PCB contaminated material, total suspended particulate (TSP) and high volume PCB air monitoring must be conducted in accordance with the report submitted by the Permittee titled Air Monitoring Requirements During the Over 50 mg/kg PCB Soil Removal for the East Plant Area.

FLOOD PROTECTION

22. If the vault is ever determined to be in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map 100 year flood plain, the waste in the vault must be removed or protected by a flood control structure whose minimum elevation is at least 2 feet above the respective 100 year flood plain elevation. Rainwater falling on the vault must not be allowed to accumulate to a level that would allow its entry to the leachate collection system or the secondary leak detection system through the manhole risers or clean outs.

QUALITY ASSURANCE FOR ENVIRONMENTAL DATA AND INFORMATION

23. The Permittee must perform sampling and analysis in accordance with the Quality Assurance Project Plan RCRA Facility Investigation and Removal Action Work Plans Addendum No. 2 dated July 19, 2006.

FINAL CONSTRUCTION REPORT

24. The Final Construction Report for the vault must contain the information as described in the vault application plus all photographs taken during the construction of the vault.

RECORDKEEPING

25. The Permittee must record the following information in a log:

    a. Daily waste information.

        i. identification of the source (i.e., location) of excavated material

        ii. estimated quantity (volume and/or weight) of material excavated and placed in the vault

    b. The quantity of liquid collected from the leachate collection system.

c. The quantity of liquid collected from the leak detection system.

d. The quantity of liquid collected from the underdrain.

e. The water elevation in the underdrain and over the primary liner.

f. The amount of water treated in the water treatment facility and the PCB concentration, if known.

26. All required documents must be collected and maintained for at least 20 years after the vault is no longer used for the disposal of PCB waste. The required documents must be kept at one central location and must be made available for inspection by authorized representatives of the U.S. EPA, Region 5.

REPORTING

27. An annual report for the previous calendar year must be submitted to the U.S. EPA, Region 5 by July 15 of each year. The report must include:

    a. A summary of the information itemized in the log required by Condition 25 of this Approval.

    b. All analytical results from the monitoring of the air, groundwater, leachate, leak detection and underdrain and the water treatment facility analytical results.

    c. The volume, PCB concentration and disposal destination for leachate and leak detection water with a PCB concentration equal or greater than 1 ppm.

    d. A summary of the water elevation over the primary liner and in the underdrain.

    e. Spill cleanup reports, if any.

    f. Updated financial assurance for the operation, closure and post-closure care costs adjusted annually.

28. The first annual report submitted under this Approval must contain the most recent analytical results for groundwater collected from the closest wells around the vault, prior to any placement of PCB contaminated waste in the vault.

NOTICE

29. Within one working day of discovery, the Permittee must notify the U.S. EPA, Region 5 by telephone of any incident, anomaly or accident that may affect the disposal conditions of this Approval or that has or may result in the release of PCBs to the environment. The Permittee also must provide a written notification within seven days.

30. Within one working day of discovery, the Permittee must notify the U.S. EPA, Region 5 by telephone of any statistically significant increase in leak detection system samples. The Permittee also must provide a written notification within seven days.

31. Within one working day of discovery, the Permittee must notify the U.S. EPA, Region 5 by phone if the water level over the primary liner or in the underdrain exceeds one foot.

32. Within five days of discovery, the Permittee must verbally notify the U.S. EPA, Region 5 of any non-compliance of the NPDES permit at Outfall 003 or the requirements established under CERCLA followed by a written report regarding the incident and the steps taken or that will be taken to correct the situation.

33. For the one working day telephone notification, the Permittee must contact the U.S. EPA, Region 5, Toxics Program Section, at (312) 886-6003. For the seven day written notification, the Permittee must submit the report to the Director of the Waste Pesticides and Toxics Division at the following address:

    WPTD Director (D-8J)
    U.S. EPA, Region 5
    77 W. Jackson Blvd.
    Chicago, Illinois 60604-3590

34. If there is a spill or release of the equivalent of 1 pound or more of pure PCBs, the Permittee must notify the National Response Center at (800) 424-8802 within 24 hours.

VAULT SECURITY

35. The vault must be secured to restrict public access in accordance with the procedures outlined in Section 8.0 of the Vault Development Plan.

INSPECTION

36. The Agency reserves the right for its employees and authorized representatives to perform inspections, review records, and take samples at any reasonable time.

CLOSURE AND POST-CLOSURE

37. PCB waste may not be disposed of in the vault after the placement of:

    a. Approximately 110,000 cubic yards of PCB contaminated soil generated from the excavation of 50 ppm and over PCB contaminated soil within the East Plant Area of the Site.

    b. PCB contaminated soil generated from the excavation of 50 ppm and over PCB contaminated soil from the northern tributary fill area.

c. Sediments collected from the wheel wash operation while the 50 ppm and over material excavated from the East Plant Area is being placed in the vault.

d. Imported granular materials originally used for access road construction but which has contacted the 50 ppm and over PCB contaminated fill or soils excavated from the East Plant Area.

38. The Permittee must submit a closure and post-closure plan to the U.S. EPA, Region 5 for review and approval a minimum of 21 days prior to closure of the vault.

39. The closure and post-closure plan must contain the information described in Section 11.0 of the Vault Development Plan plus a detailed estimate of closure and post-closure care costs.

40. The Permittee cannot close the vault unless the Permittee has received written approval of the closure plan from the Director of the Waste Pesticides and Toxics Division, U.S. EPA, Region 5.

41. The Permittee must clean any surfaces within the East Plant Area contaminated by spills of PCB material that was to be disposed of in the vault. The surfaces must be cleaned to 50 ppm or 10 $\mu g/100\ cm^2$.

42. Upon closure of the vault, the Permittee must remediate the roads and parking lots used during the disposal of the PCB contaminated material, except roads and parking areas which are otherwise addressed as part of the Corrective Action activities, in accordance with the cleanup standards outlined in 40 CFR § 761.61.

43. The Permittee must care for the vault and perform post-closure environmental monitoring and maintenance in perpetuity.

<u>**FINANCIAL ASSURANCE**</u>

44. The Permittee must establish financial assurance for the operation, closure and post-closure care costs. The Permittee may use any combination of financial assurance mechanisms described in 40 CFR § 761.65(g). The financial assurance mechanism can be part of the financial assurance mechanism developed for the East Plant Area or the Final Corrective Measure.

45. The Permittee must submit proof of financial assurance to the U.S. EPA, Region 5 annually. If the U.S. EPA, Region 5 determines that the amount is inadequate, the Permittee must obtain additional financial assurance funding.

46. The Permittee must annually adjust the closure and post-closure care cost estimates for inflation. This may require an increase in the financial assurance funding mechanism.

47. The Permittee must adjust the operation, closure and post-closure care cost estimates for any modification or change that increases these costs. This may require an increase in the financial assurance funding mechanism.

48. Financial assurance must be maintained in perpetuity.

MODIFICATIONS

49. The Permittee must notify the U.S. EPA, Region 5 in writing of any intended modifications to this Approval or their application.

50. Any major modification of this Approval requires the written approval of the Director of the Waste Pesticides and Toxics Division, U.S. EPA, Region 5. A major modification is a material change in design or operation of the vault. Such changes include, but are not limited to, changes in the scope of work of the Approval. Increasing disposal capacity beyond that specified in Condition 1 is an example of a major modification.

51. Any minor modification of this Approval requires written approval of the Chief of the Pesticides and Toxic Substances Branch, Waste Pesticides and Toxics Division, U.S. EPA, Region 5. A minor modification is a change in operations that is not a major modification, such as changing the groundwater, leachate or air monitoring locations, the analytical methodology or waste acceptance procedures.

52. If there is any question as to whether a change in operations is a major or minor modification, such question should be raised to the appropriate representative(s) of the U.S. EPA, Region 5 as soon as possible. In such cases, the Agency will determine whether a proposed change is major or minor.

APPROVAL EXPIRATION

53. This Approval does not expire unless and until all PCBs are removed from the vault. Otherwise, the Approval's conditions remain valid in perpetuity.

54. The Permittee's authorization to place PCBs in the vault will expire upon placement of the material itemized in Condition 1.

COMPLIANCE AND APPROVAL SUSPENSION AND TERMINATION

55. Nothing in this Approval relieves the Permittee from the duty to comply with all applicable state and Federal laws, including, but not limited to CERCLA, RCRA and TSCA and the regulations promulgated thereunder.

56. Any knowing or persistent failure of the Permittee to comply with all applicable Federal laws, regulations, requirements or orders could result in the termination of the Permittee's authority to dispose of PCBs in the vault.

57. Failure to comply with any provision of this Approval, TSCA, the Federal PCB regulations found at 40 CFR Part 761, or any other applicable Federal, state or local requirements may constitute a sufficient basis for suspension or termination of the Approval.

58. Failure to completely and effectively implement components and tasks of the East Plant Area Interim Measure in a manner that will not present an unreasonable risk to human health and the environment may result in the termination of this Approval and, subsequently, may result in the requirement to remove the PCB waste from the vault and dispose of the removed material at a permitted facility.

59. This Approval may be terminated if the Director of the Waste, Pesticides and Toxics Division, U.S. EPA, Region 5 determines that the vault poses an unreasonable risk to human health or the environment.

PCB DISPOSAL AUTHORITY REINSTATEMENT

60. The Director of the Waste, Pesticides and Toxics Division, U.S. EPA, Region 5 may reinstate the Approval if it is determined that the Permittee is in compliance with the applicable state and Federal laws and the conditions of the Approval and the vault no longer poses an unreasonable risk to human health or the environment.

SEVERABILITY

61. All terms and/or conditions of this Approval are severable. If any provision(s) of this Approval or any application of any provision, is changed, amended, or held invalid, the remaining terms and conditions will still be valid and not affected thereby.

OWNERSHIP TRANSFER

62. The requirement and responsibilities for perpetual care transfers with ownership of the vault.

63. The Permittee must provide a written notice to the U.S. EPA, Region 5 at least 90 days in advance of any planned transfer in ownership of the vault. The name of the prospective transferee must be included in the notice

64. The prospective transferee must submit to the U.S. EPA, Region 5 at least 90 days before the transfer:

    a. A notarized affidavit signed by the transferee which states that the transferee will abide by the conditions of the Approval.

    b. A listing of past environmental violations by the transferee, its employees or assigns.

    c. The qualifications of the principals and key employees.

d. Documentation of acceptable financial assurance and funding pursuant to the TSCA regulations at 40 C.F.R. § 761.65(g).

65. After reviewing the notification, affidavit and background information, the U.S. EPA, Region 5 will either issue a modified approval substituting the transferee's name for the transferor's name, or require the transferee to apply for a new PCB disposal approval. The transferee must abide by the conditions of the Approval and the application submitted by General Motors Corporation on October 17, 2005 and the revised application submitted by General Motors Corporation on June 16, 2006, until the U.S. EPA, Region 5 issues a modified approval or until notified otherwise.

66. If the U.S. EPA, Region 5 requires the transferee to apply for a new PCB disposal approval, the transferee must submit to the Regional Administrator a complete TSCA application for disposal, closure and post-closure care. The Regional Administrator may also require any additional information necessary to ensure that the vault poses no unreasonable risk to health and the environment.

BANKRUPTCY

67. In the event that the Permittee, or its successor or assigns, declare bankruptcy, the Permittee shall immediately provide written notice of such to the Director of the Waste, Pesticides and Toxics Division, U.S. EPA, Region 5.

APPROVAL

Approval is hereby granted to General Motors Corporation to dispose of PCB contaminated material from the East Plant Area of the Bedford Powertrain Facility in a vault constructed on the Site at 105 GM Drive in Bedford, Indiana at latitude North 38° 52' 54" and longitude West 86° 28' 52", subject to the Approval Conditions stated herein, and based on the information described in the application submitted by General Motors Corporation on October 17, 2005; the Vault Development Plan submitted by General Motors Corporation on February 28, 2006; the revised application submitted by General Motors Corporation on June 16, 2006 and additional information submitted by General Motors at the request of the U.S. EPA, Region 5.

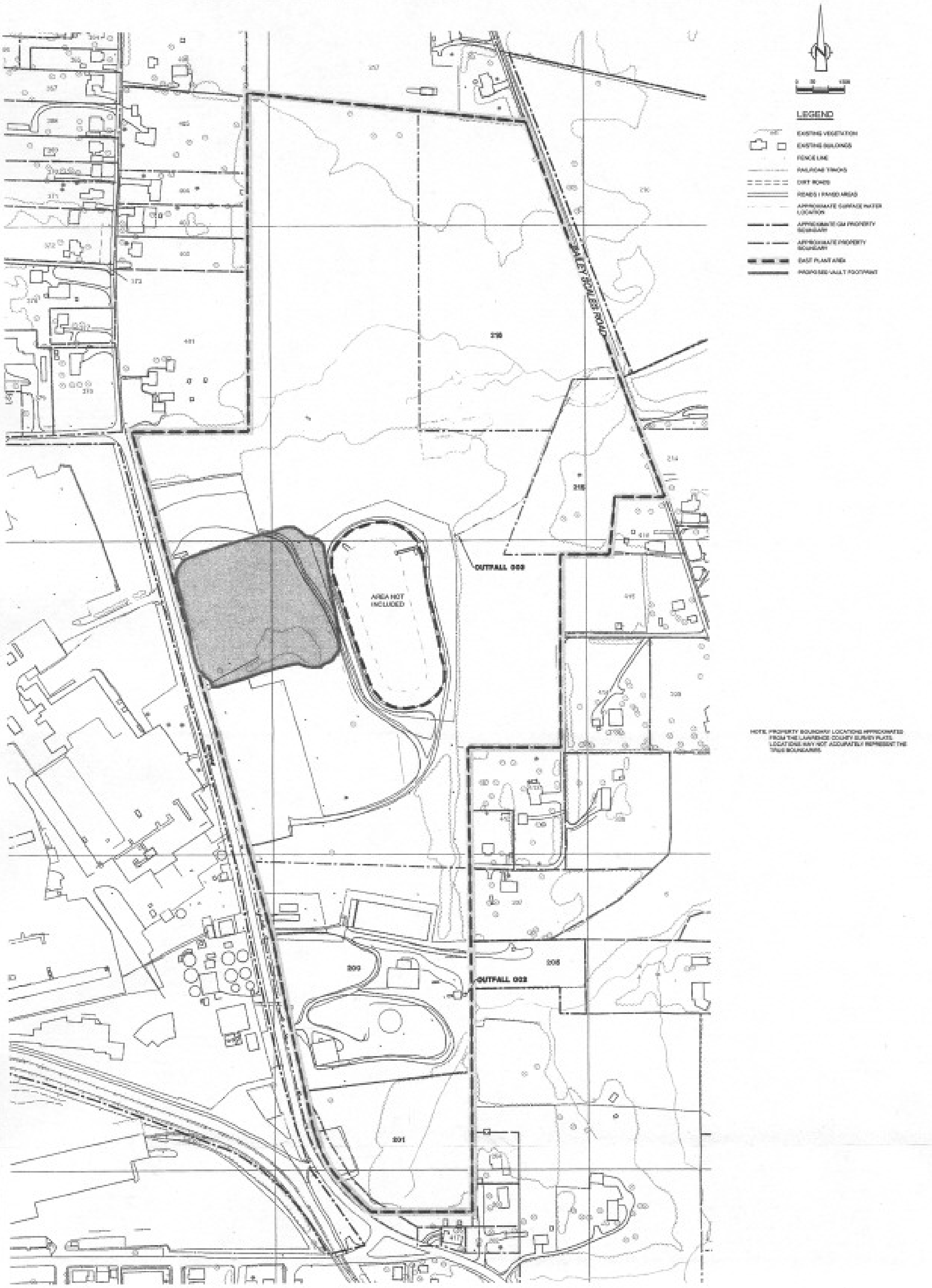
The Approval shall become effective on the date of the signature and remain in effect unless revoked, suspended or terminated in accordance with the Approval Conditions stated herein

General Motors Corporation is responsible for all actions of any of its agents, assigns, employees and contractors when those actions are within the scope of operating or administering the vault. This Approval does not relieve General Motors Corporation from compliance with all applicable Federal, state and local regulatory requirements, including the Federal PCB regulations at 40 CFR Part 761.

The United States Environmental Protection Agency reserves the right for its employees or agents to inspect the vault and the support facilities at any reasonable time. The U.S. EPA also reserves all legal rights available under all applicable statutes and regulations.

Bruce Sypniewski, Deputy Director
Waste, Pesticides and Toxics Division
United States Environmental Protection Agency
Region 5

10/18/06
Date



SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

VAULT DESIGN REPORT

PROPOSED VAULT FOOTPRINT

CONESTOGA-ROVERS & ASSOCIATES

Source Reference: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2007.

Project Manager	Reviewed By	Date	
J.M.	D.C.	APRIL 2008	
Scale: AS SHOWN	Project Nº 13968-00	Report Nº 149	Drawing Nº figure 1.3

13968-00(149)GN-WA005 OCT 15/2008

TABLE I

Parameter	STORET No.	CAS No.
Bromodichloromethane	32101	75-27-4
Bromoform	32104	75-25-2
Bromomethane	34413	74-83-9
Carbon tetrachloride	32102	56-23-5
Chlorobenzene	34301	108-90-7
Chloroethane	34311	75-00-3
2-Chloroethylvinyl ether	34576	100-75-8
Chloroform	32106	67-66-3
Chloromethane	34418	74-87-3
Dibromochloromethane	32105	124-48-1
1,2-Dichlorobenzene	34536	95-50-1
1,3-Dichlorobenzene	34566	541-73-1
1,4-Dichlorobenzene	34571	106-46-7
Dichlorodifluoromethane	34668	75-71-8
1,1-Dichloroethane	34496	75-34-3
1,2-Dichloroethane	34531	107-06-2
1,1-Dichloroethene	34501	75-35-4
trans-1,2-Dichloroethene	34546	156-60-5
1,2-Dichloropropane	34541	78-87-5
cis-1,3-Dichloropropene	34704	10061-01-5
trans-1,3-Dichloropropene	34699	10061-02-6
Methylene chloride	34423	75-09-2
1,1,2,2-Tetrachloroethane	34516	79-34-5
Tetrachloroethene	34475	127-18-4
1,1,1-Trichloroethane	34506	71-55-6
1,1,2-Trichloroethane	34511	79-00- 5
Tetrachloroethene	39180	79-01-6
Trichlorofluoromethane	34488	75-69-4
Vinyl chloride	39715	75-01-4

Parameter	STORET No.	CAS No.
Benzene	34030	71-43-2
Chlorobenzene	34301	108-90-7
1,2-Dichlorobenzene	34536	95-50-1
1,3-Dichlorobenzene	34566	541-73-1
1,4-Dichlorobenzene	34571	106-46-7
Ethylbenzene	34371	100-41-4
Toluene	34010	108-88-3

APPENDIX B

AMBIENT AIR QUALITY MONITORING PLAN

Worldwide Facilities Group
Remediation Team

January 9, 2007 Reference No. 013968

Mr. Peter Ramanauskas
Project Manager for IND 0060306099
Waste, Pesticide and Toxins Division
U.S. EPA Region 5
77 West Jackson Blvd. (DW-8J)
Chicago, IL 60604-3590

Dear Mr. Ramanauskas:

Re: GM Powertrain – Bedford Facility, IND 006036099
Revised Request for East Plant Area AAQMP Modifications
GM Powertrain Group, Bedford Indiana Facility
Bedford, Indiana

Based on air monitoring results over the last few months and comments received from U.S. EPA via e-mail dated December 22, 2006 on our December 7, 2006 proposed revisions to the AAQMP, this letter proposes modifications to the Ambient Air Quality Monitoring Plan (AAQMP) (CRA, 2003), the revised AAQMP dated November 23, 2004, and the AAQMP modifications for approved East Plant Area Interim Measures (IM); the Over 50 mg/kg PCB Soil Removal (CRA, 2006), the Vault Design Report (CRA, 2006), and the Draft Cover System (CRA, 2006) (the AAQMP supports work defined in the United States Environmental Protection Agency (U.S. EPA) approved East Plant Area IM). PCB air monitoring results have been below the action level set forth in the AAQMP through October and November of 2006, and these results were obtained during excavation of >50 mg/kg PCB soils in the East Plant Area. The >50 mg/kg PCB excavations are now completed and remaining work will involve <50 mg/kg soils, which should create even less issues for air monitoring. Currently we are monitoring at seven paired locations, at a significant monthly cost for both the rental and management of the equipment, as well as the quick turn around laboratory analysis.

The objective of the AAQMP is to monitor the airborne concentrations of contaminants, if any, at locations in proximity to potential human receptors associated with the implementation of East Plant Area IM activities. Air quality data is utilized to modify work practices and controls where issues are identified. This letter is focused on proposed modifications to the AAQMP as it relates to the East Plant Area IM. The existing air-sampling program and the basis for the proposed modifications to the air-sampling program presented in this letter are described below.

Proposed changes to the AAQMP will be implemented as soon as practicable following approval by U.S. EPA.

•2000 Centerpoint Pkwy •Mail Code 483-520-190 • Pontiac, MI 48341-3147 • FAX (248) 753-5829

Should you have any questions regarding this request, please do not hesitate to contact me at (248) 753-5799.

Yours truly,

General Motors Corporation

Cheryl R. Hiatt
Project Manager

PG/cnb/81
Encl.

c.c.: Brad Stimple – U.S. EPA, OSC
Gerald O'Callaghan – IDEM
Ed Peterson – GM
Glenn Turchan - CRA
Jim McGuigan – CRA
Jeff Daniel – CRA
Katie Kamm – CRA
C.Y. Jeng – ENVIRON
Steve Song - ENVIRON

1.0 EXISTING AIR MONITORING PROGRAM

The Ambient Air Quality Monitoring Plan (AAQMP) provides air monitoring data to address the potential for the emission of levels of total suspended particulates (TSPs) and total polychlorinated biphenyls (PCBs) above action levels during soil excavation and material handling activities at the General Motors Corporation (GM) Powertrain, Bedford Indiana Facility (Facility). Air monitoring is currently conducted daily around the East Plant Area (Site) perimeter during excavation and material handling activities.

In accordance with the AAQMP, air monitoring is performed around the active work areas on a 24-hour basis. The air-monitoring program provides average concentrations in the ambient air for the selected compounds over each 24-hour period. Concentrations of TSPs and PCBs are determined by measuring the amount of TSPs/PCBs collected onto absorbent media, or filters, over the 24-hour period and measuring the volume of air collected over the same 24-hour period. Meteorological readings (i.e., temperature, humidity, and barometric pressure) are recorded daily from on-Site weather stations to correct and reduce (for reporting) the measured data to ambient conditions.

TSP/PCB samples are obtained from sampling locations positioned around active work areas. The current air monitoring station group set up at the perimeter of the East Plant Area (identified as Group 9) is comprised of seven pairs (one station for TSP sampling and one station for PCB sampling) plus one duplicate pair of stations for Quality Assurance/Quality Control (QA/QC). The existing locations of the monitoring stations comprising Group 9 are presented on Figure 1.1. These seven locations are re-located, as appropriate, as the active work area progresses.

1.1 TSP MONITORING PROGRAM

TSP sampling is completed at all seven stations in the East Plant Area on a daily basis during construction. Daily, one of the air monitoring stations in the group is established to represent the upwind location, based on average wind direction during the sampling event. The results of the upwind sample are compared to the downwind sample results to determine the concentration of dust that may be migrating downwind potentially attributable to on-Site construction activities.

The current ambient air criteria for a 24-hour sampling period are provided in Table E.3.2 of the AAQMP. The action level for TSPs is currently defined as 67% in excess of the upwind ambient air concentration, based on Indiana Department of Environmental Management (IDEM), Title 326, Article 6, Rule 4 of the Indiana Administrative Code.

The current high volume sampling method requires the monitoring station to run over a 24-hour period, at which time the media is removed and shipped to the analytical laboratory. The laboratory performs the analysis on a 24-hour turn-around time (TAT) and e-mails the preliminary TSP analytical results to the Site. Despite this accelerated schedule, the total elapsed time from the start of sample collection to data review is approximately three to four days.

Upon receipt, the TSP data is reviewed in relation to the weather data and work practices for the day the samples were collected to determine if modification to either the work practices or dust controls is warranted.

Results are periodically transmitted to U.S. EPA.

1.2 PCB MONITORING PROGRAM

Similarly to the TSP sample collection, PCB samples are collected daily at the seven monitoring stations in Group 9 and sent to the analytical laboratory for analysis on a 24-hour TAT basis. The total time from the start of sample collection to preliminary data (without validation) receipt is three to four days.

The current ambient air criteria for a 24-hour sampling period are provided in Table E.3.2 of the AAQMP (CRA, 2003). The action level for PCBs is based on National Institute for Occupational Safety and Health (NIOSH) level of 1 $\mu g/m^3$. This is the Permissible Exposure Limit (PEL). An evaluation of work area practice improvement (to reduce emissions) is initiated at a detected concentration in excess of 0.5 $\mu g/m^3$ PCBs.

Upon receipt, the PCB data is reviewed in relation to the weather data and work practices for the day the samples were collected to determine if modification to either the work practices or dust controls is warranted.

Results are routinely transmitted to U.S. EPA.

2.0 SUMMARY OF AIR MONITORING RESULTS

2.1 TSP MONITORING RESULTS

TSP air monitoring results collected for the duration of >50 mg/kg PCB material excavation and handling in the East Plant Area (May 19, 2006, to present) are presented in Table 2.1. These results were evaluated against the upwind concentration and the action level for TSP is expressed in these tables as Percent of Allowable, which is defined as 67% in excess of the upwind ambient air concentration.

As presented in Table 2.1, the majority of exceedances occurred at air monitoring Station 1B/1C.

2.2 PCB MONITORING RESULTS

Air monitoring results during construction activities of the Grading Areas and Vault liner prior to the movement of >50 mg/kg PCB soil had no PCB detections above the action limit (Table 2.2).

Based on the PCB air monitoring results collected between May 19, 2006, and November 15, 2006 (Table 2.3), there have been detections above the action level at the perimeter of >50 mg/kg PCB impacted soil excavation in the East Plant Area and during placement of the >50 mg/kg PCB soil into the Vault. These occurrences were transmitted to the U.S. EPA periodically as preliminary data became available and modifications to the work procedures were discussed with the U.S. EPA and implemented.

3.0 ASSESSMENT OF EXISTING DATA/CORRECTIVE ACTIONS

3.1 TSP RESULTS EVALUATION

3.1.1 ADDITIONAL DUST SUPPRESSION ACTIVITIES

Since the initial stages of the excavation and hauling activities at the Site, contractors have employed various additional and enhanced dust suppression techniques to minimize the amount of dust generated. These were actions taken in response to visual observations and TSP monitoring data. Additional dust suppression techniques being utilized include:

- monitoring weather conditions and forecasts (e.g., dry windy conditions, etc.);
- installing tire wash station for haul trucks leaving the staging pad area;
- replacing gravel entrances to work areas with larger size gravel;
- wetting on-Site haul roads;
- adjusting construction techniques;
- restricting vehicle and truck speed; and
- adjusting street sweeping activities for dry or wet weather.

There were considerably fewer exceedances in TSP results collected as a result of the utilization of additional dust suppression activities.

3.1.2 EVALUATION OF TSP CRITERIA

The current TSP criteria of 67% in excess of the upwind ambient air concentration does not provide a good representation of the actual mass of TSP being generated during the construction activities. For example, if the TSP concentration for the upwind station is low for that day, a small increase in TSP concentration in downwind stations will likely cause an exceedance. Conversely, if the TSP concentration in the upwind station is high, it will likely not cause any exceedance for the downwind stations. This creates a situation where you have lower particulate levels causing an exceedance on one day, where the same levels do not cause an exceedance on another day. As an illustration, data from fall 2006 is provided below and in Table 3.1.

On October 19, 2006, the upwind station is Station 1C with a relatively low TSP concentration of 0.0122 mg/m^3. As a result, a relatively low reading of 0.0308 mg/m^3 at Station 22B yielded an exceedance of 139%. In contrast, on September 19, 2006, the upwind station is Station 1C with a relatively high TSP concentration of 0.0882 mg/m^3 and as a result there were no exceedances from the downwind stations.

Although the current approach has been useful to guide the implementation of dust suppression techniques, project experience to date, and the limitations related to the impact of wind conditions on results and the timeframe required to obtain useable data warrant a revision to the ongoing AAQMP procedures.

3.1.3 REAL-TIME MONITORING VERSUS HIGH VOLUME SAMPLING

The current high volume sampling method requires a TAT of one day from the laboratory for the preliminary TSP results, and a total of three to four days from the date the sample collections is initiated. This TAT diminishes the relevance of this data in many instances, because as elevated dust levels are observed in the field, or measured, they are addressed and resolved immediately, regardless of the future receipt of TSP analytical results for that day.

Real-time air monitoring units (handheld or stationary) can provide real time, or averaged TSP concentration measurements, which will allow GM and the Project Team to address and resolve any elevated dust issues immediately.

3.2 PCB RESULTS EVALUATION

Previous Site experience has been that dust control practices were also effective for controlling PCBs in the air. Control practices at the onset of work in the East Plant Area included:

- monitoring weather conditions and forecasts (e.g., dry windy conditions, etc.);
- installing tire wash station for haul trucks leaving the staging pad area;
- replacing gravel entrances to work areas with larger size gravel;
- wetting on-Site haul roads;
- adjusting construction techniques;
- restricting vehicle and truck speed; and
- adjusting street sweeping activities for dry or wet weather.

Air sampling of the East Plant Area during placement of <50 mg/kg PCB material in the Grading Areas and construction of the vault liner (June 2005 through April 2006) did not have any results above the PCB action limit. As work in the East Plant Area with >50 mg/kg PCB material progressed, additional controls and soil management strategies were put in place:

- mulching exposed >50 mg/kg PCB areas including the Vault, excavations and stockpiles throughout the day when use of area is no longer required;
- tarping exposed areas that will not be used for extended periods;
- eliminating casting of material (which was a time saving method) toward the dozer and instead placing soil gently to reduce soil disturbance;
- repositioning of the vault dumping ramp to the southeast corner of the vault, further from receptor locations to the north;

- adjustments to the mulch 'recipe' and quantity of mulch applied; and
- 12-hour sampling tests to better understand the source of PCBs in the air.

It is believed that a portion of the PCB detected in the air may have been volatile PCBs due to the warm summer temperatures and the higher level of concentrations of >50 mg/kg PCBs found in the open excavations and stock piles of the East Plant Area. The detections of PCBs above the stop-work action limit (both work evaluation and stop work limits) have dropped to nil with the onset of cooler fall weather and reduction of soil removal and Vault placement activities (As presented in Table 2.3 from September 15, 2006 to present). It should be noted that the completion of >50 mg/kg PCB excavation and placement into the Vault is now substantially complete. Backfilling of >50 mg/kg PCB excavations and interim capping of the Vault is ongoing. The combination of these factors will serve to further reduce ambient air PCB concentrations.

4.0 PROPOSED MODIFICATION TO THE AAQMP

4.1 PROPOSED TSP MONITORING MODIFICATION

GM is proposing to replace the current high volume sampling method with real-time air monitoring for TSP at the perimeter of the Site for the remainder of the East Plant Area IM. This proposed modification is based on project experience, the dust suppression activities successfully employed to date, direct observation, real-time monitoring, and over two years of laboratory TSP monitoring results. It should also be noted that real-time monitoring is also currently being conducted within work areas by the contractors, as part of the contractors' Site health and safety programs.

The revised AAQMP will include:

- Daily real-time monitoring to be performed during any material handling activities which may potentially create airborne particulates. The real-time monitoring stations will be located between the work areas and nearest human receptors at the perimeter of the Site where Stations 1C, 14, 22B, 23, and 29, are currently found. The Contractor TSP "real-time" program will also remain in effect.
- The action level will be set at 67% above the background level. The cause of the fugitive dust will be investigated in case of any exceedance. To the extent the fugitive dust is a result of work activities, abatement actions will be taken to mitigate the potential release of TSP emissions.
- The revised approach presented above is consistent with the TSP data collected to date, the approach utilized at other project sites, and the construction activities being conducted as part of the IM and GM Powertrain Bedford Facility Removal Action (RA). Proposed TSP monitoring locations are presented on Figure 4.1.

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4.2 PROPOSED PCB MONITORING MODIFICATION

A modification to the AAQMP consisting of reductions to the air monitoring for PCBs for the remainder of the East Plant Area IM is proposed based upon project experience to date. This proposed modification is based on the validated analytical results obtained from June 2005 to the present. Work practice modifications/controls and cooler temperatures have resulted in a significant decrease in detected concentrations. Also, experience in handling <50 mg/kg PCB material within the East Plant Area, and in Upstream and Downstream work areas, has demonstrated that when working with materials with lower PCB concentrations (e.g., <50 mg/kg) dust suppression techniques employed at the Site are effective at keeping PCB detections below the action level.

The revised AAQMP will include:

PCB air monitoring will be conducted at Stations 1C and 31 whenever actively disposing remaining >50 ppm material in the vault or otherwise disturbing contaminated soils in the vault until the interim/final cover is in place.

- In addition to the air monitoring noted above, Stations 1C, 22B, 23, 29, and 31 will be run at least 3 days per week when actively managing <50 ppm impacted soil materials. At least 3 samples per week will be analyzed for PCBs from the downwind monitor(s). Upon receipt of analytical data indicating a monitoring station has a detection above 1 $\mu g/m^3$ PCBs or the 0.5 $\mu g/m^3$ PCBs work area practice improvement level (action limits), we will evaluate the work area practices and make proper modifications to reduce emissions. Monitoring at the same location (or a new downwind location, if the wind direction has changed) will take place the day following receipt of the data in excess of the action limits to ensure reduction of airborne PCBs.
- Duplicate QA/QC stations will not be run. The laboratory QA/QC will remain unchanged.

Proposed PCB monitoring locations are presented on Figure 4.2.

5.0 REFERENCES

CRA, 2003, Upstream Parcel Removal Action Work Plan;

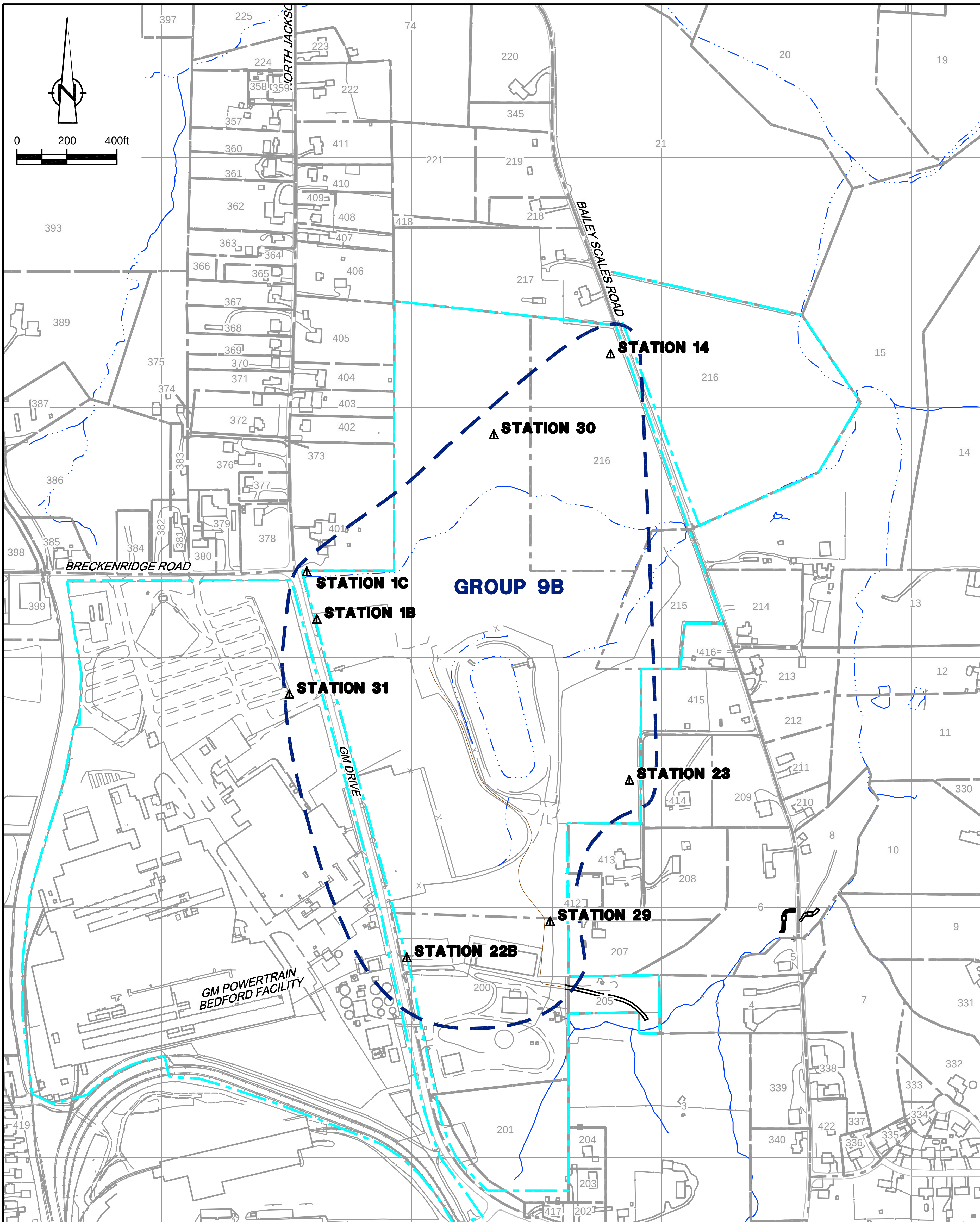
CRA, Final Proposed Modification to the AAQMP, letter to U.S. EPA, November 23, 2004;

CRA, Proposed Modification to the Ambient Air Quality Monitoring Plan, March 9, 2006;

CRA, East Plant Area Vault Design Report, June 16, 2006;

CRA, East Plant Area Over 50 mg/kg PCB Soil Removal, May 26, 2006; and

CRA, Draft East Plant Area Cover System, August 3, 2006.



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

NOTES: 1) PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES.

2) STATION 1C REPLACES STATION 1B, JUNE 2006.

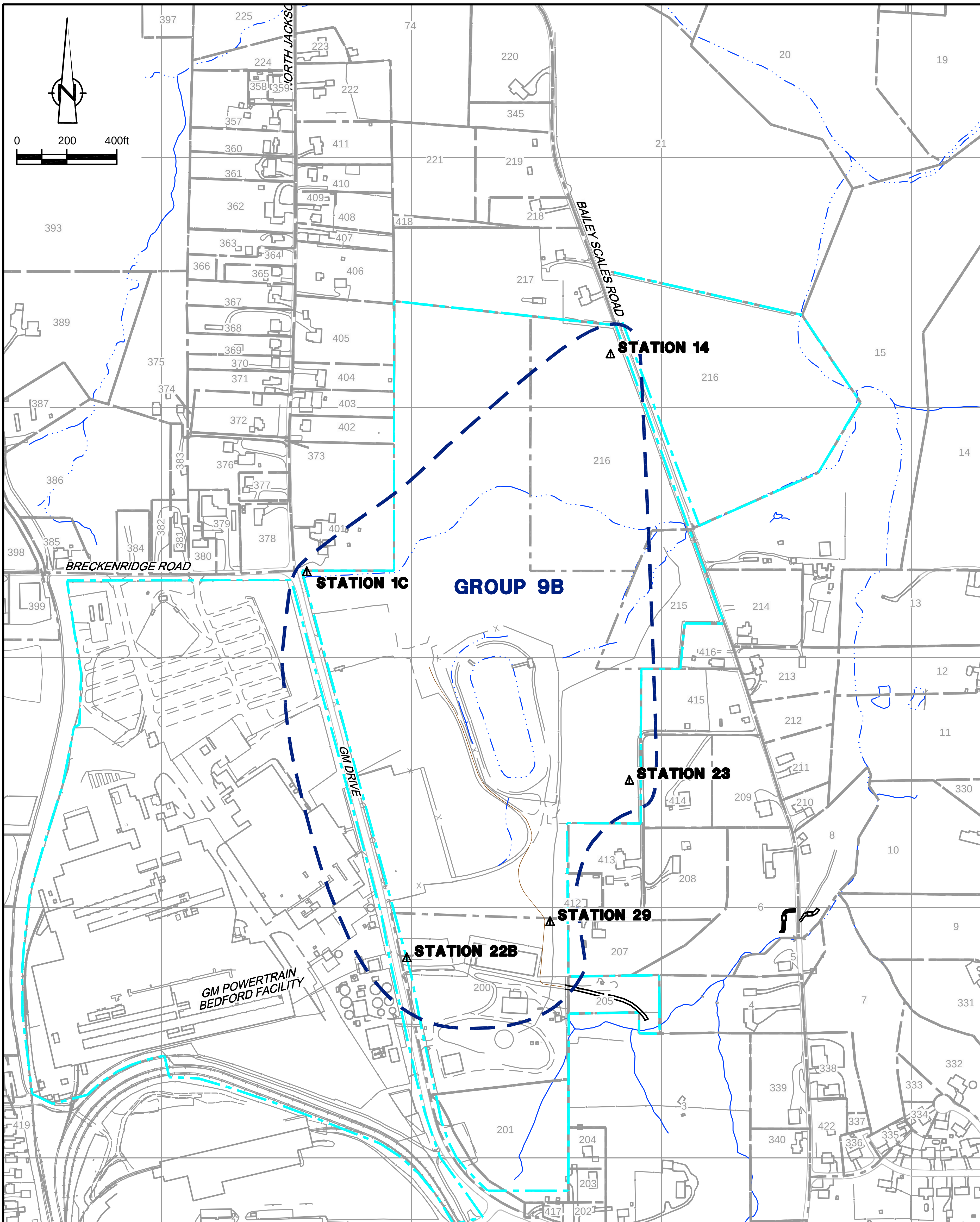
LEGEND

- EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE PARCEL BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- STATION 3 AIR SAMPLING LOCATION
- AIR SAMPLING GROUP

figure 1.1

AIR MONITORING STATIONS - GROUP 9B
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(RAMA081)GN-WA001 JAN 09/2007



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

NOTES: 1) PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES.

2) STATION 1C REPLACES STATION 1B, JUNE 2006.

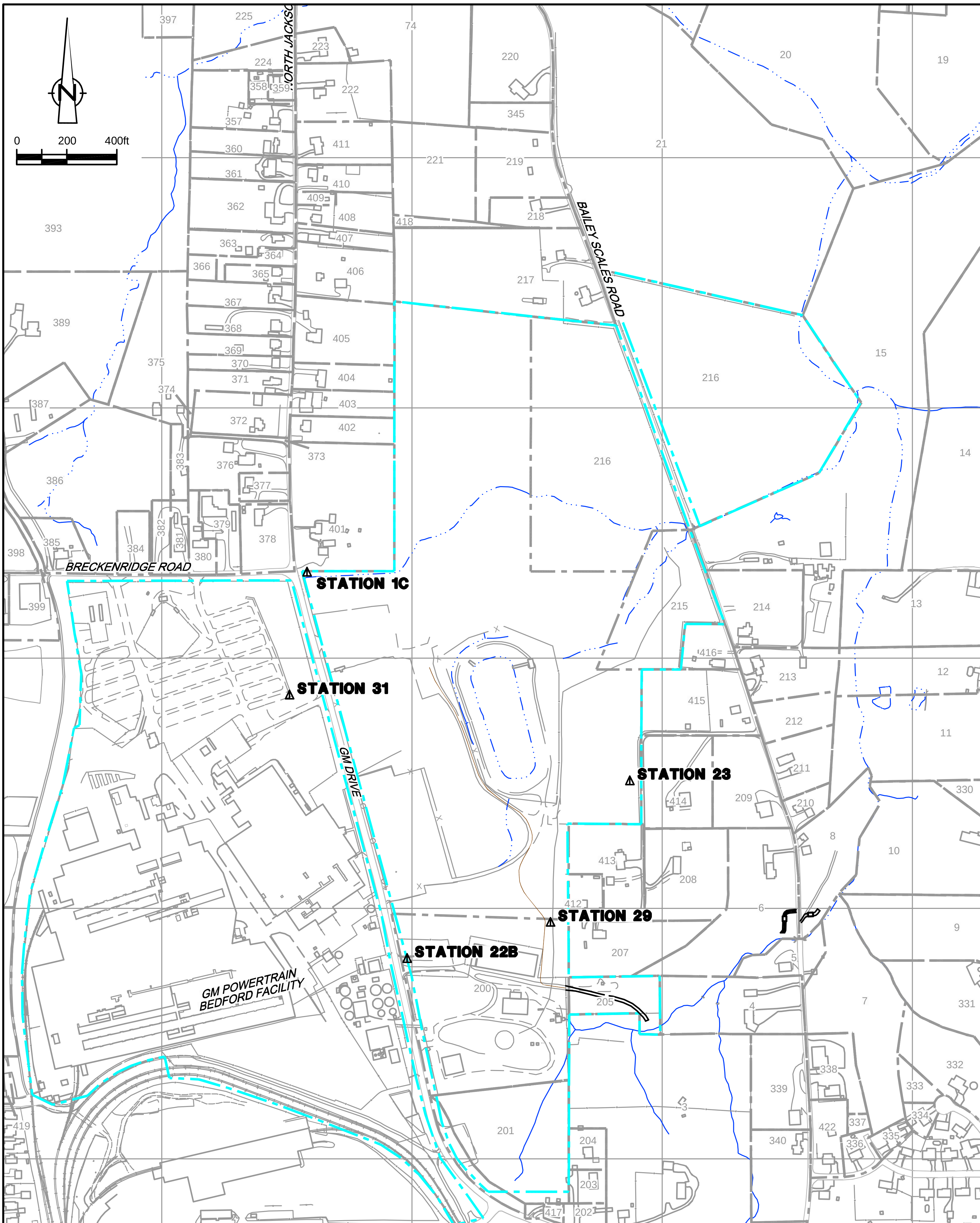
LEGEND

- EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE PARCEL BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- STATION 1C AIR SAMPLING LOCATION
- AIR SAMPLING GROUP

figure 4.1

PROPOSED TSP MONITORING LOCATION
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(RAMA081)GN-WA002 JAN 09/2007



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001.

NOTES: 1) PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. LOCATIONS MAY NOT ACCURATELY REPRESENT THE TRUE BOUNDARIES.

2) STATION 1C REPLACES STATION 1B, JUNE 2006.

LEGEND

- EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- EXISTING VEGETATION
- EXISTING BUILDINGS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- APPROXIMATE SURFACE WATER LOCATION
- APPROXIMATE PARCEL BOUNDARY
- APPROXIMATE GM PROPERTY BOUNDARY
- STATION 1C AIR SAMPLING LOCATION

figure 4.2

PROPOSED PCB MONITORING LOCATIONS
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(RAMA081)GN-WA003 JAN 09/2007

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
5/19/2006							
Total Volume(m3)	954	NR (NR)	1437	954	1509	87	1428
Average Flow(m3/min)	0.58	NR (NR)	0.87	0.61	0.89	*	1.31
TSP Concentration(mg/m3)	0.0869	NR (NR)	0.0711	0.0611	0.0528	*	0.0401
Percent of Allowable(%)	--	NR (NR)	--	--	--	*	--
5/22/2006							
Total Volume(m3)	927	1256 (1268)	1339	776	1418	987	1812
Average Flow(m3/min)	0.61	0.9 (0.91)	0.89	0.56	0.9	0.73	1.2
TSP Concentration(mg/m3)	0.0548	0.0589 (0.0676)	0.0624	0.0684	0.0461	0.0428	0.0413
Percent of Allowable(%)	49	UPWIND (UPWIND)	55	61	41	38	37
5/23/2006							
Total Volume(m3)	935	1389 (1402)	1279	974	1295	1135	1863
Average Flow(m3/min)	0.68	0.92 (0.93)	0.93	0.66	0.96	0.76	1.34
TSP Concentration(mg/m3)	0.0718	0.0551 (0.0524)	0.0686 J	0.0496 J	0.0643 J	0.08	0.0691
Percent of Allowable(%)	67	51 (49)	64	46	UPWIND	75	64
5/24/2006							
Total Volume(m3)	1780	1237 (1334)	2110	960	1511	1034	1940
Average Flow(m3/min)	1.14	0.9 (0.97)	1.38	0.71	0.93	0.73	1.26
TSP Concentration(mg/m3)	0.1049	0.0721 (0.0643)	0.0499	0.0608	0.0719	0.0734	0.042
Percent of Allowable(%)	126	87 (77)	UPWIND	73	86	88	50
5/25/2006							
Total Volume(m3)	1410	1193 (1315)	1560	843	1230	968	416
Average Flow(m3/min)	1.1	0.87 (0.96)	1.29	0.62	0.94	0.71	*
TSP Concentration(mg/m3)	0.0799	0.0581 (0.0637)	0.0576	0.0706	0.0711	0.0799	*
Percent of Allowable(%)	83	60 (66)	UPWIND	73	74	83	*
5/30/2006							
Total Volume(m3)	1588	1380 (1454)	2084	851	1328	1017	1242
Average Flow(m3/min)	1.08	0.95 (1)	1.33	0.59	0.9	0.69	0.84
TSP Concentration(mg/m3)	0.0773	0.0638 (0.0587)	0.0436	0.0766	0.1047	0.0572	0.074
Percent of Allowable(%)	44	36 (34)	25	44	UPWIND	33	42
5/31/2006							
Total Volume(m3)	1615	1441 (1411)	1852	728	1370	1066	1191
Average Flow(m3/min)	1.12	0.97 (0.95)	1.37	0.5	0.94	0.72	0.82
TSP Concentration(mg/m3)	0.0695	0.0713 (0.0629)	0.0454	0.1059	0.1214	0.0655	0.0765
Percent of Allowable(%)	34	35 (31)	22	52	UPWIND	32	38
6/1/2006							
Total Volume(m3)	1596	1358 (1329)	1939	707	1199	1140	1280
Average Flow(m3/min)	1.11	0.97 (0.95)	1.36	0.5	0.82	0.81	0.9
TSP Concentration(mg/m3)	0.0493	0.0644 (0.0709)	0.0464	0.1184	0.1261	0.0611	0.0406
Percent of Allowable(%)	42	UPWIND (UPWIND)	39	100	107	52	34

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
6/2/2006							
Total Volume(m3)	1647	1440 (1380)	1956	895	1284	1270	1350
Average Flow(m3/min)	1.11	0.98 (0.94)	1.34	0.61	0.84	0.86	0.91
TSP Concentration(mg/m3)	0.0326	0.0572 (0.0609)	0.0451	0.0555	0.0379	0.0404	0.0376
Percent of Allowable(%)	32	UPWIND (UPWIND)	44	55	37	40	37
6/5/2006							
Total Volume(m3)	1566	1362 (1405)	2018	1282	956	1089	1355
Average Flow(m3/min)	1.08	0.93 (0.96)	1.38	0.89	0.65	0.74	0.93
TSP Concentration(mg/m3)	0.0321	0.0566 (0.0547)	0.0538	0.0333	0.0521	0.0667	0.0637
Percent of Allowable(%)	35	UPWIND (UPWIND)	59	36	57	73	70
6/6/2006							
Total Volume(m3)	1617	1546 (1454)	1994	1006	1244	1192	1216
Average Flow(m3/min)	1.08	1.01 (0.95)	1.36	0.67	0.86	0.85	0.86
TSP Concentration(mg/m3)	0.1007	0.0752 (0.0803)	0.0699	0.0678	0.0714	0.0868	0.0799
Percent of Allowable(%)	84	63 (67)	59	57	UPWIND	73	67
6/7/2006							
Total Volume(m3)	1523	1334 (1293)	1916	830	1152	1249	467
Average Flow(m3/min)	1.11	0.96 (0.93)	1.35	0.61	0.78	0.82	*
TSP Concentration(mg/m3)	0.0486	0.041 (0.0444)	0.0501	0.0752	0.0408	0.0484	*
Percent of Allowable(%)	71	60 (65)	74	110	UPWIND	71	*
6/8/2006							
Total Volume(m3)	1302	1322 (1343)	1382	891	1363	513	1210
Average Flow(m3/min)	0.89	0.97 (0.98)	0.95	0.67	0.87	*	0.82
TSP Concentration(mg/m3)	0.047	0.0578 (0.0517)	0.0517	0.0569	0.0426	*	0.095
Percent of Allowable(%)	54	UPWIND (UPWIND)	60	66	49	*	110
6/9/2006							
Total Volume(m3)	1171	1373 (1279)	1293	1154	1224	1145	1288
Average Flow(m3/min)	0.84	0.97 (0.91)	0.93	0.83	0.86	0.81	0.92
TSP Concentration(mg/m3)	0.0681	0.0597 (0.069)	0.0681	0.0378	0.0391	0.0561	0.0638
Percent of Allowable(%)	59	UPWIND (UPWIND)	59	33	34	49	55
6/10/2006							
Total Volume(m3)	522	583 (572)	501	362	468	292	509
Average Flow(m3/min)	*	* (*)	*	*	*	*	*
TSP Concentration(mg/m3)	*	* (*)	*	*	*	*	*
Percent of Allowable(%)	*	* (*)	*	*	*	*	*
6/12/2006							
Total Volume(m3)	1337	1494 (1377)	1379	1168	1218	4	1254
Average Flow(m3/min)	0.81	1.02 (0.94)	0.89	0.67	0.71	*	0.81
TSP Concentration(mg/m3)	0.0462	0.0386 (0.0415)	0.0616	0.0566	0.0345	*	0.0949
Percent of Allowable(%)	67	UPWIND (UPWIND)	89	82	50	*	137

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
6/13/2006							
Total Volume(m3)	1042	1397 (1426)	1278	919	981	957	1221
Average Flow(m3/min)	0.84	0.92 (0.94)	0.94	0.74	0.84	0.86	0.88
TSP Concentration(mg/m3)	0.0647	0.0278 (0.0426)	0.0738	0.0631	0.0382	0.0404	0.1496
Percent of Allowable(%)	91	UPWIND (UPWIND)	104	89	54	57	210
6/14/2006							
Total Volume(m3)	1110	1210 (1249)	1238	803	1352	1155	1157
Average Flow(m3/min)	0.84	0.89 (0.92)	0.92	0.6	0.92	0.82	0.86
TSP Concentration(mg/m3)	0.0841	0.0534 (0.0589)	0.1083	0.074	0.0564	0.0624	0.0978
Percent of Allowable(%)	85	UPWIND (UPWIND)	110	75	57	63	99
6/15/2006							
Total Volume(m3)	1313	1298 (1314)	1411	286	1348	1160	1184
Average Flow(m3/min)	0.89	0.9 (0.91)	0.92	*	0.92	0.81	0.81
TSP Concentration(mg/m3)	0.2136	0.0994 (0.1002)	0.079	*	0.0763	0.0734	0.1497
Percent of Allowable(%)	168	78 (79)	62	*	UPWIND	58	117
6/16/2006							
Total Volume(m3)	1175	1276 (1318)	1236	13	1318	1153	1139
Average Flow(m3/min)	0.84	0.9 (0.93)	0.92	*	0.92	0.81	0.81
TSP Concentration(mg/m3)	0.2638	0.0731 (0.0774)	0.0725	*	0.0519	0.0709	0.1169
Percent of Allowable(%)	304	84 (89)	84	*	UPWIND	82	135
6/17/2006							
Total Volume(m3)	1359	1431 (1430)	1490		1525	1286	1311
Average Flow(m3/min)	0.83	0.91 (0.91)	0.91		0.91	0.81	0.8
TSP Concentration(mg/m3)	0.177	0.0348 (0.0518)	0.0626		0.056	0.0868	0.0629
Percent of Allowable(%)	169	33 (50)	UPWIND		54	83	60
6/19/2006							
Total Volume(m3)	1114	1194 (1222)	1331	1256	1250	1097	1218
Average Flow(m3/min)	0.8	0.84 (0.86)	0.95	0.92	0.88	0.77	0.87
TSP Concentration(mg/m3)	0.123	0.0456 (0.0459)	0.0609	0.0498	0.055	0.0549	0.0491
Percent of Allowable(%)	121	45 (45)	UPWIND	49	54	54	48
6/20/2006							
Total Volume(m3)	NR	1283 (1293)	1621	1343	1323	1176	1182
Average Flow(m3/min)	NR	0.88 (0.89)	0.96	0.96	0.91	0.8	0.82
TSP Concentration(mg/m3)	NR	0.0536 (0.0561)	0.0835	0.0572	0.0661	0.0571	0.062
Percent of Allowable(%)	NR	38 (40)	UPWIND	41	47	41	44

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
6/21/2006							
Total Volume(m3)	742	1248 (1278)	1342	1340	1486	1158	1158
Average Flow(m3/min)	0.66	0.88 (0.9)	0.97	0.95	0.9	0.8	0.79
TSP Concentration(mg/m3)	0.1716	0.0772 (0.0864)	0.084	0.0726	0.123	0.0959	0.0129
Percent of Allowable(%)	122	55 (62)	UPWIND	52	88	68	9
6/22/2006							
Total Volume(m3)	1154	1335 (1278)	1435	1309	1376	1174	1120
Average Flow(m3/min)	0.81	0.93 (0.89)	0.96	0.93	0.91	0.81	0.78
TSP Concentration(mg/m3)	0.0939	0.0553 (0.0667)	0.0617	0.0731	0.062	0.0575	0.0646
Percent of Allowable(%)	91	54 (65)	UPWIND	71	60	56	63
6/23/2006							
Total Volume(m3)	1249	1395 (1392)	1151	586	1048	1260	1120
Average Flow(m3/min)	0.91	0.97 (0.97)	0.97	*	0.9	0.87	0.82
TSP Concentration(mg/m3)	0.0392	0.0338 (0.0409)	0.0602	*	0.0344	0.0209	0.0739
Percent of Allowable(%)	57	UPWIND (UPWIND)	88	*	50	31	108
6/24/2006							
Total Volume(m3)	1093	1272 (1362)	1361	0	1297	1238	1274
Average Flow(m3/min)	0.77	0.87 (0.93)	0.97	*	0.9	0.86	0.89
TSP Concentration(mg/m3)	0.0554	0.0616 (0.0599)	0.0699	*	0.0465	0.0426	0.0827
Percent of Allowable(%)	55	UPWIND (UPWIND)	70	*	46	43	83
6/26/2006							
Total Volume(m3)	1044	1243 (1256)	1302		1131	1223	1159
Average Flow(m3/min)	0.78	0.85 (0.86)	0.93		0.86	0.83	0.86
TSP Concentration(mg/m3)	0.0839	0.0507 (0.0515)	0.0624		0.0579	0.038	0.0728
Percent of Allowable(%)	87	52 (53)	65		UPWIND	39	75
6/27/2006							
Total Volume(m3)	1192	1332 (1332)	1350		1358	1226	1199
Average Flow(m3/min)	0.83	0.92 (0.92)	0.97		0.94	0.86	0.83
TSP Concentration(mg/m3)	0.1694	0.0572 (0.0589)	0.1087		0.0703	0.0484	0.0622
Percent of Allowable(%)	163	55 (57)	105		68	47	UPWIND
6/28/2006							
Total Volume(m3)	1189	1357 (1355)	1402	1110	1259	1265	1194
Average Flow(m3/min)	0.83	0.92 (0.92)	0.97	0.92	0.87	0.86	0.83
TSP Concentration(mg/m3)	0.1779	0.0474 (0.0496)	0.0904	0.0803	0.0901	0.045	0.0614
Percent of Allowable(%)	118	31 (33)	UPWIND	53	60	30	41
6/29/2006							
Total Volume(m3)	1191	1406 (1377)	1319	1283	1392	1258	1198
Average Flow(m3/min)	0.83	0.92 (0.9)	0.91	0.92	0.96	0.87	0.85
TSP Concentration(mg/m3)	0.1082	0.0546 (0.0606)	0.1029	0.0686	0.0545	0.0417	0.0908
Percent of Allowable(%)	107	UPWIND (UPWIND)	102	68	54	41	90

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C* *TSP-12*	*STATION 14* *TSP-11 (TSP-5)*	*STATION 22B* *TSP-9*	*STATION 23* *TSP-3*	*STATION 29* *TSP-8*	*STATION 30* *TSP-1*	*STATION 31* *TSP-16*
6/30/2006							
Total Volume(m3)	1500	1332 (1363)	1541	1437	1581	1359	1405
Average Flow(m3/min)	0.88	0.9 (0.92)	0.91	0.92	0.9	0.87	0.83
TSP Concentration(mg/m3)	0.1177	0.0637 (0.0643)	0.0857	0.0588	0.0662	0.0699	0.0806
Percent of Allowable(%)	82	45 (45)	UPWIND	41	46	49	56
7/3/2006							
Total Volume(m3)	1293	1799 (1663)	1392	1721	1407	3	1314
Average Flow(m3/min)	0.8	0.97 (0.96)	0.87	1	0.85	*	0.82
TSP Concentration(mg/m3)	0.1259	0.0565 (0.0384)	0.0815	0.0679	0.0828	*	0.0744
Percent of Allowable(%)	93	42 (28)	UPWIND	50	61	*	55
7/5/2006							
Total Volume(m3)	919	1565 (1290)	1137	1507	1264	4	1106
Average Flow(m3/min)	0.72	1.08 (0.89)	0.88	1.06	0.91	*	0.85
TSP Concentration(mg/m3)	0.069	0.0231 (0.0505)	0.0898	0.05	0.0305	*	0.0841
Percent of Allowable(%)	82	UPWIND (UPWIND)	106	59	36	*	100
7/6/2006							
Total Volume(m3)	1241	1623 (1448)	1437	1554	1384	1248	1231
Average Flow(m3/min)	0.81	1.09 (0.97)	0.92	1.07	0.96	0.96	0.84
TSP Concentration(mg/m3)	0.0493	0.0404 (0.0484)	0.0869	0.0244	0.0516	0.027	0.1094
Percent of Allowable(%)	61	UPWIND (UPWIND)	108	30	64	33	135
7/7/2006							
Total Volume(m3)	1040	1550 (1294)	1252	1458	1341	1165	1154
Average Flow(m3/min)	0.8	1.09 (0.91)	0.92	1.02	0.97	0.82	0.89
TSP Concentration(mg/m3)	0.0312	0.0344 (0.0457)	0.16	0.0396	0.0257	0.0489	0.0764
Percent of Allowable(%)	41	UPWIND (UPWIND)	210	52	34	64	100
7/8/2006							
Total Volume(m3)	1256	1763 (1424)	1427	1391	1456	1228	1316
Average Flow(m3/min)	0.8	1.15 (0.93)	0.95	0.95	0.95	0.81	0.83
TSP Concentration(mg/m3)	0.1763 J	0.04 J (0.0581 J)	0.0672 J	0.0597 J	0.0442 J	0.0628 J	0.1065 J
Percent of Allowable(%)	239	54 (79)	91	81	UPWIND	85	144
7/10/2006							
Total Volume(m3)	997	1366 (1324)	1227	1174	1283	1098	1174
Average Flow(m3/min)	0.7	0.95 (0.92)	0.86	0.84	0.89	0.77	0.82
TSP Concentration(mg/m3)	0.1099	0.0592 (0.0514)	0.0769	0.0575	0.0627	0.0805	0.0721
Percent of Allowable(%)	86	46 (40)	UPWIND	45	49	63	56
7/17/2006							
Total Volume(m3)	1088	1401 (1312)	1237	1196	1269	17	1205
Average Flow(m3/min)	0.75	0.97 (0.91)	0.86	0.83	0.87	*	0.82
TSP Concentration(mg/m3)	0.0867	0.0594 (0.0607)	0.084	0.0735	0.0735	*	0.0841
Percent of Allowable(%)	62	42 (43)	UPWIND	52	52	*	60

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C* *TSP-12*	*STATION 14* *TSP-11 (TSP-5)*	*STATION 22B* *TSP-9*	*STATION 23* *TSP-3*	*STATION 29* *TSP-8*	*STATION 30* *TSP-1*	*STATION 31* *TSP-16*
7/18/2006							
Total Volume(m3)	1106	436 (457)	1130	1365	1292	792	1150
Average Flow(m3/min)	0.78	* (*)	0.8	0.98	0.9	0.78	0.8
TSP Concentration(mg/m3)	0.0023	* (*)	0.1603	0.076	0.0685	0.09	0.1131
Percent of Allowable(%)	4	* (*)	298	141	127	167	210
7/19/2006							
Total Volume(m3)	NR	1436 (NR)	1240	1389	1335	1174	1178
Average Flow(m3/min)	NR	0.97 (NR)	0.85	0.96	0.9	0.8	0.8
TSP Concentration(mg/m3)	NR	0.0841 (NR)	0.105	0.0896	0.0866	0.0958	0.153
Percent of Allowable(%)	NR	58 (NR)	73	62	UPWIND	66	106
7/20/2006							
Total Volume(m3)	1178	1194 (1291)	1267	1064	1442	1109	1134
Average Flow(m3/min)	0.8	0.86 (0.93)	0.83	0.79	0.92	0.8	0.78
TSP Concentration(mg/m3)	0.0789	0.0729 (0.0649)	0.0997	0.0914	0.0716	0.0814	0.0802
Percent of Allowable(%)	66	61 (54)	83	76	UPWIND	68	67
7/21/2006							
Total Volume(m3)	1124	1182 (1304)	1164		1238	1094	1259
Average Flow(m3/min)	0.83	0.86 (0.95)	0.86		0.9	0.8	0.93
TSP Concentration(mg/m3)	0.052	0.057 (0.0518)	0.0519		0.0536	0.0512	0.0237
Percent of Allowable(%)	60	UPWIND (UPWIND)	60		62	59	27
7/22/2006							
Total Volume(m3)	1662	1411 (1634)			1582	1408	1518
Average Flow(m3/min)	0.95	0.83 (0.96)			0.91	0.81	0.86
TSP Concentration(mg/m3)	0.0278	0.0322 (0.0204)			0.0273	0.0276	0.0295
Percent of Allowable(%)	82	UPWIND (UPWIND)			80	81	87
7/24/2006							
Total Volume(m3)	1125	1108 (1172)	1073		1314	1132	1138
Average Flow(m3/min)	0.84	0.87 (0.92)	0.79		0.95	0.92	0.85
TSP Concentration(mg/m3)	0.0421	0.0562 (0.0529)	0.077		0.0644	0.0107	0.0773
Percent of Allowable(%)	39	52 (49)	72		UPWIND	10	72
7/25/2006							
Total Volume(m3)	1289	1312 (1324)	1235	1067	1428	1268	1251
Average Flow(m3/min)	0.88	0.86 (0.95)	0.84	0.79	0.96	0.92	0.85
TSP Concentration(mg/m3)	0.0874	0.0723 (0.0725)	0.1161	0.0991	0.0884	0.0677	0.0845
Percent of Allowable(%)	45	37 (37)	UPWIND	51	46	35	44
7/26/2006							
Total Volume(m3)	1291	1300 (1383)	1241	1108	1452	1348	1228
Average Flow(m3/min)	0.87	0.88 (0.93)	0.82	0.78	0.94	0.91	0.82
TSP Concentration(mg/m3)	0.0787	0.0771 (0.0645)	0.0943	0.0702		0.1115	0.082
Percent of Allowable(%)	50	49 (41)	UPWIND	45		71	52

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
7/28/2006							
Total Volume(m3)	1057	1223 (1371)	495	1186	1063	1282	1177
Average Flow(m3/min)	0.75	0.84 (0.94)	0.35	0.83	0.74	0.89	0.83
TSP Concentration(mg/m3)	0.0702	0.0459 (0.0441)	0.0923	0.0617	0.0685	0.0542	0.039
Percent of Allowable(%)	46	30 (29)	UPWIND	40	44	35	25
7/29/2006							
Total Volume(m3)	1276	1226 (1477)	1187	1150	1144	1357	1143
Average Flow(m3/min)	0.88	0.84 (1.01)	0.81	0.81	0.77	0.94	0.78
TSP Concentration(mg/m3)	0.0614	0.0662 (0.0538)	0.093	0.0863	0.0853	0.0629	0.073
Percent of Allowable(%)	40	43 (35)	UPWIND	56	55	40	47
7/31/2006							
Total Volume(m3)	1218	1363 (1739)	1320	1195	1172	1271	1255
Average Flow(m3/min)	0.88	0.98 (1.25)	0.94	0.88	0.82	0.92	0.9
TSP Concentration(mg/m3)	0.0632	0.0836 (ND(0.0006))	0.0735	0.0837	0.0708	0.0488	0.059
Percent of Allowable(%)	53	71 ()	62	71	UPWIND	41	50
8/1/2006							
Total Volume(m3)	1342	1504 (1824)	1329	1189	1192	1307	1147
Average Flow(m3/min)	0.92	1.02 (1.24)	0.92	0.84	0.8	0.9	0.78
TSP Concentration(mg/m3)	0.0537	0.0592 (0.0471)	0.0895	0.0732	0.0956	0.0765	0.0802
Percent of Allowable(%)	36	40 (32)	UPWIND	49	64	51	54
8/2/2006							
Total Volume(m3)	1269	1501 (1812)	1393	1214	1039	1292	1177
Average Flow(m3/min)	0.88	1.02 (1.23)	0.94	0.84	0.71	0.9	0.81
TSP Concentration(mg/m3)	0.0749	0.0546 (0.0375)	0.0818	0.0774	0.0982	0.0766	0.0663
Percent of Allowable(%)	55	40 (27)	UPWIND	57	72	56	49
8/3/2006							
Total Volume(m3)	1143	1489 (1793)	1227	1375	1116	1117	1052
Average Flow(m3/min)	0.79	1.02 (1.23)	0.85	0.95	0.77	0.78	0.77
TSP Concentration(mg/m3)	0.0744	0.0564 (0.048)	0.1108	0.0916	0.1918	0.0734	0.0846
Percent of Allowable(%)	40	30 (26)	UPWIND	50	104	40	46
8/4/2006							
Total Volume(m3)	1269	1321 (1590)	1326	1243	1192	1167	1146
Average Flow(m3/min)	0.89	1.03 (1.24)	0.91	0.87	0.81	0.84	0.8
TSP Concentration(mg/m3)	0.0244	0.0341 J (0.0176 J)	0.0762	0.0378	0.0394	0.0171	0.0672
Percent of Allowable(%)	83	UPWIND (UPWIND)	259	129	134	58	229
8/5/2006							
Total Volume(m3)	1432	1632 (1950)	1595	1301	1180	1305	1262
Average Flow(m3/min)	0.88	1.03 (1.23)	0.96	0.83	0.7	0.82	0.77
TSP Concentration(mg/m3)	0.0377	0.0423 J (0.0231 J)	0.0571	0.0523	0.061	0.0743	0.1577
Percent of Allowable(%)	98	UPWIND (UPWIND)	148	136	158	193	409

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
8/7/2006							
Total Volume(m3)	1250	1430 (1747)	1353	1217	990	1045	1180
Average Flow(m3/min)	0.86	0.99 (1.21)	0.91	0.86	0.66	0.72	0.8
TSP Concentration(mg/m3)	0.064	0.0552 (0.0361)	0.0739	0.0871	0.1253	0.0612	0.072
Percent of Allowable(%)	106	UPWIND (UPWIND)	123	144	208	102	119
8/8/2006							
Total Volume(m3)	886	1213 (1429)	1074	773	770	908	1042
Average Flow(m3/min)	0.74	1.01 (1.19)	0.89	0.71	0.63	0.76	0.87
TSP Concentration(mg/m3)	0.0429	0.0322 (0.0301)	0.0615	0.0414	0.0429	0.0385	0.0345
Percent of Allowable(%)	85	UPWIND (UPWIND)	122	82	85	77	69
8/10/2006							
Total Volume(m3)	1126	1329 (1302)	1365	1175	899	1132	1089
Average Flow(m3/min)	0.8	0.96 (0.94)	1.03	0.86	0.67	0.82	0.81
TSP Concentration(mg/m3)	0.0533	0.0346 (0.0399)	0.0498	0.0451	0.0356	0.0362	0.0505
Percent of Allowable(%)	80	UPWIND (UPWIND)	75	68	53	54	76
8/11/2006							
Total Volume(m3)	1405	1377 (1392)	1456	1176	932	1178	1239
Average Flow(m3/min)	1.01	0.95 (0.96)	1.01	0.83	0.64	0.82	0.86
TSP Concentration(mg/m3)	0.0413	0.0552 (0.0467)	0.0446	0.0595	0.0515	0.034	0.0428
Percent of Allowable(%)	53	UPWIND (UPWIND)	57	76	66	44	55
8/12/2006							
Total Volume(m3)	1800	1634 (1699)	1690	769	1236	1401	1499
Average Flow(m3/min)	1.02	0.96 (1)	0.98	0.46	0.71	0.83	0.88
TSP Concentration(mg/m3)	0.0167	0.0386 J (0.0206 J)	0.0396	0.0598	0.021	0.0457	0.042
Percent of Allowable(%)	49	UPWIND (UPWIND)	115	174	61	133	122
8/14/2006							
Total Volume(m3)	1026	1184 (1197)	1355	1100	1075	1175	175
Average Flow(m3/min)	0.73	0.84 (0.85)	0.97	0.79	0.76	0.84	*
TSP Concentration(mg/m3)	0.0507	0.0524 (0.0618)	0.048	0.07	0.0558	0.0494	*
Percent of Allowable(%)	63	65 (77)	UPWIND	87	70	62	*
8/15/2006							
Total Volume(m3)	1010	1378 (1432)	1464	1139	1412	1255	325
Average Flow(m3/min)	0.71	0.96 (1)	1.02	0.81	0.98	0.88	*
TSP Concentration(mg/m3)	0.0307	0.0356 J (0.1068 J)	0.0546	0.0536	0.0191	0.0582	*
Percent of Allowable(%)	17	UPWIND (UPWIND)	31	30	11	33	*
8/16/2006							
Total Volume(m3)	874	1363 (1420)	1366	1142	1260	1251	1069
Average Flow(m3/min)	0.65	0.96 (1)	1.02	0.82	0.86	0.89	0.89
TSP Concentration(mg/m3)	0.0629	0.0455 J (0.0218 J)	0.0483	0.042	0.0317	0.1143	0.0393
Percent of Allowable(%)	173	UPWIND (UPWIND)	133	115	87	314	108

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
8/17/2006							
Total Volume(m3)	467	1369 (1340)	711	1105	1221	1250	321
Average Flow(m3/min)	*	0.95 (0.93)	*	0.79	0.85	0.88	*
TSP Concentration(mg/m3)	*	0.0628 (0.0672)	*	0.0561	0.0434	0.2256	*
Percent of Allowable(%)	*	87 (93)	*	77	UPWIND	311	*
8/18/2006							
Total Volume(m3)	472	1334 (1307)	736	940	1287	1211	638
Average Flow(m3/min)	*	0.95 (0.93)	*	0.67	0.85	0.87	*
TSP Concentration(mg/m3)	*	0.0652 (0.065)	*	0.0617	0.0513	0.1387	*
Percent of Allowable(%)	*	76 (76)	*	72	UPWIND	162	*
8/19/2006							
Total Volume(m3)	377	1309 (1309)	671	1139	1013	1137	573
Average Flow(m3/min)	*	0.95 (0.95)	*	0.82	0.75	0.84	*
TSP Concentration(mg/m3)	*	0.0481 (0.0466)	*	0.0781	0.0731	0.0607	*
Percent of Allowable(%)	*	UPWIND (UPWIND)	*	100	94	78	*
8/21/2006							
Total Volume(m3)	756	1381 (1428)	1536	1165	1045	1209	1292
Average Flow(m3/min)	0.5	0.94 (0.97)	1	0.82	0.77	0.83	0.84
TSP Concentration(mg/m3)	0.0807	0.0587 (0.0511)	0.0658	0.0609	0.0498	0.1803	0.0906
Percent of Allowable(%)	95	UPWIND (UPWIND)	77	71	58	211	106
8/22/2006							
Total Volume(m3)	817	1249 (1304)	959	1144	1179	1226	1176
Average Flow(m3/min)	0.58	0.89 (0.93)	0.68	0.83	0.83	0.89	0.84
TSP Concentration(mg/m3)	0.0661	0.0633 (0.0713)	0.1397	0.0778	0.056	0.4307	0.0969
Percent of Allowable(%)	56	UPWIND (UPWIND)	117	65	47	362	81
8/23/2006							
Total Volume(m3)	859	1291 (1366)	1088	1077	965	1222	1271
Average Flow(m3/min)	0.57	0.88 (0.93)	0.76	0.74	0.67	0.85	0.92
TSP Concentration(mg/m3)	0.1234	0.0883 (0.0615)	0.1232	0.0854	0.1098	0.563	0.0732
Percent of Allowable(%)	120	UPWIND (UPWIND)	120	83	107	548	71
8/24/2006							
Total Volume(m3)	781	1269 (1312)	1064	1182	922	1240	1285
Average Flow(m3/min)	0.57	0.88 (0.91)	0.73	0.86	0.63	0.88	0.93
TSP Concentration(mg/m3)	0.1293	0.2025 (0.1974)	0.1081	0.1007	0.0954	1.1726	0.0607
Percent of Allowable(%)	81	127 (124)	68	63	UPWIND	736	38
8/25/2006							
Total Volume(m3)	710	1300 (1359)	1163	1192	840	1131	1221
Average Flow(m3/min)	0.5	0.87 (0.91)	0.81	0.81	0.58	0.77	0.85
TSP Concentration(mg/m3)	0.1366	0.1362 (0.1332)	0.08	0.0864	0.0952	0.3165	0.0975
Percent of Allowable(%)	86	86 (84)	50	54	UPWIND	199	61

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
8/26/2006							
Total Volume(m3)	826	1475 (1526)	1324	1392	1053	1299	1465
Average Flow(m3/min)	0.47	0.88 (0.91)	0.75	0.84	0.59	0.78	0.83
TSP Concentration(mg/m3)	0.115	0.0827 (0.0826)	0.0702	0.0589	0.0693	0.2071	0.0526
Percent of Allowable(%)	99	71 (71)	61	51	UPWIND	179	45
8/29/2006							
Total Volume(m3)	898	1184 (1228)	1129	1097	742	1065	1198
Average Flow(m3/min)	0.64	0.84 (0.87)	0.8	0.8	0.52	0.76	0.86
TSP Concentration(mg/m3)	0.0468	0.0312 (0.0228)	0.0399	0.0693	0.0404	0.0122	0.0242
Percent of Allowable(%)	UPWIND	40 (29)	51	89	52	16	31
8/30/2006							
Total Volume(m3)	867	1259 (1317)	1179	1206	833	1147	1150
Average Flow(m3/min)	0.6	0.86 (0.9)	0.8	0.86	0.56	0.79	0.78
TSP Concentration(mg/m3)	0.0358	0.0477 (0.0532)	0.0696	0.0531	0.0348	0.0227	0.0557
Percent of Allowable(%)	40	UPWIND (UPWIND)	78	60	39	26	63
8/31/2006							
Total Volume(m3)	879	1286 (1328)	1217	1316	936	1118	1351
Average Flow(m3/min)	0.58	0.89 (0.92)	0.8	0.88	0.61	0.79	0.9
TSP Concentration(mg/m3)	0.0387	0.0638 (0.0595)	0.0863	0.0608	0.0449	0.0331	0.0326
Percent of Allowable(%)	39	UPWIND (UPWIND)	87	61	45	33	33
9/5/2006							
Total Volume(m3)	696	1243 (1257)	1119	1258	847	1146	1216
Average Flow(m3/min)	0.49	0.85 (0.86)	0.78	0.88	0.58	0.8	0.85
TSP Concentration(mg/m3)	0.0618	0.0418 (0.0414)	0.092	0.0612	0.0626	0.0279	0.0461
Percent of Allowable(%)	89	UPWIND (UPWIND)	133	89	91	40	67
9/6/2006							
Total Volume(m3)	714	1317 (1344)	1273	1067	801	1162	1158
Average Flow(m3/min)	0.49	0.91 (0.93)	0.87	0.75	0.54	0.8	0.79
TSP Concentration(mg/m3)	0.049	0.0342 (0.0387)	0.0542	0.0459	0.0699	0.031	0.0389
Percent of Allowable(%)	76	UPWIND (UPWIND)	84	71	108	48	60
9/7/2006							
Total Volume(m3)	1183	1286 (1285)	1094	1077	813	1123	1130
Average Flow(m3/min)	0.84	0.91 (0.91)	0.77	0.77	0.57	0.8	0.79
TSP Concentration(mg/m3)	0.0617	0.0505 (0.0475)	0.0868	0.052	0.075	0.0481	0.0894
Percent of Allowable(%)	49	40 (38)	69	42	UPWIND	38	71
9/8/2006							
Total Volume(m3)	1135	1375 (1375)	1124	1409	1186	1219	1113
Average Flow(m3/min)	0.76	0.91 (0.91)	0.75	0.96	0.78	0.82	0.76
TSP Concentration(mg/m3)	0.0705	0.0582 (0.064)	0.1059	0.0781	0.0329	0.0509	0.1177
Percent of Allowable(%)	128	106 (116)	193	142	UPWIND	93	214

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
9/9/2006							
Total Volume(m3)	1187	1642 (1573)	1220	1599	1293	1422	1265
Average Flow(m3/min)	0.7	0.97 (0.93)	0.71	0.96	0.75	0.85	0.79
TSP Concentration(mg/m3)	0.0556	0.0445 (0.0598)	0.1	0.0588	0.0688	0.0506	0.0798
Percent of Allowable(%)	56	UPWIND (UPWIND)	100	59	69	51	80
9/11/2006							
Total Volume(m3)	931	1072 (1281)	995	1324	1060	1087	1122
Average Flow(m3/min)	0.65	0.76 (0.9)	0.7	0.94	0.74	0.77	0.79
TSP Concentration(mg/m3)	0.043	0.0401 (0.0367)	0.0492	0.0393	0.0358	0.0386	0.0437
Percent of Allowable(%)	72	67 (61)	82	66	UPWIND	65	73
9/14/2006							
Total Volume(m3)	1035	1201 (1201)	1040	1315	1119	1136	1218
Average Flow(m3/min)	0.73	0.83 (0.83)	0.72	0.92	0.77	0.8	0.85
TSP Concentration(mg/m3)	0.029	0.0233 (0.0316)	0.0481	0.0471	0.0268	0.0238	0.0361
Percent of Allowable(%)	55	UPWIND (UPWIND)	91	89	51	45	68
9/15/2006							
Total Volume(m3)	1582	1292 (1366)	1133	1431	1250	1207	1188
Average Flow(m3/min)	1	0.88 (0.93)	0.73	0.99	0.8	0.83	0.77
TSP Concentration(mg/m3)	0.0265	0.0356 (0.0388)	0.0565	0.037	0.0376	0.034	0.0648
Percent of Allowable(%)	41	UPWIND (UPWIND)	87	57	58	52	100
9/16/2006							
Total Volume(m3)	1523	902 (951)	1179	1517	1284	1293	1364
Average Flow(m3/min)	1	0.88 (0.93)	0.73	0.96	0.77	0.82	0.85
TSP Concentration(mg/m3)	0.0361	0.0421 (0.0389)	0.0492	0.0369	0.0366	0.0472	0.0315
Percent of Allowable(%)	59	69 (64)	80	60	UPWIND	77	52
9/18/2006							
Total Volume(m3)	856	1170 (1364)	958	1096	1208	1140	1114
Average Flow(m3/min)	0.62	0.98 (0.94)	0.69	0.93	0.85	0.77	0.77
TSP Concentration(mg/m3)	0.0479	0.0154 (0.0117)	0.0355	0.0411	0.0116	0.014	0.0189
Percent of Allowable(%)	81	26 (20)	UPWIND	69	20	24	32
9/19/2006							
Total Volume(m3)	1394	1329 (1315)	1063	1300	1150	1184	1207
Average Flow(m3/min)	0.98	0.96 (0.95)	0.74	0.9	0.78	0.85	0.84
TSP Concentration(mg/m3)	0.0882	0.0105 J (0.0259 J)	0.079	0.0685	0.0435	0.0211	0.0331
Percent of Allowable(%)	UPWIND	7 (18)	54	47	30	14	22
9/20/2006							
Total Volume(m3)	1246	1384 (1383)	1100	1144	1227	1288	1268
Average Flow(m3/min)	0.87	0.95 (0.95)	0.77	0.8	0.83	0.89	0.88
TSP Concentration(mg/m3)	0.0257	0.0202 (0.0145)	0.0582	0.0149	0.0171	0.0093	0.0386
Percent of Allowable(%)	UPWIND	47 (34)	136	35	40	22	90

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
9/21/2006							
Total Volume(m3)	1142	1413 (1341)	1108	1055	1134	1181	1224
Average Flow(m3/min)	0.79	0.99 (0.94)	0.79	0.75	0.79	0.84	0.84
TSP Concentration(mg/m3)	0.0403	0.0354 (0.038)	0.0397	0.0237	0.0256	0.0415	0.0449
Percent of Allowable(%)	94	83 (89)	93	55	UPWIND	97	105
9/25/2006							
Total Volume(m3)	1116	1381 (1266)	1087	930	1117	1319	1279
Average Flow(m3/min)	0.78	0.97 (0.89)	0.77	0.68	0.78	0.93	0.91
TSP Concentration(mg/m3)	0.1057	0.0268 (0.034)	0.0736	0.0301	0.0439	0.0258	0.0461
Percent of Allowable(%)	144	37 (46)	100	41	UPWIND	35	63
9/26/2006							
Total Volume(m3)	1157	1386 (1276)	1178	964	1172	1298	1198
Average Flow(m3/min)	0.81	0.98 (0.9)	0.83	0.69	0.82	0.92	0.84
TSP Concentration(mg/m3)	0.083	0.0339 (0.0392)	0.0688	0.0207	0.0427	0.0401	0.0409
Percent of Allowable(%)	72	30 (34)	UPWIND	18	37	35	36
9/27/2006							
Total Volume(m3)	1274	1393 (1334)	1178	1033	1202	1286	1278
Average Flow(m3/min)	0.89	0.97 (0.93)	0.82	0.73	0.83	0.91	0.89
TSP Concentration(mg/m3)	0.062	0.0416 (0.048)	0.0942	0.0339	0.0632	0.0435	0.0266
Percent of Allowable(%)	39	26 (31)	UPWIND	22	40	28	17
9/28/2006							
Total Volume(m3)	1451	1456 (1364)	1227	1047	1189	1399	1305
Average Flow(m3/min)	0.97	0.97 (0.91)	0.83	0.7	0.81	0.94	0.87
TSP Concentration(mg/m3)	0.0296	0.0185 (0.0242)	0.0823	0.0334	0.0177	0.0129	0.0322
Percent of Allowable(%)	73	UPWIND (UPWIND)	204	83	44	32	80
9/29/2006							
Total Volume(m3)	959	1446 (1318)	1199	918	1232	1323	1171
Average Flow(m3/min)	0.68	1.02 (0.93)	0.85	0.66	0.86	0.94	0.84
TSP Concentration(mg/m3)	0.0719	0.0256 (0.0288)	0.0475	0.0251	0.0325	0.0325	0.029
Percent of Allowable(%)	91	32 (36)	UPWIND	32	41	41	37
9/30/2006							
Total Volume(m3)	1614	1617 (1539)	1345	1095	1343	1486	1444
Average Flow(m3/min)	1.02	1.01 (0.96)	0.83	0.7	0.81	0.93	0.9
TSP Concentration(mg/m3)	0.0316	0.0303 (0.0221)	0.0483	0.032	0.0454	0.033	0.0263
Percent of Allowable(%)	39	38 (27)	UPWIND	40	56	41	33
10/2/2006							
Total Volume(m3)	1380	1193 (1390)	1183	1407	1206	1176	1258
Average Flow(m3/min)	0.91	0.85 (0.99)	0.79	0.98	0.8	0.85	0.84
TSP Concentration(mg/m3)	0.058	0.0427 (0.046)	0.0676	0.0327	0.0539	0.0655	0.0437
Percent of Allowable(%)	51	38 (41)	UPWIND	29	48	58	39

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
10/4/2006							
Total Volume(m3)	1257	1275 (1344)	1167	1144	1130	1179	1177
Average Flow(m3/min)	0.89	0.91 (0.96)	0.82	0.82	0.79	0.84	0.83
TSP Concentration(mg/m3)	0.0811	0.0541 (0.0506)	0.096	0.0682	0.0912	0.056	0.0527
Percent of Allowable(%)	51	34 (32)	UPWIND	43	57	35	33
10/5/2006							
Total Volume(m3)	1289	1578 (1561)	1238	1451	1452	1405	1375
Average Flow(m3/min)	0.9	1.06 (1.05)	0.85	1.01	0.97	0.96	0.95
TSP Concentration(mg/m3)	0.0147	0.0266 (0.0218)	0.0759	0.0262	0.0145	0.0128	0.0182
Percent of Allowable(%)	40	UPWIND (UPWIND)	208	72	40	35	50
10/6/2006							
Total Volume(m3)	1075	1499 (1361)	1837	1328	1144	1189	1304
Average Flow(m3/min)	0.76	1.1 (1)	1.33	0.98	0.82	0.88	0.93
TSP Concentration(mg/m3)	0.0372	0.02 (0.0309)	0.0523	0.0392	0.035	0.0219	0.0299
Percent of Allowable(%)	72	UPWIND (UPWIND)	101	76	68	42	58
10/7/2006							
Total Volume(m3)	1377	1819 (1748)	2279	1640	1483	1559	1595
Average Flow(m3/min)	0.78	1.05 (1.01)	1.31	0.95	0.84	0.9	0.91
TSP Concentration(mg/m3)	0.0414	0.0231 (0.0349)	0.0351	0.0402	0.0243	0.0276	0.0401
Percent of Allowable(%)	71	UPWIND (UPWIND)	60	69	42	47	69
10/9/2006							
Total Volume(m3)	967	1373 (1405)	1777	1312	1200	1122	1191
Average Flow(m3/min)	0.68	0.94 (0.96)	1.23	0.92	0.82	0.78	0.83
TSP Concentration(mg/m3)	0.1148	0.0393 (0.0484)	0.0557	0.0488	0.04	0.0597	0.0915
Percent of Allowable(%)	142	UPWIND (UPWIND)	69	60	49	74	113
10/10/2006							
Total Volume(m3)	1157	1476 (1490)	1901	1367	1221	1207	1217
Average Flow(m3/min)	0.79	0.99 (1)	1.28	0.94	0.81	0.82	0.82
TSP Concentration(mg/m3)	0.1288	0.0562 (0.0611)	0.0626	0.0549	0.0647	0.0953	0.1487
Percent of Allowable(%)	123	54 (58)	UPWIND	53	62	91	142
10/11/2006							
Total Volume(m3)	2573	1373 (1417)	1858	1447	1213	1219	1221
Average Flow(m3/min)	1.82	0.95 (0.98)	1.3	0.99	0.83	0.85	0.84
TSP Concentration(mg/m3)	0.0163	0.016 J (0.0289 J)	0.0301	0.0415	0.0528	0.0328	0.0262
Percent of Allowable(%)	32	32 (57)	UPWIND	83	105	65	52
10/12/2006							
Total Volume(m3)	1100	1114 (1378)	1914	1420	1240	1281	1341
Average Flow(m3/min)	0.79	0.76 (0.94)	1.33	1.02	0.85	0.88	0.95
TSP Concentration(mg/m3)	0.0855	0.0377 (0.0377)	0.0418	0.0444	0.0597	0.0414	0.035
Percent of Allowable(%)	122	54 (54)	UPWIND	64	86	59	50

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
10/13/2006							
Total Volume(m3)	1155	1129 (1381)	1967	1655	1365	1285	1311
Average Flow(m3/min)	0.81	0.76 (0.93)	1.34	1.15	0.91	0.88	0.91
TSP Concentration(mg/m3)	0.0788	0.0523 (0.0319)	0.0447	0.035	0.0637	0.0475	0.0397
Percent of Allowable(%)	106	70 (43)	UPWIND	47	85	64	53
10/14/2006							
Total Volume(m3)	1000	1066 (1313)	1223	1207	NR	1227	616
Average Flow(m3/min)	0.69	0.77 (0.95)	0.86	0.86	NR	0.89	0.43
TSP Concentration(mg/m3)	0.085	0.0432 J (0.016 J)	0.0515	0.0646	NR	0.0367	0.0763
Percent of Allowable(%)	99	50 (19)	UPWIND	75	NR	43	89
10/16/2006							
Total Volume(m3)	997	988 (1327)	1190	1299	1083	1212	541
Average Flow(m3/min)	0.69	0.67 (0.9)	0.81	0.89	0.81	0.83	0.37
TSP Concentration(mg/m3)	0.0221	0.0152 (0.0151)	0.0202	0.0239	0.0139	0.019	0.0518
Percent of Allowable(%)	95	65 (65)	87	103	UPWIND	82	223
10/17/2006							
Total Volume(m3)	1024	892 (1276)	1179	1258	1178	1201	473
Average Flow(m3/min)	0.73	0.65 (0.93)	0.82	0.88	0.82	0.84	0.33
TSP Concentration(mg/m3)	0.0283	0.0314 J (0.0157 J)	0.0483	0.0342	0.0314	0.0241	0.0634
Percent of Allowable(%)	35	39 (19)	UPWIND	42	39	30	79
10/18/2006							
Total Volume(m3)	1442	999 (1325)	1224	1255	1299	1225	2007
Average Flow(m3/min)	0.99	0.68 (0.9)	0.83	0.87	0.88	0.84	1.36
TSP Concentration(mg/m3)	0.0347	0.043 (0.0506)	0.0539	0.0478	0.0293	0.0245	0.0284
Percent of Allowable(%)	71	88 (103)	110	98	UPWIND	50	58
10/19/2006							
Total Volume(m3)	1276	1081 (1306)	1234	1257	1164	1220	1922
Average Flow(m3/min)	0.91	0.76 (0.92)	0.87	0.9	0.82	0.88	1.39
TSP Concentration(mg/m3)	0.0133	0.013 (0.0107)	0.0308	0.0772	0.0189	0.0066	0.013
Percent of Allowable(%)	UPWIND	59 (48)	139	348	85	30	59
10/20/2006							
Total Volume(m3)	1523	1051 (1449)	1260	1342	1268	1496	597
Average Flow(m3/min)	1.03	0.69 (0.95)	0.86	0.9	0.84	0.94	0.41
TSP Concentration(mg/m3)	0.0525	0.0533 J (0.0317 J)	0.0548	0.0432	0.0331	0.0154	0.0787
Percent of Allowable(%)	95	96 (57)	99	78	UPWIND	28	142
10/21/2006							
Total Volume(m3)	1648	1074 (1461)	1308	1457	1300	1310	2261
Average Flow(m3/min)	1.02	0.69 (0.94)	0.82	0.95	0.83	0.89	1.42
TSP Concentration(mg/m3)	0.0231	0.0419 J (0.0226 J)	0.026	0.0213	0.0231	0.0153	0.0164
Percent of Allowable(%)	60	109 (59)	67	55	UPWIND	40	43

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
10/23/2006							
Total Volume(m3)	1347	1032 (1358)	1944	1329	1293	1230	2029
Average Flow(m3/min)	0.94	0.7 (0.92)	1.34	0.92	0.88	0.84	1.41
TSP Concentration(mg/m3)	0.0505	0.0281 (0.0258)	0.0448	0.0813	0.0526	0.0244	0.0217
Percent of Allowable(%)	UPWIND	33 (31)	53	96	62	29	26
10/24/2006							
Total Volume(m3)	1504	1121 (1322)	1963	1308	1294	1252	1997
Average Flow(m3/min)	1.07	0.78 (0.92)	1.37	0.93	0.9	0.88	1.41
TSP Concentration(mg/m3)	0.0485	0.0473 (0.0439)	0.0438	0.0497	0.0325	0.0184	0.031
Percent of Allowable(%)	UPWIND	58 (54)	54	61	40	23	38
10/25/2006							
Total Volume(m3)	1589	826 (1359)	1979	1344	1275	1297	1229
Average Flow(m3/min)	1.08	0.72 (0.93)	1.32	0.93	0.87	0.91	0.85
TSP Concentration(mg/m3)	0.056	0.0593 (0.0589)	0.0273	0.0417	0.0212	0.037	0.0773
Percent of Allowable(%)	158	167 (166)	77	118	UPWIND	105	218
10/26/2006							
Total Volume(m3)	1235	1029 (1364)	1890	1293	1316	1157	1179
Average Flow(m3/min)	0.88	0.71 (0.94)	1.35	0.92	0.91	0.79	0.83
TSP Concentration(mg/m3)	0.0162	0.0175 (0.0117)	0.0111	0.0209	0.0129	0.0121	0.0399
Percent of Allowable(%)	46	50 (34)	32	UPWIND	37	35	114
10/27/2006							
Total Volume(m3)	1556	NR (NR)	1870	1365	1089	1166	1195
Average Flow(m3/min)	1.08	NR (NR)	1.29	0.93	0.73	0.77	0.82
TSP Concentration(mg/m3)	ND(0.0006)	NR (NR)	0.0176	0.0418	NR	0.0137	0.0502
Percent of Allowable(%)	NR	NR (NR)	77	183	NR	UPWIND	219
10/28/2006							
Total Volume(m3)	981	841 (1301)	1211	1309	1124	1119	1204
Average Flow(m3/min)	0.66	0.6 (0.93)	0.82	0.91	0.76	0.81	0.81
TSP Concentration(mg/m3)	0.0683	0.0309 J (0.0085 J)	0.033	0.0474	0.0383	0.0223	0.0249
Percent of Allowable(%)	124	56 (15)	UPWIND	86	69	40	45
10/30/2006							
Total Volume(m3)	794	900 (1262)	1153	6	1040	860	1216
Average Flow(m3/min)	0.56	0.62 (0.87)	0.81	*	0.71	0.71	0.86
TSP Concentration(mg/m3)	0.1096	0.0833 (0.0507)	0.0338	*	0.0654	0.1419	0.0452
Percent of Allowable(%)	194	148 (90)	UPWIND	*	116	251	80
10/31/2006							
Total Volume(m3)	985	870 (1097)	1227	15	1137	0	1192
Average Flow(m3/min)	0.69	0.73 (0.92)	0.85	*	0.77	*	0.83
TSP Concentration(mg/m3)	0.0538	0.0264 (ND (0.0009))	0.0424	*	0.0255	*	0.0445
Percent of Allowable(%)	122	UPWIND (UPWIND)	96	*	58	*	101

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TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C TSP-12*	*STATION 14 TSP-11 (TSP-5)*	*STATION 22B TSP-9*	*STATION 23 TSP-3*	*STATION 29 TSP-8*	*STATION 30 TSP-1*	*STATION 31 TSP-16*
11/1/2006							
Total Volume(m3)	1048	1094 (1351)	1214	4	1196	0	1293
Average Flow(m3/min)	0.72	0.76 (0.94)	0.84	*	0.82	*	0.9
TSP Concentration(mg/m3)	0.0821	0.0201 (0.0355)	0.0857	*	0.0192	*	0.0565
Percent of Allowable(%)	UPWIND	15 (26)	63	*	14	*	41
11/2/2006							
Total Volume(m3)	1089	1154 (1410)	1210	11	1129	0	1352
Average Flow(m3/min)	0.77	0.8 (0.98)	0.85	*	0.78	*	0.95
TSP Concentration(mg/m3)	0.0716	0.0485 (0.0142)	0.0983	*	0.0735	*	0.0422
Percent of Allowable(%)	58	40 (12)	80	*	UPWIND	*	34
11/3/2006							
Total Volume(m3)	1072	669 (868)	1297	33	1299	0	1342
Average Flow(m3/min)	0.73	* (*)	0.85	*	0.84	*	0.91
TSP Concentration(mg/m3)	0.1054	* (*)	0.0933	*	0.0431	*	0.0544
Percent of Allowable(%)	146	* (*)	130	*	UPWIND	*	76
11/4/2006							
Total Volume(m3)	1196	1013 (1536)	1347	1468	1267	0	1429
Average Flow(m3/min)	0.73	0.73 (0.99)	0.84	1.09	0.78	*	0.89
TSP Concentration(mg/m3)	0.0385	0.0602 (0.0475)	0.046	0.0334	0.041	*	0.0301
Percent of Allowable(%)	56	88 (69)	67	49	UPWIND	*	44
11/6/2006							
Total Volume(m3)	1034	449 (1301)	953	1296	1122	1	1111
Average Flow(m3/min)	0.76	0.3 (0.87)	0.7	0.97	0.82	*	0.81
TSP Concentration(mg/m3)	0.028	0.0735 (0.0323)	0.0325	0.027	0.0481	*	0.063
Percent of Allowable(%)	35	92 (40)	40	34	UPWIND	*	78
11/7/2006							
Total Volume(m3)	884	323 (1378)	1221	1434	1267	30	1123
Average Flow(m3/min)	0.62	0.22 (0.94)	0.84	0.99	0.86	*	0.79
TSP Concentration(mg/m3)	0.0192	0.031 (0.0145)	0.0156	0.0502	0.0237	*	0.0169
Percent of Allowable(%)	79	UPWIND (UPWIND)	64	207	98	*	70
11/8/2006							
Total Volume(m3)	1007	327 (1239)	1179	1414	1295	2	604
Average Flow(m3/min)	0.71	0.24 (0.91)	0.8	0.98	0.86	*	0.39
TSP Concentration(mg/m3)	0.0536	0.1193 (0.0484)	0.1332	0.0474	0.0595	*	0.1026
Percent of Allowable(%)	24	54 (22)	UPWIND	21	27	*	46
11/9/2006							
Total Volume(m3)	877	321 (1416)	931	1366	1195	779	1054
Average Flow(m3/min)	0.61	0.21 (0.93)	0.66	0.98	0.83	0.65	0.78
TSP Concentration(mg/m3)	0.2178	0.2181 (0.077)	0.1547	0.0454	0.0728	0.086	0.0806
Percent of Allowable(%)	84	84 (30)	UPWIND	18	28	33	31

TABLE 2.1

EAST PLANT AREA TSP ANALYTICAL RESULTS SUMMARY
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1C* *TSP-12*	*STATION 14* *TSP-11 (TSP-5)*	*STATION 22B* *TSP-9*	*STATION 23* *TSP-3*	*STATION 29* *TSP-8*	*STATION 30* *TSP-1*	*STATION 31* *TSP-16*
11/10/2006							
Total Volume(m3)	1234	511 (1340)	1104	1188	1253	1157	1127
Average Flow(m3/min)	0.88	0.35 (0.92)	0.77	0.84	0.86	0.76	0.79
TSP Concentration(mg/m3)	0.0632	0.0294 (0.0396)	0.058	0.021	0.0519	0.0458	0.0417
Percent of Allowable(%)	65	30 (41)	UPWIND	22	54	47	43
11/11/2006							
Total Volume(m3)	1068	430 (1543)	1243	1471	1418	1408	1267
Average Flow(m3/min)	0.68	0.27 (0.97)	0.78	0.94	0.87	0.87	0.83
TSP Concentration(mg/m3)	0.0225	0.0326 (0.0175)	0.0306	0.07	0.0141	0.0107	0.0213
Percent of Allowable(%)	UPWIND	87 (47)	81	186	38	28	57
11/12/2006							
Total Volume(m3)	1143	614 (1343)	1029	1342	1532	949	1149
Average Flow(m3/min)	0.9	0.47 (1.03)	0.79	1.05	1.15	0.84	0.88
TSP Concentration(mg/m3)	0.0131	0.0212 (0.0067)	0.0301	0.0216	0.0137	0.0169	0.0235
Percent of Allowable(%)	36	59 (19)	83	UPWIND	38	47	65
11/13/2006							
Total Volume(m3)	922	421 (1191)	1146	1355	1380	1241	1313
Average Flow(m3/min)	0.64	0.29 (0.82)	0.79	0.95	0.93	0.84	0.91
TSP Concentration(mg/m3)	0.0564	0.0926 (0.0285)	0.0672	0.0266	0.0297	0.0363	0.0213
Percent of Allowable(%)	114	187 (57)	135	54	UPWIND	73	43
11/14/2006							
Total Volume(m3)	946	749 (1396)	1141	1327	1302	1193	1153
Average Flow(m3/min)	0.65	0.51 (0.95)	0.79	0.92	0.89	0.81	0.8
TSP Concentration(mg/m3)	0.0349	0.0401 (0.0279)	0.028	0.0294	0.0177	0.031	0.0399
Percent of Allowable(%)	71	82 (57)	57	UPWIND	36	63	81
11/15/2006							
Total Volume(m3)	901	584 (1305)	863	1237	1317	1013	1077
Average Flow(m3/min)	0.64	0.42 (0.94)	0.61	0.88	0.91	0.7	0.76
TSP Concentration(mg/m3)	0.0078	0.0325 (0.0199)	0.0394	0.021	0.0068	0.0118	0.013
Percent of Allowable(%)	23	UPWIND (UPWIND)	119	63	20	36	39

Notes:
* - Results not reported due to machine malfunction
NR - No result because machine was not setup
J - Estimated Result
Station 1C replaced Station 1B June 21, 2006.

TABLE 2.2

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2005 THROUGH APRIL 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

	STATION 1B	*STATION 14*	*STATION 22*	*STATION 23*
Unit_ID	*PUF-7*	*PUF-12(PUF-4)*	*PUF-3*	*PUF-2*
6/1/2005				
Total Volume(m3)	NR	319(235)	NR	NR
Total PCB Mass(ug)	NR	3.8(4.3)	NR	NR
PCB Concentration(ug/m3)	NR	0.0119(0.0183)	NR	NR
Percent of Allowable(%)	NR	1(2)	NR	NR
6/9/2005				
Total Volume(m3)	NR	328(228)	NR	NR
Total PCB Mass(ug)	NR	14(19)	NR	NR
PCB Concentration(ug/m3)	NR	0.0427(0.0833)	NR	NR
Percent of Allowable(%)	NR	4(8)	NR	NR
6/15/2005				
Total Volume(m3)	308	306(236)	35	253
Total PCB Mass(ug)	6.3	2.5(2.8)	*	5.4
PCB Concentration(ug/m3)	0.0205	0.0082(0.0119)	*	0.0213
Percent of Allowable(%)	2	1(1)	*	2
6/16/2005				
Total Volume(m3)	345	224(171)	57	207
Total PCB Mass(ug)	14	3.9(5.1)	*	3.9
PCB Concentration(ug/m3)	0.0406	0.0174(0.0298)	*	0.0188
Percent of Allowable(%)	4	2(3)	*	2
6/17/2005				
Total Volume(m3)	385	312(237)	143	365
Total PCB Mass(ug)	8.3	3.6(3.6)	2.3	7.1
PCB Concentration(ug/m3)	0.0216	0.0115(0.0152)	0.0161	0.0195
Percent of Allowable(%)	2	1(2)	2	2
6/20/2005				
Total Volume(m3)	343	318(249)	133	NR
Total PCB Mass(ug)	56	15(16)	10	NR
PCB Concentration(ug/m3)	0.1633	0.0472(0.0643)	0.0752	NR
Percent of Allowable(%)	16	5(6)	8	NR
6/21/2005				
Total Volume(m3)	376	277(316)	128	265
Total PCB Mass(ug)	12	7.2(7.3)	2.7	8.1
PCB Concentration(ug/m3)	0.0319	0.026(0.0231)	0.0211	0.0306 J
Percent of Allowable(%)	3	3(2)	2	3
6/22/2005				
Total Volume(m3)	361	311(354)	142	343
Total PCB Mass(ug)	93	14(14)	8.6	9.1
PCB Concentration(ug/m3)	0.2576	0.045(0.0395)	0.0606	0.0265
Percent of Allowable(%)	26	4(4)	6	3
6/29/2005				
Total Volume(m3)	411	325(NR)	140	325
Total PCB Mass(ug)	76	21(NR)	5.8	14
PCB Concentration(ug/m3)	0.1849	0.0646(NR)	0.0414	0.0431 J
Percent of Allowable(%)	18	6(NR)	4	4

TABLE 2.2

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2005 THROUGH APRIL 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-7*	*STATION 14* *PUF-12(PUF-4)*	*STATION 22* *PUF-3*	*STATION 23* *PUF-2*
7/6/2005				
Total Volume(m3)	314	304(NR)	83	335
Total PCB Mass(ug)	38	7.7(NR)	1.9	7.2
PCB Concentration(ug/m3)	0.121	0.0253(NR)	0.0229	0.0215
Percent of Allowable(%)	12	3(NR)	2	2
7/13/2005				
Total Volume(m3)	379	300(342)	119	364
Total PCB Mass(ug)	33	2.8(3)	2.5	2.9
PCB Concentration(ug/m3)	0.0871 J	0.0093(0.0088)	0.021	0.008
Percent of Allowable(%)	9	1(1)	2	1
7/20/2005				
Total Volume(m3)	355	320(334)	132	82
Total PCB Mass(ug)	20	14(17)	3.1	*
PCB Concentration(ug/m3)	0.0563 J	0.0438(0.0509)	0.0235 J	*
Percent of Allowable(%)	6	4(5)	2	*
7/28/2005				
Total Volume(m3)	348	165(180)	129	350
Total PCB Mass(ug)	25	*(*)	2.5	7.1
PCB Concentration(ug/m3)	0.0718	*(*)	0.0194	0.0203
Percent of Allowable(%)	7	*(*)	2	2
8/3/2005				
Total Volume(m3)	365	319(348)	130	364
Total PCB Mass(ug)	37	19(22)	7.2	7.3
PCB Concentration(ug/m3)	0.1014	0.0596(0.0632)	0.0554	0.0201
Percent of Allowable(%)	10	6(6)	6	2
8/10/2005				
Total Volume(m3)	337	307(321)	126	346
Total PCB Mass(ug)	27	12(13)	10	7.9
PCB Concentration(ug/m3)	0.0801 J	0.0391(0.0405)	0.0794	0.0228
Percent of Allowable(%)	8	4(4)	8	2
8/17/2005				
Total Volume(m3)	343	0(1)	142	371
Total PCB Mass(ug)	93	*(*)	47	6.1
PCB Concentration(ug/m3)	0.2711	*(*)	0.331	0.0164 J
Percent of Allowable(%)	27	*(*)	33	2
8/24/2005				
Total Volume(m3)	NR	150(131)	148	372
Total PCB Mass(ug)	NR	*(*)	73	13
PCB Concentration(ug/m3)	NR	*(*)	0.4932	0.0349
Percent of Allowable(%)	NR	*(*)	49	3
9/1/2005				
Total Volume(m3)	NR	2(2)	157	381
Total PCB Mass(ug)	NR	*(*)	97	31
PCB Concentration(ug/m3)	NR	*(*)	0.6178	0.0814
Percent of Allowable(%)	NR	*(*)	62	8

TABLE 2.2

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2005 THROUGH APRIL 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-7*	*STATION 14* *PUF-12(PUF-4)*	*STATION 22* *PUF-3*	*STATION 23* *PUF-2*
9/8/2005				
Total Volume(m3)	NR	238(216)	133	184
Total PCB Mass(ug)	NR	32(29)	47	*
PCB Concentration(ug/m3)	NR	0.1345(0.1343)	0.3534	*
Percent of Allowable(%)	NR	13(13)	35	*
9/14/2005				
Total Volume(m3)	NR	3(2)	128	364
Total PCB Mass(ug)	NR	*(*)	77	42
PCB Concentration(ug/m3)	NR	*(*)	0.6016	0.1154
Percent of Allowable(%)	NR	*(*)	60	12
10/12/2005				
Total Volume(m3)	NR	387(318)	146	362
Total PCB Mass(ug)	NR	21(22)	45	18
PCB Concentration(ug/m3)	NR	0.0543(0.0692)	0.3082	0.0497
Percent of Allowable(%)	NR	5(7)	31	5
10/26/2005				
Total Volume(m3)	NR	371(314)	120	358
Total PCB Mass(ug)	NR	8.9(8.5)	18	21
PCB Concentration(ug/m3)	NR	0.024(0.0271)	0.15 J	0.0587
Percent of Allowable(%)	NR	2(3)	15	6
11/2/2005				
Total Volume(m3)	292	323(308)	170	279
Total PCB Mass(ug)	68	17(15)	2.3	19
PCB Concentration(ug/m3)	0.2329	0.0526(0.0487)	0.0135	0.0681
Percent of Allowable(%)	23	5(5)	1	7
11/9/2005				
Total Volume(m3)	398	364(320)	159	349
Total PCB Mass(ug)	2	0.78(0.75)	10	74
PCB Concentration(ug/m3)	0.005	0.0021(0.0023)	0.0629	0.212
Percent of Allowable(%)	0	0(0)	6	21
11/30/2005				
Total Volume(m3)	407	332(293)	164	336
Total PCB Mass(ug)	11	2(2.2)	7.4	11
PCB Concentration(ug/m3)	0.027	0.006(0.0075)	0.0451	0.0327
Percent of Allowable(%)	3	1(1)	5	3
12/7/2005				
Total Volume(m3)	373	409(366)	135	425
Total PCB Mass(ug)	3.6	0.95(0.76)	3	8.1
PCB Concentration(ug/m3)	0.0097 J	0.0023 J(0.0021 J)	0.0222 J	0.0191 J
Percent of Allowable(%)	1	0(0)	2	2
12/21/2005				
Total Volume(m3)	425	450(434)	16	396
Total PCB Mass(ug)	5.1	2.7(2.6)	*	4.9
PCB Concentration(ug/m3)	0.012	0.006(0.006)	*	0.0124
Percent of Allowable(%)	1	1(1)	*	1

TABLE 2.2

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2005 THROUGH APRIL 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-7*	*STATION 14* *PUF-12(PUF-4)*	*STATION 22* *PUF-3*	*STATION 23* *PUF-2*
1/4/2006				
Total Volume(m3)	NR (399)	397(411)	146	84
Total PCB Mass(ug)	NR (2.9)	0(0)	5.7	*
PCB Concentration(ug/m3)	NR (0.0073)	ND(0.0019)(ND(0.0018))	0.039	*
Percent of Allowable(%)	NR (1)	--(--)	4	*
1/12/2006				
Total Volume(m3)	NR (428)	481(531)	145	408
Total PCB Mass(ug)	NR (24)	5.5(5.3)	1.2	3.3
PCB Concentration(ug/m3)	NR (0.0561)	0.0114(0.01 J)	0.0083	0.0081
Percent of Allowable(%)	NR (6)	1(1)	1	1
1/18/2006				
Total Volume(m3)	NR (412)	368(420)	141	346
Total PCB Mass(ug)	NR (6.2)	1(0.98)	0.6	1.9
PCB Concentration(ug/m3)	NR (0.015)	0.0027(0.0023)	0.0043 J	0.0055
Percent of Allowable(%)	NR (2)	0(0)	0	1
1/25/2006				
Total Volume(m3)	NR (355)	448(418)	2	384
Total PCB Mass(ug)	NR (3)	2.4(2.9)	*	25
PCB Concentration(ug/m3)	NR (0.0085)	0.0054(0.0069)	*	0.0651
Percent of Allowable(%)	NR (1)	1(1)	*	7
2/1/2006				
Total Volume(m3)	NR (364)	469(466)	147	453
Total PCB Mass(ug)	NR (8.1)	12(13)	9.1	15
PCB Concentration(ug/m3)	NR (0.0223)	0.0256(0.0279)	0.0619	0.0331
Percent of Allowable(%)	NR (2)	3(3)	6	3
2/7/2006				
Total Volume(m3)	NR (357)	353(367)	19	327
Total PCB Mass(ug)	NR (1.2)	0.78(0.94)	*	22
PCB Concentration(ug/m3)	NR (0.0034)	0.0022(0.0026)	*	0.0673
Percent of Allowable(%)	NR (0)	0(0)	*	7
2/13/2006				
Total Volume(m3)	NR (414)	379(452)	142	391
Total PCB Mass(ug)	NR (1.6)	5.5(6.4)	0.91	3.8
PCB Concentration(ug/m3)	NR (0.0039 J)	0.0145(0.0142)	0.0064	0.0097 J
Percent of Allowable(%)	NR (0)	1(1)	1	1
2/20/2006				
Total Volume(m3)	NR (371)	421(NR)	125	415
Total PCB Mass(ug)	NR (2.2)	1.7(NR)	1.3	3.2
PCB Concentration(ug/m3)	NR (0.0059)	0.004(NR)	0.0104	0.0077
Percent of Allowable(%)	NR (1)	0(NR)	1	1
2/27/2006				
Total Volume(m3)	NR (369)	360(402)	113	376
Total PCB Mass(ug)	NR (7.8)	6.6(6.1)	6.4	8.4
PCB Concentration(ug/m3)	NR (0.0211)	0.0183(0.0152)	0.0566	0.0223
Percent of Allowable(%)	NR (2)	2(2)	6	2

TABLE 2.2

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2005 THROUGH APRIL 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

	STATION 1B	*STATION 14*	*STATION 22*	*STATION 23*
Unit_ID	*PUF-7*	*PUF-12(PUF-4)*	*PUF-3*	*PUF-2*
3/6/2006				
Total Volume(m3)	NR (330)	341(399)	117	358
Total PCB Mass(ug)	NR (3.4)	2(2.3)	9.5	7.4
PCB Concentration(ug/m3)	NR (0.0103)	0.0059(0.0058 J)	0.0812	0.0207 J
Percent of Allowable(%)	NR (1)	1(1)	8	2
3/15/2006				
Total Volume(m3)	NR (349)	395(381)	130	367
Total PCB Mass(ug)	NR (14)	4.7(4.7)	8.4	14
PCB Concentration(ug/m3)	NR (0.0401 J)	0.0119 J(0.0123 J)	0.0646 J	0.0381 J
Percent of Allowable(%)	NR (4)	1(1)	6	4
3/20/2006				
Total Volume(m3)	NR (5)	415(401)	119	387
Total PCB Mass(ug)	NR (*)	2.5(0)	12	0
PCB Concentration(ug/m3)	NR (*)	0.006(ND(0.0019))	0.1008	ND(0.0019)
Percent of Allowable(%)	NR (*)	1(--)	10	--
3/29/2006				
Total Volume(m3)	NR (306)	411(396)	129	354
Total PCB Mass(ug)	NR (18)	5(5.2)	7.8	5.9
PCB Concentration(ug/m3)	NR (0.0588)	0.0122(0.0131)	0.0605	0.0167
Percent of Allowable(%)	NR (6)	1(1)	6	2
4/10/2006				
Total Volume(m3)	NR (242)	406(349)	145	335
Total PCB Mass(ug)	NR (75)	4.6(4.3)	4	6
PCB Concentration(ug/m3)	NR (0.3099)	0.0113(0.0123)	0.0276	0.0179
Percent of Allowable(%)	NR (31)	1(1)	3	2
4/11/2006				
Total Volume(m3)	NR (282)	429(0)	125	373
Total PCB Mass(ug)	NR (34)	11(*)	2.7	4.2
PCB Concentration(ug/m3)	NR (0.1206)	0.0256(*)	0.0216	0.0113
Percent of Allowable(%)	NR (12)	3(*)	2	1
4/20/2006				
Total Volume(m3)	247 (NR)	NR(NR)	NR	NR
Total PCB Mass(ug)	34 (NR)	NR(NR)	NR	NR
PCB Concentration(ug/m3)	0.1377 (NR)	NR(NR)	NR	NR
Percent of Allowable(%)	14 (NR)	NR(NR)	NR	NR

Notes:
* - Results not reported due to machine malfunction
NR - No result because machine was not setup
J - Estimated Result

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-3*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
5/19/2006							
Total Volume(m3)	410	454(267)	148	422	474	39	327
Total PCB Mass (ug)	25	4.5(4.5)	22	24	25	*	11
PCB Concentration(ug/m3)	0.061	0.0099(0.0169)	0.1486	0.0569	0.0527	*	0.0336
Percent of Allowable(%)	6	1(2)	15	6	5	*	3
5/22/2006							
Total Volume(m3)	410	386(207)	135	346	425	365	308
Total PCB Mass (ug)	25	3.9(3.9)	34	15	13	4.6	47
PCB Concentration(ug/m3)	0.061	0.0101(0.0188)	0.2519	0.0434 J	0.0306	0.0126	0.1526
Percent of Allowable(%)	6	1(2)	25	4	3	1	15
5/23/2006							
Total Volume(m3)	343	433(188)	124	396	377	417	375
Total PCB Mass (ug)	71	6.3(5.8)	10	12	11	7.9	240
PCB Concentration(ug/m3)	0.207	0.0145(0.0309)	0.0806	0.0303	0.0292	0.0189	0.64
Percent of Allowable(%)	21	1(3)	8	3	3	2	64
5/24/2006							
Total Volume(m3)	421	340(204)	137	324	455	367	431
Total PCB Mass (ug)	370	9.2(9.7)	12	6.1	20	25	38
PCB Concentration(ug/m3)	0.8789	0.0271(0.0475)	0.0876	0.0188	0.044	0.0681	0.0882
Percent of Allowable(%)	88	3(5)	9	2	4	7	9
5/25/2006							
Total Volume(m3)	401	393(217)	108	288	364	394	96
Total PCB Mass (ug)	170	23(24)	5.9	9.9	27	43	*
PCB Concentration(ug/m3)	0.4239	0.0585(0.1106)	0.0546	0.0344	0.0742	0.1091	*
Percent of Allowable(%)	42	6(11)	5	3	7	11	*
5/30/2006							
Total Volume(m3)	440	419(231)	141	389	412	442	399
Total PCB Mass (ug)	380	14(15)	5.1	13	23	25	190
PCB Concentration(ug/m3)	0.8636	0.0334(0.0649)	0.0362	0.0334	0.0558	0.0566	0.4762
Percent of Allowable(%)	86	3(6)	4	3	6	6	48
5/31/2006							
Total Volume(m3)	418	427(236)	121	378	393	429	377
Total PCB Mass (ug)	130	7.5(8.1)	29	19	28	8.6	90
PCB Concentration(ug/m3)	0.311	0.0176(0.0343)	0.2397	0.0503	0.0712	0.02	0.2387
Percent of Allowable(%)	31	2(3)	24	5	7	2	24
6/1/2006							
Total Volume(m3)	431	402(222)	129	381	394	407	383
Total PCB Mass (ug)	110	9.7(8.8)	41	28	47	14	53
PCB Concentration(ug/m3)	0.2552	0.0241 J(0.0396)	0.3178	0.0735	0.1193	0.0344	0.1384
Percent of Allowable(%)	26	2(4)	32	7	12	3	14

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-3*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
6/2/2006							
Total Volume(m3)	444	396(423)	131	381	412	413	385
Total PCB Mass (ug)	47	11(11)	120	26	39	12	500
PCB Concentration(ug/m3)	0.1059	0.0278(0.026)	0.916	0.0682	0.0947	0.0291	1.2987
Percent of Allowable(%)	11	3(3)	92	7	9	3	130
6/5/2006							
Total Volume(m3)	435	436(422)	146	389	411	441	392
Total PCB Mass (ug)	38	9.1(9.3)	39	13	15	9.8	510
PCB Concentration(ug/m3)	0.0874	0.0209 J(0.022 J)	0.2671	0.0334	0.0365	0.0222	1.301
Percent of Allowable(%)	9	2(2)	27	3	4	2	130
6/6/2006							
Total Volume(m3)	434	426(441)	132	375	390	378	339
Total PCB Mass (ug)	750	19(20)	8.2	13	11	56	87
PCB Concentration(ug/m3)	1.7281	0.0446 J(0.0454 J)	0.0621	0.0347	0.0282	0.1481	0.2566
Percent of Allowable(%)	173	4(5)	6	3	3	15	26
6/7/2006							
Total Volume(m3)	411	0(339)	128	340	369	411	137
Total PCB Mass (ug)	460	*(12)	24	46	72	33	*
PCB Concentration(ug/m3)	1.1192	*(0.0354)	0.1875	0.1353	0.1951	0.0803	*
Percent of Allowable(%)	112	*(4)	19	14	20	8	*
6/8/2006							
Total Volume(m3)	411	379(385)	131	305	423	162	382
Total PCB Mass (ug)	110	18(14)	95	21	35	*	490
PCB Concentration(ug/m3)	0.2676	0.0475(0.0364)	0.7252	0.0689	0.0827	*	1.2827
Percent of Allowable(%)	27	5(4)	73	7	8	*	128
6/9/2006							
Total Volume(m3)	403	377(407)	125	319	383	407	363
Total PCB Mass (ug)	53	6.2(6)	99	10	8.4	7.2	280
PCB Concentration(ug/m3)	0.1315	0.0164(0.0147)	0.792	0.0313	0.0219	0.0177	0.7713
Percent of Allowable(%)	13	2(1)	79	3	2	2	77
6/10/2006							
Total Volume(m3)	166	378(403)	50	142	157	98	148
Total PCB Mass (ug)	*	0.67(2.6)	*	*	*	*	*
PCB Concentration(ug/m3)	*	0.0018 J(0.0065 J)	*	*	*	*	*
Percent of Allowable(%)	*	0(1)	*	*	*	*	*
6/12/2006							
Total Volume(m3)	508	NR(435)	139	435	480	1	417
Total PCB Mass (ug)	28	NR(3.3)	170	23	22	*	230
PCB Concentration(ug/m3)	0.0551	NR(0.0076)	1.223	0.0529	0.0458	*	0.5516
Percent of Allowable(%)	6	NR(1)	122	5	5	*	55

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICATIONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit_ID	*STATION 1B* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-3*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
6/14/2006							
Total Volume(m3)	370	417(392)	107	321	350	394	348
Total PCB Mass (ug)	58	8.9(8.5)	250	47	210	13	430
PCB Concentration(ug/m3)	0.1568	0.0213(0.0217)	2.3364	0.1464	0.6	0.033	1.2356
Percent of Allowable(%)	16	2(2)	234	15	60	3	124
6/15/2006							
Total Volume(m3)	412	417(387)	122	137	351	400	379
Total PCB Mass (ug)	750	6(7.2)	13	*	12	12	630
PCB Concentration(ug/m3)	1.8204	0.0144(0.0186)	0.1066	*	0.0342	0.03	1.6623
Percent of Allowable(%)	182	1(2)	11	*	3	3	166
6/16/2006							
Total Volume(m3)	390	424(368)	121	3	315	398	365
Total PCB Mass (ug)	1300	13(12)	15	*	24	24	1200
PCB Concentration(ug/m3)	3.3333 J	0.0307 J(0.0326 J)	0.124 J	*	0.0762 J	0.0603 J	3.2877 J
Percent of Allowable(%)	333	3(3)	12	*	8	6	329
6/17/2006							
Total Volume(m3)	474	468(406)	131	394	402	444	360
Total PCB Mass (ug)	830	32(33)	6.5	11	19	140	76
PCB Concentration(ug/m3)	1.7511 J	0.0684 J(0.0813 J)	0.0496 J	0.0279 J	0.0473 J	0.3153 J	0.2111 J
Percent of Allowable(%)	175	7(8)	5	3	5	32	21
6/19/2006							
Total Volume(m3)	417	423(367)	126	327	340	413	363
Total PCB Mass (ug)	300	12(11)	21	40	28	33	200
PCB Concentration(ug/m3)	0.7194	0.0284(0.03)	0.1667	0.1223	0.0824	0.0799	0.551
Percent of Allowable(%)	72	3(3)	17	12	8	8	55
6/20/2006							
Total Volume(m3)		417(374)	135	363	349	411	360
Total PCB Mass (ug)		19(330)	34	14	68	78	130
PCB Concentration(ug/m3)		0.0456 J(0.8824 J)	0.2519	0.0386	0.1948	0.1898	0.3611
Percent of Allowable(%)		5(88)	25	4	19	19	36

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
6/21/2006							
Total Volume(m3)	168	412(369)	344	369	396	390	352
Total PCB Mass(ug)	11	71(72)	7.6	30	24	89	6
PCB Concentration(ug/m3)	0.0655	0.1723(0.1951)	0.0221	0.0813	0.0606	0.2282	0.017
Percent of Allowable(%)	7	17(20)	2	8	6	23	2
6/22/2006							
Total Volume(m3)	214	428(371)	358	366	363	420	373
Total PCB Mass(ug)	56	9.5(9.7)	170	50	49	17	67
PCB Concentration(ug/m3)	0.2617	0.0222(0.0261)	0.4749	0.1366	0.135	0.0405	0.1796
Percent of Allowable(%)	26	2(3)	47	14	14	4	18
6/23/2006							
Total Volume(m3)	205	425(367)	296	157	314	405	338
Total PCB Mass(ug)	18	5.9(6)	310	*	27	9.2	190
PCB Concentration(ug/m3)	0.0878	0.0139(0.0163)	1.0473	*	0.086	0.0227	0.5621
Percent of Allowable(%)	9	1(2)	105	*	9	2	56
6/24/2006							
Total Volume(m3)	213	435(NR)	350	417	388	406	372
Total PCB Mass(ug)	18	6.7(NR)	320	8.2	32	11	370
PCB Concentration(ug/m3)	0.0845	0.0154(NR)	0.9143	0.0197	0.0825	0.0271	0.9946
Percent of Allowable(%)	8	2(NR)	91	2	8	3	99
6/26/2006							
Total Volume(m3)	200	424(432)	364		367	412	363
Total PCB Mass(ug)	65	7.9(8.3)	100		68	13	190
PCB Concentration(ug/m3)	0.325	0.0186(0.0192)	0.2747		0.1853	0.0316	0.5234
Percent of Allowable(%)	32	2(2)	27		19	3	52
6/27/2006							
Total Volume(m3)	215	397(426)	348		389	398	375
Total PCB Mass(ug)	18	7.4(7.1)	17		180	12	34
PCB Concentration(ug/m3)	0.0837	0.0186(0.0167)	0.0489		0.4627	0.0302	0.0907
Percent of Allowable(%)	8	2(2)	5		46	3	9
6/28/2006							
Total Volume(m3)	229	404(435)	361	316	390	411	360
Total PCB Mass(ug)	56	8.8(8.3)	200	100	65	17	130
PCB Concentration(ug/m3)	0.2445	0.0218(0.0191)	0.554	0.3165	0.1667	0.0414	0.3611
Percent of Allowable(%)	24	2(2)	55	32	17	4	36
6/29/2006							
Total Volume(m3)	215	421(451)	362	335	391	404	362
Total PCB Mass(ug)	52	7.3(7.5)	190	23	160	12	360
PCB Concentration(ug/m3)	0.2419	0.0173(0.0166)	0.5249	0.0687	0.4092	0.0297	0.9945
Percent of Allowable(%)	24	2(2)	52	7	41	3	99
6/30/2006							
Total Volume(m3)	512	407(437)	424	374	457	421	435
Total PCB Mass(ug)	240	11(11)	20	17	23	37	220
PCB Concentration(ug/m3)	0.4688	0.027(0.0252)	0.0472	0.0455	0.0503	0.0879	0.5057
Percent of Allowable(%)	47	3(3)	5	5	5	9	51
7/3/2006							
Total Volume(m3)	468	477(426)	384	412	446	1	416
Total PCB Mass(ug)	6.4	31(31)	10	65	51	*	4.7
PCB Concentration(ug/m3)	0.0137 J	0.065(0.0728)	0.026	0.1578	0.1143	*	0.0113
Percent of Allowable(%)	1	6(7)	3	16	11	*	1

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
7/5/2006							
Total Volume(m3)	369	428(271)	336	369	389	0	363
Total PCB Mass(ug)	7.2	3.2(1.9)	430	15	14	*	27
PCB Concentration(ug/m3)	0.0195	0.0075(0.007)	1.2798	0.0407	0.036	*	0.0744
Percent of Allowable(%)	2	1(1)	128	4	4	*	7
7/6/2006							
Total Volume(m3)	475	431(208)	405	348	345	362	395
Total PCB Mass(ug)	10	3.9(2.4)	650	9.9	35	8.9	320
PCB Concentration(ug/m3)	0.0211	0.009(0.0115)	1.6049	0.0284	0.1014	0.0246	0.8101
Percent of Allowable(%)	2	1(1)	160	3	10	2	81
7/7/2006							
Total Volume(m3)	403	420(353)	340	376	373	298	337
Total PCB Mass(ug)	14	4.2(4.8)	420	11	60	8.3	480
PCB Concentration(ug/m3)	0.0347	0.01(0.0136)	1.2353	0.0293	0.1609	0.0279	1.4243
Percent of Allowable(%)	3	1(1)	124	3	16	3	142
7/8/2006							
Total Volume(m3)	470	437(467)	360	366	414	303	396
Total PCB Mass(ug)	120	6.1(5.3)	63	5.7	17	8.8	430
PCB Concentration(ug/m3)	0.2553 J	0.014 J(0.0113 J)	0.175 J	0.0156 J	0.0411 J	0.029 J	1.0859 J
Percent of Allowable(%)	26	1(1)	18	2	4	3	109
7/10/2006							
Total Volume(m3)	427	379(436)	356	335	389	385	372
Total PCB Mass(ug)	350	46(45)	8.8	40	32	130	170
PCB Concentration(ug/m3)	0.8197	0.1214(0.1032)	0.0247	0.1194	0.0823	0.3377	0.457
Percent of Allowable(%)	82	12(10)	2	12	8	34	46
7/17/2006							
Total Volume(m3)	421	401(430)	359	345	393	6	366
Total PCB Mass(ug)	380	24(22)	280	49	85	*	450
PCB Concentration(ug/m3)	0.9026	0.0599(0.0512)	0.7799	0.142	0.2163	*	1.2295
Percent of Allowable(%)	90	6(5)	78	14	22	*	123
7/18/2006							
Total Volume(m3)	409	379(407)	339	264	373	274	342
Total PCB Mass(ug)	56	11(8.9)	730	19	37	11	330
PCB Concentration(ug/m3)	0.1369	0.029(0.0219)	2.1534	0.072	0.0992	0.0401	0.9649
Percent of Allowable(%)	14	3(2)	215	7	10	4	96
7/19/2006							
Total Volume(m3)	435	392(421)	350	274	385	381	353
Total PCB Mass(ug)	550	12(10)	300	8.2	69	30	750
PCB Concentration(ug/m3)	1.2644	0.0306(0.0238)	0.8571	0.0299	0.1792	0.0787	2.1246
Percent of Allowable(%)	126	3(2)	86	3	18	8	212
7/20/2006							
Total Volume(m3)	425	371(399)	381	255	407	359	348
Total PCB Mass(ug)	220	19(18)	220	27	170	56	430
PCB Concentration(ug/m3)	0.5176	0.0512(0.0451)	0.5774	0.1059	0.4177	0.156	1.2356
Percent of Allowable(%)	52	5(5)	58	11	42	16	124
7/21/2006							
Total Volume(m3)	391	366(393)	338	277	371	355	324
Total PCB Mass(ug)	140	15(15)	270	71	570	59	170
PCB Concentration(ug/m3)	0.3581	0.041(0.0382)	0.7988	0.2563	1.5364	0.1662	0.5247
Percent of Allowable(%)	36	4(4)	80	26	154	17	52

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	STATION 1C PUF-16	STATION 14 PUF-4(PUF-12)	STATION 22B PUF-18	STATION 23 PUF-2	STATION 29 PUF-5	STATION 30 PUF-17	STATION 31 PUF-6
7/22/2006							
Total Volume(m3)	525	473(507)	448	357	469	451	405
Total PCB Mass(ug)	26	5.8(5.5)	670	55	530	11	75
PCB Concentration(ug/m3)	0.0495	0.0123(0.0108)	1.4955	0.1541	1.1301	0.0244	0.1852
Percent of Allowable(%)	5	1(1)	150	15	113	2	19
7/24/2006							
Total Volume(m3)	386	351(364)	352	262	372	331	347
Total PCB Mass(ug)	65	19(20)	93	120	240	31	660
PCB Concentration(ug/m3)	0.1684	0.0541(0.0549)	0.2642	0.458	0.6452	0.0937	1.902
Percent of Allowable(%)	17	5(5)	26	46	65	9	190
7/25/2006							
Total Volume(m3)	424	372(415)	382	256	400	358	352
Total PCB Mass(ug)	560	29(28)	21	91	160	180	83
PCB Concentration(ug/m3)	1.3208	0.078(0.0675)	0.055	0.3555	0.4	0.5028	0.2358
Percent of Allowable(%)	132	8(7)	6	36	40	50	24
7/26/2006							
Total Volume(m3)	445	422(421)	378	259	431	385	374
Total PCB Mass(ug)	42	180(180)	8.9	33	30	420	8.4
PCB Concentration(ug/m3)	0.0944	0.4265(0.4276)	0.0235 J	0.1274	0.0696	1.0909	0.0225 J
Percent of Allowable(%)	9	43(43)	2	13	7	109	2
7/28/2006							
Total Volume(m3)	421	418(431)	354	271	402	389	382
Total PCB Mass(ug)	59	50(48)	5.2	82	17	110	7.7
PCB Concentration(ug/m3)	0.1401	0.1196(0.1114)	0.0147	0.3026	0.0423	0.2828	0.0202
Percent of Allowable(%)	14	12(11)	1	30	4	28	2
7/29/2006							
Total Volume(m3)	435	417(433)	352	270	401	375	381
Total PCB Mass(ug)	210	24(24)	27	97	340	70	260
PCB Concentration(ug/m3)	0.4828	0.0576(0.0554)	0.0767	0.3593	0.8479	0.1867	0.6824
Percent of Allowable(%)	48	6(6)	8	36	85	19	68
7/31/2006							
Total Volume(m3)	373	384(412)	281	299	381	386	344
Total PCB Mass(ug)	520	44(36)	16	70	31	120	170
PCB Concentration(ug/m3)	1.3941 J	0.1146(0.0874)	0.0569	0.2341	0.0814	0.3109	0.4942
Percent of Allowable(%)	139	11(9)	6	23	8	31	49
8/1/2006							
Total Volume(m3)	452	421(450)	304	325	446	421	411
Total PCB Mass(ug)	360	61(53)	16	160	66	170	32
PCB Concentration(ug/m3)	0.7965	0.1449(0.1178)	0.0526	0.4923	0.148	0.4038	0.0779
Percent of Allowable(%)	80	14(12)	5	49	15	40	8
8/2/2006							
Total Volume(m3)	432	436(466)	310	347	423	402	392
Total PCB Mass(ug)	15	130(120)	7.9	160	36	290	6.6
PCB Concentration(ug/m3)	0.0347	0.2982(0.2575)	0.0255	0.4611	0.0851	0.7214	0.0168
Percent of Allowable(%)	3	30(26)	3	46	9	72	2
8/3/2006							
Total Volume(m3)	448	429(429)	288	332	409	443	368
Total PCB Mass(ug)	14	14(14)	250	190	460	32	5.9
PCB Concentration(ug/m3)	0.0312	0.0326(0.0326)	0.8681 J	0.5723	1.1247	0.0722	0.016
Percent of Allowable(%)	3	3(3)	87	57	112	7	2

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
8/4/2006							
Total Volume(m3)	427	387(430)	306	329	441	403	429
Total PCB Mass(ug)	20	8.2(9.3)	790	21	36	21	170
PCB Concentration(ug/m3)	0.0468	0.0212(0.0216)	2.5817 J	0.0638	0.0816	0.0521	0.3963
Percent of Allowable(%)	5	2(2)	258	6	8	5	40
8/5/2006							
Total Volume(m3)	505	458(489)	349	360	506	477	492
Total PCB Mass(ug)	37	46(22)	400	20	17	26	1000
PCB Concentration(ug/m3)	0.0733	0.1004 J(0.045 J)	1.1461	0.0556	0.0336	0.0545	2.0325
Percent of Allowable(%)	7	10(4)	115	6	3	5	203
8/7/2006							
Total Volume(m3)	436	462(462)	312	340	435	421	399
Total PCB Mass(ug)	24	9.9(9.3)	460	82	250	23	68
PCB Concentration(ug/m3)	0.055	0.0214(0.0201)	1.4744 J	0.2412	0.5747	0.0546	0.1704
Percent of Allowable(%)	6	2(2)	147	24	57	5	17
8/8/2006							
Total Volume(m3)	356	359(382)	266	261	366	334	323
Total PCB Mass(ug)	73	9.3(10)	300	25	110	19	430
PCB Concentration(ug/m3)	0.2051	0.0259(0.0262)	1.1278	0.0958	0.3005	0.0569	1.3313 J
Percent of Allowable(%)	21	3(3)	113	10	30	6	133
8/9/2006							
Total Volume(m3)	432	424(452)	389	365	432	395	409
Total PCB Mass(ug)	140	19(20)	190	34	130	59	380
PCB Concentration(ug/m3)	0.3241	0.0448(0.0442)	0.4884	0.0932	0.3009	0.1494	0.9291
Percent of Allowable(%)	32	4(4)	49	9	30	15	93
8/10/2006							
Total Volume(m3)	422	427(426)	344	327	375	373	349
Total PCB Mass(ug)	91	18(19)	180	26	120	36	110
PCB Concentration(ug/m3)	0.2156	0.0422(0.0446)	0.5233	0.0795	0.32	0.0965	0.3152
Percent of Allowable(%)	22	4(4)	52	8	32	10	32
8/11/2006							
Total Volume(m3)	431	446(460)	360	340	408	402	374
Total PCB Mass(ug)	19	5(5.5)	320	9.6	18	17	220
PCB Concentration(ug/m3)	0.0441	0.0112(0.012)	0.8889 J	0.0282	0.0441	0.0423	0.5882
Percent of Allowable(%)	4	1(1)	89	3	4	4	59
8/12/2006							
Total Volume(m3)	514	506(523)	448	401	504	472	408
Total PCB Mass(ug)	26	6.2(6.7)	390	11	42	24	220
PCB Concentration(ug/m3)	0.0506	0.0123(0.0128)	0.8705	0.0274	0.0833	0.0508	0.5392
Percent of Allowable(%)	5	1(1)	87	3	8	5	54
8/14/2006							
Total Volume(m3)	435	418(411)	363	334	409	391	52
Total PCB Mass(ug)	15	8.6(12)	170	82	200	29	*
PCB Concentration(ug/m3)	0.0345	0.0206(0.0292)	0.4683	0.2455	0.489	0.0742	*
Percent of Allowable(%)	3	2(3)	47	25	49	7	*
8/15/2006							
Total Volume(m3)	440	425(NR)	373	337	417	399	121
Total PCB Mass(ug)	14	8.1(NR)	390	20	42	32	*
PCB Concentration(ug/m3)	0.0318	0.0191(NR)	1.0456 J	0.0593	0.1007	0.0802	*
Percent of Allowable(%)	3	2(NR)	105	6	10	8	*

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	STATION 1C PUF-16	STATION 14 PUF-4(PUF-12)	STATION 22B PUF-18	STATION 23 PUF-2	STATION 29 PUF-5	STATION 30 PUF-17	STATION 31 PUF-6
8/16/2006							
Total Volume(m3)	430	333(359)	348	334	424	393	288
Total PCB Mass(ug)	18	6.2(7)	280	15	36	31	6.4
PCB Concentration(ug/m3)	0.0419	0.0186(0.0195)	0.8046 J	0.0449	0.0849	0.0789	0.0222
Percent of Allowable(%)	4	2(2)	80	4	8	8	2
8/17/2006							
Total Volume(m3)	221	412(412)	186	335	416	397	72
Total PCB Mass(ug)	*	110(1.3)	*	15	14	57	*
PCB Concentration(ug/m3)	*	0.267 J(0.0032 J)	*	0.0448	0.0337	0.1436	*
Percent of Allowable(%)	*	27(0)	*	4	3	14	*
8/18/2006							
Total Volume(m3)	232	426(413)	199	336	439	389	208
Total PCB Mass(ug)	*	14(12)	*	31	85	25	*
PCB Concentration(ug/m3)	*	0.0329(0.0291)	*	0.0923	0.1936	0.0643	*
Percent of Allowable(%)	*	3(3)	*	9	19	6	*
8/19/2006							
Total Volume(m3)	196	383(396)	182	333	392	365	191
Total PCB Mass(ug)	*	8.8(9.3)	*	68	140	23	*
PCB Concentration(ug/m3)	*	0.023(0.0235)	*	0.2042	0.3571	0.063	*
Percent of Allowable(%)	*	2(2)	*	20	36	6	*
8/21/2006							
Total Volume(m3)	487	440(426)	384	369	435	423	430
Total PCB Mass(ug)	36	7.2(6.5)	280	13	29	23	110
PCB Concentration(ug/m3)	0.0739	0.0164(0.0153)	0.7292 J	0.0352	0.0667	0.0544	0.2558
Percent of Allowable(%)	7	2(2)	73	4	7	5	26
8/22/2006							
Total Volume(m3)	464	418(416)	380	358	426	399	378
Total PCB Mass(ug)	18	8.3(8.9)	270	20	38	25	140
PCB Concentration(ug/m3)	0.0388	0.0199(0.0214)	0.7105 J	0.0559	0.0892	0.0627	0.3704 J
Percent of Allowable(%)	4	2(2)	71	6	9	6	37
8/23/2006							
Total Volume(m3)	467	450(449)	386	364	417	417	373
Total PCB Mass(ug)	69	16(16)	170	14	46	30	240
PCB Concentration(ug/m3)	0.1478	0.0356(0.0356)	0.4404 J	0.0385	0.1103	0.0719	0.6434
Percent of Allowable(%)	15	4(4)	44	4	11	7	64
8/24/2006							
Total Volume(m3)	423	443(414)	378	330	424	380	359
Total PCB Mass(ug)	150	13(13)	110	6.3	20	34	210
PCB Concentration(ug/m3)	0.3546	0.0293(0.0314)	0.291 J	0.0191	0.0472	0.0895	0.585 J
Percent of Allowable(%)	35	3(3)	29	2	5	9	58
8/25/2006							
Total Volume(m3)	426	457(427)	358	353	405	396	374
Total PCB Mass(ug)	220	25(23)	48	16	18	62	250
PCB Concentration(ug/m3)	0.5164 J	0.0547(0.0539)	0.1341	0.0453	0.0444	0.1566	0.6684 J
Percent of Allowable(%)	52	5(5)	13	5	4	16	67
8/26/2006							
Total Volume(m3)	524	515(465)	442	397	499	433	441
Total PCB Mass(ug)	220	14(12)	46	35	72	96	66
PCB Concentration(ug/m3)	0.4198	0.0272(0.0258)	0.1041	0.0882	0.1443	0.2217	0.1497
Percent of Allowable(%)	42	3(3)	10	9	14	22	15

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
8/29/2006							
Total Volume(m3)	418	432(419)	365	342	413	406	362
Total PCB Mass(ug)	12	3.9(3.8)	100	48	270	7.2	6.4
PCB Concentration(ug/m3)	0.0287	0.009(0.0091)	0.274	0.1404	0.6538	0.0177	0.0177
Percent of Allowable(%)	3	1(1)	27	14	65	2	2
8/30/2006							
Total Volume(m3)	450	448(404)	383	327	430	392	383
Total PCB Mass(ug)	29	3.4(3.4)	190	14	70	7.5	73
PCB Concentration(ug/m3)	0.0644	0.0076(0.0084)	0.4961	0.0428	0.1628	0.0191	0.1906
Percent of Allowable(%)	6	1(1)	50	4	16	2	19
8/31/2006							
Total Volume(m3)	467	449(376)	395	358	445	382	375
Total PCB Mass(ug)	5.2	1.6(0.6)	210	11	16	3.3	32
PCB Concentration(ug/m3)	0.0111	0.0036 J(0.0016 J)	0.5316	0.0307	0.036	0.0086	0.0853
Percent of Allowable(%)	1	0(0)	53	3	4	1	9
9/5/2006							
Total Volume(m3)	412	420(NR)	387	356	452	415	400
Total PCB Mass(ug)	11	4.1(NR)	300	17	84	15	12
PCB Concentration(ug/m3)	0.0267	0.0098(NR)	0.7752 J	0.0478	0.1858	0.0361	0.03
Percent of Allowable(%)	3	1(NR)	78	5	19	4	3
9/6/2006							
Total Volume(m3)	422	416(347)	410	358	430	406	381
Total PCB Mass(ug)	45	9.8(9.3)	210	19	96	26	300
PCB Concentration(ug/m3)	0.1066	0.0236(0.0268)	0.5122 J	0.0531	0.2233	0.064	0.7874 J
Percent of Allowable(%)	11	2(3)	51	5	22	6	79
9/7/2006							
Total Volume(m3)	450	406(397)	369	347	414	393	389
Total PCB Mass(ug)	110	9(8.8)	150	9.9	26	24	340
PCB Concentration(ug/m3)	0.2444	0.0222(0.0222)	0.4065 J	0.0285	0.0628	0.0611	0.874 J
Percent of Allowable(%)	24	2(2)	41	3	6	6	87
9/8/2006							
Total Volume(m3)	492	434(449)	404	367	456	430	395
Total PCB Mass(ug)	110	18(17)	210	12	45	36	570
PCB Concentration(ug/m3)	0.2236	0.0415(0.0379)	0.5198	0.0327	0.0987	0.0837	1.443 J
Percent of Allowable(%)	22	4(4)	52	3	10	8	144
9/9/2006							
Total Volume(m3)	543	468(502)	464	432	499	0	464
Total PCB Mass(ug)	110	17(15)	260	17	80	*	680
PCB Concentration(ug/m3)	0.2026	0.0363(0.0299 J)	0.5603	0.0394	0.1603	*	1.4655
Percent of Allowable(%)	20	4(3)	56	4	16	*	147
9/11/2006							
Total Volume(m3)	499	424(427)	391	367	415	423	386
Total PCB Mass(ug)	380	14(16)	37	8.2	27	42	210
PCB Concentration(ug/m3)	0.7615	0.033(0.0375)	0.0946	0.0223	0.0651	0.0993	0.544
Percent of Allowable(%)	76	3(4)	9	2	7	10	54
9/14/2006							
Total Volume(m3)	481	442(455)	392	399	466	442	414
Total PCB Mass(ug)	23	7.8(11)	200	41	120	38	83
PCB Concentration(ug/m3)	0.0478	0.0176(0.0242)	0.5102	0.1028	0.2575	0.086	0.2005
Percent of Allowable(%)	5	2(2)	51	10	26	9	20

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
9/15/2006							
Total Volume(m3)	538	435(404)	418	375	452	413	431
Total PCB Mass(ug)	120	8.8(8.7)	140	12	36	34	590
PCB Concentration(ug/m3)	0.223	0.0202(0.0215)	0.3349 J	0.032	0.0796	0.0823	1.3689 J
Percent of Allowable(%)	22	2(2)	33	3	8	8	137
9/16/2006							
Total Volume(m3)	487	454(485)	439	426	466	457	433
Total PCB Mass(ug)	340	10(11)	68	5.7	12	62	180
PCB Concentration(ug/m3)	0.6982	0.022(0.0227)	0.1549	0.0134	0.0258	0.1357	0.4157
Percent of Allowable(%)	70	2(2)	15	1	3	14	42
9/18/2006							
Total Volume(m3)	454	429(458)	388	354	383	358	401
Total PCB Mass(ug)	7.9	3(2.9)	13	27	54	4.7	2.8
PCB Concentration(ug/m3)	0.0174	0.007(0.0063)	0.0335	0.0763	0.141	0.0131	0.007
Percent of Allowable(%)	2	1(1)	3	8	14	1	1
9/19/2006							
Total Volume(m3)	469	429(442)	402	331	441	403	416
Total PCB Mass(ug)	4.4	1(1)	2.8	38	130	2.2	1.7
PCB Concentration(ug/m3)	0.0094	0.0023(0.0023)	0.007	0.1148	0.2948	0.0055	0.0041
Percent of Allowable(%)	1	0(0)	1	11	29	1	0
9/20/2006							
Total Volume(m3)	470	432(462)	414	343	458	433	403
Total PCB Mass(ug)	21	3.4(3.7)	74	16	50	12	66
PCB Concentration(ug/m3)	0.0447	0.0079(0.008)	0.1787	0.0466	0.1092	0.0277	0.1638
Percent of Allowable(%)	4	1(1)	18	5	11	3	16
9/21/2006							
Total Volume(m3)	477	424(436)	406	338	448	407	408
Total PCB Mass(ug)	180	2.3(2.2)	18	4.5	6.7	10	230
PCB Concentration(ug/m3)	0.3774	0.0054(0.005)	0.0443	0.0133	0.015	0.0246	0.5637
Percent of Allowable(%)	38	1(0)	4	1	2	2	56
9/25/2006							
Total Volume(m3)	472	424(437)	409	342	443	424	393
Total PCB Mass(ug)	16	8.8(9.2)	21	26	31	26	55
PCB Concentration(ug/m3)	0.0339	0.0208(0.0211)	0.0513	0.076	0.07	0.0613	0.1399
Percent of Allowable(%)	3	2(2)	5	8	7	6	14
9/26/2006							
Total Volume(m3)	485	419(434)	380	335	428	424	399
Total PCB Mass(ug)	180	15(15)	9.9	9.9	13	66	11
PCB Concentration(ug/m3)	0.3711	0.0358(0.0346)	0.0261	0.0296	0.0304	0.1557	0.0276
Percent of Allowable(%)	37	4(3)	3	3	3	16	3
9/27/2006							
Total Volume(m3)	441	425(411)	416	325	406	413	416
Total PCB Mass(ug)	14	28(26)	21	30	80	61	8.7
PCB Concentration(ug/m3)	0.0317	0.0659(0.0633)	0.0505	0.0923	0.197	0.1477	0.0209
Percent of Allowable(%)	3	7(6)	5	9	20	15	2
9/28/2006							
Total Volume(m3)	495	460(459)	427	343	454	442	419
Total PCB Mass(ug)	13	3.8(3.8)	41	26	76	11	28
PCB Concentration(ug/m3)	0.0263	0.0083(0.0083)	0.096	0.0758	0.1674	0.0249	0.0668
Percent of Allowable(%)	3	1(1)	10	8	17	2	7

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	STATION 1C PUF-16	STATION 14 PUF-4(PUF-12)	STATION 22B PUF-18	STATION 23 PUF-2	STATION 29 PUF-5	STATION 30 PUF-17	STATION 31 PUF-6
9/29/2006							
Total Volume(m3)	465	420(433)	410	306	443	408	390
Total PCB Mass(ug)	72	18(17)	5	9.9	13	34	5.9
PCB Concentration(ug/m3)	0.1548	0.0429(0.0393)	0.0122	0.0324	0.0293	0.0833	0.0151
Percent of Allowable(%)	15	4(4)	1	3	3	8	2
9/30/2006							
Total Volume(m3)	538	475(490)	453	360	497	463	433
Total PCB Mass(ug)	11	17(18)	15	12	18	23	4.8
PCB Concentration(ug/m3)	0.0204	0.0358(0.0367)	0.0331	0.0333	0.0362	0.0497	0.0111
Percent of Allowable(%)	2	4(4)	3	3	4	5	1
10/2/2006							
Total Volume(m3)	500	403(431)	435	373	467	403	420
Total PCB Mass(ug)	140	25(23)	36	5.9	18	99	32
PCB Concentration(ug/m3)	0.28	0.062(0.0534)	0.0828	0.0158	0.0385	0.2457	0.0762
Percent of Allowable(%)	28	6(5)	8	2	4	25	8
10/4/2006							
Total Volume(m3)	436	418(432)	398	378	428	416	410
Total PCB Mass(ug)	12	26(24)	57	25	25	77	9.9
PCB Concentration(ug/m3)	0.0275	0.0622(0.0556)	0.1432	0.0661	0.0584	0.1851	0.0241
Percent of Allowable(%)	3	6(6)	14	7	6	19	2
10/5/2006							
Total Volume(m3)	443	456(456)	407	385	463	423	375
Total PCB Mass(ug)	2.6	1.4(1.6)	110	2.6	4.7	13	3.5
PCB Concentration(ug/m3)	0.0059	0.0031(0.0035)	0.2703	0.0068	0.0102	0.0307	0.0093
Percent of Allowable(%)	1	0(0)	27	1	1	3	1
10/6/2006							
Total Volume(m3)	422	418(417)	400	366	432	391	378
Total PCB Mass(ug)	10	2.9(3.1)	82	6.1	7.5	25	49
PCB Concentration(ug/m3)	0.0237	0.0069(0.0074)	0.205	0.0167	0.0174	0.0639	0.1296
Percent of Allowable(%)	2	1(1)	20	2	2	6	13
10/7/2006							
Total Volume(m3)	529	495(444)	487	431	530	484	454
Total PCB Mass(ug)	27	7.5(7.1)	76	8.3	36	34	160
PCB Concentration(ug/m3)	0.051	0.0152(0.016)	0.1561	0.0193	0.0679	0.0702	0.3524
Percent of Allowable(%)	5	2(2)	16	2	7	7	35
10/9/2006							
Total Volume(m3)	412	401(371)	418	370	437	416	387
Total PCB Mass(ug)	87	20(17)	73	20	50	49	300
PCB Concentration(ug/m3)	0.2112	0.0499(0.0458)	0.1746	0.0541	0.1144	0.1178	0.7752
Percent of Allowable(%)	21	5(5)	17	5	11	12	78
10/10/2006							
Total Volume(m3)	439	408(365)	415	363	436	398	370
Total PCB Mass(ug)	170	34(30)	15	7.8	13	99	24
PCB Concentration(ug/m3)	0.3872	0.0833(0.0822)	0.0361	0.0215	0.0298	0.2487	0.0649
Percent of Allowable(%)	39	8(8)	4	2	3	25	6
10/11/2006							
Total Volume(m3)	411	398(341)	400	350	424	386	364
Total PCB Mass(ug)	3.9	22(22)	2.9	23	39	29	1.3
PCB Concentration(ug/m3)	0.0095	0.0553(0.0645)	0.0072	0.0657	0.092	0.0751	0.0036
Percent of Allowable(%)	1	6(6)	1	7	9	8	0

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C PUF-16*	*STATION 14 PUF-4(PUF-12)*	*STATION 22B PUF-18*	*STATION 23 PUF-2*	*STATION 29 PUF-5*	*STATION 30 PUF-17*	*STATION 31 PUF-6*
10/12/2006							
Total Volume(m3)	410	403(375)	345	361	437	410	285
Total PCB Mass(ug)	1.5	5(5.9)	2.6	13	9.5	11	0.8
PCB Concentration(ug/m3)	0.0037	0.0124(0.0157)	0.0075	0.036	0.0217	0.0268	0.0028
Percent of Allowable(%)	0	1(2)	1	4	2	3	0
10/13/2006							
Total Volume(m3)	455	410(366)	353	345	450	405	373
Total PCB Mass(ug)	1.5	4(4.1)	2.6	11	10	2.7	0.9
PCB Concentration(ug/m3)	0.0033	0.0098(0.0112)	0.0074	0.0319	0.0222	0.0067	0.0024
Percent of Allowable(%)	0	1(1)	1	3	2	1	0
10/14/2006							
Total Volume(m3)	449	381(340)	355	335	449	385	186
Total PCB Mass(ug)	11	3.5(3.6)	9.1	17	21	13	48
PCB Concentration(ug/m3)	0.0245	0.0092(0.0106)	0.0256	0.0507	0.0468	0.0338	0.2581
Percent of Allowable(%)	2	1(1)	3	5	5	3	26
10/16/2006							
Total Volume(m3)	447	404(347)	352	349	410	408	190
Total PCB Mass(ug)	110	12(11)	3.7	3.8	4.2	27	49
PCB Concentration(ug/m3)	0.2461	0.0297(0.0317)	0.0105	0.0109	0.0102	0.0662	0.2579
Percent of Allowable(%)	25	3(3)	1	1	1	7	26
10/17/2006							
Total Volume(m3)	421	411(341)	316	314	402	372	200
Total PCB Mass(ug)	45	7.5(7.8)	4.5	30	24	15	9.8
PCB Concentration(ug/m3)	0.1069	0.0182(0.0229)	0.0142	0.0955	0.0597	0.0403	0.049
Percent of Allowable(%)	11	2(2)	1	10	6	4	5
10/18/2006							
Total Volume(m3)	466	478(363)	355	331	413	393	207
Total PCB Mass(ug)	200	12(11)	16	26	58	28	98
PCB Concentration(ug/m3)	0.4292	0.0251(0.0303)	0.0451	0.0785	0.1404	0.0712	0.4734
Percent of Allowable(%)	43	3(3)	5	8	14	7	47
10/19/2006							
Total Volume(m3)	447	463(336)	352	321	411	387	184
Total PCB Mass(ug)	2.4	0.6(0)	13	11	46	1.3	1.4
PCB Concentration(ug/m3)	0.0054	0.0013(ND(0.0015))	0.0369	0.0343	0.1119	0.0034	0.0076
Percent of Allowable(%)	1	0(--)	4	3	11	0	1
10/20/2006							
Total Volume(m3)	476	495(375)	338	327	440	461	218
Total PCB Mass(ug)	37	5.4(5.1)	3.1	9.5	13	17	4
PCB Concentration(ug/m3)	0.0777	0.0109(0.0136)	0.0092	0.0291	0.0295	0.0369	0.0183
Percent of Allowable(%)	8	1(1)	1	3	3	4	2
10/21/2006							
Total Volume(m3)	511	505(399)	381	413	476	412	223
Total PCB Mass(ug)	91	7.2(7)	5.3	9.3	12	17	37
PCB Concentration(ug/m3)	0.1781	0.0143(0.0175)	0.0139	0.0225	0.0252	0.0413	0.1659
Percent of Allowable(%)	18	1(2)	1	2	3	4	17
10/23/2006							
Total Volume(m3)	466	495(393)	377	332	508	438	215
Total PCB Mass(ug)	1.5	0(0)	0.9	11	32	0.5	0
PCB Concentration(ug/m3)	0.0032	ND(0.001)(ND(0.0013))	0.0024	0.0331	0.063	0.0011	ND(0.0023)
Percent of Allowable(%)	0	--(--)	0	3	6	0	--

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
10/24/2006							
Total Volume(m3)	463	478(379)	357	379	445	426	199
Total PCB Mass(ug)	8.6	6(6.4)	9.9	11	27	8.8	40
PCB Concentration(ug/m3)	0.0186	0.0126(0.0169)	0.0277	0.029	0.0607	0.0207	0.201
Percent of Allowable(%)	2	1(2)	3	3	6	2	20
10/25/2006							
Total Volume(m3)	498	473(372)	370	389	454	438	404
Total PCB Mass(ug)	74	15(17)	4.2	2.8	4.1	6.1	120
PCB Concentration(ug/m3)	0.1486	0.0317(0.0457)	0.0114	0.0072	0.009	0.0139	0.297
Percent of Allowable(%)	15	3(5)	1	1	1	1	30
10/26/2006							
Total Volume(m3)	450	455(370)	336	379	434	424	406
Total PCB Mass(ug)	99	7.2(8)	1.1	2.2	2.6	5.6	39
PCB Concentration(ug/m3)	0.22	0.0158(0.0216)	0.0033	0.0058	0.006	0.0132	0.0961
Percent of Allowable(%)	22	2(2)	0	1	1	1	10
10/27/2006							
Total Volume(m3)	460	466(335)	376	381	443	424	392
Total PCB Mass(ug)	13	4.4(4.3)	21	8.6	25	2.7	84
PCB Concentration(ug/m3)	0.0283	0.0094(0.0128)	0.0559	0.0226	0.0564	0.0064	0.2143
Percent of Allowable(%)	3	1(1)	6	2	6	1	21
10/28/2006							
Total Volume(m3)	475	288(358)	398	373	443	386	401
Total PCB Mass(ug)	2.3	1.2(1.2)	2.3	25	67	1.1	1.1
PCB Concentration(ug/m3)	0.0048	0.0042(0.0034)	0.0058	0.067	0.1512	0.0028	0.0027
Percent of Allowable(%)	0	0(0)	1	7	15	0	0
10/30/2006							
Total Volume(m3)	436	286(373)	370	1	425	371	383
Total PCB Mass(ug)	12	50(49)	2.6	*	7.7	61	3.2
PCB Concentration(ug/m3)	0.0275	0.1748(0.1314)	0.007	*	0.0181	0.1644	0.0084
Percent of Allowable(%)	3	17(13)	1	*	2	16	1
10/31/2006							
Total Volume(m3)	456	291(391)	375	4	442	126	386
Total PCB Mass(ug)	3.8	4(3.3)	16	*	32	*	4
PCB Concentration(ug/m3)	0.0083	0.0137(0.0084)	0.0427	*	0.0724	*	0.0104
Percent of Allowable(%)	1	1(1)	4	*	7	*	1
11/1/2006							
Total Volume(m3)	449	299(384)	419	0	379	43	403
Total PCB Mass(ug)	1.2	0.8(0.7)	5.9	*	24	*	0.6
PCB Concentration(ug/m3)	0.0027	0.0027(0.0018)	0.0141	*	0.0633	*	0.0015
Percent of Allowable(%)	0	0(0)	1	*	6	*	0
11/2/2006							
Total Volume(m3)	484	299(384)	412	2	376	423	398
Total PCB Mass(ug)	5.3	4.5(4.7)	9.3	*	27	5	16
PCB Concentration(ug/m3)	0.011	0.0151(0.0122)	0.0226	*	0.0718	0.0118	0.0402
Percent of Allowable(%)	1	2(1)	2	*	7	1	4
11/3/2006							
Total Volume(m3)	483	315(419)	441	11	402	466	427
Total PCB Mass(ug)	28	6.2(7.1)	4.6	*	14	9	38
PCB Concentration(ug/m3)	0.058	0.0197(0.0169)	0.0104	*	0.0348	0.0193	0.089
Percent of Allowable(%)	6	2(2)	1	*	3	2	9

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
11/4/2006							
Total Volume(m3)	524	307(444)	480	377	438	386	433
Total PCB Mass(ug)	89	7(6.7)	3	3	3.9	22	11
PCB Concentration(ug/m3)	0.1698	0.0228(0.0151)	0.0062	0.008	0.0089	0.057	0.0254
Percent of Allowable(%)	17	2(2)	1	1	1	6	3
11/6/2006							
Total Volume(m3)	449	298(416)	394	374	370	415	425
Total PCB Mass(ug)	96	8.5(9.6)	6.6	3.4	4	16	200
PCB Concentration(ug/m3)	0.2138	0.0285(0.0231)	0.0168	0.0091	0.0108	0.0386	0.4706
Percent of Allowable(%)	21	3(2)	2	1	1	4	47
11/7/2006							
Total Volume(m3)	470	290(405)	421	391	384	83	426
Total PCB Mass(ug)	68	5(5.5)	27	21	74	*	26
PCB Concentration(ug/m3)	0.1447	0.0172(0.0136)	0.0641	0.0537	0.1927	*	0.061
Percent of Allowable(%)	14	2(1)	6	5	19	*	6
11/8/2006							
Total Volume(m3)	468	269(389)	442	357	390	0	433
Total PCB Mass(ug)	78	15(16)	7.7	12	26	*	11
PCB Concentration(ug/m3)	0.1667	0.0558(0.0411)	0.0174	0.0336	0.0667	*	0.0254
Percent of Allowable(%)	17	6(4)	2	3	7	*	3
11/9/2006							
Total Volume(m3)	474	299(419)	424	362	389	323	391
Total PCB Mass(ug)	130	79(77)	29	39	66	64	180
PCB Concentration(ug/m3)	0.2743	0.2642(0.1838)	0.0684	0.1077	0.1697	0.1981	0.4604
Percent of Allowable(%)	27	26(18)	7	11	17	20	46
11/10/2006							
Total Volume(m3)	462	474(458)	428	397	378	426	414
Total PCB Mass(ug)	49	38(38)	3.3	10	16	74	8.3
PCB Concentration(ug/m3)	0.1061	0.0802(0.083)	0.0077	0.0252	0.0423	0.1737	0.02
Percent of Allowable(%)	11	8(8)	1	3	4	17	2
11/11/2006							
Total Volume(m3)	548	515(499)	478	405	518	452	459
Total PCB Mass(ug)	1.7	0.9(0.6)	5.3	13	46	1.3	4.9
PCB Concentration(ug/m3)	0.0031	0.0017(0.0012)	0.0111	0.0321	0.0888	0.0029	0.0107
Percent of Allowable(%)	0	0(0)	1	3	9	0	1
11/12/2006							
Total Volume(m3)	456	436(410)	382	353	426	338	391
Total PCB Mass(ug)	32	2.5(2.6)	12	1.9	2.6	3.6	110
PCB Concentration(ug/m3)	0.0702	0.0057(0.0063)	0.0314	0.0054	0.0061	0.0107	0.2813
Percent of Allowable(%)	7	1(1)	3	1	1	1	28
11/13/2006							
Total Volume(m3)	487	471(457)	450	328	474	442	431
Total PCB Mass(ug)	38	7.1(7.5)	15	7.4	18	11	54
PCB Concentration(ug/m3)	0.078	0.0151(0.0164)	0.0333	0.0226	0.038	0.0249	0.1253
Percent of Allowable(%)	8	2(2)	3	2	4	2	13
11/14/2006							
Total Volume(m3)	480	433(434)	433	316	453	411	431
Total PCB Mass(ug)	72	3.2(3.3)	12	2.3	2.5	8	190
PCB Concentration(ug/m3)	0.15	0.0074(0.0076)	0.0277	0.0073	0.0055	0.0195	0.4408
Percent of Allowable(%)	15	1(1)	3	1	1	2	44

TABLE 2.3

EAST PLANT AREA PCB ANALYTICAL RESULTS SUMMARY
MAY 2006 THROUGH NOVEMBER 2006
AAQMP MODIFICAITONS
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Unit ID	*STATION 1C* *PUF-16*	*STATION 14* *PUF-4(PUF-12)*	*STATION 22B* *PUF-18*	*STATION 23* *PUF-2*	*STATION 29* *PUF-5*	*STATION 30* *PUF-17*	*STATION 31* *PUF-6*
11/15/2006							
Total Volume(m3)	437	244(196)	410	309	434	404	425
Total PCB Mass(ug)	5.7	*(*)	12	2	4.2	2.3	63
PCB Concentration(ug/m3)	0.013	*(*)	0.0293	0.0065	0.0097	0.0057	0.1482
Percent of Allowable(%)	1	*(*)	3	1	1	1	15
11/17/2006							
Total Volume(m3)	512	446(417)	463	340	481	476	423
Total PCB Mass(ug)	36	5.1(5.2)	16	5.4	21	11	79
PCB Concentration(ug/m3)	0.0703	0.0114(0.0125)	0.0346	0.0159	0.0437	0.0231	0.1868
Percent of Allowable(%)	7	1(1)	3	2	4	2	19
11/18/2006							
Total Volume(m3)	452	511(513)	440	389	487	505	450
Total PCB Mass(ug)	2.1	0.8(0.7)	6.2	26	49	1.7	2.8
PCB Concentration(ug/m3)	0.0046	0.0016(0.0014)	0.0141	0.0668	0.1006	0.0034	0.0062
Percent of Allowable(%)	0	0(0)	1	7	10	0	1
11/19/2006							
Total Volume(m3)	338	361(359)	328	244	359	364	328
Total PCB Mass(ug)	1	0(0.5)	4.8	12	23	0.8	0.7
PCB Concentration(ug/m3)	0.003	ND(0.0014)(0.0014)	0.0146	0.0492	0.0641	0.0022	0.0021
Percent of Allowable(%)	0	--(0)	1	5	6	0	0

Notes:
* - Results not reported due to machine malfunction
NR - No result because machine was not setup
ND - Non-Detect
J - Estimated Result
Station 1C replaced Station 1B June 21, 2006.

TABLE 3.1

EXAMPLE VALIDATED TSP SAMPLE RESULTS
AAQMP MODIFICATIONS PROPOSAL - NOVEMBER 2006
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

	STATION 1C	*STATION 14*	*STATION 22B*	*STATION 23*	*STATION 29*	*STATION 30*	*STATION 31*
9/19/2006		*(duplicate result)*					
TSP Concentration(mg/m3)	0.0882	0.0105 J(0.0259 J)	0.079	0.0685	0.0435	0.0211	0.0331
Percent of Allowable(%)	UPWIND	7(18)	54	47	30	14	22
10/19/2006							
TSP Concentration(mg/m3)	0.0133	0.013(0.0107)	0.0308	0.0772	0.0189	0.0066	0.013
Percent of Allowable(%)	UPWIND	59(48)	139	348	85	30	59

J - Estimated Result

APPENDIX C

CONSOLIDATED HEALTH AND SAFETY PLAN

Revision 1
April 13, 2007

CONSOLIDATED GM BEDFORD HEALTH AND SAFETY PLAN (HASP)

GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

APRIL 2007
REF. NO. 13968 (95)
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LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AOC	area of concern
AOI	area of interest
APR	air purifying respirator
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Contractor	General Contractors (Sevenson Environmental Services, Inc. and ENTACT & Associates, LLC)
CPR	cardiopulmonary resuscitation
CRA	Conestoga-Rovers & Associates, Inc.
Creek Areas	Bailey's Branch Creek, Pleasant Run and its tributaries
CRZ	Contaminant Reduction Zone
dBA	decibles (acoustic)
DEET	diethyltoluamide
ENTACT	ENTACT & Associates, LLC
EZ	Exclusion Zone
FM	Factory Mutual Engineering Corporation
GFCI	ground fault circuit interrupters
GM	General Motors Corporation
GMPT	General Motors Powertrain
HASP	Site Health and Safety Plan
HSO	Health and Safety Officer
IDLH	Immediately Dangerous to Life and Health
LEL	lower explosive limit
MSD	musculoskeletal disorders
MSDS	Material Safety Data Sheets
MSHA	Mine Safety & Health Administration
NEC	National Electrical Code
NESC	National Electrical Safety Code
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic & Atmospheric Administration

LIST OF ACRONYMS

NRC	National Response Center
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PE	Professional Engineer
PEL	Permissible Exposure Limit
PID	photoionization detector
PPE	Personal Protective Equipment
ppm	parts per million
RA	removal action
REL	Recommended Exposure Limit
RMSF	Rocky Mountain Spotted Fever
SCBA	self-contained breathing apparatus
SERC	State Emergency Response Commission
SES	Sevenson Environmental Services
Site	GMPT Bedford Facility and general vicinity (including Upstream Parcels, Parcel 22, and Downstream Parcels)
SOP	Standard Operating Procedures
SOW	Scope of Work
SZ	Support Zone
THA	Task Hazard Analysis
TLV	Threshold Limit Value
U.S. EPA	United States Environmental Protection Agency
UL	Underwriters Laboratory
USCG	United States Coast Guard
VOC	volatile organic compound

1.0 INTRODUCTION

Conestoga-Rovers & Associates, Inc. (CRA) has prepared this comprehensive Health and Safety Plan (HASP) on behalf of General Motors Corporation (GM). This HASP presented herein describes the health and safety procedures and emergency response guidelines to be implemented during activities within the general vicinity of the GM Powertrain (GMPT) Bedford Facility (Site) located in Bedford, Indiana. This HASP will address the safety and health requirements associated with the various environmental Work Plans prepared by CRA for the Site. Figures depicting the Site Location and the Site Plan are included in this HASP as Figures 1.1 and 1.2, respectively.

A Removal Action (RA) will be implemented on portions of the creek and floodplains associated with Bailey's Branch, Pleasant Run and its tributaries (Creek Areas), in accordance with an Administrative Order by Consent (AOC) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) between the U.S. Environmental Protection Agency (U.S. EPA) and GM. Additionally, CRA personnel and its subcontractors will implement an investigation and sampling program at the Site.

The scope of work (SOW) to be completed during Site activities includes the following work activities:

i) mobilization and demobilization of labor, materials, and equipment to and from the Site;

ii) oversight of construction activities which includes: staging area construction; placement of designated materials within the staging area and subsequent off-Site transportation and disposal of impacted materials; contractor mobilization, demobilization, decontamination, and Site set-up; Site clearing (removal of trees); temporary fencing installation; survey layout of excavation areas; construction of stormwater controls (berms, swales, and culverts); excavation and handling of contaminated materials and backfilling activities; stream monitoring and water management activities; air monitoring/sampling; and Site restoration activities;

iii) sampling and monitoring activities involving the sampling of soil, water, debris, and sediment. Sampling tasks may involve drilling (investigative) activities;

iv) perimeter air monitoring at the Site;

v) test pit excavations, which include subsequent sampling activities;

vi) Site restoration; and

vii) decontamination activities.

During a portion of these activities, personnel may come in contact with washwaters, soils, debris, groundwater, and surface water that contain hazardous substances. This HASP has been developed to minimize direct contact by Site personnel with materials potentially having chemical presence by ensuring:

i) that Site personnel are not adversely exposed to the compounds of concern;

ii) that public health and the environment are not adversely impacted by materials with elevated chemical presence which may potentially migrate off-Site during work activities at the Site;

iii) compliance with applicable governmental and non-governmental (American Conference of Governmental Industrial Hygienists [ACGIH]) regulations and guidelines. In particular, the amended rules of the Occupational Safety and Health Administration (OSHA) for Part 1926 (Title 29 Code of Federal Regulations [CFR] Part 1926.65) will be implemented for all Site work; and

iv) initiation of proper emergency response procedures to minimize the potential for any adverse impact to Site workers, the general public, or the environment.

For the purpose of this HASP, activities performed on-Site involving contact with materials with potentially elevated chemical presence will be considered contaminated operations requiring Personal Protective Equipment (PPE). A detailed description of the PPE required is presented in Section 6.1.

All work activities at the Site will be conducted in accordance with provisions of an approved Site-specific HASP. The applicability of this HASP extends to personnel who will be on Site, including, CRA employees, CRA subcontractors and visitors to the Site. Certain activities at this Site where personnel will not have the potential for contact with contamination and no potential for exposure exists will be exempt from all provisions of the standard (29CFR1926.65 or 29CFR1910.120), including the medical and training requirements.

Contractors and subcontractors who will be working at the Site will be required to develop a HASP based on their specific SOW. The contractor's HASP must meet the applicable requirements of this HASP, which has been prepared by CRA. A contractor or subcontractor may adopt the provisions contained in this HASP as part of its own

HASP, but must still provide a Site-specific HASP and SOW that details their activities and health and safety procedures that will be implemented as part of their activities.

A copy of this HASP and employer specific Standard Operating Procedures (SOP)/Safety Programs will be maintained on Site whenever activities are in progress. Contractor Programs for similar activities must meet or exceed any referenced CRA Programs. A copy of any CRA Health and Safety Programs referenced in this HASP will be available at the Site.

1.1 PROJECT ORGANIZATION

The project will be organized as follows (See Figure 1.3 entitled, Project Team Organization, for additional information):

Remedial Contractor(s)

There is the potential for various contractor(s) to be working on-Site concurrently. The selected contractor(s) will be responsible for providing both a Site Superintendent (competent person) and a Health and Safety Officer (HSO) to direct their activities. These individuals will be responsible for ensuring that all contract specifications are met, including those related to Site health and safety. The names of these individuals will be presented in the HASPs of each contractor. All contractor personnel working at the Site will report to the CRA Project Coordinator through the CRA On-Site Construction Coordinator and, in keeping with OSHA requirements, are required to comply with all procedures referenced in this HASP, the contractor HASP, OSHA regulations, and the GMPT Bedford Facility Safety Operating Procedures.

Sevenson Environmental Services and Entact Environmental Services

Sevenson Environmental Services (SES) and Entact Environmental Services (ENTACT) is contracted directly to GM and as such is the General Contractor (Contractor) for the RA portion of the project responsible for performing remedial construction activities which includes the supervision, inspection, and direction of remedial activities. SES and ENTACT may employ various subcontractors as necessary to assist with the completion of project activities.

SES and ENTACT will employ and keep on-Site at all times a competent resident supervisor (Site Superintendent) and necessary assistants (i.e., foremen, engineers, etc.)

to ensure that all project specifications are met including those related to safety and health. Additionally, SES and ENTACT will designate a qualified and experienced safety representative (Site Health and Safety Officer) at the Site whose duties and responsibilities will be the prevention of accidents, implementation and enforcement of the Site-specific HASP, and maintaining and supervising Site safety precautions and programs.

Project Coordinator (*Conestoga-Rovers and Associates)*

CRA will act as the overall Project Coordinator for the Site. The CRA Project Coordinator will direct and generally oversee activities on behalf of GM during the implementation of Site activities. Additionally, CRA will provide Engineering Oversight services for project activities. However, CRA may employ various environmental subcontractors (drilling contractors, specialty consultants, etc.) to assist with Site activities as necessary.

CRA will provide an On-Site Construction Coordinator who will direct the day-to-day activities of CRA personnel and provide engineering oversight for remedial contractor activities. Additional support will be provided by a CRA HSO who will be responsible for ensuring compliance with the Site-specific HASP.

2.0 SITE CHARACTERIZATION AND POTENTIALLY HAZARDOUS COMPOUNDS

Creek Areas

The Creek Areas are located in Bedford and Lawrence County, Indiana. The properties which make up the Creek Areas include residential, agricultural, vacant land, and industrial uses. The GMPT Bedford Facility is located at 105 GM Drive, in Bedford, Indiana as depicted on Figures 1.1 and 1.2. The GMPT Bedford Facility is located in a commercial and industrial setting.

The GMPT Bedford Facility is an active facility and has been operating as an aluminum foundry since 1942. Current products include transmission cases, engine blocks, and pistons.

Based on previous sampling, the constituent of concern at the Creek Areas is polychlorinated biphenyls (PCBs). PCBs are a series of technical mixtures, consisting of many isomers and compounds that vary from mobile oily liquids to white crystalline solids to hard non-crystalline resins. The variability is based upon the degree of chlorination (and location of chlorine atoms) on the diphenyl rings that act as the skeleton for PCBs. The name Aroclor® 1221, 1233, 1242, 1248, 1254, 1260 etc. corresponds to the percentage that the diphenyl rings have been substituted, i.e., 21%, 33%, 42%, etc.

The most commonly encountered PCBs are chlorodiphenyl (42% chlorine) [Aroclor® 1242] and chloridiphenyl (54% chlorine) [Aroclor® 1254]. These compounds are light, straw-colored liquids with typical chlorinated aromatic odors; 42% chlorodiphenyl is a mobile liquid and 54% chlorodiphenyl is a viscous liquid. Chlorodiphenyl (42% chlorine) boils between 617°F and 691°F and freezes at -2°F. Chlorodiphenyl (54% chlorine) boils between 689°F and 734°F and freezes at 50°F. The synonyms for PCBs are chlorodiphenyls, Aroclors, and Kanechlors. Names further defining PCBs, based upon chlorine substitution are Aroclor® 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268, 2565, 4465, 5442, 5460 and Kanechlor 300, 400, 500. PCBs are incompatible with strong oxidizers. PCBs are used alone and in combination with chlorinated naphthalenes. They are stable, thermoplastic, and nonflammable, and find chief use in insulation for electric cables and wires, in the production of electric condensers, as additives for extreme pressure lubricants, and as a coating in foundry use. PCBs are one member of a class of chlorinated aromatic organic compounds which are of increasing concern because of their apparent ubiquitous dispersal, persistence in the environment, and tendency to accumulate in food chains, with possible adverse effects on animals at the top of food webs, including man. The OSHA Permissible Exposure Limit (PEL) and ACGIH Threshold Limit Value (TLV) are 1 mg/m^3 for chlorodiphenyl 42% Cl and 0.5 mg/m^3 for 54% Cl. The National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) for both 42% and 54% are 0.001 mg/m^3. The Immediately Dangerous to Life and Health (IDLH) level is 5 mg/m^3.

Long term exposure to PCBs at high levels of 1 to 10 mg/m^3 may produce a burning feeling in the eyes, nose, and face; dry throat; lung and throat irritation; nausea; dizziness; and chloracne and the aggravation of existing acne. Liver damage and digestive disturbance have been reported in some individuals. OSHA has identified PCBs as a dermal carcinogen. PCBs may impair the function of the immune system. PCBs at high levels have been shown to produce cancer and birth defects in laboratory animals. Whether PCBs produce these effects in humans is not known.

Routes of entry are via inhalation of fume or vapor and percutaneous absorption of liquid, ingestion, eye and skin contact. Harmful effects from short term exposure are as follows:

Inhalation - May produce irritation to nose, throat, and lungs. Levels above 10 mg/m^3 are reported to be unbearable. Inhalation may contribute significantly to all symptoms of long term exposure.

Skin - Absorption is moderate. Contributes significantly to all symptoms of long term exposure. Sensitized individuals may develop a rash after 2 days exposure by contact or inhalation.

Eyes - May produce irritation. Levels of 10 mg/m^3 are severely irritating.

Ingestion - Absorption in the digestive system contributes significantly to all symptoms of long term exposure. There are no reported deaths of humans due to a single ingestion. However, experiments in animals suggest that ingestion of 6 to 10 fluid ounces would cause death to a healthy 150 pound adult.

<u>Test Pitting Activities</u>

On-Site test pit areas include the former north disposal area (Area of Interest (AOI) 4), the former east sand disposal area [plateau and ravine] (AOI 5), the former sludge disposal and fire training area (AOI 6), the former north lagoon and Outfall 001 (AOI 7), and the former equipment storage area (AOI 15).

Off-Site test pit areas include Areas 1, 2, and 3 located adjacent to the GMPT Bedford Facility, just north of Breckenridge Road. Area 4 is situated approximately 2 miles to the northwest of the first three areas.

Risks associated with these activities will be minimized by implementing engineering controls, safe work practices, and the proper use of PPE.

Potential constituents of concern and exposure routes and exposure limits associated with test pit operations are included in the following table:

Potential Site Contaminants (Currently Known)	*Ionization Potential (eV)*	*Physical Description and Symptoms of Exposure*	*Routes of Entry*	*OSHA – PEL (1) ACGIH – TLV (2) IDLH (3)*
Benzene	9.24	Colorless to light-yellow liquid with an aromatic odor. Note: A solid below 42 degrees F. Symptoms: Eye, nose, and skin irritant; heachache; nausea; giddiness; fatigue; anorexia; exhaustion; and depression.	Skin Absorption, Ingestion, Inhalation, and Contact	1 ppm (1) 0.5 ppm (2) 500 ppm (3)
Ammonia	10.18	Colorless gas with a pungent suffocating odor. Symptoms: Eye, nose, and throat irritant; breathing difficulty; wheezing; chest pain; pulmonary edema; pink frothy saliva; skin burns; vesiculation; and frostbite.	Inhalation, Ingestion, and Contact	50 ppm (1) 25 ppm (2) 300 ppm (3)

Potential Site Contaminants (Currently Known)	*Ionization Potential (eV)*	*Physical Description and Symptoms of Exposure*	*Routes of Entry*	*OSHA – PEL (1) ACGIH – TLV (2) IDLH (3)*
Ethyl-benzene	8.76	Colorless liquid with an aromatic odor. Symptoms: Eye, skin, and mucous membrane irritant; headache; dermatitis; narcosis; and coma.	Inhalation, Ingestion, and Contact	100 ppm (1)(2) 800 ppm (3)
Fuel Oil	Not Listed	Mostly found as a clear liquid with a distinct odor. Symptoms: Eye, nose, and throat irritant; burning sensation in chest; headache; nausea; weakness; restlessness; incoordination; confusion; drowsiness; vomiting; diarrhea; dermatitis; and chemical pneumonia.	Inhalation, Ingestion, and Contact	10 ppm
Sodium Hydroxide	Not Applicable	Colorless to white odorless solid (flakes, beads, granular form). Symptoms: Eye, skin, and mucous membrane irritant; pneumonitis; eye and skin burns; and temporary loss of hair.	Inhalation, Ingestion, and Contact	2 mg/m^3 (1) 2 mg/m^3 (2) - Ceiling Limit 10 mg/m^3 (3)
Xylenes	8.44 – 8.56	Colorless liquid with an aromatic odor. Symptoms: Eye, skin, throat, and nose irritant; dizziness; excitement; drowsiness; incoordination; staggering; anorexia; nausea; vomit; abdominal pain; and dermatitis.	Skin Absorption, Inhalation, Ingestion, and Contact	100 ppm (1)(2) 900 ppm (3)

Potential Site Contaminants (Currently Known)	*Ionization Potential (eV)*	*Physical Description and Symptoms of Exposure*	*Routes of Entry*	*OSHA – PEL (1) ACGIH – TLV (2) IDLH (3)*
Poly-chlorinated Biphenols	Not Listed	See the chemical description provided in Section 2.0 for signs and symptoms of exposure.	Skin Absorption, Inhalation, Ingestion, and Contact	0.5 mg/m^3 (1)(2) 5 mg/m^3 (3)
Toluene	8.82	Colorless liquid with a sweet, pungent, benzene-like odor. Symptoms: Eye and nose irritant; fatigue; confusion; euphoria; dizziness; headache; dilated pupils; tearing; nervousness; muscle fatigue; insomnia; parasthesia; and dermatitis.	Skin Absorption, Inhalation, Ingestion, and Contact	200 ppm (1) 50 ppm (2) 500 ppm (3)

As the Site covers an extensive amount of territory, the maximum detected concentrations for PCBs and other chemicals of concern will be determined prior to initiating operations in each specific work area. This will ensure that the most accurate data pertaining to that particular work area is utilized.

3.0 BASIS FOR DESIGN

This comprehensive HASP was developed to provide a clear and concise document that combines safety and health information from the various Site HASPs which were developed for each individual Work Plan, HASP Addendums, and safety information provided by the GMPT Bedford Facility.

Regulations set forth by OSHA in Title 29, CFR, Parts 1910 and 1926 (29 CFR 1910 and 1926) form the basis of this HASP. Emphasis is placed on Sections 1926.65 (Hazardous Waste Operations and Emergency Response), 1910 Subpart I (Personal Protective Equipment), and 1910 Subpart Z (Toxic and Hazardous Substances). In addition, current TLVs formulated by the ACGIH, have been considered in the development of the selection of PPE. Some of the specifications within this section are in addition to the OSHA regulations, and reflect the positions of the U.S. EPA, the NIOSH, and the United States Coast Guard (USCG) regarding safe operating procedures at hazardous waste sites.

The health and safety of the public and 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 CRA HSO shall be responsible, along with the Construction Coordinator, for all decisions regarding operations and work stoppage due to health and safety considerations. The HSO will have prior experience in working at hazardous waste sites.

The on-Site HSO responsibilities include:

i) issue confined space entry and hot work permits as required;

ii) responsible for ensuring that proper utility clearances are observed and that "One Call" utility services and GMPT Bedford Facility Site Contact are properly notified prior to excavating, drilling, etc.;

iii) supervision and enforcement of safety equipment usage, including the required use of extra equipment if appropriate;

iv) supervision and inspection of equipment cleaning;

v) periodically conduct a training needs assessment for CRA Site personnel based on potential tasks/activities and conduct training as necessary to ensure compliance;

vi) implementation of the CRA Excavation and Trenching Program to meet the requirements set forth in 29 CFR 1926 – Subpart P;

vii) supervision of decontamination;

viii) conduct the on-Site personnel safety indoctrination session for potential hazards, personal hygiene principles, confined space entry procedures, all other Programs, safety equipment usage, emergency procedures, location of first aid kits, and identification of personnel trained in first aid and cardiopulmonary resuscitation (CPR);

ix) maintain Exclusion Zone (EZ) and Contaminant Reduction Zone (CRZ) work areas;

x) review and modify the HASP in the form of an Addenda as more information becomes available or conditions warrant;

xi) authority to suspend work activity due to unsafe working conditions;

xii) coordination of emergency procedures;

xiii) ensure that air monitoring for CRA personnel and subcontractors is being performed;

xiv) responsible for overseeing the remedial contractor's air monitoring/sampling program to ensure that the program is being conducted as per the contractor's Site-specific HASP;

xv) ensure that all on-Site personnel have obtained the required medical examination prior to arrival at the Site, have met the OSHA training requirements, and have been fit tested for the respiratory equipment they may use;

xvi) maintain the on-Site Hazard Communication Program including copies of Material Safety Data Sheets (MSDSs);

xvii) conduct brief daily safety meetings;

xviii) administer the overall Site accident prevention program;

xix) provide instruction to Site personnel regarding operating, procedures, hazards, and safeguards of tools and equipment when necessary to perform their job; and

xx) ensure that task hazard analysis (THA) tables are completed/updated by work crews and field supervisor(s) prior to beginning work activities.

5.0 WORKER TRAINING AND EDUCATION

Prior to commencing Site activities, a Health and Safety/Site Indoctrination Session will be presented. Attendance is mandatory for all personnel who will be or who are expected to be involved with project activities.

The training program will stress the importance that each attendee understands the basic principles of personnel protection and safety, be able to perform their assigned job tasks in a safe and environmentally responsible manner, and be prepared to respond in an appropriate manner to any emergency which may arise. A brief history of the Site will be included and the various components of the project HASP will be presented, followed by an opportunity to ask questions to ensure that each attendee understands the HASP. Personnel not successful in completing this training program will not be permitted to enter or work in potentially contaminated areas of the Site. Personnel successful in completing this training program shall sign an acknowledgement form, a copy of which is presented in Appendix A. In addition, daily "tailgate" safety meetings will take place each day prior to beginning the day's work. All Site personnel will attend these safety meetings. The safety meetings will be documented with written sign-in sheets containing a list of topics discussed. Appendix B presents the form that will be used for this purpose.

Contractors working at the GMPT Bedford Plant are required to undergo additional safety training. The Safe Job Operating Procedure entitled, Safety and Fire Specifications for Outside Contractors – Procedure # 532-1, is to be reviewed with Site personnel as part of the Site Safety Indoctrination Session. A copy of this document has been attached to the HASP as Appendix C. Supervisory personnel completing this training are to complete and sign the Contractor Safety and Environmental Agreement Form which is included in Appendix C.

This training will be given in addition to the basic training required under OSHA and is not intended to meet the requirements of 29 CFR 1926.65. Prior to working in or entering an EZ environment (as defined in Section 6.0), all personnel will be required to provide documentation to the HSO indicating successful completion of the training requirements of 29 CFR 1926.65.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section of the HASP describes the requirements for PPE and the specific levels of protection required for each work task to be conducted at the Site during project activities. Basic PPE in all Site areas will consist of hard hats, high visibility safety vests, safety glasses with side shields, and safety boots/shoes with steel or composite toes.

6.1 PROTECTION LEVELS

Personnel will wear protective equipment when project activities involve potential exposure to chemicals from vapors, gases, or particulates that may be generated on Site or when direct contact with potentially hazardous substances may occur. Chemical resistant clothing protects the skin from contact with skin-destructive and absorbable chemicals. Respirators protect lungs, the gastrointestinal tract, and if a full-face respirator is worn, the eyes, against airborne toxicants. Respiratory protection levels will be based on the real-time air monitoring results and the action levels that are presented in Section 6.5.

Protection levels are selected based upon the following:

i) measured concentrations of the Site chemicals and expected concentrations in the ambient atmosphere compared to allowable exposure levels;

ii) potential for exposure to chemicals in air, splashes of liquids, or other contact due to the nature of work tasks; and

iii) Site chemical toxicity, route of exposure, and chemical matrix.

The specific protection levels to be employed at the Site for each work task are listed in Table 6.1. All project activities conducted at the Site will require the use of one of the following levels of PPE.

<u>Level B:</u>

i) supplied air respirator (Mine Safety and Health Administration [MSHA]/NIOSH approved). Respirators may be positive pressure-demand, self-contained breathing apparatus (SCBA) or positive pressure-demand airline respirator (with escape bottle for IDLH or potential for IDLH atmosphere);

ii) polycoated tyvek® or saranex® coveralls;

iii) safety-toed work boots and disposable boot covers or rubber boots;

iv) disposable nitrile inner gloves;

v) outer nitrile work gloves;

vi) high visibility safety vest;

vii) hearing protection as necessary; and

viii) hard hat.

Level C:

i) tyvek® coveralls (polycoated tyvek® when handling or working with liquids [e.g., decontamination]);

ii) safety-toed work boots and disposable boot covers or rubber boots;

iii) disposable nitrile inner gloves;

iv) high visibility safety vest;

v) outer nitrile inner gloves;

vi) full-face air purifying respirator (APR), equipped with combination cartridges for organic vapors and particulates (P-100);

vii) safety glasses (if necessary);

viii) goggles or face shield (if necessary);

ix) hearing protection as necessary; and

x) hard hat.

Modified Level D:

i) tyvek® coveralls (polycoated tyvek® when handling or working with liquids);

ii) safety-toed work boots and disposable boot covers or rubber boots;

iii) disposable nitrile inner gloves;

iv) outer nitrile work gloves;

v) high visibility safety vest;

vi) safety glasses;

vii) splash shields as necessary;

viii) hearing protection as necessary; and

ix) hard hat.

Level D:

i) standard work uniform or coveralls;

ii) safety-toed work boots;

iii) gloves as necessary;

iv) safety glasses;

v) splash shield as needed;

vi) hearing protection as necessary; and

vii) hard hat.

PPE will be maintained in a clean sanitary condition and ready for use. Disposable coveralls shall be discarded when torn and as an employee leaves the EZ. Hard hats shall be thoroughly cleaned after leaving the EZ. Respirators shall be cleaned after each day's use and cartridges discarded. A sufficient quantity of potable water shall be supplied for washing, cleaning PPE, and drinking. A potable water supply for washing and cleaning PPE will be maintained adjacent to the decontamination area described in Section 9.0. Fresh potable water for drinking will be supplied on a daily basis and be maintained at a location removed from the active work area.

6.2 REASSESSMENT OF PROTECTION LEVELS

Protection levels provided by PPE selection shall be upgraded or downgraded based upon a change in Site conditions or the review of the results of air monitoring.

When a significant change occurs, the hazards shall be reassessed. Some indicators of the need for reassessment are:

i) commencement of a new work phase;

ii) change in job tasks during a work phase;

iii) change of season/weather;

iv) when temperature extremes or individual medical considerations limit the effectiveness of PPE;

v) chemicals other than those expected to be encountered are identified;

vi) change in ambient levels of chemicals; and

vii) change in work scope that effects the degree of contact with areas of potentially elevated chemical presence.

All proposed changes to protection levels and PPE requirements will be reviewed and approved prior to their implementation by the HSO and Regional Safety and Health Manager.

6.3 DURATION OF WORK TASKS

The duration of project activities involving the usage of PPE will follow ACGIH guidelines and will be established by the HSO or his designee based upon ambient temperature and weather conditions, the capacity of personnel to work in the designated level of PPE (see Section 7.3 – Heat Stress, Section 7.4 – Cold Stress, and Section 12.4 - Temperature), and limitations of the protective equipment (i.e., ensemble permeation rates, life expectancy of air-purifying respirator cartridges, etc.). As a minimum, rest breaks will be observed at the following intervals:

i) 15 minutes midway between shift startup and lunch;

ii) 0.5 hour for lunch; and

iii) 15 minutes in the afternoon, between lunch and shift end.

All rest breaks will be taken in a clean area (e.g., support zone) after full decontamination and PPE removal. Additional rest breaks will be observed based upon the heat and cold stress monitoring guidelines presented in Sections 7.3 and 7.4, and the CRA Health and Safety Programs.

6.4 LIMITATIONS OF PROTECTIVE CLOTHING

PPE ensembles designated for use during project activities have been selected to provide protection against chemicals at known or anticipated concentrations in the soil and groundwater. However, no protective garment, glove, or boot is chemical-proof, nor will it afford protection against all chemical types. Permeation of a given chemical through PPE is a complex process governed by the chemical concentrations, environmental conditions, physical condition of the protection garment, and the resistance of a garment to a specific chemical; chemical permeation may continue even after the source of the chemical has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all Site personnel using PPE:

i) when using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;

ii) inspect all clothing, gloves, and boots both prior to and during use for:
   a) imperfect seams,
   b) non-uniform coatings,
   c) tears,
   d) poorly functioning closures; and

iii) inspect reusable garments, boots, and gloves both prior to and during use for:
   a) visible signs of chemical permeation,
   b) swelling,
   c) discoloration,
   d) stiffness,
   e) brittleness,
   f) cracks,
   g) any sign of puncture, and
   h) any sign of abrasion.

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of chemicals will not be reused.

EZ personnel also carry certain responsibilities for their own health and safety, and are required to observe the following safe work practices:

i) familiarize themselves with this HASP;

ii) use the "buddy system" when working in a contaminated operation;

iii) use the safety equipment in accordance with training received, labeling instructions, and common sense;

iv) maintain safety equipment in good condition and proper working order;

v) refrain from activities that would create additional hazards (i.e., smoking, eating, etc., in restricted areas, leaning against dirty, contaminated surfaces);

vi) smoking, eating, and drinking will be prohibited except in designated areas. These designated areas may change during the duration of the project to maintain adequate separation from the active work area(s). Designation of these areas will be the responsibility of the HSO; and

vii) soiled disposable outerwear shall be removed and placed into a covered container prior to washing hands and face, eating, using lavatory facilities, or leaving the Site.

6.5 RESPIRATORY PROTECTION PROGRAM

All on-Site personnel will be required to comply with their employer specific written respiratory protection program developed in accordance with OSHA 29 CFR 1910.134. CRA personnel will comply with the CRA Respiratory Protection Program.

Respiratory protection may be required during some of the project activities. This is to ensure worker protection from potentially contaminated particulates and volatile organic compounds (VOCs). During intrusive activities, a photoionization detector (PID) will be used to determine the levels of organic vapors present and a particulate monitor will be used to monitor particulate levels in the breathing zone. Background readings will be established prior to commencing work activities at each active work area.

Sustained (greater than five minutes) air monitoring action levels and appropriate respiratory protection when dealing with unknown atmospheres and/or areas that have not been previously characterized for the presence of chemicals of concern (i.e., test pit excavation activities, drilling in new area(s), etc.) are as follows:

Sustained Organic Vapor Reading Above Background Within Worker Breathing Zone in Parts Per Million (ppm)	*Action Taken*
0 or Background	• Full-face air purifying respirator available
>0 – <5	• Upgrade to Level C - Wear full-face air purifying respirator equipped with OV/Acid Gas/P-100 filter cartridge. • Attempt to identify chemical(s) in air via colorimetric evaluation and/or air sampling. **NOTE:** If GM or CRA are unable to identify and quantify the contaminants, level B will be required when the PID reading is greater than background (and designated site contaminants are ruled out or air sampling does not provide pertinent data). The contaminant will be unknown and NIOSH, OSHA, and manufacturer's use requirements for air purifying respirators will not be met thus requiring an upgrade to level B. If readings subside then workers can downgrade to level D respiratory protection.
>5	• Must wear supplied air respirator - Implement additional engineering controls
> 50	• Shut down activities

Dust control measures will be implemented to limit the excessive emission of dust. Therefore, the action level for total dust is as follows:

Sustained Particulate Reading Above Background Within Worker Breathing Zone in Parts Per Million	*Action Taken*
0 – 0.5 mg/m^3	• Full-face air purifying respirator available
0.5 mg/m^3 - 2.5 mg/m^3	• Upgrade to Level C - Wear full-face air purifying respirator equipped with OV/Acid Gas/P-100 filter cartridge
> 2.5 mg/m^3	• Shut down Site activities and implement additional engineering controls

All efforts will be made to implement additional engineering controls to minimize the need to wear a supplied air respirator. If the ambient concentrations of organic vapors are due to identifiable substances, the level of respiratory protection may be altered by the HSO.

The appropriate air purifying respirator cartridge to be used at the Site is a combination organic vapor/acid gas and P-100 particulate cartridge. The cartridge used must be of the same manufacturer as the respiratory face piece.

6.6 SITE CONTROL

A temporary fence and/or caution tape with appropriate warning signs will be installed to prevent unauthorized access to the Site work areas. Visitors may gain access to the other side of the fence only if they are escorted. The intention is to keep them out of the EZ. Designated work areas will be set up as appropriate during the Site field activities, as required. The purpose of these procedures is to limit access to areas with potentially elevated chemical presence, and prevent the migration of potentially hazardous materials into adjacent clean areas. These areas are described in the following:

i) The Exclusion Zone (EZ) is the area immediately surrounding the active work area. Sufficient area will be provided for efficient movement of personnel and equipment as well as chemical control. Boundaries are modifiable depending on operational requirements. The HSO will be responsible for maintaining the boundaries of this area. Personnel entering this area are required to wear the PPE as defined previously. A wind direction indication device (i.e., flagging, windsock, etc.) will be mounted in the area of any EZ during Site activities.

   All personnel (including visitors) entering the EZ or CRZ using respiratory protection must have successfully passed a respirator fit test in accordance with OSHA 29 CFR 1910.134. Documentation of fit testing is the responsibility of each employer.

   In the event that unauthorized personnel enter the EZ, work will stop. Work will not resume until the unauthorized personnel have been removed from the EZ or have been moved to an acceptable on-Site area. A log of all visitors to the Site, including those entering the EZ, will be maintained.

ii) The Contaminant Reduction Zone (CRZ) will provide a location for removal of PPE which has contacted material with elevated chemical presence and final removal and decontamination of personnel and equipment. Supplemental safety equipment, such as fire extinguishers, portable eyewash, and extra quantities of

PPE may be stored in this area. The general order in which safety equipment is to be donned is as follows:

a) Tyvek® suit;

b) rubber boots;

c) gloves;

d) safety vest and glasses;

d) respirator (if required); and

e) hard hat.

iii) The Support Zone (SZ) is situated in clean areas where there is a minimal risk of encountering hazardous materials or conditions. PPE beyond standard construction safety equipment is therefore not required.

7.0 ACTIVITY HAZARD/RISK ANALYSIS

This section identifies the general hazards associated with specific project activities and presents the documented or potential health and safety hazards that exist at the Site. Every effort will be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or PPE. Table 7.1 presents the anticipated hazards/risks and hazard controls.

In addition to the chemical hazards presented in Section 2.0 of this HASP, physical hazards at the Site include: uneven terrain; ladders; excavations and test pits; biological hazards; manual material handling; steep slopes; slippery surfaces; potential confined spaces; the use of heavy equipment; working from/on elevated surfaces; the use of decontamination equipment; and potential heat and cold stress. It will be the responsibility of each on-Site contractor and their personnel to identify the physical hazards posed by the various Site project activities and implement preventative and corrective action.

7.1 CHEMICAL EXPOSURE

Preventing exposure to toxic chemicals is a primary concern. Chemical substances can enter the unprotected body by inhalation, skin absorption, ingestion, or through a puncture wound (injection). A contaminant can cause damage at the point of contact or can act systematically, causing a toxic effect at a part of the body distant from the point of initial contact.

Chemical exposures are generally divided into two categories: acute and chronic. Symptoms resulting from acute exposures usually occur during or shortly after exposure to a sufficiently high concentration of a chemical. The concentration required to produce such effects varies widely from chemical to chemical. The term "chronic exposure" generally refers to exposures to "low" concentrations of a contaminant over a long period of time. The "low" concentrations required to produce symptoms of chronic exposure depend upon the chemical, the duration of each exposure, and the number of exposures. For a given chemical, the symptoms of an acute exposure may be completely different from those resulting from chronic exposure.

For either chronic or acute exposure, the toxic effect may be temporary and reversible, or may be permanent (disability or death). Some chemicals may cause obvious symptoms such as burning, coughing, nausea, tearing eyes, or rashes. Other chemicals may cause health damage without any such warning signs (this is a particular concern for chronic exposures to low concentrations). Health effects, such as cancer or respiratory disease, may not become manifest for several years or decades after exposure. In addition, some toxic chemicals may be colorless and/or odorless, may dull the sense of smell, or may not produce any immediate or obvious physiological sensations. Thus, a worker's senses or feelings cannot be relied upon in all cases to warn of potential toxic exposure.

The effects of exposure not only depend on the chemical, its concentration, route of entry, and duration of exposure, but may also be influenced by personal factors such as the individual's smoking habits, alcohol consumption, medication use, nutrition, age, and sex.

An important exposure route of concern at the Site is inhalation. The lungs are extremely vulnerable to chemical agents. Even substances that do not directly affect the lungs may pass through lung tissue into the bloodstream, where they are transported to other vulnerable areas of the body. Some toxic chemicals present in the atmosphere may not be detected by human senses (i.e., they may be colorless, odorless, and their toxic effects may not produce any immediate symptoms). Respiratory protection is therefore extremely important if there is a possibility that the work site atmosphere may contain such hazardous substances. Chemicals also can enter the respiratory tract through punctured eardrums. Where this is a hazard, individuals with punctured eardrums should be medically evaluated specifically to determine if such a condition would place them at an unacceptable risk and preclude their working at the task in question.

Direct contact of the skin and eyes by hazardous substances is another important route of exposure. Some chemicals directly injure the skin. Some pass through the skin into the bloodstream where they are transported to vulnerable organs. Skin absorption is enhanced by abrasions, cuts, heat, and moisture. The eye is particularly vulnerable because airborne chemicals can dissolve in its moist surface and be carried to the rest of the body through the bloodstream (capillaries are very close to the surface of the eye). Wearing protective equipment, not using contact lenses in chemical atmospheres (since they may trap chemicals against the eye surface), keeping hands away from the face, and minimizing contact with liquid and solid chemicals can help protect against skin and eye contact.

Although ingestion should be the least significant route of exposure at the Site, it is important to be aware of how this type of exposure can occur. Deliberate ingestion of chemicals is unlikely; however, personal habits such as chewing gum or tobacco, drinking, eating, smoking cigarettes, and applying cosmetics at the Site may provide a route of entry for chemicals.

The last primary route of chemical exposure is injection, whereby chemicals are introduced into the body through puncture wounds (i.e., by stepping or tripping and falling onto contaminated sharp objects). Wearing safety shoes, avoiding physical hazards, and taking common sense precautions are important protective measures against injection.

7.2 GENERAL PRACTICES

Additional general safety practices to be implemented are as follows:

i) at least one copy of this HASP and the contractor HASP must be at the project Site, in a location readily available to all personnel, and reviewed by all project personnel prior to starting work;

ii) all Site personnel must use the buddy system (working in pairs or teams) when performing work within an EZ;

iii) food, beverages, or tobacco products must not be present or consumed in the EZ and CRZ. Cosmetics must not be applied within these zones;

iv) emergency equipment such as eyewash, fire extinguishers, etc., must be removed from storage areas and staged in readily accessible locations;

v) contaminated waste, debris, and clothing must be properly contained and legible and understandable precautionary labels must be affixed to the containers;

vi) removing contaminated soil from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited;

vii) containers must be moved only with the proper equipment, and must be secured to prevent dropping or loss of control during transport; and

viii) visitors to the Site must be instructed to stay outside the EZ and CRZ and remain within the SZ during the extent of their stay. Visitors must be cautioned to avoid skin contact with surfaces that are contaminated or suspected to be contaminated.

7.2.1 BUDDY SYSTEM

All on-Site personnel must use the buddy system while performing work within the EZ. Visual contact must be maintained between crew members at all times, and crew members must observe each other for signs of chemical exposure, heat, or cold stress. Indications of adverse effects include, but are not limited to:

i) changes in complexion and skin coloration;
ii) changes in coordination;
iii) excessive salivation and pupillary response; and
iv) changes in speech pattern.

Team members must also be aware of potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures. Employees must inform their partners or fellow team members of non-visible effects of exposure to toxic materials. The symptoms of such exposure may include:

i) headaches;
ii) dizziness;
iii) nausea;
iv) blurred vision;
v) cramps; and
vi) irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

7.3 HEAT STRESS

Heat stress is caused by a number of interacting factors including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, wearing PPE can increase the risk of developing heat stress therefore the CRA Heat Stress Program will be routinely covered with Site personnel. Personnel must be aware of the types and causes of heat-related illnesses and be able to recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat Rashes: One of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat Cramps: Usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much and too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3 percent NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat Exhaustion: Occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache; vertigo; weakness; thirst; and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. Fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat Stroke: This the most serious form of heat stress. Heat stroke occurs when the body's system of temperature regulation fails and the body's temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of105.8°F (41°C). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protestations, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions: Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F (22.2°C). A minimum work rest regimen and procedures for calculating ambient adjusted temperature are described below.

Adjusted Temperature[(1)]	*Work-Rest Regimen Normal Work Ensemble*[(2)]	*Work-Rest Regimen Impermeable Ensemble*
90°F (32.0°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° to 90°F (30.8°C to 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° to 87.5°F (28.1° to 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° to 82.5°F (25.3° to 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° to 77.5°F (22.5° to 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Notes:

(1) Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F=ta °F + (13 x percent sunshine). Measure air temperature (ta) with a standard thermometer, with the bulk shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows).

(2) A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

In order to determine if the work rest cycles are adequate for the personnel and specific Site conditions, additional monitoring of individuals heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one-third and maintain the same rest period.

Additional one or more of the following control measures can be used to help control heat stress and are mandatory if any Site worker has a heart rate (measure immediately prior to rest period) exceeding 115 beats per minute:

i) Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day;

ii) on-Site drinking water will be kept cool (50 to 60°F) (10 to 15.6°C);

iii) a work regimen that will provide adequate rest periods for cooling down will be established, as required;

iv) all personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps;

v) cooling devices such as vortex tubes or cooling vests should be used when personnel must wear impermeable clothing in conditions of extreme heat;

vi) employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary;

vii) a shaded rest area must be provided. All breaks should take place in the shaded rest area;

viii) employees must not be assigned to other tasks during breaks;

ix) employees must remove impermeable garments during rest periods. This includes Tyvek® garments; and

x) all employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

Note: Additional information can be referenced in the CRA Health and Safety Program for Heat Stress.

7.4 COLD STRESS

Cold stress is similar to heat stress in that it is caused by a number of interacting factors including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. 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 (37°C), can be life threatening. A drop in core temperature to 95°F (35°C) 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 and insulating capabilities of clothing. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the body's core 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.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 95°F (35°C). This must be taken as a sign of danger to the employees on site, and cold exposures should be immediately terminated for any employee when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

7.4.1 PREDISPOSING FACTORS FOR COLD STRESS

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 HSO 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.

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 that 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.

7.4.2 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 physiological 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.

It may not be practically feasible to implement all the above prevention measures. Follow the guidelines given below when the ambient air temperature is below 0°F (-18°C):

- dress warmly;
- replenish fluids and electrolytes at regular intervals;
- provide shelter from the cold; and
- adjust work/rest schedules.

7.4.3 FIRST AID GUIDELINES FOR COLD STRESS

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

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.

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.

Note: Additional information on cold stress can be found within the CRA Health and Safety Program for Cold Stress.

7.5 EXCAVATION AND TRENCHING

Site activities will involve excavation and trenching of materials. It is the responsibility of the CRA Site HSO and the contractor's Site Supervisor (competent person) to implement the following components of the CRA Excavation and Trenching Program as they relate to project activities:

i) that all excavations are completed in accordance with an approved contractor's Program;
ii) that the proper protective materials and equipment are available to complete the excavation and/or trenching procedures;
iii) complete and document all inspections of the excavation as required before personnel attempt to enter the excavation; and
iv) submit any contractor's Excavation and Trenching Program to CRA's Safety and Health Group for review prior to initiating excavation activities.

Excavation and trenching operations require pre-planning to determine whether sloping or shoring systems are required, and to develop appropriate designs for such systems. Also, the estimated location of all underground installations must be determined before digging/drilling begins.

If there are any nearby buildings, walls, sidewalks, tress, or roads that may be threatened or undermined by the excavation, where the stability of any of these items may be endangered by the excavation, they must be removed or supported by adequate shoring, bracing, or underpinning.

Excavations may <u>not</u> go below the base of footings, foundations, or retaining walls, unless they are adequately supported or a person who is registered as a Professional Engineer (PE) has determined that they will not be affected by the soil removal. OSHA recommends using civil engineers or those with licenses in a related discipline and experience in the design and use of slopping and shoring systems. PE qualifications must be documented in writing.

Personnel required to enter or work in the excavation at any time must be protected from the hazards of cave-ins. This requires the use of sloping and/or shoring systems that comply with State and Federal OSHA standards.

An approved contractor's Excavation and Trenching Program will be followed during all excavation activities and provides detailed information regarding such activities.

7.6 SAMPLING AND INSPECTION ACTIVITIES

Activities associated with the sample collection and inspection tasks may include collection of soil, groundwater, surface water, and sediment samples in/at various work areas (excavations, test pits, drilling operations, etc.). Physical hazards associated with sampling/inspection activities may include: severe weather; working from an elevated surface; slips, trips and falls; sharp objects; confined spaces; lifting heavy objects; noise; electrical safety; heat/cold stress; moving or backing vehicles; and use of hand tools.

Sampling activities may involve sampling in excavations. Therefore, CRAs Health and Safety Program for Excavation and Trenching is to be followed. As a minimum, CRA personnel will not enter any excavation until it has been inspected by a competent person and deemed safe for entry. Sampling personnel may request to view the inspection log.

7.7 CONFINED SPACES

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, oxygen deficient atmospheres, limited visibility, and restricted movement. This section establishes requirements for safe entry into, continued work in, and safe exit from confined spaces. Additional information regarding confined space entry can be found in 29 CFR 1926.21, 29 CFR 1910.146, and NIOSH-106. Entry into a confined space will only be undertaken after remote methods have been tried and found not to be successful. Such work will follow the guidelines presented in the CRA Health and Safety Confined Space Program or an approved contractor's Confined Space Entry Program. The contractor's Program must minimally meet the requirements set forth in the CRA Confined Space Program.

7.8 FALL HAZARDS

Site personnel may be exposed to fall hazards greater than six feet above another surface with no barriers in place to protect them. These hazards may be found in the following activities: working from elevated surfaces, working from ladders, near excavations, or on equipment, etc.

It is the contractor's responsibility to identify and control all fall hazards posed by the various Site activities. This information will be added to Site-specific HASP and will include procedures to implement preventative and corrective actions. The contractor will provide and document the necessary training on fall protection to affected employees.

7.9 BIOLOGICAL HAZARDS

Biological hazards may include poison ivy, poison oak, snakes, thorny bushes and trees, ticks, mosquitoes, and other pests.

7.9.1 TICK-BORNE DISEASES

Lyme Disease, Erlichiosis, and Rocky Mountain Spotted Fever (RMSF) are diseases transmitted by ticks and occur throughout the United States during spring, summer, and fall.

Lyme Disease: The disease commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states.

Erlichiosis: The disease also commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin. Few cases have been identified in other states.

These diseases are transmitted primarily by the Deer Tick, which is smaller and redder than the common Wood Tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, swelling and pain in the joints, and eventually, arthritis. Symptoms of

Erlichiosis include muscle and joint aches, flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever: This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (*Rickettsia rickettsii*) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for two to three weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death if untreated, but if identified and treated promptly, death is uncommon.

Control: Tick repellent containing diethyltoluamide (DEET) should be used in tick-infested areas, and pants legs should be tucked into boots. In addition, workers should search the entire body every three or four hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

7.9.2 POISONOUS PLANTS

Poison ivy, poison sumac, and poison oak may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

Control: The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

7.9.3 POISONOUS SNAKES

The possibility of encountering snakes (cottonmouths and rattlesnakes) exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snake bites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control: To minimize the threat of snake bites, all personnel walking through vegetated areas must be aware of the potential for encountering snakes, and the need to avoid actions promoting encounters, such as turning over logs, etc. If a snake bite occurs, an attempt should be made to kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band and washing the area around the wound to remove any unabsorbed venom.

In areas where snakes may be encountered, affected personnel are required to wear leather work gloves and snakeproof chaps and/or snakeproof boots. Additionally, a snake bite kit is to be readily available at all times.

7.10 NOISE

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on Site. CRA's Hearing Conservation Program is to be implemented for personnel exposed noise levels above the OSHA action level of 85 decibels (acoustic) (dBA).

Control: All personnel must wear hearing protection with a Noise Reduction Rating (NRR) of at least 20 when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All Site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss.

Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

7.11 SANITARY FACILITIES

Site sanitation will be maintained according to OSHA and Department of Health requirements.

7.11.1 BREAK AREA

Breaks must be taken in the SZ, away from the active work area after Site personnel go through decontamination procedures. There will be no eating, drinking, or chewing gum or tobacco in the area other than the SZ. Smoking is <u>not</u> permitted anywhere within the GMPT Bedford Facility.

7.11.2 POTABLE WATER

The following rules apply for all project field operations:

i) an adequate supply of potable water will be provided at each work Site. Potable water must be kept away from hazardous materials, contaminated clothing, and contaminated equipment;

ii) portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be drunk directly from the container, nor dipped from the container;

iii) containers used for drinking water must be clearly marked and not used for any other purpose; and

iv) disposable cups must be supplied, and both a sanitary container for unused cups and a receptacle for disposing of used cups must be provided.

7.11.3 TRASH COLLECTION

Trash collected from the CRZ will be separated as potentially contaminated waste. Trash collected in the support and break areas will be disposed of as non-hazardous waste. Trash receptacles will be set up in the CRZ and in the SZ.

7.12 ELECTRICAL HAZARDS

Electricity may pose a particular hazard to Site workers due to the use of portable electrical equipment. When electrical work is needed, it must be performed by a qualified electrician in accordance with the CRA Health and Safety Program for Electrical Safety.

General electrical safety requirements include:

a) all electrical wiring and equipment must be a type listed by Underwriters Laboratory (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency;

ii) all installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations;

iii) portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle;

iv) tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM;

v) live parts of wiring or equipment must be guarded to prevent persons or objects from touching them;

vi) electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching;

vii) all circuits must be protected from overload;

viii) temporary power lines, switch boxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage;

ix) plugs and receptacles must be kept out of water unless approved for submersible construction;

x) all extension outlets must be equipped with ground fault circuit interrupters (GFCIs);

xi) attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment;

xii) extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire; and

xiii) flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

7.13 MANUAL MATERIAL HANDLING HAZARDS

Ergonomics is the science of adapting project activities to the Site personnel that will actually be completing the activity/task. Ergonomics allows personnel to work safely and efficiently by considering the limitations, physical characteristics and other human factors involved during task activities. In this section we will address problems commonly associated with ergonomics, risk factors and preventing these ergonomic problems (commonly referred to as musculoskeletal disorders [MSDs]). An MSD is an injury/disorder of the muscles, tendons, joints, spinal column, and ligaments. (NOTE: This does not include injuries caused by slips, trips and falls. These hazards should be addressed in the task safety analysis.)

7.13.1 BACK DISORDERS

Back disorders are frequently caused by repeated lifting, sudden movements, whole body vibration, lifting and twisting movements, bending over for extended periods, poor physical condition, and bad posture. Lifting heavy and/or awkward objects during a single lift can cause back problems. However, most back problems result from cumulative trauma caused by minor strains accumulating over a period of time. Repetitive movements can irritate and weaken muscle and/or ligaments eventually causing a more serious injury. Tasks involving the frequent lifting of heavy objects present the highest risks for CRA Site personnel.

7.13.2 OTHER MSD DISORDERS

MSDs from manual lifting in the construction field usually involve the hands, wrists, neck, shoulders, upper/lower back, hips, and knees. The following list presents some of the more common MSDs:

i) sprains – injury/tear to a ligament;
ii) strains – injury to muscles;
iii) degenerative discs – damage to the spine;
iv) tendinitis – inflammation/soreness of tendons due to repeated movement;
v) carpal tunnel syndrome;
vi) thoracic outlet syndrome – hand and wrist nerve disorder; and
vii) carpet layer's knee – knee pain and sprains.

7.13.3 PREVENTION

Work practice controls for the task should be developed during the safety analysis. Personnel should be instructed on the proper posture for the task in order to alleviate stress and strain to the body.

7.13.3.1 PROPER LIFTING PROCEDURES

Proper lifting techniques can help you lift safely. When you are preparing to lift a load, check the load by testing the weight at one of the corners. Get help or use a device/machine if the load is too heavy. Do not be afraid to ask for help if the load looks too heavy. Do not carry a load you cannot see around or over.

Make sure route of travel is clear of debris and trash. There should be no slip, trip or fall hazards present. Check to make sure that there is enough room/space and that there are no obstructions or overhead hazards.

Always wear proper footwear to protect your feet and to avoid losing your footing. If the object has rough and/or sharp corners and edges wear suitable work gloves. Gloves will assist by providing a good grip (coupling factor) and by protecting the hands.

When attempting the lift, stand close to the load and center yourself over the load. Squat down and get a firm footing and a good grip on the object with feet apart (one foot should be slightly behind the other foot for good balance). As you rise, lift with your legs and keep the load as close to the body as possible. Remember that your legs are stronger than your arms.

When the lift has been made, do not twist or turn the body. If the load must be moved to the left or right, move/change the position of your feet to change direction. Twisting and turning with your back creates out-of-neutral forces that could injure your back. Carry the load as close as possible to your body. Do not carry a load above your head or on your side and never carry a load that is too heavy. Get help or get a machine such as a handcart, forklift, crane, etc.

Set the load down properly by reversing the lifting procedure (i.e., bend at the knees, use your legs instead of your back and arms, do not turn or rotate, etc.) The load should be touching the ground before you release control of it. Always push an object rather than attempting to pull it. Pushing puts less strain on the back.

7.13.3.2 OTHER PREVENTATIVE MEASURES

MSDs can be prevented through proper techniques (i.e., lifting, etc.), proper diet, exercise, and PPE. Examples of proper techniques and planning include obtaining tools include acquiring tools that are ergonomically designed. These include tools that have full hand grips instead of pinch grips, knives and other cutting utensils with ergonomically designed handles, cutting and shearing tools with long handles to increase leverage and power and the distance between the person and the object being cut, and shovels with curved handles to alleviate back strain.

Exercise and the proper diet can assist in the prevention of MSDs by maintaining an overall health body. Personnel should drink 8 glasses of water a day to remain hydrated. This will reduce tearing injuries and prevent stiffness in the muscles, joints and ligaments. A well balanced diet is important to maintain optimal physical and mental function. Caffeine intake should be modified as caffeine increases muscle sensitivity to pain. Additionally, exercise will strengthen your body and increase the body's flexibility. A strong, flexible body is less apt to become injured.

Back belts are used mostly in general industry but are becoming common in the construction industry as well. Short-term studies indicate that the use of back belts provides a significant reduction in back injuries. Back belts are not considered PPE.

7.13.4 PERSONAL PROTECTIVE EQUIPMENT

The use of PPE will complement the ergonomic solutions and other measures (engineering and administrative controls) implemented by CRA during manual material handling operations. PPE provides a barrier between the worker and the hazard source (sharp edge, hard surface, etc.). Safety shoes, gloves and hard hats are examples of required PPE when handling materials manually. However, for any given situation the proper PPE should be selected so that personnel are properly protected. Over-protection as well as under-protection should be avoided as both instances can be hazardous.

Training involving PPE should include the following: when PPE is necessary; what PPE is necessary; how to wear the required PPE; limitations of PPE; and the proper care/maintenance of PPE.

Hardhats are to be worn to protect against injuries caused by the impact and penetration of falling or flying objects and to prevent unprotected heads from bumping into fixed objects. Eye and face protection will be worn to protect against hazards from flying objects during material handling activities (i.e., cutting metal banding, straps, rope, etc.).

Hand protection is the most important form of PPE when handling materials manually. The Site HSO will select the appropriate hand protection for the task/activity. Gloves are often relied upon to prevent against abrasions, cuts, and burns during material handling activities and many types of gloves actually improve your grip factor. Therefore, it is most important that the most appropriate glove (leather, cotton, kevlar, metal mesh, nitrile, etc.) is selected for the given situation. The following table presents protection factors for commonly used gloves.

Type of Glove	*Protection*
Rubber	Acids, bases, alcohol – moderate resistance to cuts.
Canvas or cloth	Dirt, wood slivers, sharp edges – some resistance to cuts.
Metal mesh or kevlar	Highly resistant to cuts and scratches and caught between hazards (crushing, etc.)
Insulated	Electrical charges
Cuffed	Protects against liquids trickling into glove and protects the wrist/forearm area from cuts and abrasions.
Leather	Moderate resistance to cuts and abrasions and caught between hazards.

It is important to wash hands frequently when wearing gloves to prevent the build-up of sweat and dirt on the hands. Check gloves regularly for cracks, holes and rips/tears. Keep gloves clean and dry as much as possible.

7.14 DRILLING ACTIVITIES

Drilling operations taking place may include the drilling of boreholes and the installation of monitoring wells. Drilling and sampling activities present several potential hazards. Minimizing these hazards requires strict adherence to safe operating procedures.

Drilling personnel shall adhere to the following practices:

- Equipment should be inspected daily by the operator to ensure that there are no operational problems.
- Before leaving the controls, shift the transmission controlling the rotary drive into neutral and place the feed level in neutral. Before leaving the vicinity of the drill, shut down the drill engine.
- Do not drive the drill rig with the mast in the raised position.
- Before raising the mast, check for overhead obstructions.
- Before the mast of a drill rig is raised, the drill rig must first be leveled and stabilized with leveling jacks and/or cribbing. Re-level the drill rig if it settles after initial set up. Lower the mast only when the leveling jacks are down, and do not raise the leveling jack pads until the mast is lowered completely.

- Employees involved in the operation shall not wear any loose-fitting clothing that has the potential to catch in moving machinery.
- Personnel shall wear safety-toed shoes, safety glasses, hearing protection and hard hats during drilling operations and safety vests during non-intrusive work activities.
- The area shall be roped off, marked or posted, to keep the area clear of pedestrian traffic or spectators.
- All personnel should be instructed in the use of the emergency kill switch on the drill rig. Personnel should routinely verify that the kill switch is functional and documented.
- Any Hot Work activities, including brazing, cutting, torching and/or welding, must have a hot work permit issued prior to beginning operations. Personnel should seek additional information from the HSO prior to commencement of work.

7.15 UTILITY CLEARANCES

Elevated superstructures (e.g., drill rig, backhoe, scaffolding, ladders, cranes) shall remain a minimum distance of 10 feet away from utility lines (<50 kV) and 20 feet away from power lines. Distance from utility lines may be adjusted by the HSO depending on actual voltage of the lines. Contact GMPT Bedford Facility Contact for assistance in determining line voltage, etc.

During all intrusive activities (e.g., drilling, excavating, and probing), the locator line service should be contacted to mark underground lines before any work is started.

Personnel involved in intrusive work shall determine the minimum distance from marked utilities which work can be conducted with the assistance of the locator line service.

7.16 LADDERS

Personnel that will use ladders or have the potential hazard of working on elevated surfaces during project activities shall follow the CRA Program for fall protection. Specific guidelines for ladders are outlined below.

Portable Ladders

Employees who use ladders on worksites must be familiar with safe ladder usage. The pertinent OSHA regulations are found in 29 CFR 1926 – Subpart X Stairways and Ladders.

- Use the 4-to-1 ratio; that is, place the ladder so its feet are 1 foot away from what it leans against for every 4 feet in height to the point where the ladder rests. Example: If the top of a 16-foot ladder leans against a wall, its feet should be placed 4 feet from the wall. The "fireman's method" is a convenient way of checking the angle of the ladder. Place your toes against the base of the ladder; fully extend both arms toward the side rail and parallel to the ground. When standing erect you should be able to hold the ladder's side rails.
- Do not use a ladder in a horizontal position as a runway or a scaffold.
- Do not place a ladder in front of a door that opens toward it unless the door is locked, blocked, or guarded by someone.
- Place a portable ladder so that both side rails have a secure footing. Provide solid footing on soft ground to prevent the ladder from sinking.
- Place the ladder's feet on a substantial and level base, not on a movable object.
- On uneven surfaces, use a block, wedge, or ladder foot.
- On wet or oily pavement, a smooth floor, or an icy or metal surface, the ladder footing must be lashed, blocked, or otherwise secured.
- Do not lean a ladder against unsafe backing, such as loose boxes or barrels.
- When using a ladder for access to high places securely lash or otherwise fasten the ladder to prevent its slipping.
- To gain access to a roof or elevated platform, extend the ladder at least 3 rungs (3 feet) above the point of support.

Ascending or Descending of Ladders

- Maintain three points of contact at all times when going up or down. If material must be handled, raise or lower it with a rope.
- Always face the ladder when ascending or descending.
- Maintain clean, dry footwear as much as possible to prevent slipping on the rungs.

7.17 FLAMMABLE AND COMBUSTIBLE LIQUIDS

The storage, dispensing, and handling of flammable and combustible liquids must be in accordance with OSHA 29 CFR 1910.106. The specific flammable or combustible liquids used at the site may include gasoline, diesel, kerosene, oils, and solvents.
Flammable and combustible liquids are classified according to flash point. This is the temperature at which the liquid gives off sufficient vapors to readily ignite. Flammable liquids have flash points below 100°F. Combustible liquids have flash points above 100°F and below 200°F.

Flammable Liquid Classes

Flammable liquids are known as Class I liquids, and divided into three classes:

- **Class 1A**, liquids having a flash point below 73°F (22.8°C), and having a boiling point below100°F (37.8°C) (ethyl ether, isoprene, pentane, petroleum ether).
- **Class 1B**, liquids having a flash point below 73°F (22.8°C), and a boiling point at or above 100°F (37.8°C) (acetone, benzene, denatured alcohol, gasoline, methyl ethyl ketone, octane).
- **Class 1C**, liquids having a flash point at or above 73°F (22.8°C) and below 100°F (37.8°C) (amyl acetate, turpentine).

Combustible Liquid Classes

Combustible liquids are known as Class II and III liquids, and divided into three classes:

- **Class II,** liquids include those with a flash point at or above 100°F (37.8°C), and below 140°F (60°C) (diesel, fuel oils, kerosene, mineral spirits).
- **Class III**, liquids are those with a flash point above 140°F. Class III liquids are further divided into two subclasses:
- **Class IIIA**, liquids with a flash point above 140°F and below 200°F (93.3°C).
- **Class IIIB**, liquids with a flash point at or above 200°F (93.3°C).

Note: When a combustible liquid is heated for use to within 30°F (16.7°C) of its flash point, it must be handled in accordance with the requirements for the next lower class of liquids.

Storage

Many flammables can ignite at temperatures at or below room temperature. They are far more dangerous than combustibles when they are heated. As a result, these products must be handled very carefully. At normal temperatures, these liquids can release vapors that are explosive and hazardous to employee health. Exposure to heat can cause some of these liquids to break down into acids, corrosives, or toxic gases.
For this reason, flammable/combustible liquids should be stored in cool, well ventilated areas away from any source of ignition. Always consult the MSDS of the product for specific information.

Flammable and combustible liquids must be stored in designated areas. Such areas must be isolated from equipment and work activity, which may produce flames, sparks, heat or any form of ignition, including smoking. The most practical method is the use of one or more approved (commercially available) flammable/combustible liquid storage cabinets. Each cabinet may store up to the following quantities:

a) 60 gallons of Class I or II liquids.

b) 120 gallons of Class III liquids.

Cabinets must be labeled "Flammable – Keep Fire Away". Doors must be kept closed and labeled accordingly. Containers must be kept in the cabinet when not in use.
There are also restrictions on the maximum allowable container size depending on the class of the products. See table below.

Maximum Size of Containers and Portable Tanks

Container Type	***Flammable Liquids***			***Combustible Liquids***	
	Class 1A	***Class 1B***	***Class 1C***	***Class II***	***Class III***
Glass or approved plastic	1 pt	1 qt	1 gal	1 gal	1 gal
Metal (other than DOT drums)	1 gal	5 gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT spec)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

General Requirements

- Keep containers of flammable/combustible liquids closed when not in use.
- Keep flammable/combustible liquids in designated areas and approved cabinets.
- Do not allow use of unapproved containers for transfer or storage. Use only approved safety cans (5-gallon maximum) with a spring closing lid and spout cover, designated to safely relieve internal pressure when exposed to heat or fire.
- Use only approved self-closing spigots, faucets, and manual pumps when drawing flammable/combustible liquids from larger containers/barrels.
- Use only approved metal waste cans with lids for disposal of shop towels/oily rags.
- Designate "Smoking" and "No Smoking" areas.
- Observe all signs indicating "No Smoking," "No Flames," "No Ignition."

Transferring Flammable/Combustible Liquids

- This seemingly routine task can be hazardous if certain precautions are not followed. Grounding and bonding must be observed at all times to prevent the accumulation of static electricity when transferring containers/barrels one to another:
  - Drums should be grounded (#4 copper conductor) to a grounding rod.
  - Bonding is necessary between conductive containers; (e.g., a barrel and a 5-gallon container).

8.0 AIR MONITORING

This section of the HASP presents the requirements for conducting air monitoring at the Site. The air monitoring program is designed to ensure protection for both personnel working on Site and the surrounding community. The on-Site monitoring program will be conducted by the HSO and will consist of monitoring Site personnel exposures to VOCs, inorganic compounds of concern, oxygen and combustible gas levels, hydrogen sulfide and carbon monoxide. This monitoring will be completed with the use of real-time reading instruments.

Identification of volatile organic vapor or particulate levels in excess of the action levels cited in Section 6.5 shall be reported to the HSO who, in conjunction with the Regional Safety and Health Manager, 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.

On-Site Air Monitoring

The HSO or Environmental Monitoring Technician will perform air monitoring to evaluate the exposure of Site personnel to chemical and physical hazards, verify the effectiveness of engineering controls, and determine the proper level of PPE. Air quality will be monitored at the initiation of each work activity and periodically thereafter. Background measurements immediately upwind of the EZ will be taken before activities commence.

During the progress of excavation activities, the HSO will monitor the levels of VOCs, oxygen and combustible gases, and particulate levels on an hourly basis or more frequently as necessary. The following monitoring equipment will be used for this purpose:

i) a PID equipped with a 10.6 eV lamp;

ii) a multigas personal alarm meter (e.g., MSA Passport® Five Star Personal Alarm or equivalent); and

iii) personal aerosol monitor (e.g., MIE® Personal DataRam or equivalent).

All instruments will be calibrated on a daily basis in accordance with the manufacturer's guidelines. Records of all calibrations and real-time measurements will be kept in a bound field log book.

Real-Time VOC Monitoring

The HSO will monitor for the presence of VOCs based on Site characteristics, historical data, work being conducted in a previously uncharacterized area, etc. PID readings will be taken in and around the exclusion zone. Action levels for upgrading or downgrading of PPE have been established by the U.S. EPA for atmospheres containing unknown concentrations of VOCs.

Combustible Gas, Oxygen, Hydrogen Sulfide, and Carbon Monoxide

Air monitoring for combustible gases and oxygen will be conducted during excavation entry activities, test pitting activities and during other activities where oxygen deficient and/or flammable atmospheres may be encountered (e.g. confined spaces; entry into excavations). The point of excavation and the immediate work area around these activities must be monitored to ensure that an adequate level of oxygen is present, and to determine if a flammable atmosphere exists. Combustible gas and oxygen level monitoring will be conducted as needed in areas that are suspect. The HSO will determine the monitoring frequency based on the observed Site conditions. All work activity must stop where monitoring indicates the flammable vapors concentration is 10 percent of the lower explosive limit (LEL) at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level.

Action levels for oxygen and LEL are provided below:

- If oxygen concentrations <19.5 percent are obtained in any personnel work area, supplied air respiratory protection will be required and the area will be ventilated.
- If any oxygen concentrations >22.5 percent are obtained in any work area, retreat to a safe atmosphere. Consult the Regional Safety and Health Manager and Project Management for guidance.

Based upon the scope of work involved, oxygen enriched atmospheres are not anticipated. However, it is necessary to be apprised of such readings as they impact LEL readings and vice versa.

LEL Meter Reading: If any readings ≥10 percent LEL are obtained:	**Action Taken:** Stop all activities in the area to those that will not generate sparks; wear non-sparking gear and use non-sparking tools.
If any readings ≥20 percent LEL are obtained:	Cease all activities and retreat to a safe atmosphere. Consult the Regional Safety and Health Manager and Project Management.

In addition to combustible gas and oxygen, monitoring for hydrogen sulfide and carbon monoxide will be conducted during confined space entry activities, including excavation entry and test pitting activities.

Carbon Monoxide Reading: If any readings ≥20 ppm are obtained:	**Action Taken:** Cease work immediately and contact the Site HSO and confer with the CRA Regional Safety and Health Manager.
Hydrogen Sulfide Meter Reading: If any readings ≥10 ppm are obtained:	**Action Taken:** Cease all activities in the area and wait for direction from Site HSO and confer with the CRA Regional Safety and Health Manager.

Air Sampling Program

Selected remedial contractors will be responsible for developing and implementing a personal air-monitoring program for its workers. This program will be included in the contractor's Site-specific HASP.

CRA will implement a personnel air-monitoring program for CRA personnel and subcontractor workers having the highest potential for exposure to chemicals present on Site. Samples would be collected during the startup of activities, at locations where personnel would face potential exposure. The purpose of this is to verify the adequacy of personal protection and to document the actual exposure level to the selected chemicals of concern. Sampling frequency will be determined by the HSO. Samples will be collected and analyzed for the presence of the compounds of concern as determined by the HSO. It is expected that samples will be collected and analyzed for PCBs. Appropriate NIOSH procedures and methods will be followed and all samples are to be sent to an American Industrial Hygiene Association (AIHA) accredited laboratory. Results of the air-sampling program will be posted for personnel to review.

9.0 DECONTAMINATION PROCEDURES

In general, everything that enters the EZ at the Site must either be decontaminated or properly discarded upon exit from the EZ. All personnel, including any State and local officials, must enter and exit the EZ through the decontamination area. Prior to demobilization, potentially contaminated equipment will be decontaminated and inspected by the HSO before it is moved into the clean zone. Materials generated during decontamination will be containerized for off-Site disposal.

The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for this Site is Liquinox (soap) for equipment and for any reusable PPE. A MSDS for Liquinox and all other chemical containing products will be maintained on-Site by the HSO.

9.1 EQUIPMENT DECONTAMINATION PROCEDURES

A temporary Equipment Decontamination Pad will be constructed and operational before any work begins involving contact with potentially contaminated material. All equipment must be decontaminated within the CRZ or on the decontamination pad by a high-pressure washer upon exit from the EZ. All waste transport vehicles must be inspected and clean prior to leaving the Site. Decontamination procedures should include: knocking soil/mud from machines; water rinsing using a solution of water and Liquinox; scraping and brushing with long-handled brushes to remove remaining soils and a final water rinse. Particular attention should be paid to tire treads, equipment tracks, springs, joints, sprockets, and under carriages. Equipment will be allowed to air dry in a clean zone before being moved from the Site or traveling onto clean areas. Personnel shall wear Level C or Modified D protection when decontaminating equipment. Modified D protection may be used if authorized by the HSO. Runoff and sediments will be collected and stored until appropriate disposal arrangements are made. Appropriate measures (i.e., wind shields) will be taken to minimize the drift of mist and spray during decontamination. Following decontamination and prior to equipment removal from the Site or travel on clean areas, each piece of equipment will be inspected by the CRA On-Site Construction Coordinator and/or the HSO to ensure that the equipment has been properly cleaned. This inspection shall be included in the Site logbook.

In general, equipment decontamination pads should be installed and operated under the following guidelines:

i) Sized for the width and weight of the heaviest equipment expected, leaving sufficient room for decontamination equipment, personnel, and waste fluid storage drums.

ii) Provide an impermeable barrier capable of containing all decontaminated liquids.

iii) Durably constructed to withstand the wear and tear of equipment tires/tracks.

iv) Provided with a low point sump where all decontaminated fluids can be collected and pumped out.

v) Be constructed such that a minimum amount of materials will require special disposal when the decontamination pad is decommissioned. The use of granular fills or stone as the primary load-bearing surface should be avoided.

vi) The length of the decontamination pad need not be sufficient to contain the entire vehicle. The vehicle can be decontaminated in sections as it passes over the pad.

vii) If possible, vehicle access into the work zone should be made around the decontamination pad rather than over it. This will reduce the wear and tear on the pad. If such access is made possible, the pad should remain blocked whenever it is not in use.

An equipment decontamination inspection record will be maintained onsite, which includes:

- equipment descriptions with identification numbers or license plates;
- time and date entering decontamination facility;
- time and date exiting the decontamination facility; and
- name of inspector(s) with comment stating that decontamination was performed and completed.

9.2 PERSONNEL DECONTAMINATION PROCEDURES

Personnel decontamination will be completed in accordance with the CRA Health and Safety Program for personnel decontamination. Washwater and sediments will be collected and stored with any runoff water collected for subsequent treatment/disposal. PPE, trash, etc. will be sent off-Site for disposal. It will be kept separate from trash generated in clean areas of the Site. A description of the proper procedures for doffing PPE as well as personnel decontamination procedures are prescribed in detail in the

CRA Health and Safety Programs. However, the general guidelines for a typical Level C decontamination line are described below:

i) upon entering the CRZ, rinse contaminated materials from boots or remove contaminated boot covers;

ii) clean reusable protective equipment;

iii) remove protective garments, equipment, and respirator. All disposable clothing should be placed in a covered container which is labeled;

iv) wash hands, face, and neck or shower (if necessary);

v) proceed to clean area and dress in clean clothing; and

vi) clean and disinfect respirator for next use.

10.0 GENERAL SAFETY AND PERSONAL HYGIENE

1. Eating at the Site is prohibited except in specifically designated areas. Designation of eating areas will be the responsibility of the HSO. The location of these areas may change during the duration of the project to maintain adequate separation from the active work area(s).
2. Smoking at the Site is prohibited except in specifically designated areas.
3. Individuals getting wet to the skin with effluent from the washing operation must wash the affected area immediately. If clothes in contact with skin are wet, then these must be changed.
4. Hands must be washed with soap and water before eating, drinking, smoking, and before using toilets.
5. All disposable coveralls and soiled gloves will be placed in covered containers at the end of every shift or sooner, if deemed necessary by the HSO. Wastes will be stored until proper disposal arrangements have been made.
6. Personnel working on Site will not be permitted to wear facial hair that interferes with the mask-to-face seal on air-purifying respirators.

11.0 MEDICAL SURVEILLANCE

In accordance with the requirements detailed in 29 CFR 1926.65, 29 CFR 1926.62, and 29 CFR 1910.134, all Site personnel who will come in contact with materials with potentially elevated chemical presence will have received medical surveillance by a licensed physician or physician's group as per a medical surveillance program complying with 29 CFR 1926.65.

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.

The medical records will be available to the employee or his/her designated representative upon written request, as outlined in 29 CFR 1910.1020.

Each employer will provide certifications to the HSO that its personnel involved in Site activities will have all necessary medical examinations and will have obtained medical certification prior to commencing work, which requires respiratory protection or potential exposure to hazardous materials. Personnel not obtaining medical certification will not perform work within the CRZ and EZ.

Interim medical surveillance will be completed if an individual exhibits poor health or high stress responses due to any Site activity or when accidental exposure to elevated concentrations of chemicals occur.

12.0 ENVIRONMENTAL CONTROL PROGRAM

This section of the HASP outlines measures to be implemented at the Site to prevent hazards associated with environmental conditions.

12.1 WEATHER MONITORING

The HSO or Site Superintendent will be responsible for checking weather forecasts for the next day and week of work to provide advance notification of any severe weather conditions. Severe weather conditions (e.g., heavy rains) may cause unsafe conditions at the site and in some situations work may have to be stopped.

12.2 TORNADO SAFETY POLICY AND PROCEDURES

Tornadoes occur most frequently between April and October from 3:00 to 7:00 P.M. but can occur any time. In most cases, tornadoes move from a west/southwest direction. A typical tornado is a swirling storm of short duration with winds up to 300 miles per hour and a near vacuum at its center. It appears as a rotating funnel-shaped cloud, from gray to black in color, extending towards the ground from the base of a thundercloud.

Tornadoes usually only cover a limited geographical area and give off a roaring sound. A tornado is the most concentrated and destructive potential weather event at the Site. Tornadoes are usually the result of the interaction of a warm, moist air mass with a cool or cold air mass. Secondary effects of tornadoes include flash flooding, electric power outages, transportation-system and communication-system disruption, and fires.

Whenever weather conditions develop that indicate tornadoes are expected, the National Weather Service will issue a tornado watch to alert people in a designated area for a specific time period (normally six hours) to remain alert for approaching storms. The tornado watch is upgraded to a tornado warning when a funnel cloud (tornado) is actually sighted or indicated by weather radar.

When a tornado is approaching Site personnel will only have a short time to react. Therefore Site personnel must be prepared to react during periods of severe weather. Memorize the following tornado danger signs:

i) approaching clouds of debris can mark the location of a tornado even if a funnel cloud is not visible;

ii) before a tornado hits, the wind may die down and the air can become very still/calm; and

iii) it is not uncommon to see clear, sunlit skies behind a tornado as they usually occur at/near the trailing edge of thunderstorms.

Tornado Evacuation Procedures
(Tasks being conducted in close proximity of GMPT Bedford Facility and Downstream Creek Areas)

Plant Security continuously monitors weather related information provided by Weather Data Service. If Weather Data Service issues a tornado warning (an actual funnel cloud is heading in the direction of the GMPT Bedford Facility), Plant Security will activate the GMPT Bedford Facility emergency response plan. CRA will be notified verbally via the GMPT Bedford Facility two-way radio system by Plant Security. Note: Plant Security tornado notification will override all other radio transmissions.

The "take shelter" warning signal is a "slow wail" of the alarm system. This alarm will not be audible to all CRA personnel that are working near the plant. Therefore, all Site personnel will evacuate the work zone(s) when a tornado watch has been issued by the National Weather Service. Personnel will be contacted by cellular telephones or contractor-supplied two-way radios. Check remote areas of the work zone(s) to ensure all personnel have reacted to the alert. Personnel must proceed to the Site mustering point and wait for further instructions. If a tornado watch is upgraded to a tornado warning, all personnel will proceed to the designated tornado shelters. Once inside the shelter, proceed to the basement and conduct a head count to ensure that all personnel are accounted for. In general, stay away from all windows and doors that lead to the outside. Remain in the shelter until the "all clear" signal is given by Plant Security. The "all clear" signal is a steady horn.

The tornado shelter most accessible to CRA personnel, and personnel occupying the adjacent trailers at GM Drive and 4th Street, is located at the wastewater treatment plant on the west side of GM Drive. The shelter has a designated “Tornado Shelter” sign visible on the exterior east wall facing GM Drive. The entrance is located on the northwest side of the building.

The tornado shelter in close proximity to the downstream Creek Area activities (Peerless Road and Bud Ikerd Road is located at the DIVE Christian Church on Peerless Road. The entrance to the basement is located on the west side of the church.

Personnel that occupy the trailer at GM Drive and Breckenridge Road will be directed to use the main security guard house at the north end of the GM plant building as their tornado shelter.

Directions to the shelter are to be communicated to Site personnel during initial Site safety orientation and throughout the tornado season during subsequent safety meetings. See Figure 12.1 for shelter locations.

If unable to reach the designated shelter, refer to the emergency procedures listed in the next section for personnel working in remote areas. The best protection in a tornado is usually an underground area. If an underground area is not available, consider small interior rooms on the lowest floor without windows, hallways on the lowest floor away from doors and windows, rooms constructed with reinforced concrete/brick/block with a heavy concrete floor and roof, and protected areas away from doors and windows.

Tornado Evacuation Procedures
(Tasks being conducted in areas further from the GMPT Bedford Facility)

Personnel working in remote areas away from the GMPT Bedford Facility will need to implement additional safety and emergency response procedures. As personnel have the potential to work in areas away from the main trailer complex/GMPT Bedford Facility without adequate protective structures (creek/stream and floodplain areas) they will depend on having adequate warning of approaching tornadoes. Field personnel will utilize the following procedures when severe weather threatens:

i) monitor weather broadcasts via hand-held battery operated National Oceanic and Atmospheric Administration (NOAA) weather radios;

ii) communicate with base station at CRA trailer complex via hand-held two-way radios and/or cellular telephones in order to have current weather data from GM Plant Security, etc.;

iii) stay alert for tornado warning signs and evacuate to the trailer complex during thunderstorms; and

iv) be aware of the potential for flooding (do not drive through areas with high ponding water).

If outdoors during a tornado, personnel should attempt to get inside a safe building. However if shelter is unavailable or there is no time to get indoors, personnel should lie in a ditch or low-lying crouch near a strong building/structure or rock formation (try to stay on the east side). Use arms to protect the neck and head. If traveling in a car/truck, never try to out drive a tornado as tornadoes can change direction and lift a car or truck into the air. Get out of the car immediately and seek shelter.

12.3 RAIN AND SNOW

Excessive amounts of precipitation may cause potential safety hazards for all work tasks. The hazards that would be most commonly associated are slipping, tripping, or falling due to slippery surfaces. Further hazards are detailed by work task (Table 7.1).

Severe weather conditions will result in work stoppage and the implementation of further emergency measures, as described in the CRA Health and Safety Program.

12.4 TEMPERATURE

Site activities are expected to be conducted year-round. Temperature extremes may be experienced which require measures to be implemented to prevent health and safety hazards from occurring. Potential hazards arising from temperature extremes are heat stress and cold exposure.

12.5 WIND

High winds may be encountered at the Site and these can cause hazards that may affect Site personnel health and safety. Preventative measures that will be implemented if necessary are as follows:

i) restricted Site activity;
ii) battening down light equipment or building materials;
iii) partially enclosing work areas; and
iv) reduction or stoppage of work activities.

13.0 CONFINED SPACE ENTRY PROCEDURE

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, oxygen deficient atmospheres, limited visibility, and restricted movement. Included in this definition is any excavation that is greater than or equal to four feet deep and has limited access. This section establishes requirements for safe entry into, continued work in, and safe exit from confined spaces. Additional information regarding confined space entry can be found in 29 CFR 1926.21, 29 CFR 1910.146, and NIOSH-106. Entry into a confined space will only be undertaken after remote methods have been tried and found not to be successful. If confined space entry is required, such work will only be undertaken following the guidelines presented in the CRA Health and Safety Programs or an approved contractor's Confined Space Entry Program. The contractor's Program must minimally meet the requirements of the CRA Program.

14.0 EMERGENCY RESPONSE

It is essential that Site personnel be prepared in the event of an emergency. Emergencies can take many forms; illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather (See Section 12 – Environmental Control Program). The following sections outline the general procedures for emergencies. Emergency information should be posted as appropriate. All serious emergencies will be reported to the local fire and/or police departments as well as the GMPT Bedford Facility Contact. Upon arriving at the Site, they will give CRA further direction as to the responsibilities during any emergency situation. It is possible they may wish to take the lead or they may ask CRA to take the lead.

14.1 EMERGENCY CONTACTS

Fire: 911

Police: 911

Ambulance: 911

Main Hospital: .... Bedford Medical Center
2900 16th Street
Bedford, Indiana 47421
Telephone: 812-275-1200

Directions to the Hospital: Exit Trailer Complex and make left (south) onto GM Drive (0.3 miles). Go to Stop Sign and make right (West) onto 5th Street (0.7 miles). At red light make left (south) onto Lincoln Avenue (0.7 miles). Make right (west) onto Williams Boulevard (0.7 miles). Make left (south) onto Beech Street (0.7 miles). Make right (west) onto 16th Street (0.5 miles). Bedford Medical Center is on left (see Figure 14.1 for map).

Optional Hospital: .... Dunn Memorial Hospital
1600 23rd Street
Bedford, Indiana 47421
Telephone: 812-275-3331

Directions to the Hospital: Exit Trailer Complex and make left (south) onto GM Drive (0.3 miles). Go to Stop Sign and make right (West) onto 5th Street (0.7 miles). At red light make left (south) onto Lincoln Avenue (0.7 miles). Make right (west) onto 15th Street (0.8 miles). Make left (south) onto M Street (0.1 miles). Make right (west) onto 25th Street (0.7 miles). Make a right into hospital entrance (see Figure 14.1 for map).

14.2 ADDITIONAL EMERGENCY NUMBERS

National Response Center (NRC)	800-424-8802
Agency for Toxic Substances and Disease Registry	404-488-4100 (24 Hours)
Poison Control Center	800-942-5969
U.S. EPA Emergency Response	800-424-8802
State of Indiana Emergency Response Commission	317-243-5176
Underground Utilities Location Service	800-382-5544
GM Contact (Cheryl Hiatt)	248-680-5219 (Office)
	313-510-4328 (Cell)
GM Contact (Ed Peterson)	248-680-5726 (Office)
	313-506-9465 (Cell)
GM Contact (Laura Fitzpatrick)	313-665-4881
CRA Project Manager (Glenn Turchan)	519-884-0510
CRA Regional Manager of Safety and Health (Jeffrey Maranciak)	412-963-7313 (Office)
	412-225-6375 (Cell)
CRA Overall Project Coordinator (Jim McGuigan)	773-380-9933 (Office)
	708-476-4793 (Cell)
CRA On-Site Construction Coordinator (Katie Kamm)	812-277-8954 (Office)
	651-295-7400 (Cell)
CRA On-Site HSO (Dan Nelson)	812-278-8965 (Office)
	812-276-3505 (Cell)

14.3 EMERGENCY EQUIPMENT AVAILABLE ON SITE

Communication Equipment	*Location*
Emergency Alarms/Horns	CRZ

Medical Equipment

OSHA Approved First Aid Kit	CRZ/SZ and Each Site Vehicle
Sized for a Minimum of 20 people	
Portable Emergency Eyewash Bottles	

Fire Fighting Equipment

Two 20-Pound ABC Type Dry Chemical Fire Extinguishers	CRZ
One 2.5-Pound ABC Type Dry Chemical Fire Extinguishers	Each Site Vehicle

14.4 PROJECT PERSONNEL RESPONSIBILITIES DURING EMERGENCIES

HEALTH AND SAFETY OFFICER (HSO)

As the administrator of the HASP, the HSO has primary responsibility for responding to and correcting emergency situations. The HSO will:

i) take appropriate measures to protect personnel including: withdrawal from the EZ, total evacuation and securing of the Site or upgrading or downgrading the level of protective clothing and respiratory protection;

ii) take appropriate measures to protect the public and the environment including isolating and securing the Site, preventing runoff to surface waters and ending or controlling the emergency to the extent possible;

iii) ensure that appropriate Federal, State, and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be notified immediately. In the event of an air release of toxic materials, local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted;

iv) ensure that appropriate decontamination treatment or testing for exposed or injured personnel is obtained;

v) determine the cause of the incident and make recommendations to prevent the recurrence;

vi) ensure that Section 12 - Environmental Control Program is implemented when severe weather (flooding, tornado threats, high winds, rain/snow, etc.) threatens the Site; and

vii) ensure that all required reports have been prepared.

14.5 MEDICAL EMERGENCIES

Any person who becomes ill or injured in the EZ must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed as much as possible without causing further harm to the patient. First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the HSO and On-Site Construction Coordinator.

Any person transporting an injured/exposed person to a clinic or hospital for treatment should take with them directions to the hospital and a listing of the contaminants of concern to which they may have been exposed.

Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

14.6 FIRE OR EXPLOSION

In the event of a fire or explosion, the local fire department should be notified immediately. The local fire department may be deployed if there is a fire or the possibility of a fire or explosion. Upon their arrival, the HSO or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on Site. The nature of the emergency will dictate measures to be implemented.

If it is safe to do so, Site personnel may:

i) if hazardous, report to the Agency On-Scene Coordinator and/or Project Manager;
ii) use fire fighting equipment available on Site; or
iii) remove or isolate flammable or other hazardous materials that may contribute to the fire.

14.7 SPILLS OR CONTAINER LEAKS

In the event of a spill or leak, Site personnel will:

i) report spills and releases to the Agency On-Scene Coordinator, Project Manager, the NRC, and State Emergency Response Commission (SERC);

ii) locate the source of the spillage and stop the flow if it can be done safely; and

iii) begin containment and recovery of the spilled materials.

15.0 RECORD KEEPING

The HSO shall establish and maintain records of all necessary and prudent monitoring activities as described below:

i) name and job classification of the employees involved on specific tasks;

ii) records of qualitative/quantitative fit testing and physical examination results for Site personnel;

iii) daily air monitoring/sampling logs and daily instrument calibration logsheets;

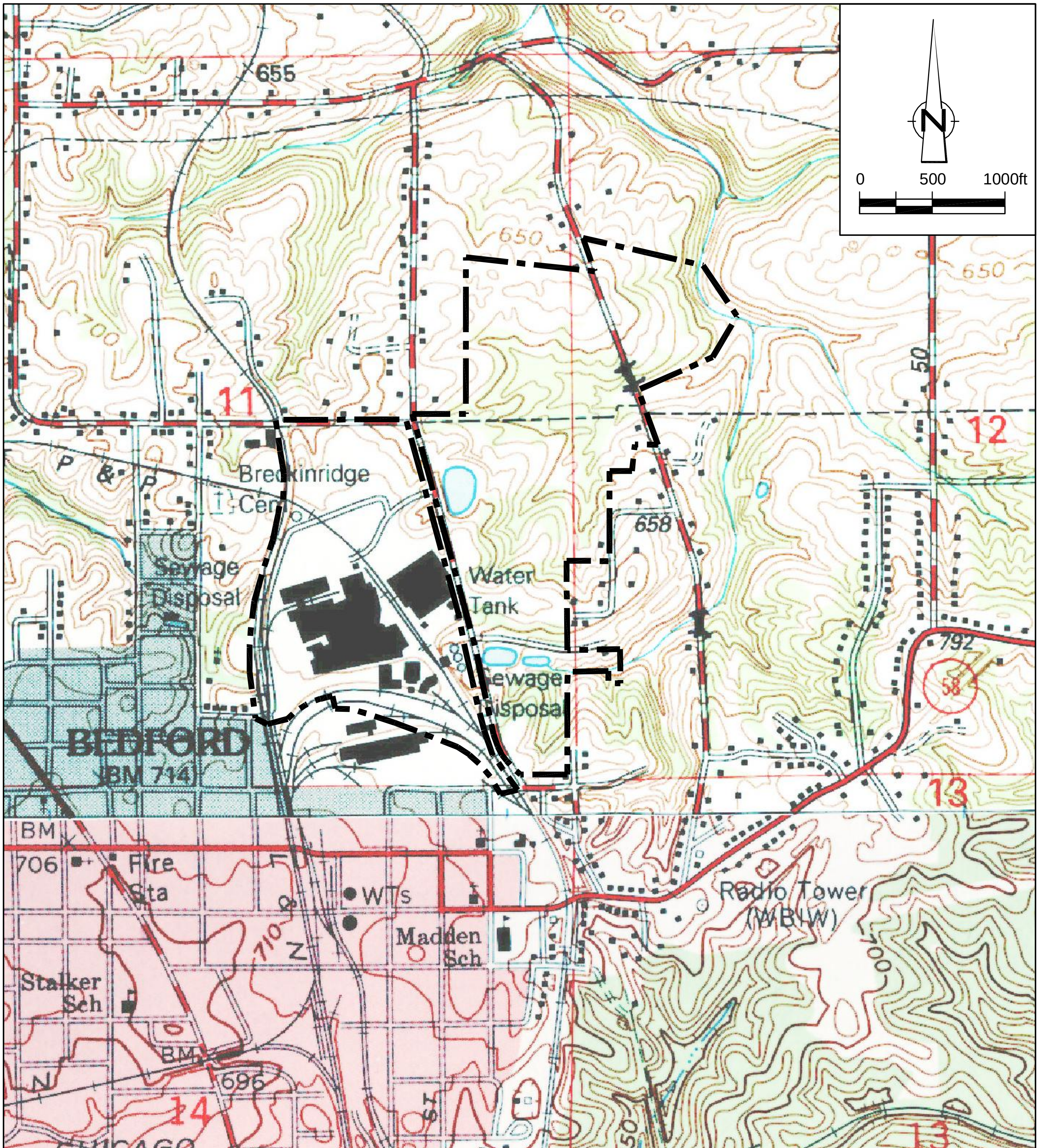
iv) air sampling results;

v) maintaining a Site safety logbook;

vi) records of all OSHA training certification for Site personnel;

vii) records of training acknowledgment forms; and

viii) emergency reports describing any incidents or accidents.



BASE SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES;
BARTLETTSVILLE, INDIANA 1994
BEDFORD EAST, INDIANA 1978
BEDFORD WEST, INDIANA 1993
OOLITIC, INDIANA 1987

LEGEND

FACILITY BOUNDARY

figure 1.1

SITE LOCATION
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(095)GN-WA001 APR 17/2007

Nº	Revision	Date	Initial

0 100 200ft

LEGEND

- 600 EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- APPROXIMATE GM PROPERTY BOUNDARY
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

GM POWERTRAIN BEDFORD FACILITY BEDFORD, INDIANA

SITE PLAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI. APRIL 2001

Project Manager:	Reviewed By:	Date:	
J.M.	M.K.	NOVEMBER 2004	
Scale: AS SHOWN	Project Nº: 13968-00	Report Nº: 095	Drawing Nº: figure 1.2

13968-00(095)GN-WA006 APR 17/2007

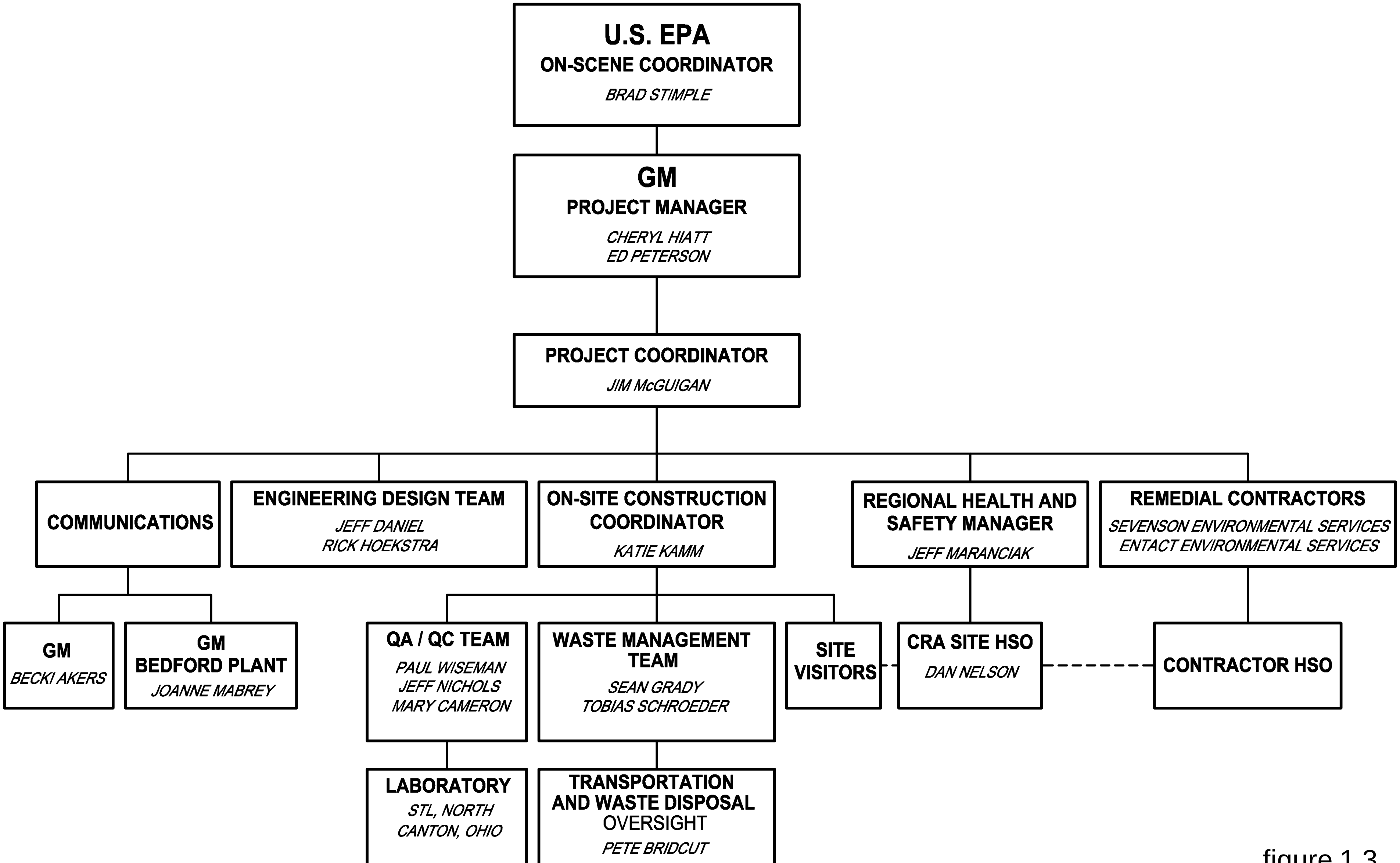
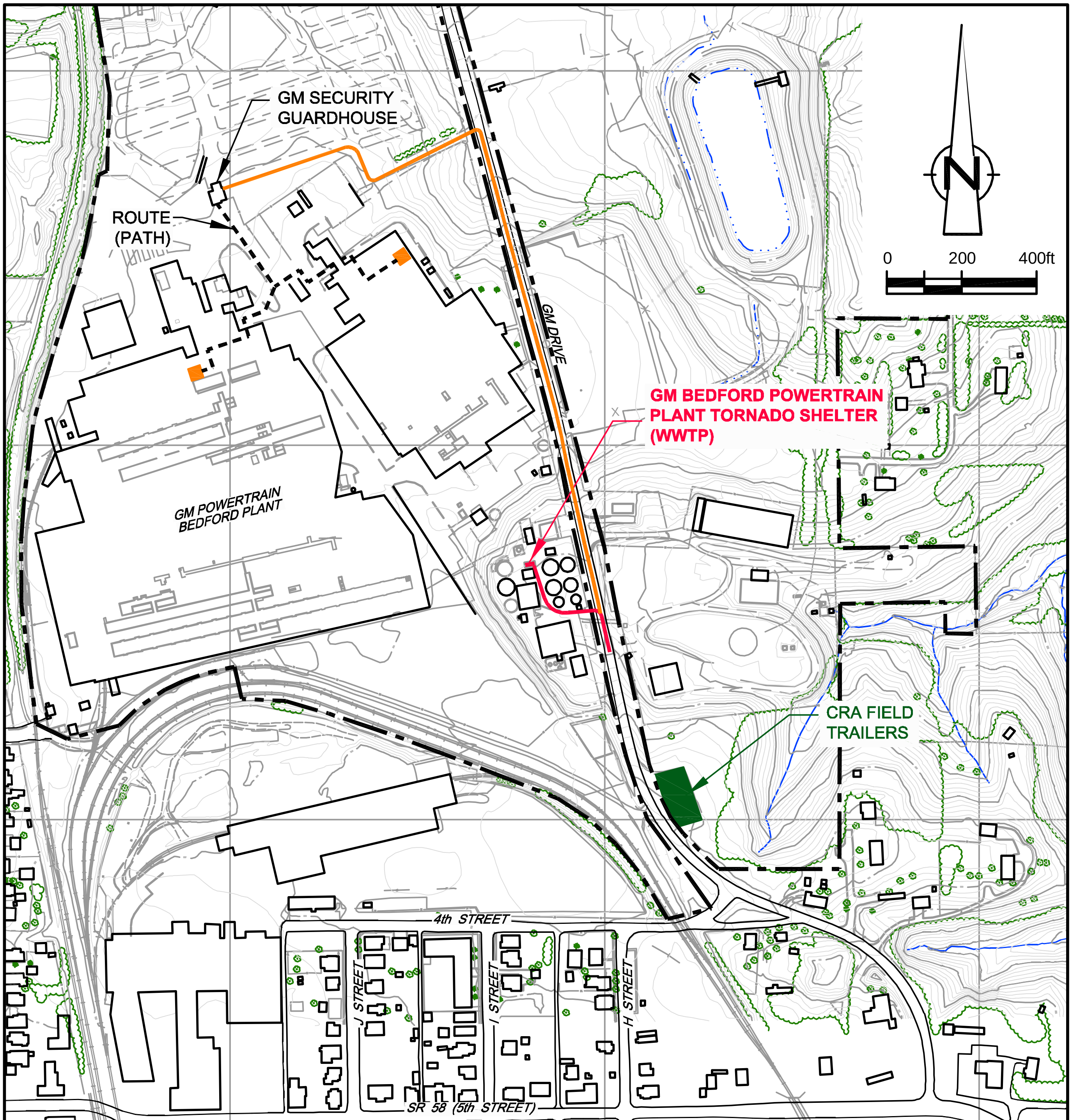


figure 1.3

PROJECT TEAM ORGANIZATION
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(095)GN-WA009 APR 17/2007



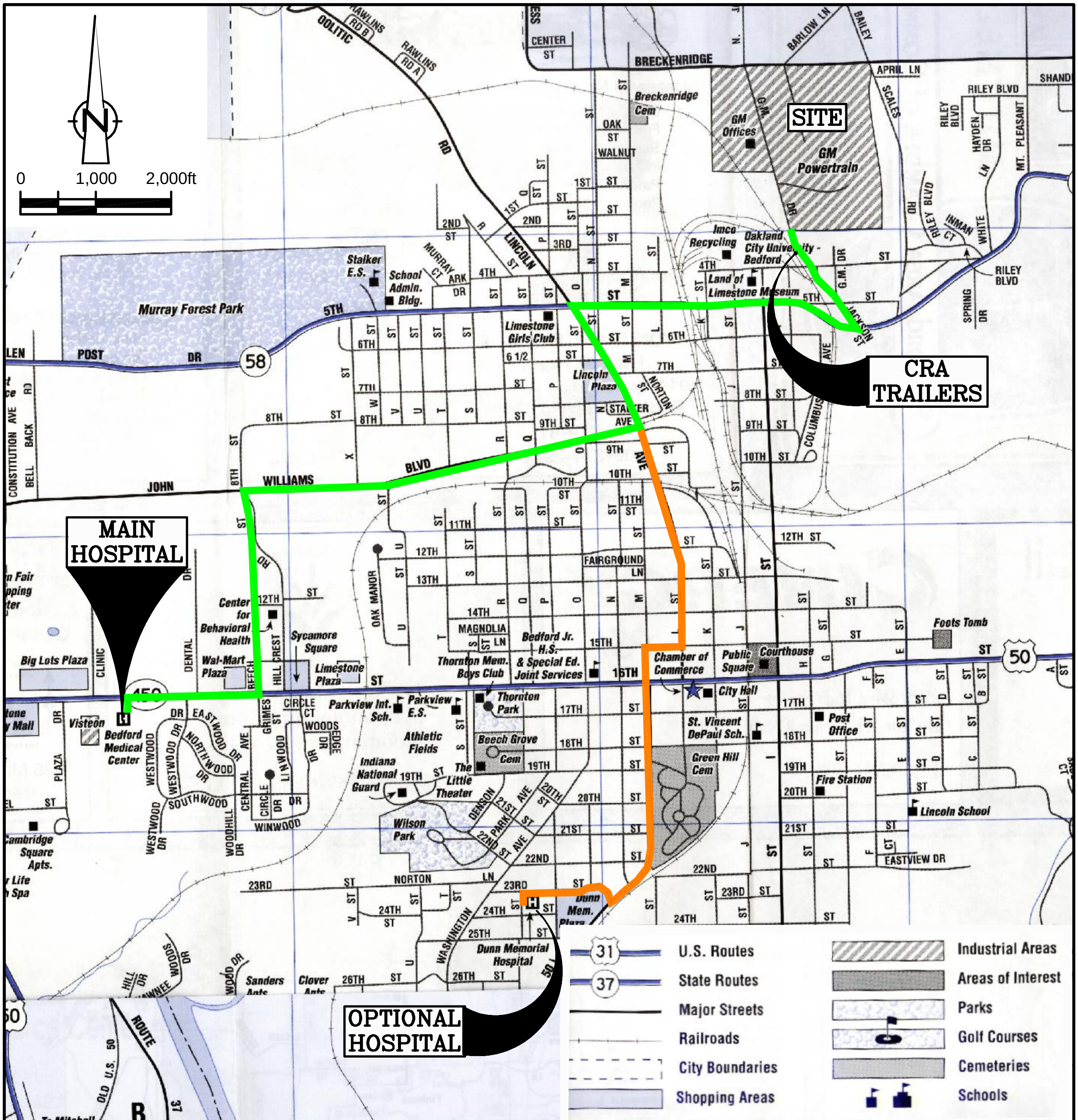
LEGEND

610	EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)		ROADS / UNPAVED AREAS
	EXISTING VEGETATION		ROADS / PAVED AREAS
	EXISTING BUILDINGS		APPROXIMATE SURFACE WATER LOCATION
	FENCE LINE		APPROXIMATE GM PROPERTY BOUNDARY
	RAILROAD TRACKS		PRIMARY TORNADO SHELTER
	DIRT ROADS		SECONDARY TORNADO SHELTER

figure 12.1

TORNADO SHELTER LOCATIONS
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(095)GN-WA007 APR 13/2007



DIRECTIONS TO BEDFORD MEDICAL CENTER (812 275 1200)

1. Leave office trailer and make left (South) on GM Dr. (0.3 miles)
2. At stop sign make right (West) on to 5th St. (0.7 miles).
3. At Red light make left (South) on to Lincoln Ave. (0.7 miles).
4. Make right (West) on to Williams Blvd. (0.7 miles).
5. Make left (South) on to Beech St. (0.7 miles).
6. Make a right (West) on to 16th St. (0.5 miles).
7. Bedford Medical Center on left (South).
8. Directions for optional hospital are included in Section 14 of the HASP.

BASE SOURCE: HAMPTON PUBLISHING CO.

figure 14.1

HOSPITAL ROUTE MAP
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

TABLE 6.1

SPECIFIC PERSONAL PROTECTION LEVELS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Work Task	*Expected Maximum Protection Level* (1)	*Alternate Protection Level* (2)
Mobilization and demobilization of labor, materials, and equipment to and from the Site	Modified D	D
Oversight of construction activities: Staging area construction; placement of designated materials within the staging area and subsequent off-Site transportation and disposal of impacted materials; contractor mobilization, demobilization, decontamination, and setup activities; Site clearing/tree removal; stormwater control construction; excavation, handling and backfilling activities; stream monitoring and water management activities; air monitoring/sampling; and Site restoration activities	Level C	Modified D Level D
Drilling (investigative) activities	Level C	Modified D Level D
Sampling and monitoring (investigative) activities	Modified D	Level D
Perimeter air monitoring activities	Modified D	Level D
Test pit excavations and associated activities (Note: If intact drums are encountered then the CRA HSO and On-Site Coordinator will implement the CRA Drum Handling Program.)	Level B	Level C Modified D
Site restoration activities	Modified D	Level D
Personnel and equipment decontamination activities	Level C	Modified D Level D

Notes:
Specific requirements for protection levels are detailed in Section 6.1.

(1) Level B: To be worn when the highest level of respiratory protection is needed. Activities associated with the test pitting operations may require the use of Level B protection. If above background PID readings are encountered and CRA is unable to identify and quantify the contaminants then Level B protection will be necessary (see Section 6.5 for additional information). If readings subside workers will be able to downgrade. All unknown intact drums will be handled in Level B.
Level C: To be worn when the criterion for using air purifying respirators (APRs) are met and a lesser level of skin protection is needed.
Modified D: To be worn when dermal protection is required; however, no respiratory hazards are present. It provides minimal protection against chemical hazards.

(2) Alternate protection levels will be used if monitoring indicates that conditions are appropriate or the HSO and On-Site Construction Coordinator agree that there is a reduced potential of exposure.

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: DECONTAMINATION OF PERSONNEL AND EQUIPMENT

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Personnel and Equipment Decontamination Activities	Slip, Trip, Falls	Use three points of contact to mount and dismount equipment. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; boot covers/ rubber booties; faceshield or goggles (as needed); and hearing protection (as necessary). Contingency: Level C: Modified Level D plus full-face APR with OV/Acid Gas and P-100 Cartridges.
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	
	Fueling Equipment	No smoking, allow device to cool before re-fueling, follow storage requirements (reference MSDS).	

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Chemical Hazards	Follow air monitoring program and wear proper PPE.	
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace or remove defective tools, wear the appropriate eye and foot protection.	
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA. Follow CRA Hearing Conservation Program.	

Training Requirements

- Inspect site daily to recognize and correct hazards (inspect equipment before using);
- Hazard Communication;
- 40-Hour HAZWOPER and 8-Hour Refresher (as necessary);
- Personal Protective Equipment ; and
- Site specific training on specific site tasks (i.e., use of pressure washer).

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: MOBILIZATION AND DEMOBILIZATION ACTIVITIES AND SITE RESTORATION ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Mobilization and Demobilization of Equipment, Materials and Personnel and Site Restoration Activities	Slip, Trip, Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Level D: Hard hat; high-visibility safety vest; safety glasses; hearing protection (as necessary); work gloves; and safety-toed boots. Contingency - Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; and boot covers/ rubber booties; and hearing protection (as necessary).
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	
	Fueling Equipment	No smoking, allow device to cool before re-fueling, follow storage requirements (reference MSDS).	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA. Follow CRA Hearing Conservation Program.	
	Utilities	Maintain proper utility clearances – Use a spotter if necessary. All utilities will be located prior to conducting work.	
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace defective tools, wear the appropriate eye and foot protection.	

Training Requirements

- Inspect site daily to recognize and correct hazards (inspect equipment and hand/power tools daily/before use);
- Hazard Communication;
- Personal Protective Equipment ; and
- Site-specific training on specific site tasks and safety procedures.

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: OVERSIGHT OF REMEDIAL CONTRACTOR ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Oversight of Contractor(s) Performing Remedial Action Activities	Slip, Trip, Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Level D: Hard hat; high-visibility safety vest; safety glasses; hearing protection (as necessary); work gloves; and safety-toed boots. Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; and boot covers/ rubber booties; and hearing protection (as necessary). Contingency – Level C: Modified Level D plus full-face APR with OV/Acid Gas and P-100 Cartridges.
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Chemical Hazards	Wear proper PPE. Follow air monitoring program. Ensure that Site is properly demarcated – Follow proper Site control measures as outlined in the HASP.	
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Ladder Safety Hazards	Provide training to affected personnel on the safe use and inspection of ladders. Enforce compliance.	
	Fall Hazards	Maintain a 100% tie-off at/above 6 feet, follow a fall protection program in accordance with 29 CFR 1926 – Subpart M, and provide appropriate training to affected personnel. See guidelines contained in the HASP.	
	Excavation Hazards	Ensure that all excavation activities are conducted according to procedures outlined in the HASP and according to 29 CFR 1926 - Subpart P. Contractor is to designate a “competent person” that is responsible for meeting all requirements of Subpart P.	
	Utilities	Maintain proper utility clearances – Use a spotter if necessary. All utilities will be located prior to conducting work.	

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace defective tools, wear the appropriate eye and foot protection.	
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA. Follow CRA Hearing Conservation Program.	
Training Requirements			
• Hazard Communication; • Inspect site daily to recognize and correct hazards (inspect equipment and hand/power tools daily/before use); • Site-specific training on specific site tasks and safety procedures. • 40-Hour HAZWOPER, 8-Hour Refresher (as necessary) and 8-Hour HAZWOPER Supervisory Training (as necessary); and • Personal Protective Equipment.			

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: DRILLING (INVESTIGATIVE) ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Installation of Monitoring Wells, etc.	Slips/Trips/Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Modified D: Safety glasses; hard hat; ear plugs/muffs; inner gloves; work gloves; Tyvek coveralls (as needed); and safety-toed boots. Contingency – Level C: Modified Level D plus full-face APR with OV/Acid Gas and P-100 Cartridges.
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	
	Fueling Equipment	No smoking, allow device to cool before re-fueling and follow proper storage requirements.	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Chemical Hazards	Wear proper PPE. Follow air monitoring program. Ensure that Site is properly demarcated – Follow proper Site control measures as outlined in the HASP.	
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Fall Hazards	Maintain a 100% tie-off at/above 6 feet, follow a fall protection program in accordance with 29 CFR 1926 – Subpart M, and provide appropriate training to affected personnel. See guidelines contained in the HASP.	
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace defective tools, wear the appropriate eye and foot protection.	
	Rigging	Inspect rigging before each use.	
	Utilities	Maintain proper utility clearances. All utilities will be located prior to conducting work. Conduct an underground utility search.	
	Hazards Associated with Drilling: Proximity of Drill Rig, etc.	Beware of drill rig and struck-by hazards. Ensure that driller conducts daily inspections and follows safe work practices. Drilling contractor will provide and implement a Site-specific HASP for its scope of work.	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA. Follow the CRA and drilling contractor's Hearing Conservation Program.	
Training Requirements			
• Hazard Communication; • 40-Hour HAZWOPER, 8-Hour Refresher (as necessary) and 8-Hour HAZWOPER Supervisory Training (as necessary); and • Personal Protective Equipment; • Inspect site daily to recognize and correct hazards (inspect equipment and hand/power tools daily/before use); • Inspect drill rig daily; and • Site-specific training on specific tasks (drilling safety procedures, etc.).			

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: AIR MONITORIING ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Air Sampling Activities – Collection and Deployment of Sampling Media, Calibration, Operation and Maintenance of Samplers, etc.	Slips/Trips/Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Level D: Hard hat; high-visibility safety vest; safety glasses; hearing protection (as necessary); work gloves; and safety-toed boots. Contingency - Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; and boot covers/ rubber booties; and hearing protection (as necessary).
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use and according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Chemical Hazards	Wear proper PPE. Follow air monitoring program. Ensure that Site is properly demarcated – Follow proper Site control measures as outlined in the HASP.	
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace defective tools, wear the appropriate eye and foot protection.	
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA.	
Training Requirements			
• Hazard Communication; • Inspect site daily to recognize and correct hazards (inspect equipment and hand/power tools daily/before use); • Site-specific training on specific site tasks and safety procedures. • 40-Hour HAZWOPER and 8-Hour Refresher (as necessary); and • Personal Protective Equipment.			

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: SAMPLING AND MONITORING (INVESTIGATIVE) ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Collect Monitoring Well Water Elevations; Water, Soil, Sediment, and Oil Samples; and Other Relevant Data Collection	Slips/Trips/Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Level D: Hard hat; high-visibility safety vest; safety glasses; hearing protection (as necessary); inner gloves; boot covers (as necessary) and safety-toed boots. Contingency - Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; and boot covers/ rubber booties; and hearing protection (as necessary).
	Electrical Hazards	GFCIs will be used to reduce electric shock. All electrical equipment will be inspected prior to use and according to CRA SOPs. Do not stand in water when using electrical equipment. All electrical equipment will be UL/FM approved.	
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	
	Fueling Equipment	No smoking, allow device to cool before re-fueling, follow storage requirements (reference MSDS).	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Chemical Hazards	Wear proper PPE. Follow air monitoring program. Ensure that Site is properly demarcated – Follow proper Site control measures as outlined in the HASP.	
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Fall Hazards	Maintain a 100% tie-off at/above 6 feet, follow a fall protection program in accordance with 29 CFR 1926 – Subpart M, and provide appropriate training to affected personnel. See guidelines contained in the HASP.	
Training Requirements			
• Inspect site daily to recognize and correct hazards (inspect equipment before using); • Hazard Communication; • Personal protective equipment; • 40-Hour HAZWOPER and 8-Hour Refresher (as necessary); and • Site specific training on specific site tasks (i.e., use of sampling equipment).			

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Activity: TEST PIT EXCAVATION ACTIVITIES

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Excavation of Test Pits and Subsequent Sampling Activities	Slip, Trip, Falls	Use three points of contact to mount/dismount machinery. Continuously inspect work areas for slip, trip & fall hazards. Be aware of surroundings. Practice good housekeeping.	Modified D: Hard hat; high visibility safety vest; safety glasses; safety-toed boots; Tyvek or polycoated Tyvek coveralls (as needed); inner/ outer gloves; and boot covers/ rubber booties; and hearing protection (as necessary). Level C: Modified Level D plus full-face APR with OV/Acid Gas and P-100 Cartridges. Contingency- Level B: Modified D (with polycoated Tyvek or Saranex coveralls) and a supplied air respirator. Respirator is to be a positive pressure-demand SCBA or positive pressure-demand airline respirator with escape bottle for emergency egress purposes.
	Heat/Cold Stress	Dress appropriately and follow guidelines found in the HASP. Drink sports drinks/plenty of water and use cooling devices.	
	Biological Hazards – Insects, Snakes, Poison Plants, etc.	Wear appropriate PPE and keep necessary first aid supplies readily available. Use insect repellant and snake chaps as needed and follow guidelines presented in the HASP. Practice good personal hygiene – wash hands and face regularly. Learn to identify poisonous plants, insects and snakes.	
	Dangerous Weather Conditions	Consult local weather reports daily, watch for signs of severe weather, use portable, battery-powered weather radio, etc. Suspend or reduce work during sever weather.	
	Pinch Points and Sharp Objects	Keep hands, feet, & clothing away from moving parts/devices. Use appropriate PPE and select the proper tool for the job. Provide barriers and/or signage indicating swing radius of equipment, according to CRA's SOPs.	
	Fueling Equipment	No smoking, allow device to cool before re-fueling, follow storage requirements (reference MSDS).	
	Chemical Hazards	Wear proper PPE. Follow air monitoring program. Ensure that Site is properly demarcated – Follow proper Site control measures as outlined in the HASP.	

TABLE 7.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
	Heavy Lifting	Follow safe lifting practices in the HASP. Lift items within your capabilities. Ask for assistance if necessary. Limit single person lifts to 50 pounds or less unless a lifting device (dolley, lift truck, etc.) is used.	
	Moving Heavy Equipment and Vehicles	Inspect work area and be aware of surroundings at all times. Establish traffic patterns and wear safety vests. Use a spotter around moving or backing equipment.	
	Noise	Wear appropriate hearing protection if noise levels exceed 85 dBA.	
	Utilities	Maintain proper utility clearances. All utilities will be located prior to conducting work. Conduct an underground utility search/subsurface investigation.	
	Fall Hazards	Maintain a 100% tie-off at/above 6 feet, follow a fall protection program in accordance with 29 CFR 1926 – Subpart M, and provide appropriate training to affected personnel. See guidelines contained in the HASP.	
	Potential to Encounter Buried Drums - Intact	Follow CRA Drum Handling SOP. Utilize proper PPE and air monitoring procedures for unknown drums, etc.	
	Use of Hand & Power Tools	Follow manufacturer's safety precautions, inspect tools daily prior to use, replace defective tools, wear the appropriate eye and foot protection.	
	Excavation and Trenching Hazards	Ensure that all excavation activities are conducted according to procedures outlined in the HASP and according to 29 CFR 1926 - Subpart P. CRA will designate a "competent person" that is responsible for meeting all requirements of Subpart P.	

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
REMEDIAL ACTION ACTIVITIES
GMPT – BEDFORD PLANT
BEDFORD, INDIANA

Description of Task	Potential Hazards	Preventative Measures and Controls	PPE
Training Requirements			

- Inspect site daily to recognize and correct hazards (inspect equipment and hand/power tools daily/before use);
- Hazard Communication;
- Competent Person Training for Excavations for Person(s) Supervising Excavation(s);
- 40-Hour HAZWOPER, 8-Hour Refresher (as necessary) and 8-Hour HAZWOPER Supervisory Training (as necessary); and
- Personal Protective Equipment ; and
- Site-specific training on specific site tasks and safety procedures (drum handling, excavation safety, etc.).

APPENDIX A

TRAINING AND ACKNOWLEDGEMENT FORM

TRAINING ACKNOWLEDGEMENT FORM

I have read and/or received instruction on the Site Safety Plan and understand the Site Safety Plan. I have been informed who to contact if I have any questions and know where to report any additional health and safety hazards. I agree to work to the safety plan guidelines and understand that failure to do so could result in removal from the Site.

Date	*Printed Name*	*Signature*	*Company*

APPENDIX B

DAILY SAFETY MEETING LOGS

DAILY SAFETY MEETING LOG

PROJECT: ________________________ LOCATION: ____________________________

DATE/TIME: _________________________

1. Safety Issues or Topics Discussed:
DAILY SITE SAFETY INSPECTION/AUDIT CONDUCTED – REPORT UNSAFE ACTS,
CONDITIONS, and/or PRACTICES IMMEDIATELY.
2. Work Summary and Physical/Chemical Hazards of Concern:
Planned Activities:
Physical hazards:
Biological hazards:
Chemicals onsite:
3. Protective Equipment/Procedures:
Level D PPE = ***hardhat; gloves, safety vest and hearing protection (as needed); safety glasses;***
steel-toed work shoes/boots.
4. Emergency Procedure:
MUSTERING POINT:
In event of an emergency gather/proceed to mustering point(s).
5. Signatures of Attendees (Handwriting must be legible):

APPENDIX C

POWERTRAIN GROUP – BEDFORD PLANT SAFETY AND FIRE SPECIFICATIONS FOR OUTSIDE CONTRACTORS

1.0 Responsibility.

1.1 The contractor is responsible for the health and safety of his/her employees.

1.2 Each contractor shall have a competent supervisor/leader on the job site at all times.

1.3 The contractor is responsible for abiding by and enforcing the provisions of the Occupational Health and Safety Acts (General Industry / Construction).

1.4 The contractor is responsible for abiding by and enforcing the provisions of all applicable General Motors corporate, divisional and plant health, safety and fire prevention specifications as outlined within this procedure. The contractor, his/her employees, subcontractors and their employees shall abide by the same health, safety and fire prevention requirements placed upon GMPT Bedford Casting Plant employees.

1.5 The contractor is responsible for reporting all incidents (including serious near miss incidents) which have caused injury, or may have had the potential to cause injury, to personnel under their supervision. Upon occurrence, incidents shall be immediately reported to the GM project engineer or designated representative.

2.0 Access to plant premises and identifications.

2.1 Entrance onto GM plant property by contract personnel, subcontractors, and suppliers of materials shall be controlled by GM plant security.

2.2 Contractor employees must identify themselves to plant security upon entry, and to GM management upon demand.

2.3 GM plant security will maintain a daily record of all individuals entering and leaving the plant job site.

2.4 An approved contractors' employee list must be furnished, by the contractor, to GM plant security. The contractors' supervisor/leader is responsible updating this list as required.

2.5 Upon verification of contractor employee identification, each individual will be issued a numbered GMPT Contractor's Badge daily. This badge must be worn on the front and above the waist of an outer garment, so as to be visible in plain sight at all times while on GMPT property.

2.6 Contractor's employees will be required to sign "in" and "out" on the contractor's register. Badges must be turned in as employees leave plant property through the security area.

3.0 Personal protective equipment.

3.1 All contractors working inside GMPT Bedford Casting Plant building areas, or areas outside the plant in the course of their work assignment, must wear approved ANSI Z87.1 safety glasses with permanently attached side-shields at all times.

3.1.1 Approved ANSI Z87.1 safety glasses with a "tint" greater than #1 are not permitted inside the GM Bedford plant buildings.

3.2 Steel toed shoes must be worn by each contractor employee while on the work site. Any deviations must be approved by the GM safety supervisor (e.g. roof work where additional traction/footing is required).

3.3 In specific areas of the plant, where additional safety equipment is required (e.g. hearing protection), specific requirements will be covered by the GM project engineer with the contractor before commencing work.

3.5 All contractors must provide, and require that their employees utilize hard hats in all tunnel areas, or any other areas where there is the possibility of falling/flying debris. The contractor is to post conspicuous warning signs regarding hard hat usage areas if there are situations created where debris can be falling/flying.
(Reference Federal Standard 29CFR1910.135 (a) (1)).

4.0 Rules of personal conduct.

4.1 Alcoholic beverages are not permitted on GM property, nor are persons who have been drinking alcoholic beverages. Use, possession, distribution, or the sale of narcotics / illegal drugs on GM property is strictly prohibited. Violators will be prosecuted to the full extent of the law.

4.2 No gambling of any kind is allowed on GM property.

4.3 All contractor's employees are restricted to their specifically assigned work areas in the plant. They are not to wander around the plant, without escort from GM personnel.

4.4 Smoking is not permitted in plant areas designated as "no smoking."

4.5 Contractor employees found to be involved in the theft or misappropriation of employee / company property shall be subject to immediate and permanent removal from plant property.

4.6 Horseplay will not be tolerated.

4.7 GMPT Bedford shop rules regarding personal hygiene (e.g. toilet facilities) must be adhered to.

4.8 The GM plant health services department will only be available to contractor employees for extreme medical emergencies.

4.9 Under no circumstances will contractor employees be permitted on GM property without proper attire. Shirts with short-sleeves are required. Tanks tops and sleeveless shirts are not permitted.

4.10 Answers to general questions while on GM property can be obtained by calling GM plant security (Ext. 7360). Company telephones are not to be used by contractor personnel except GM related contractor business.

4.11 Contractor refusal to cooperate with members of GM plant security in the performance of their duties will result in the contractor employee being denied access to GM property.

4.12 Compressed air must never be directed at another employee.

*5.0 Housekeeping.

*5.1 Contractors must keep work areas clean, orderly, and safe. All surplus material, rubbish, and debris *should* be *cleaned-up* daily or at times designated by GMPT Bedford.

5.2 Loose materials such as bolts, nuts, hand tools, and any other materials must not be left laying on beams, ledges, or any place from where they could fall or be knocked down at a later time. Contractors must make provisions while working to prevent tools, materials, etc., from falling.

*5.3 Wipe up *incidental spills of* oil, grease, water or other substances immediately *and notify in-plant contact that spill occurred and action taken. If a spill is beyond the control of the contractor or could impact health, safety, or the environment contact plant security at x-7333 and report the chemical spill.*

5.4 Pipes, conduits, or structural steel must not be left hanging unguarded where they would constitute a hazard.

5.5 Boards with protruding nails or other loose material must not be left on floor where they may be stepped on or become tripping hazards. Holes, inserts, bolts or other tripping hazards on floor must not be left unguarded.

5.6 All equipment must be returned to contractors assigned storage area at the end of the working period; exceptions to this rule should be reviewed by the GM plant engineering department.

5.7 All lunch bags, coffee cups, sandwich wrappings, etc., are to be placed in proper disposal containers furnished by contractor. **Aluminum beverage cans and glass bottles are not permitted on GM property at any time**.

5.8 All pressurized cans or containers must be approved by the GM project engineer in advance. If used, the container(s) shall be removed from the premises by contractors. GM plant security will keep track of all full containers entering the property and all empty containers leaving the property. All containers must be accounted for. **Containers must not be thrown in GMPT Bedford trash containers, as a serious molten metal explosion may result if a container comes in contact with molten metal.**

5.9 Contractors will be assigned designated areas in which they may park vehicles, store tools, and store materials.

6.0 Acetylene and oxygen cylinders.

6.1 All acetylene and oxygen bottles (including empties) must be secured upright by chains on carts. No bottles shall be loose on the floor or roof areas.

6.2 Always transport acetylene and oxygen bottles in an upright position with caps on, unless a gauge is attached.

6.3 When it is necessary to transport acetylene and oxygen bottles by a crane or hoist, an approved rack must be used. (Never use a sling or choker.) Rack or cart to be furnished by contractor.

6.4 While welding or burning operations are in process, the wrench to the acetylene cylinder must always be in place.

7.0 Welding and cutting procedure.

7.1 A "Welding or Burning Permit" must be obtained daily from GM plant security before any welding or cutting job is started on the GM property. The welding or burning permit is issued for a specific area, not a general area.

7.2 All welding and burning equipment is subject to inspection by GM plant security and management.

7.3 It is imperative that all welding on any machine must have a proper ground connection to the machine on which the welding is being done.

7.4 Contractor electric welding machines shall be equipped with plugs that fit the GMPT Bedford standard outlets.

7.5 An approved fire extinguisher furnished by the contractor must be at the location prior to, and during all welding and cutting operations.

7.6 It is the contractors' responsibility to understand how to operate both fire extinguishers and fire fighting equipment under their control.

7.7 When plant fire equipment is used, notify GM plant security as soon as possible.

7.8 If GMPT personnel deem that a work area needs to be protected from welding and cutting operations, the contractor is responsible for that protection. The contractor is also responsible for cleaning and/or changing the protective cover or curtain daily. If a spotter is required, the contractor will be responsible for furnishing one.

7.9 No welding or cutting is to be done on the structural steel of the building without authorization from the GM plant engineering department.

7.10 A fire watch shall be required if the vision of the person welding is restricted by a welder's hood or other personal protective equipment.

8.0 Contractor vehicles.

8.1 All contractor vehicles entering the plant gates must be identified with the company name or logo.

8.2 Contractor owned vehicles will be allowed to enter GM property only for the purpose of transporting material and equipment which is too heavy or bulky to carry. Parking areas will be designated for contractor owned vehicles.

8.3 Contractor employee vehicles must be driven in a safe manner while on GM property. Contractor employee vehicles must be parked in the North East corner of the parking lot. Violator's vehicles will be towed at owner's expense.

8.2 All traffic control signs must be obeyed while on GM property.

8.3 A signal man must be used when a contractor's vehicle is transporting material and equipment through the plant.

8.4 Watch for trucks and cranes.

8.5 Do not leave trucks or vehicles unattended in plant aisle-ways.

8.6 Vehicle safety devices must be maintained in working order.

8.7 Do not leave trucks or equipment running while unattended.

8.8 Trucks shall not be driven across electrical cords, air hoses, or oxy-acetylene hoses.

8.9 No trucks with propane tanks will be permitted on GM property.

**8.10 No E-Z Go Carts shall be used on plant property.*

9.0 Material handling.

9.1 No suspended load will ever be transported over or through a populated area unless that area has been vacated and properly barricaded.

9.2 Loads must not be left suspended and unattended.

9.3 Heavy loads, while being transported, must be kept as close to the ground/floor as possible.

9.4 When handling loads in confined or populated areas, the move must be accompanied by a spotter.

9.5 Free falling of overhead steel and equipment to be removed is prohibited.

9.6 No more than one day's worth of combustible building material shall be stored in any one location within the building at any time. All roofing materials, roof insulation, etc., must be stored outside the buildings in an appropriate manner.

9.7 Contractors shall not store any material or equipment within three (3) feet of the inside walls of the plant or within six (6) feet of the plant perimeter fence. Combustible material shall not be stored within 100 feet of outside walls and non-combustible material shall not be stored within 50 feet of outside walls.

9.8 Any contractor-supplied materials, which have been approved for shipment to the contractor at GMPT Bedford, will be handled as outlined in Plant

Procedure 533-07, "Receiving and Unloading of Materials Bought by Outside Contractors and Shipped to GMPT". The project engineer granting approval will notify Security that on-site delivery is approved and will provide direction to Security for routing of the material.

9.9 When moving any single piece of equipment weighing over 40,000 lbs., or when the equipment must be raised 12" or more above its normal grade, the minimum conveyance requirement is a rubber tired lowboy trailer with a sufficient load rating. The same conveyance requirement holds true if the equipment weighs less than 40,000 lbs., but more than 20,000 lbs., when the equipment center of gravity is five (5) feet or more above its base.

10.0 Tools and equipment.

10.1 All contractor tools and equipment must be kept in safe working order.

10.2 GMPT Bedford personnel reserves the right to inspect all equipment, and to prohibit the use of any equipment judged to be unsafe.

10.3 Powder cartridge driven tools must not be used for any job on GM property.

10.4 Rope used for swinging staging must not be used for any other purpose.

10.5 Scaffold planks must be OSHA compliant (wood cleated).

10.6 Only fiberglass framed ladders will be permitted on GM property.

10.7 All ladders must be equipped with safety feet.

10.8 Ladders in aisleways or walkways must be protected by suitable signs, flashing lights, barricades or by an attendant.

10.9 Contractor's ladders are to be plainly marked with the name of the company.

11.0 GMPT Bedford equipment, tools and utilities.

11.1 Safety guards removed from the GMPT Bedford equipment while making repairs or alterations must be replaced at the completion of the job, and before the equipment is placed back in operation.

11.2 The contractor must have specific approval from the GM plant engineer or GM maintenance superintendent before using any GM equipment.

11.3 If any GMPT Bedford utility must be cut off, or curtailed to perform necessary work, prior specific approval to do so must be obtained from the GM plant engineering department.

11.4 Any temporary utility must be approved by the GM plant engineering department.

11.5 Approval from GM plant security must be obtained before any alterations can be made to the plant fire suppression systems.

11.6 Authorized GM trades persons must be present for any contractor use of GMPT Bedford pendant push button controlled overhead traveling cranes.

12.0 Flammable liquids, explosives and hazardous materials.

12.1 Gasoline, or any other flammable liquid cannot be brought onto GM property unless approved by the GM plant security fire captain. If approved, the material must be stored in containers as approved by the underwriters and bearing their seal of approval. Cans must be kept secure.

12.2 Plant security will inspect all contractor equipment while on GM property, and remove all flammable liquids not kept in approved safety containers and in locations designated by plant security.

12.3 Gasoline is not to be stored in the plant buildings at any time. Gasoline may be stored outside of the plant buildings, but must be kept at minimum of 75 feet away from any cutting or welding operations. Any container holding over 10 gallons of gasoline shall be considered bulk storage, and approval must be obtained from the GM plant security fire captain or the plant safety director before being allowed on the premises. Any container of 10 gallons or less shall be an approved safety can with flame arrest screens.

12.4 All equipment is to be fueled outside of the plant building a minimum of 75 feet from open flames and cutting and welding operations. If it is absolutely necessary to fuel inside the plant buildings, an approved 5 gallon safety can, equipped with flame arrest screens is to be used. Plant security must be notified prior to refueling. The 5 gallon can must be removed to the outside storage when refueling of equipment is completed.

12.5 No explosives will be allowed on the premises without prior approval from the plant safety director. GMC Treasury Permit (Form 4708-Part 1) must be posted at locations where explosives are stored, also where their inventory records are maintained.

12.6 No tar kettles will be allowed within or upon any buildings.

12.7 The contractor is responsible for obtaining information on any potentially hazardous materials in the area where the work is being performed, as well as notifying all of his/her employees of these hazardous materials, if any.

12.8 The contractor must notify the GM project engineer of any hazardous materials that may be required for performing the work outlined in the contract. The contractor will then be required to obtain the Material Safety Data Sheets for each proposed product, and present that information (with the GM project engineer) at the bi-monthly GMPT Bedford – Hazardous Materials Control Committee meeting for approval. Submittals shall be on GM forms requiring full disclosure.

13.0 Underground and pit areas.

13.1 GM plant engineering must be contacted before starting any excavation or dumping of heavy loads to assure that no underground service such as power cables, fire lines, etc., are in the area.

13.2 Pits or trenches which are open during digging, forming, pouring, and removal of equipment, will be barricaded with OSHA compliant railings and marked with "DANGER" signs while open. A barricade shall surround the entire work site area. Barricades are to be constructed of 1 1/2 inch diameter standard pipe. Area access openings shall have removable pipe lengths; whenever access barricades are down, a contractor employee must be stationed on guard.

13.3 All completed pits or trenches which have no covers must be barricaded with permanent steel pipe railing and posts.

13.4 In addition to being barricaded on all sides, all openings in the ground, inside or outside of the plant, shall be illuminated at night for the protection of GM employees.

13.5 In the case of drilling holes or breaking concrete, dust must be kept down by the use of wet burlap. Spraying the work area with water is also acceptable.

14.0 Overhead and under roof.

14.1 No work is to be done overhead or under roof unless specifically directed by the GM plant engineering department.

14.2 Any construction work done above the floor shall comply with Section 16.0 entitled "Barricades" and Section 7.0 entitled "Welding and Cutting Procedure".

14.3 Overhead scaffolding must be tied down.

14.4 No work is to be performed over personnel or any machinery that is in operation.

14.5 Do not leave materials or tools on overhead catwalks, platforms or on any other overhead structure upon completion the job.

14.6 Inform department superintendent in advance of scheduled overhead work.

14.7 Fall protection equipment shall be supplied and utilized by the contractor when working more than 6 feet above the floor. See Section 20.

15.0 Roof areas.

15.1 No work is to be done on the roof unless given specific permission and building construction specifications by the GM plant engineering department.

15.2 Any construction work done on roof shall comply with Section 16.0 entitled "Barricades" and Section 7.0 entitled "Welding and Cutting Procedure".

15.3 Rigging must be adequate for items moved or installed on roof.

15.4 Clear and barricade the area under the roof where heavy objects requiring rigging are being moved. The contractor shall post a spotter to ensure that the area remains clear of personnel.

15.5 Where objects can slide or blow off the roof, the contractor shall post sentries at ground level outside the building.

15.6 Inform department superintendents in advance of scheduled overhead work.

15.7 Any work within 6 feet of roof edges or openings shall require fall protection equipment and anchorage points. See Section 20.

16.0 Area isolation barricades - not including floor openings.

16.1 Work site areas which require isolation, other than aisles or roadways, shall be entirely surrounded by barricades.

16.2 Any construction project of a five (5) day duration or longer shall have an OSHA compliant barricade installed at a height of 42" above grade. See Item 13.2.

16.3 Any construction project of less than a five (5) day duration shall have a GM plant engineering department approved barricade installed, consisting of safety tape or an equivalent.

16.4 When a contractor has barricaded an aisle or roadway, and leaves the area for any reason (lunch or end of shift), they shall install an operating electric flasher in the area. The contractor shall display the flasher on an adequate support, at a height of 42" above grade. The contractor shall provide the electric flashers.

16.5 When proper barricades are installed, any violation of these barricades by GM personnel must be reported by the contractor to GM plant security immediately.

16.6 No barricades will be removed without the prior approval of the GM plant engineering department.

17.0 Contractor certificates of insurance.

17.1 The contractor, and all sub-contractors, shall have a current certificate of insurance coverage on file with the GMPT Bedford Plant prior to commencement of work. **NOTE:** For clarification of any of these items, please contact the GM plant engineering department.

18.0 Spotting and checking of rail cars. (529-2)

18.1 Contractors shall comply with this procedure when involved with rail cars in the course of performing their work.

18.2 Contractor shall verify the "blue flag" and derail is in place prior to performing work on or about a rail siding or car.

19.0 Arrival and exit time.

19.1 No vehicle traffic is allowed in or out of the main truck entrance, with the exception of medical personnel, within the following time periods:

Monday
6:15 - 6:45 a.m.
2:45 - 3:15 p.m.
10:45 - 11:00 p.m.
11:30 - 11:45 p.m.

Tuesday through Sunday
6:45 - 7:00 a.m.
7:30 - 7:45 a.m.
2:45 - 3:00 p.m.
3:30 - 3:45 p.m.
10:45 - 11:00 p.m.
11:30 - 11:45 p.m.

Additional times for Friday
12:00 - 12:15 a.m.
3:15 - 3:45 p.m.

19.2 The above times reflect shift changes for GM employees. For the safety of those employees entering and/or leaving the plant at these times, your cooperation is needed and very much appreciated.

20.0 Fall protection and fall prevention.

20.1 The purpose of this procedure is to set forth guidelines that must be adhered to in order to ensure employee safety when working on the roof, or at elevated positions inside the plant. This procedure covers all plant buildings, inside and out.

20.2 Whenever the performance of any task would allow a worker to fall a distance of six feet or more, or any distance where the likelihood of a serious or fatal injury exists, the fall hazards must be identified, evaluated and controlled based on the hierarchy of controls.

20.3 Each contractor shall have a fall hazard program, and shall provide to GM management upon request.

21.0 Roof safety rules.

21.1 GM plant engineering shall be responsible for providing the plant specific GMPT Bedford "Roof Safety Training Course" to each contractor assigned to visit or work on the roof. In addition, the GM plant engineering department will show the contractors suspected unsafe roof areas in their work zone.

21.1.1 Roof work of a routine nature will be scheduled and performed during daylight hours only. Night work on the roof should be conducted only in emergency.

21.2 Access roof areas using stairways where available.

21.3 Walk on designated walkways only. Designated walkways are striped-off with yellow lines. If designated walkways are not visible due to snow build-up or unlighted night conditions, do not walk on that area of the roof.

21.3.1 If you must leave a designated walkway, 2" X 10" X 8' boards, 3/4" plywood (4' X 8') or aluminum walkboards must be used. Remove planking or walkboards from roof when job is complete.

21.3.2 Do not walk on Transite-covered pitched roofs.

21.4 Fall protection equipment must be worn when working around roof openings, within six (6) feet of the roof's edge or on suspected unsafe roof areas.

21.4.1 Proper fall protection consists of a full body harness, properly connected to an approved shock absorbing lanyard or device. The shock absorbing device must be connected to a structure capable of supporting a maximum arresting force (MAF) of 1800lbs.

21.4.2 Equipment involved in a fall must be taken out of service immediately. Any fall related incident must be reported to the GM project engineer and the GM safety supervisor.

21.5 Transporting objects that are too heavy to carry should be transported on four-wheeled carts, and along the designated walkways. If the combined weight of the transported object and the cart exceeds 500 pounds, then the GM plant engineering department must be contacted to determine the safe route.

21.5.1 Before setting objects on the roof with a crane or helicopter, GM plant engineering must determine that the set-down location will safely support the load.

21.5.2 In cases where the transported load or set-down load exceeds 500 pounds, the plant area directly below the travel route must be properly barricaded and evacuated of personnel.

21.6 Never leave a roof opening unguarded. Standard OSHA guardrails are required.

21.7 Never leave unsecured material on the roof which could be blown off or fall off the roof, posing a hazard to the areas below.

21.8 Watch for low head clearance conditions when walking on the roof; (e.g. electrical cable trays, ductwork and guide wires, equipment platforms, fan intakes, etc.). **Hard hats are required to be worn at all times while on the roof.**

22.0 Suspended ceiling and mezzanine areas.

22.1 Contractor personnel working around suspended ceilings must use extreme caution.

22.1.1 The attached list and map numbers all plant suspended ceilings and mezzanine areas.

22.1.2 Suspended false ceilings should never be walked on or traveled across.

22.1.3 When in doubt, contact your supervisor.

22.2 All mezzanine areas have a posted rated load capacity per square foot. When storing objects on mezzanine areas, do not exceed this capacity. Contact GM plant engineering if questions arise.

23.0 Working in and around overhead structures inside the plant.

23.1 All contractor personnel must follow proper fall hazard safety procedures while performing overhead work (e.g. JLG lift, scissors lift, etc.).

23.2 It is permissible to leave a guarded work bucket or platform to enter a guarded catwalk or walkway on an overhead crane.

24.0 Equipment lockout / energy control.

24.1 When a contractor is assigned to perform a service, maintenance or construction task which potentially exposes him/her to hazardous energy, the exposure must be eliminated. If the exposure cannot be eliminated, the energy must be controlled through positive means (lockout, blocking, etc.)! General Motors does not recognize "tag-out" as an acceptable means of controlling hazardous energy!

24.1.1 Exposure is defined as being in a position to be injured by released energy.

24.1.2 Hazardous energy is defined as energy which could cause injury to the servicing employee if it was unexpectedly energized, released or used to start up the machine / equipment posing the exposure.

24.2 Contractors must provide a durable lockout device to each and every employee who has the potential to be exposed to hazardous energy.

24.3 Contractors must ensure that each and every employee who has the potential to be exposed to hazardous energy has been properly trained in the theory and methods pertaining to lockout / energy control.

24.4 When an exposure is identified, and cannot be eliminated, each source of hazardous energy must be controlled / locked out at its source by each and every exposed employee. This is to be accomplished by carefully following the equipment lockout placard.

24.4.1 Careful attention must be given to equipment and machines that have multiple energy sources, such as compressed air, electrical and/or hydraulic power.

24.4.2 An attempt to cycle the equipment following proper lockout / energy control procedures must be made to insure that the system is indeed de-energized.

24.4.3 A survey of adjacent equipment should be made to determine if its operation would subject the exposed employees to additional hazards.

24.5 If GM operations or utilities will be affected by contractor lockout / energy control procedures, the GM project engineer or designated GM representative must be notified.

24.6 Restoring equipment to service.

24.6.1 Check the equipment and the surrounding area to insure that nonessential servicing items have been removed.

24.6.2 Check the work area to insure that all employees have been safely positioned or removed from the area.

24.6.3 Verify that the controls are in a "neutral" position.

24.6.4 Remove the lockout / energy control devices and re-energize the equipment.

24.6.5 Notify the GM project manager or designated GM representative that the equipment has been restored to service.

25.0 Confined space entry.

25.1 A confined space is defined as any area that:

- Has limited or restricted means of entry or exit.
- Is large enough for a worker to enter and perform work.
- Is not designed for continuous employee occupancy.

25.2 Each area on GMPT Bedford property that meets the above stated criteria, has been placarded with a sign indicating that entry can only be made by obtaining a confined space permit.

25.3 If a contractor must enter to perform work in any of these areas, the GM project engineer, designated GM representative or GM safety supervisor must be contacted to discuss the local requirements of the GMPT Bedford Casting Plant Confined Space Entry Procedure (Safe Job Procedure 529-72) with the contractor prior to entry.

26.0 Presumed Asbestos Containing Material

26.1 If a contractor must demolish, remove, cut, burn, weld or disturb any presumed asbestos containing material (i.e. pipe insulation, transite roofing, asbestos containing floor or ceiling tile) in anyway, the plant environmental department and plant safety supervisor must be contacted in order to ensure that proper federal, state, local and plant safety procedures are followed.

27.0 Environmental.

27.1 All contractors and their personnel shall conform to and comply with all applicable environmental laws and regulations and requirements.

27.2 All contractors and their personnel shall understand and comply with the "Environmental Policy" of GMPT Bedford (See Attachment).

27.3 Each individual will be accountable for knowing the Four Points of the Environmental Policy.

ENVIRONMENTAL POLICY

As a responsible corporate citizen, GMPT Bedford is dedicated to protecting human health, natural resources and the local and global environment, in accordance with the Environmental Principles of General Motors Corporation. This dedication reaches further than compliance with the law to encompass the integration of sound environmental practices into our business decisions. This policy is based on the integration of risk-based, cost-effective management practices into site activities with the aim of continually improving environmental performance.

The site is committed to assess the environmental impacts of its activities and product to base its environmental management programs, and to reduce these impacts through the establishment of appropriate objectives and targets.

In particular, GMPT Bedford, will strive to achieve the following objectives through continued execution of our Environmental Management System.

1. Comply with all applicable environmental laws and regulations, and other requirements.

2. Assign management responsibility for the environment in all areas of the facility and ensure that all employees are aware of their individual responsibilities for acting in accordance with this policy, while providing effective information and training to encourage individuals to contribute effectively.

3. Practice effective pollution prevention in accordance with a hierarchy giving top priority to waste prevention at the source, elimination or reduction of wasteful practices and recycling.

4. Periodically review and, if necessary, improve procedures to minimize the potential risks to the environment in the event of any abnormal situations.

5. Maintain good communications with our local community and cooperate with legislators, regulators and other organizations with an interest in our environmental performance.

In accordance with our Environmental Management System requirements, the site's objectives will be reviewed periodically to assess progress toward continuous improvement. This policy statement will be made available to all GMPT Bedford employees and the public.

Date: 02/20/98

John Thomas, Plant Manager

ENVIRONMENTAL POLICY SUMMARY

1. OBEY THE LAWS.
2. REDUCE WASTE.
3. PREVENT POLLUTION.
4. CONTINUALLY IMPROVE.

Reviser/Originator:

Kim Dobosenski

Approved by:

Tom Dillon **11-21-03**
Department Head Date

Greg Smith **11-21-03**
Safety Supervisor Date

Reviewed with:

Gary Hamilton **11-24-03**
UAW H&S Representative Date

Brent Dalton **11-21-03**
IBEW H&S Representative Date

GM POWERTRAIN
BEDFORD PLANT

Form 5523-12(A)
Issue Date: 2/28/98
Revision # 5
Revised Date: 09/12/03

Contractor Safety and Environmental Agreement

Contractor's: Name & Address

____

____

____

Phone: ______________

Fax: ______________

As the on-site supervisor or representative of the general contractor, prior to beginning any work on GMPT-Bedford premises I understand all contractors and subcontractors under my supervision must comply with the following safety and environmental requirements:

_____ 1. I have read and have shared with my employees relevant information in Procedure 5532-1 (Safety and Fire Specifications for Outside Contractors).

_____ 2. If supplied by my plant contact, I have read and understand all applicable Environmental Procedures relating to the project.

_____ 3. I understand and will run my project in accordance with the four points of the GMPT-Bedford Environmental Policy (Obey the Law, Reduce Waste, Prevent Pollution and Continually Improve).

_____ 4. I understand that I must disclose any chemical products that will be used as part of the job and receive plant approval prior to their use on-site.

_____ 5. If required, I have read and understand GM 1638 Construction General Conditions.

_____ 6. If performing any labeling or painting of plant piping systems, I have received and read a copy of Labeling and Painting of Piping Systems.

_____ 7. I know where the allocated parking facilities are located for contractor employees as well as the location of equipment storage areas, and shall comply with these requirements. (Refer to Procedure 5532-1)

I am associated with the following project(s):

____

Signed: ______________________________ Dated: ______________

NOTE: This document is good for one year, if work activities remain consistent and the on-site supervisor, or representative of the general contractor, does not change.

APPENDIX D

BLANK TASK HAZARD ANALYSIS

CRA SMART PROGRAM — Safety Means Awareness Responsibility Teamwork	**Task Hazard Analysis/Job Safety Analysis Form**	**Date THA/JSA Issued:** ____________________
	THA/JSA Filename: THA/JSA ____________________________	**Page:** ____ **of** ____

Identify Job Steps, Key Risks, and Measures to Control Risks	
Supervisor:	
Equipment:	
Key Risks:	
Job Scope:	
PPE Required:	
Job Description:	

MEMBERS OF THE THA/JSA TEAM SIGN BELOW		
1.	4.	7.
2.	5.	8.
3.	6.	9.

PERSONNEL RESPONSIBILITY	SEQUENCE OF BASIC JOB STEPS	IDENTIFY POTENTIAL RISKS	PREVENTIVE MEASURES TO CONTROL RISKS
All Personnel	1. Perform **STAR** Process		Verify personnel training

CRA SMART PROGRAM — Safety Means Awareness Responsibility Teamwork	**Task Hazard Analysis/Job Safety Analysis Form**	**Date THA/JSA Issued:** ___________________
	THA/JSA Filename: THA/JSA ___________________________	**Page:** ____ **of** ____

PERSONNEL RESPONSIBILITY	SEQUENCE OF BASIC JOB STEPS	IDENTIFY POTENTIAL RISKS	PREVENTIVE MEASURES TO CONTROL RISKS

APPENDIX D

DRUM HANDLING STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

DRUM HANDLING

1.0 DRUM HANDLING

Although buried containers are not expected to be encountered during the excavation, should buried containers be found, containers will be handled in accordance with the standard operation procedures outlined below. Cleanup operations involving drums and containers must be carried out safely. This means that the handling, sampling, testing, staging, transport, decontamination, evacuation, excavation, and bulking of drums and containers must be carried out with minimal risk. When new containers are used, they must meet minimum standards according to Department of Transportation (DOT), Occupational Safety and Health Act (OSHA), and United States Environmental Protection Agency (USEPA) regulations.

1.1 SITE PREPARATION

Before commencing site activities involving the handling of drummed waste, the area must be prepared to facilitate operations and eliminate obvious physical hazards. Roadways, work areas, and storage areas should be constructed to provide ease of access and a sound roadbed for heavy equipment and vehicles. Security fences or barricades should be erected. Work areas should be cleared and physical hazards should be eliminated as much as possible. Physical hazards to consider include:

- Ignition sources in flammable areas such as drum opening and bulking areas.
- Exposed and/or underground electrical wiring and low overhead wires which may be cut or entangled in equipment resulting in electrical shock, short circuits, and possible fires.
- Sharp, protruding edges such as torn metal, glass, nails, and other objects which can puncture or tear protective clothing or equipment.
- Unsecured railings, loose steps or flooring, holes, slippery surfaces, debris, and other obstacles that can cause slips, trips, and falls.
- Protruding objects which can cause slips, trips, and falls.
- Weeds and debris which obstruct visibility.

Weeds and debris can be removed, walking surfaces can be cleared and repaired, skid resistant strips can be installed on slippery surfaces, railings can be repaired or installed, stairs and ladders can be secured, electrical wiring can be repaired or relocated, and sharp objects and protruding edges which cannot be removed can be covered or properly guarded. Staging areas can be constructed to facilitate safe and effective operations.

1.2 GENERAL RULES

- Drums and containers used must meet minimum DOT regulations.
- If practical, drums and containers will be inspected to insure their integrity prior to being moved. If drums or containers are stored or stacked so that inspection is impossible, they should be moved to an accessible location for inspection prior to further handling.
- Unlabeled drums and containers will be assumed to contain hazardous substances and treated accordingly until contents are positively characterized.
- Site operations shall be organized so as to minimize the amount of drum or container movement required.
- All employees exposed to transfer operations shall be warned of potential hazards associated with contents of any drums or containers involved.
- DOT specified salvage drums or containers and suitable sorbent materials shall be available in areas where spills may occur.
- Where major spills are possible, a spill containment program shall be implemented as part of the site Health and Safety Plan (HASP). The spill containment program shall allow for the containment and isolation of the entire volume being transferred.
- Drums and containers that can not be moved without rupture or leakage will be emptied into a sound container.
- Some type of detection system (such as ground-penetrating radar) shall be used to estimate the location and depth of buried drums or containers.
- Buried drums shall be excavated carefully to prevent rupture.
- Suitable fire extinguishing equipment will be kept on hand and ready for use.

2.0 OPENING DRUMS AND CONTAINERS

These procedures are to be followed in areas where drums or containers are being opened:

- The buddy system is to be utilized at all times during drum opening operations.
- Level B is mandatory if the drum contents are unknown.
- If airline respirators are used, air cylinder connections must be protected from contamination and the entire system shall be protected from physical damage.
- Employees who must work near drums or containers being opened must be provided protective shielding in case of explosion.
- Employees not directly involved in the opening procedures will be kept at a safe distance.
- Controls for opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the shield.
- Non-sparking tools and equipment will be used when flammable atmospheres are a reasonable possibility.
- Drums and containers shall be opened so as to safely relieve excess pressure. Either relieve the pressure from a remote location or place appropriate shielding between the employee and the drums or containers.
- Employees shall not stand on or work from drums or containers.

2.1 MATERIAL HANDLING EQUIPMENT

Material handling equipment shall be selected, located, and operated so as to prevent ignition of vapors released during opening procedures. There are hazards associated with gas or electrically powered units.

2.2 RADIOACTIVE WASTES

If a drum exhibits radiation levels above background (approximately >2 mrem/hr), immediately contact the Health and Safety Office (HSO). <u>Do not handle any drums that</u>

are determined to be radioactive. A special contractor will be brought in to further characterize and process the drum(s).

2.3 SHOCK-SENSITIVE, AIR REACTIVE, OR WATER REACTIVE WASTE

When handling drums containing or suspected of containing shock-sensitive or reactive wastes, the following special precautions should be followed:

- All non-essential employees shall be removed from the area of transfer.
- Material handling equipment shall be fitted with explosion containment devices or protective shields to protect operators.
- An alarm system will be used to signal the beginning and end of the procedure.
- Continuous communications will be maintained between the employee in charge of the operation and the HSO during the operation.
- Pressurized drums shall not be moved until the cause of the excessive pressure is determined and appropriate measures are implemented.
- Work will proceed in clear, dry weather.

3.0 SHIPPING AND TRANSPORT

Drums and containers shall be identified and classified prior to packaging for shipment. Staging areas shall be kept to the minimum number necessary and shall be provided adequate entrance and exit routes. Bulking of wastes shall be permitted only after a thorough characterization has been completed.

3.1 CONTAINER HANDLING

Waste containers of various types on a site may need to be handled during sampling, characterization, or preparation of material for disposal, in addition to other reasons.

3.2 VISUAL INSPECTION

Prior to handling, visually inspect the containers for the following to determine if the containers might show whether the materials may be radioactive, explosive, corrosive, toxic, flammable, or lab-packed:

- Symbols, words, or markings.
- Signs of deterioration such as corrosion, rust, or leaks.
- Indications the container is under pressure, such as swelling or bulging.
- Drum type.
- Configuration of drumhead.
- Conditions in the immediate vicinity of the container. Crystalline material on or around the containers could indicate shock-sensitive material. In addition, there may be other material leaked or spilled from the containers onto the ground which might give a clue as to what may be in the drum.

4.0 MONITORING

Before any moving or opening of containers takes place, direct reading instruments should be used to detect the presence of organic vapors, combustible gases, or above-background levels of radiation.

4.1 SUBSURFACE INVESTIGATION

If there is any reason to suspect the presence of buried containers, some type of non-destructive ground penetrating system should be used to determine the approximate location and depth of such containers.

4.2 PRELIMINARY CLASSIFICATION

As a precautionary measure, any unlabeled containers should be assumed hazardous until it is learned otherwise. Using the information gathered by visual inspection, monitoring and subsurface investigations, preliminarily classify any containers thought to be radioactive, leaking/deteriorated, under pressure, explosive/shock-sensitive, or buried.

4.3 PLANNING

Based on inspection and preliminary classification, decide if any hazards are present and the appropriate response activity. Determine which drums need to be moved in order to be opened and/or sampled. A preliminary handling plan should be developed dealing with the extent of any necessary container moving or handling and the most appropriate procedures based on the particular hazards revealed during preliminary inspection. The handling plan should be revised as new information comes to light during site operations.

5.0 OPENING CONTAINERS

If supplied air respiratory protection is used, place a bank of air cylinders outside the work area and supply air to the operators via airlines and escape SCBAs. Keep personnel at a safe distance from the drums being opened. If possible, monitor for radiation, combustibles, and toxics during opening. Use the buddy system.

5.1 REMOTELY CONTROLLED OPENING DEVICES

If possible, use remotely controlled devices for opening drums. This procedure must be explored first, prior to deciding to open drums manually.

5.2 BACKHOE SPIKE

The backhoe spike is a metal (bronze) spike attached or welded to a backhoe bucket. It is efficient and advisable for large-scale operations. The drums should be in rows with adequate aisle space to allow ease of backhoe movement. Once in rows, drums can be quickly opened by punching holes in the drum tops with the spike. To prevent cross contamination, the spike should be decontaminated after each drum is opened.

5.3 HYDRAULIC DRUM PIERCER

A hydraulically operated drum piercer consists of a manually operated pump which pressurizes oil through a hydraulic line. A piercing device with a spark-proof metal point is attached to the end of the line and pushed into the drum by the hydraulic pressure. The piercing device can be attached so that the hole is made in the side or top of the drum.

5.4 PNEUMATIC BUNG REMOVER

Operates by means of compressed air delivered through a high-pressure airline to a pneumatic drill which is adapted to turn a bung fitting. An adjustable bracket has to be attached to the drum before the drill can be operated and must be removed before the sample can be taken.

5.5 MANUALLY OPERATED OPENING DEVICES

The risks are greater when manually opening drums than when using remotely operated means. When using manual devices, the drums must be positioned to allow easy worker access to the drums.

5.6 BUNG WRENCH

A bung wrench and other hand tools must be of the non-sparking kind and should be marked as such. Although a non-sparking wrench will prevent sparking between the wrench and drum, it will not prevent sparking between the bung and the threads on the drum. The bung should be turned very slowly to allow pressure to dissipate and reduce the chance of sparking. The small bung should be opened first, as a pressure release. Avoid leaning on the drum while opening.

5.7 DRUM DEHEADER

A drum deheader can be used when the bung is not removable with a bung wrench. It can be used only with closed-head drums, not on open-top drums. It is used by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so the deheader is held against the side of the drum.

5.8 HAND PICKS, PICKAXES, AND SPIKES

Hand picks, pickaxes, and spikes are not recommended for opening drums because the drum must be struck with too much force, creating great potential for spraying and splashing. Also, drums cannot be opened slowly enough with this method, so any over-pressure can be dangerous. In addition, there is a great hazard using this method on drums with shock-sensitive materials. Use of chisels and firearms as an opening tool is prohibited.

APPENDIX E

CONSTRUCTION QUALITY ASSURANCE PLAN

DRAFT FOR REVIEW
December 12, 2007

CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE WEST PLANT AREA INTERIM MEASURE

GM POWERTRAIN BEDFORD FACILITY
105 GM DRIVE
BEDFORD, INDIANA

U.S. EPA ID NO. IND 006036099

DECEMBER 2007
REF. NO. 13968 (253) APPE
This report is printed on recycled paper.

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LIST OF ACRONYMS

AAQMP	-	Ambient Air Quality Monitoring Plan
Agreement	-	Performance Based Corrective Action Agreement
CA	-	Corrective Action
CQA	-	Construction Quality Assurance
CRA	-	Conestoga-Rovers & Associates, Inc.
Engineer	-	Engineering Consultant
Facility	-	GM Powertrain Bedford Facility
GM	-	General Motors Corporation
HASP	-	Health and Safety Plan
IDEM	-	Indiana Department of Environmental Management
IM	-	Interim Measure
LLDPE	-	Linear Low Density Polyethylene Liner
PCB	-	Polychlorinated Biphenyl
QAPP	-	Quality Assurance Project Plan
QA/QP	-	Quality Assurance/Quality Control
RCRA	-	Resource Conservation and Recovery Act
Site	-	GM Powertrain Bedford Facility
STL	-	Severn Trent Laboratories, Inc.
TAL	-	Target Analyte List
TCL	-	Target Compound List
TSP	-	Total Suspended Particulates
U.S. EPA	-	United States Environmental Protection Agency

1.0 INTRODUCTION

This Construction Quality Assurance (CQA) Plan for the General Motors Corporation (GM) Powertrain Bedford Facility (Facility or Site) located in Bedford, Indiana has been prepared by Conestoga-Rovers & Associates Inc. (CRA), on behalf of GM, as part of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) activities being conducted under the Performance-Based CA Agreement (Agreement) (effective March 20, 2001, and amended on October 1, 2002) between United States Environmental Protection Agency (U.S. EPA) and GM for the Facility.

The Facility location and Facility plan are presented on Figures 1.1 and 1.2, respectively. The above-referenced figures are included in the West Plant Area Design Report, to which this CQA Plan is an appendix.

1.1 PURPOSE AND ORGANIZATION OF REPORT

This CQA Plan presents the construction quality assurance program to be followed during implementation of the cover system Interim Measure (IM) which is being constructed as part of the West Plant Area IM, to ensure that the construction activities meet or exceed all design criteria, plans and specifications. This CQA Plan is organized as follows:

Section 2.0 – Project Description
This section provides a description of the project.

Section 3.0 – Project Organization and Responsibilities
This section outlines the project organization and responsibilities.

Section 4.0 – Personnel Qualifications
This section presents the personnel qualification requirements.

Section 5.0 – Project Meetings
This section presents the project meeting requirements.

Section 6.0 – Inspection, Testing, and Sampling Activities
This section describes the inspection, testing, and sampling activities required to ensure that construction and materials comply with all design specifications and plans.

Section 7.0 – CQA Documentation

This section describes documentation requirements of CQA activities.

2.0 PROJECT DESCRIPTION

The major components of the IM for the cover system include the following:

- implementation of Site-specific Health and Safety Plan (HASP);
- provision of Site Security;
- mobilization of construction facilities, material, equipment, and personnel necessary to perform work;
- implementation of environmental controls;
- provision and maintenance of construction facilities and temporary controls;
- Site preparations including:
    - work zone identification,
    - the provision of utilities,
    - construction of decontamination facilities,
    - construction of access roads, and
    - clearing and grubbing of existing vegetation
- deactivate/abandon/ relocate utilities;
- surface water control;
- IM closeout activities including:
    - on-Site restoration,
    - decontamination of Site equipment and facilities,
    - construction of a perimeter groundwater collection system and treatment system; and
- demobilization of construction facilities and equipment from Site.

It should be noted that this document does not include CQA activities for other West Plant Area IM activities. A separate CQA Plan will be prepared for additional West Plant Area work.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The IM activities will be managed by an Engineering Consultant (Engineer). As the construction manager, Engineer will be responsible for ensuring that the IM is implemented in accordance with the IM Work Plan and Project Specifications. Additional subcontractors for specific construction activities and specific quality assurance (QA) testing activities will also be overseen by Engineer.

The primary role of the selected contractors is to implement each of the contractors' respective components of the IM in accordance with the IM Work Plan.

The project organization chart is presented on Figure E.3.1. Brief descriptions of the duties of the key personnel are presented below.

3.1 GM PROJECT MANAGER

The duties of the GM Project Manager are as follows:

- provide overall project management;
- provide direct coordination between Project Engineers and U.S. EPA;
- ensure professional services by Engineer are cost effective and of highest quality;
- ensure all resources of Engineer are available on an as-required basis;
- participate in key technical negotiations with the U.S. EPA/Indiana Department of Environmental Management (IDEM);
- provide managerial and technical guidance to Engineer's Project Engineer;
- prepares and/or reviews all progress reports prior to submittal to U.S. EPA/IDEM; and
- prepare and/or reviews final IM construction report(s) prior to submittal to U.S. EPA/IDEM.

3.2 PROJECT ENGINEER

The duties of the Project Engineer are as follows:

- provide day-to-day project management;
- ensure project progresses on-schedule;
- provide managerial guidance to GM;
- provide guidance and direction to the Resident Engineer; and
- provide technical representation at meetings as appropriate.

3.3 RESIDENT ENGINEER

The duties of the Resident Engineer are as follows:

- report to Project Engineer and GM;
- provide immediate supervision of all on-Site project activities;
- provide field management of CQA activities;
- review design criteria, plans and specifications for clarity and completeness so that the CQA Plan can be implemented;
- identify work that should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval;
- reject defective work and verifies that corrective measures are implemented; and
- interact daily with the Contractor to provide assistance in modifying the materials and work to comply with the specified design.

3.4 SITE MANAGER (COVER SYSTEM INSTALLATION)

The duties of the Site Manager for the Cover System installation are as follows:

- report to the Resident Engineer and the Project Engineer;
- provide immediate supervision of all Cover System project activities; and
- interact daily with the CQA Officer and Contractor to provide assistance in modifying the materials and work to comply with the specified design.

3.5 CONSTRUCTION QUALITY ASSURANCE

The individual designated to be the Resident Engineer will be specified by the Engineer prior to commencement of the IM activities. The following individuals will provide support for the Resident Engineer and Site Manager:

- CQA Officer/Support Personnel;
- Air Quality Monitoring Personnel; and
- Quality Assurance/Quality Control (QA/QC) Officer.

The duties of each of these individuals are identified in the following subsections.

3.5.1 CQA OFFICER

The duties of the CQA Officer are as follows:

- report to Resident Engineer;
- provide immediate supervision of all on-Site CQA Support Personnel (including Engineer's staff and subcontractors);
- inform CQA Support Personnel on CQA requirements and procedures;
- ensure that regular calibration of testing equipment is conducted and recorded;
- review CQA procedures and results, and maintains records of all CQA testing performed by the Contractor;
- ensure that all Site activities are recorded daily and maintained; and
- ensure that CQA test results are accurately recorded.

3.5.2 CQA SUPPORT PERSONNEL

Dependent on the level of activity at the Site, additional CQA Support Personnel may be utilized. The duties of the CQA Support Personnel are as follows:

- report directly to the CQA Officer;
- conduct CQA tests and inspections as indicated in this CQA Plan;

- accurately record test results and inspections;
- calibrate testing equipment as required;
- maintain testing equipment in good working order; and
- immediately notify CQA Officer whether or not test results comply with specifications.

3.6 AIR QUALITY MONITORING

3.6.2 AIR MONITORING PERSONNEL

The duties of the Air Quality Monitoring Personnel are as follows:

- report to the Resident Engineer;
- conduct air monitoring tests in accordance with the approved Ambient Air Quality Monitoring Plan (AAQMP) and subsequent amendments. During the first month of West Plant Area capping work, daily (each day active work is conducted) polychlorinated biphenyl (PCB) and total suspended particulates (TSP) samples will be collected from the seven perimeter air monitoring stations. The PCB and TSP air monitoring program will be re-evaluated after one month of data collection;
- conduct background air monitoring at Site perimeter;
- monitor and record meteorological conditions twice daily (minimum) as described in the AAQMP;
- calibrate testing equipment, as required;
- collect quality control samples in accordance with the AAQMP;
- maintain testing equipment in good working order; and
- preparation of air monitoring reports.

3.7 QUALITY ASSURANCE/QUALITY CONTROL

3.7.1 QA/QC OFFICER

The duties of the QA/QC Officer are as follows:

- report directly to the CQA Officer; and
- review all laboratory analytical testing results received from QA/QC test laboratories retained by the Engineer to ensure compliance with the Quality Assurance Project Plan (QAPP) (CRA, December 21, 2004, as amended).

3.7.2 QA/QC TEST LABORATORIES

QA/QC Test Laboratories that will conduct CQA Quality Control tests will be identified prior to the commencement of the IM activities. QA/QC Test Laboratories are anticipated to include a geotechnical laboratory and an analytical laboratory where applicable. The analytical laboratory will continue to be Severn Trent Laboratories, Inc. (STL) as identified in the QAPP. The duties of the QA/QC Test Laboratories are to provide QA/QC testing of IM activities, as requested by the Engineer, to confirm that IM activities are being implemented in conformance with the design specifications and drawings.

3.8 CONTRACTOR

The duties of the Contractor, as they relate to QA/QC, are as follows:

- retain qualified independent testing firms (for example laboratory, geotechnical), for testing of materials and workmanship as specified in the Contract Documents;
- submit samples and/or materials for testing to determine if samples/materials meet specified requirements, and submits results directly to the Resident Engineer;
- record daily CQA activities in the Contractor's Site logbook and submits a "Daily Construction Quality Control Report" (see Section 7.2) to the Resident Engineer; and
- carry out construction activities according to Project Specifications and Drawings.

4.0 PERSONNEL QUALIFICATIONS

4.1 PROJECT ENGINEER

The Project Engineer will have the following qualifications:

- graduate of a recognized college in a technically related field;
- minimum ten (10) years experience in construction management and field oversight activities; and
- good management and communication skills.

4.2 RESIDENT ENGINEER

The Resident Engineer will have the following qualifications:

- graduate of a recognized college in a technically related field;
- minimum three (3) years experience in the oversight and implementation of hazardous waste remediation and CQA activities; and
- good management and communication skills.

4.3 SITE MANAGER (COVER SYSTEM INSTALLATION)

The Site Manager (Cover System Installation) will have the following qualifications:

- graduate of a recognized college in engineering/technology or equivalent;
- minimum of two (2) years experience in the oversight and implementation of liner/cover system; and
- good management and communication skills.

4.4 CQA ENGINEER

The CQA Engineer will have the following minimum qualifications:

- degree from a recognized college in engineering technology, or equivalent; or a minimum of two (2) years experience in hazardous waste remedial construction and CQA inspection procedures; and
- working knowledge of all relevant codes and regulations concerning material and equipment installation, observation and testing procedures, equipment, documentation procedures, and Site safety.

4.5 QA/QC OFFICER

The QA/QC Officer will have the following minimum qualifications:

- degree/diploma from a recognized university/college in engineering technology, or equivalent; and
- minimum three (3) years experience in the oversight and implementation of hazardous waste remediation and CQA activities.

4.6 HEALTH AND SAFETY OFFICER

The Health and Safety Officer will have the following qualification:

- degree/diploma from a recognized university/college;
- minimum three (3) years experience in the oversight and implementation of hazardous waste remediation and CQA activities; and
- knowledge of applicable Health and Safety laws and regulation.

4.7 CONTRACTOR

The selected Contractor will assign experienced personnel to supervise the implementation of all of the IM activities.

Experienced personnel will have a thorough knowledge of testing procedures, equipment and documentation procedures required for implementation of the IM activities.

The selected Contractor will designate an on-Site Contractor's Project Manager empowered to act on behalf of the Contractor in all matters pertaining to the IM activities.

5.0 PROJECT MEETINGS

Project meetings will be held during the IM to ensure that all tasks are accomplished according to schedule and that they are completed in accordance with the IM plans and specifications. It is anticipated that these progress meetings will be attended by the GM Project Manager, Project Engineer, Resident Engineer, Contractor Representative, IDEM, and U.S. EPA as detailed below.

5.1 PRECONSTRUCTION MEETING

Purpose: To resolve any uncertainties in the IM plans and specifications, and to review levels of responsibility, reporting requirements, and health and safety requirements.

Present: GM Project Manager, Project Engineer, Resident Engineer, CQA Officer, Engineer's Health and Safety Officer, Contractor Representative, Contractor Site Safety Officer.

Topics:

- Present Contractor's CQA Plan, Contractor's Site-specific Health and Safety Plan (HASP), and other relevant documents;
- Review the activities to be conducted during the IM;
- Review roles of each organization relative to the design criteria, plans and specifications within the CQA Plan;
- Determine any need to modify the CQA Plan to ensure that the IM is performed to meet or exceed the specified design criteria;
- Review lines of authority and communication;
- Discuss the established procedures or protocol for observations and tests including sampling strategies;
- Discuss the established procedures or protocols for handling construction deficiencies, repairs and re-testing;
- Review methods for documenting and reporting inspection data;
- Review methods for distributing and storing documents and reports;
- Review work area delineation, security and safety protocol;
- Discuss the location for storing equipment and materials, and the protection of these items during inclement weather;

- Discuss the protection of uncompleted IM work during off-hours and during inclement weather; and
- Conduct a Site tour to review work areas, safety areas, and equipment and stockpile storage locations.

5.2 DAILY PROGRESS MEETINGS

Purpose: To daily review work schedule progress. This meeting is intended to be an informal meeting held at the end of each work day or at the start of each work day.

Present: Resident Engineer, Contractor Representative

Topics:
- Review previous day's activities and progress;
- Review work location and activities for upcoming day;
- Review health and safety deficiencies from the previous work day and review health and safety requirements and potential problems for the next day's activities;
- Review Contractor's personnel and equipment assignments for the upcoming day; and
- Discuss any potential construction problems.

5.3 WEEKLY PROGRESS MEETINGS

Purpose: To provide an update of work schedule progress on a weekly basis, and identify schedule slippages and efforts required to get back onto schedule, if required.

Present: Resident Engineer, CQA Officer (optional), GM Representative (optional), Project Engineer (optional), Contractor Representative, Site Safety Officer (optional), U.S. EPA (optional), and IDEM (optional).

Topics:
- Health and safety report for previous week's activities and forthcoming week activities;
- Review work activities for the previous week;

- Comparison of actual progress to scheduled work activities, noting of schedule slippages and actions to be implemented to rectify schedule slippages;
- Review work activities for the next week; and
- Review potential IM problems and proposed solutions.

5.4 PROBLEM OR WORK DEFICIENCY MEETINGS

Purpose: To resolve any problem or deficiency that is present or likely to occur.

Present: Resident Engineer (if necessary), CQA Officer, GM Representative (optional), Contractor Representative (if problem or deficiency directly related to his work)

Topics:

- Define and discuss problem or deficiency;
- Review alternative solutions; and
- Develop and implement a plan to resolve the problem or deficiency.

5.5 PRE-FINAL CONSTRUCTION COMPLETION MEETING

Purpose: To identify outstanding issues or deficiencies related to the construction of the remedy.

Schedule: The Pre-Final Construction Completion Meeting will be conducted following 90 percent completion of the construction activities.

Attendees: Site Manager, CQA Support Personnel (optional), GM Representative (optional), U.S. EPA, IDEM, and U.S. EPA representative(s), IM Contractor Project Manager (optional if problem is not directly related to the IM Contractor's component of the work.

Topics:

- Site walk through and general project update;
- Define and discuss issues or deficiencies (punch list items);
- Review alternative solutions; and
- Develop and implement a plan to resolve the problem or deficiency.

5.6 FINAL CONSTRUCTION COMPLETION MEETING

Purpose: To conduct a final inspection of the constructed remedy and verify resolution of the issues or deficiencies identified in the Pre-Final Construction Completion Meeting.

Schedule: The Final Construction Completion Meeting will be conducted following substantial completion of the construction activities.

Attendees: Site Manager, CQA Support Personnel (optional), GM Representative (optional), U.S. EPA, IDEM, and U.S. EPA representative(s), IM Contractor Project Manager (optional if problem is not directly related to the IM Contractor's component of the work.

Topics:

- Site walk through and general project update;
- Overview of punch list items; and
- Operation, maintenance and monitoring.

For all meetings held on-Site during IM construction activities, with the exception of the daily progress meetings, minutes will be taken by the Resident Engineer. Copies of the minutes will be forwarded to all organizations present at the meeting.

6.0 INSPECTION, TESTING, AND SAMPLING ACTIVITIES

6.1 SCOPE

Throughout the implementation of IM activities there will be numerous inspections and testing required for specific work tasks. The inspection and testing requirements will ensure compliance with the IM design as presented in the Project Specifications, as well as ensure completion of the work tasks to the highest level of quality.

Inspections and testing will provide a qualitative and quantitative means of monitoring the quality and progress of work performed.

The components of each work task that will require some form of inspection or testing are as follows:

i) Construction Facilities and Temporary Controls
- clearing and grubbing,
- provision of personnel and equipment decontamination facilities,
- construction and/or upgrading of access roads,
- construction of material handling facilities, and
- provision of temporary treatment facilities;

ii) Cover System Construction
- surface water control,
- base and side slope composite liner installation,
- grading layer construction, and
- final cover construction.

6.2 INSPECTIONS

Throughout the period of the IM, the quality of work completed and material used for each of the work tasks will be maintained at its highest practical level through regular inspections of the work. Inspections will be completed throughout the construction by the CQA Officer and CQA Support Personnel, independent subcontractors (as required), and representatives of IDEM and U.S. EPA on a periodic basis, if required.

In general, inspections to be conducted by the Resident Engineer (following initial approval by the QA Officer) include the following:

i) reviewing and approving Contractor work plans;

ii) monitoring work progress;

iii) inspecting material as it is delivered to the Site to check for damage during delivery;

iv) comparing of the material and equipment delivered to the Site to the Project Specifications and Drawings;

v) inspecting materials after they have been installed or placed to ensure that they have not been damaged during installation or that they have been placed properly;

vi) performing pre-construction inspection prior to beginning work on any work task. A pre-construction inspection will include the following:
   - a review of contract requirements to ensure that all materials and/or equipment have been tested according to applicable standards and specifications,
   - ensure that provisions have been made to provide required quality control testing, and
   - examination of the work area to ascertain that all applicable preliminary work tasks have been completed;

vii) performing general inspections periodically as the amount of work completed warrants an inspection. A general inspection will include the following:
   - examination of the quality of workmanship,
   - testing of materials for compliance with Contract requirements,
   - any omissions, and
   - general progress of work performed; and

viii) performing final inspection upon completion of each work task to ensure compliance with the Project Specifications and Drawings and to ensure that deficiencies identified in the general inspections have been corrected.

These inspections will be performed by the Resident Engineer following initial approval by the CQA Officer and the results of the inspections will be provided in the Final Construction Report. U.S. EPA representatives will be notified at least fourteen (14) days in advance of any final inspections. The results of all inspections will be recorded in the daily Site logbook as described in Section 7.0. Copies of the pre-construction, general and final inspection reports will be provided to all parties involved in the inspection.

The component of each work task to be inspected, the types of inspections required, and the frequency of the inspections are summarized in Table E.6.1.

6.3 TESTING

In addition to the inspections of the construction progress, material testing will be performed by the CQA Support Personnel or the test laboratories. Materials testing will be performed to ensure compliance with material specifications and design criteria as presented in the specifications.

The testing requirements, testing methods, and testing frequency for each of the work task components are summarized in Table E.6.2.

6.3.1 EVALUATION OF OUTLYING DATA

Due to variability in materials and inaccuracies in testing, individual test results are anticipated to occasionally fail to conform to the required specifications. The allowable percentage of outliers (test results which do not meet the specifications) will be based on the technical guidance document entitled "Quality Assurance and Quality Control for Waste Containment Facilities, U.S. EPA, EPA/600/R-93/182, September 1993".

6.4 COVER SYSTEM INSPECTION

Throughout the implementation of the construction program, there will be numerous inspections and testing requirements for specific work tasks. The inspection and testing requirements will ensure compliance with the procedures and specifications summarized in Table E.6.2.

Inspections and testing will provide a qualitative means of monitoring the quality and progress of work performed.

The components of each work task which will require some form of inspection or testing as described by the CQA Plan for the cover system include:

i) grading layer:
- quality of native grading fill;
- quality of imported grading fill;
- placement of grading fill; and
- compaction of grading fill;

ii) compacted clay layer:
- quality of clay;
- compaction of clay; and
- placement of clay;

iii) Linear Low Density Polyethylene Liner (LLDPE):
- quality of LLDPE;
- transportation of LLDPE; and
- placement of LLDPE;

iv) Geonet drainage layer:
- quality of Geonet drainage material; and
- placement of Geonet drainage material;

v) common fill layer:
- quality of common fill;
- placement of common fill; and
- compaction of common fill;

vi) topsoil/vegetative Layer:
- quality of topsoil;
- placement of topsoil;
- quality of seed and/or sod materials and/or accessories;
- placement/application of materials; and
- watering/fertilizing;

vii) Miscellaneous:

- quality of clay material used, ensure the upper lift of clay is free of stones that could damage the LLDPE liner (i.e. sharp edged stones, or stones greater than 0.5 inches in diameter);
- quality of toe and cap drainage layer materials, and placement/application of materials;
- quality of aggregate and riprap and geotextile materials, and placement/application of materials;
- quality of culverts, and placement/application of culverts;
- quality of catch basins and gabion mattresses, and placement/application of materials in ditches/swales; and
- quality of fences and gates, and placement/application of fences and gates.

6.5 SAMPLING PROCEDURES

If material is imported to the Site for the IM it will be sampled and analyzed for Target Analyte List (TAL) and Target Compound List (TCL) parameters. A minimum of one sample per material source will be taken.

6.6 FIELD LOGBOOKS/DOCUMENTATION

Field logbooks will provide the means of recording the data collection 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 without reliance on memory.

The title page of each logbook will contain the following:

- person to whom the logbook is assigned;
- logbook number;
- project name;
- project start date; and
- end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, meteorological conditions, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors participating in field sampling and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink with no erasures. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the sampling point, which includes compass direction and distance taken from a reference point, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

The equipment used to collect samples will be noted, along with the time of sampling and sample location. Sample identification numbers will be assigned during sample collection. Field QC samples, which will receive an entirely separate sample identification number, will be submitted blind to avoid laboratory bias of field QC samples.

6.7 FINAL EVIDENCE FILES CUSTODY PROCEDURES

Evidentiary files for the entire project will be maintained by the Engineer and will consist of the following:

- project plan;
- project logbooks;
- field data records;
- sample identification documents;
- chain-of-custody records;
- correspondence;
- references, literature;
- final data packages;
- miscellaneous - photos, maps, drawings, etc.; and
- final report.

Each CRA location has personnel responsible for maintaining the file system (file custodian). The evidentiary file materials will be the responsibility of the evidentiary file custodian with respect to maintenance and document removal.

The project laboratory will be responsible for maintaining analytical logbooks and laboratory data. Raw laboratory data files will be inventoried and maintained by the project laboratory for a period of 6 years, at which time the Engineer will advise the laboratory regarding the need for additional storage.

6.8 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

Upon mobilization of sampling equipment, and prior to the commencement of sampling activities, all sampling equipment will be thoroughly cleaned to remove oil, grease, mud, and other foreign matter. Cleaning will take place in the on-Site decontamination area. Prior to initiating sampling activities, all sampling equipment will be cleaned to prevent cross-contamination from the previous sampling location. Cleaning of sampling equipment that will directly contact sample media, will be performed in accordance with the standard decontamination procedures developed under the RCRA CA.

Fluids used for cleaning will not be recycled. All wash water, rinse water, and decontamination fluids will be collected and treated in an on-Site treatment facility.

7.0 CQA DOCUMENTATION

7.1 GENERAL

This section details the documentation requirements for the CQA Plan. The proper, thorough, and accurate documentation of all CQA site activities is important in ensuring quality installation. CQA testing will be documented daily.

7.2 CONTRACTOR'S DAILY SITE LOGBOOK

The selected Contractor will record daily quality control activities in a Daily Site Logbook to be kept on Site at all times. The logbook will include the following information:

- date, weather conditions;
- all Site activities;
- decisions made regarding approval of units of material or of work, and/or corrective actions to be taken in cases of substandard quality;
- submittals made by suppliers verifying material quality;
- quality control test and inspection results;
- construction delays, and causes;
- areas affected by delays;
- construction problems and corrective actions;
- personnel on Site;
- present phase of construction;
- material and/or equipment delivered to the Site (including equipment demobilization);
- inspections made;
- health and safety considerations;
- quality control tests performed and results of tests taken on previous work day;
- instructions given by the Resident Engineer;
- changed conditions/conflicts encountered; and
- remarks.

Each daily entry into the log will be signed by the Contractor as verification to its correctness, and a copy of the signed entry will be provided to the Resident Engineer on a daily basis for verification. The Contractor may use alternate forms providing the same information, subject to the approval of the Resident Engineer.

7.3 CQA INSTRUMENT CALIBRATION

The CQA Support Personnel will record calibrations of test equipment in an Instrument Calibration Logbook, maintained on Site by the Resident Engineer. Actions taken as a result of recalibration will be recorded in the Inspection logbook, as described in the next section.

7.4 INSPECTION LOGBOOK

All observations and quality control field tests will be recorded by the CQA Support Personnel into Inspection Logbooks. These books will be kept on Site and maintained by the Resident Engineer. The inspection logbook will include the following information:

- date, time, weather conditions;
- description or title of the inspection activity;
- location of the inspection activity or location from which the sample increment was obtained;
- type of inspection activity and procedure used (reference to standard method when appropriate);
- recorded observation or test data, with all necessary calculations;
- results of the inspection activity and comparison with specification requirements;
- personnel involved in the inspection activity; and
- signature of the appropriate CQA inspection personnel and concurrence by the Resident Engineer.

Items above shall be formulated into checklists so that details are not overlooked.

7.5 PROBLEM/CORRECTIVE ACTION REPORTS

A problem is defined as material or workmanship that does not meet the construction specifications. Problem/Corrective Action Reports should be cross-referenced to specific inspection entries in the Inspection Logbook where the problem was identified. Problem/Corrective Action Reports will be prepared for each problem encountered and will include the following information:

- unique identifying sheet number for cross-referencing and document control;
- detailed description of the problem;
- location of the problem;
- probable cause;
- how and when the problem was located (reference to Inspection Logbook);
- estimation of how long problem has existed;
- suggested corrective action;
- documentation of correction (reference to Inspection Logbook);
- final results;
- suggested methods to prevent similar problems; and
- signature of the appropriate CQA Support Personnel and concurrence by the Resident Engineer.

In some cases, not all of the above information will be available or obtainable. However, when available, such efforts to document problems could help to avoid similar problems in the future.

7.6 WORK TASK REPORTS

Within each work task, there may be several quality characteristics, or parameters, that are specified to be observed or tested, each by a different observation or test, with the observations and/or tests recorded in different Inspection Logbooks. At the completion of each task, these logbooks should be used to write a Work Task Report summarizing all of the construction activities related to that particular work task.

Work Task Reports will be prepared by the Resident Engineer and the Project Engineer and will include the following information:

- unique identifying sheet number for cross-referencing and document control;
- description of work task;
- quality characteristic being evaluated and references to construction specifications and plans;
- quality control test locations;
- inspections made (define procedure by name or other identifier);
- summary of inspection results, which will include all data outside acceptable limits, and documentation of corrective action and retest results;
- define acceptance criteria (compare task inspection data with design specification requirements; indicate compliance or noncompliance; in the event of noncompliance, identify documentation that gives reasons for acceptance outside of the specified design); and
- signature of the Resident Engineer and Project Engineer.

7.7 FINAL CONSTRUCTION REPORT

At the completion of the IM construction activities, the Engineer will prepare and submit a Final Construction Report for the Cover System IM to U.S. EPA/IDEM. This report will include a description of the construction activities and present copies of pertinent information to the IM including the Daily Site Logbooks, Inspection Logbooks, Problem/Corrective Action reports, deviations from design and material specifications (with justifying documentation), CQA test results, and as-constructed drawings.

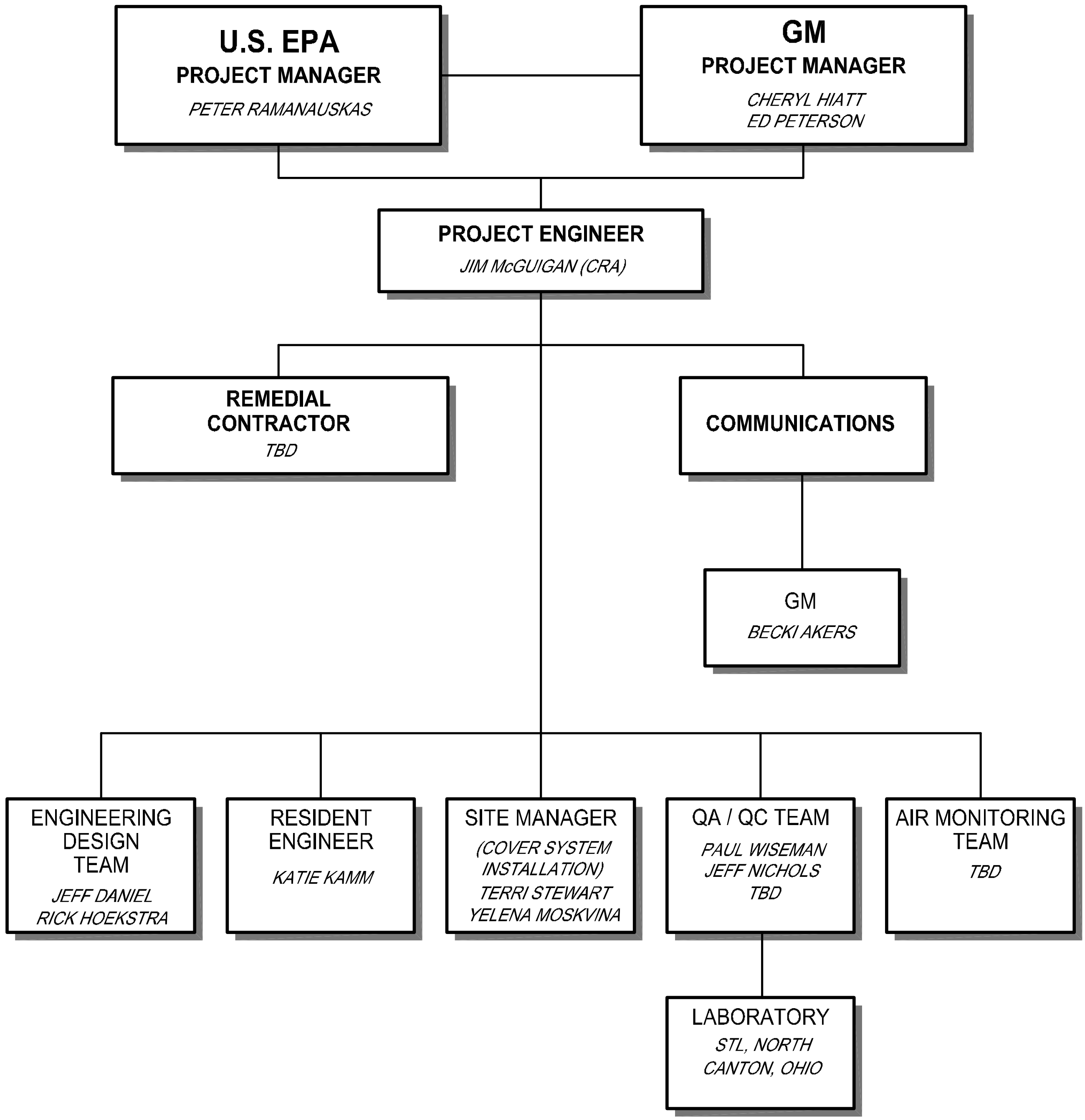

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figure E.3.1

PROJECT ORGANIZATION CHART
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY
Bedford, Indiana

13968-00(253)GN-WA025 DEC 12/2007

TABLE E.6.1

**SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY**

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
A. Construction Facilities and Temporary Controls					
• Site Operations	• is fencing in place to delineate work areas and do workers observe and respect limits marked with fencing and permits	• visual	• daily as required	• none	• fencing not installed/located correctly
	• is surface water runoff prevented from leaving work areas	• visual	• daily as required	• none	• surface water controls not implemented
	• is surface water runoff from non-contaminated areas prevented from contacting potentially contaminated areas	• visual	• daily as required	• none	• surface water controls not implemented
	• are appropriate dust control measures being followed to prevent dust release from the Site exceeding specified levels	• visual and analytical	• daily as required	• none	• dust control measures not implemented; visual observations of excess dust; and monitoring data (handheld/long-term) exceeds criteria
	• are appropriate Site access roads and parking areas being maintained	• visual	• daily as required	• none	• roads, parking areas not maintained
• Vehicle Decontamination Facility	• is vehicle decontamination facility properly maintained and inspected	• visual	• daily as required	• none	• facility not maintained
	• are appropriate equipment decontamination procedures followed	• visual	• as required	• none	• decontamination procedures not followed
	• is weigh scale facility properly maintained and inspected	• visual	• as required	• none	• facility not maintained and inspected • scale not operating properly
• Temporary soil erosion and sediment control	• as per construction drawings and permits	• visual	• daily as required	• none	• sediment and erosion controls inadequate
	• are the silt fences and straw bale structures effective in sediment control	• visual	• daily as required	• none	• visual irregularities evident, sediment escape evident
	• are the silt fences and straw bale structures being maintained during construction activities	• visual	• daily as required	• none	• evident excessive sediment material build-up

TABLE E.6.1

**SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY**

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
A. Construction Facilities and Temporary Controls (cont'd)					
• Clearing and Grubbing	• are limits of clearing-clearly marked and are clearing and grubbing proceeding only within these limits	• visual	• daily as required	• none	• failure to perform as stated
	• are all above ground portions of trees, shrubs and other cleared vegetation handled separately from below ground portions	• visual	• daily as required	• none	• N/A
	• have all above ground portions of trees, shrubs and other cleared vegetation been chipped and stockpiled on Site	• visual	• daily as required	• none	• N/A
	• have all below ground portions of trees, shrubs and other cleared vegetation been chipped and stockpiled separately from above ground portions	• visual	• daily as required	• none	• N/A
B. Cover System Construction					
• Grading Layer	• is grading material approved for grading application	• visual • analytical for imported soils • geotechnical	• prior to grading • for each source of grading material	• analytical results	• material is contaminated or otherwise unsuitable
	• have soil stockpile areas been properly prepared	• visual	• prior to grading	• none	• stockpile ares do not meet specifications
	• does grading material contain unsuitable material	• visual • check against Specifications	• each source of grading material	• none	• unsuitable material present
	• is grading material placed in proper lifts	• visual (grade stakes)	• prior to compaction	• none	• does not meet Specification
	• has grading material been compacted to Specification	• visual • in situ density	• in accordance with Specifications	• density results	• does not meet Specification
	• horizontal and vertical control	• survey	• during and on completion of grading	• survey information	• outside vertical tolerance of ±2 inches (2) and horizontal tolerance of 1± feet
• Barrier/Clay Layer Installation	• is imported material approved for application	• visual • geotechnical • chemical analyses (for imported materials)	• prior to placement for each source of material • for imported materials, prior to delivery to Site	• chemical results • geotechnical data	• specifications not met

TABLE E.6.1

SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
B. Cover System Construction (cont'd)					
• Barrier/Clay Layer Installation (cont'd)	• clay field permeability	• test pad	• each source of material (see Table B.6.2)	• field permeability test results	• field permeability > 1 x10-7 cm/s
	• does material contain unsuitable material	• visual • check against Specifications	• each source of material	• none	• unsuitable material observed
	• has clay material been compacted to specification	• visual • check test results against specifications	• see Table B.6.2	• geotechnical data	• specifications not met
	• horizontal and vertical control	• survey	• during and upon material placement [200-foot grid installation (maximum)]	• survey information	• 1 inch tolerance to design grades
• Linear Low Density Polyethylene Liner (LLDPE) Installation	• are delivered materials in acceptable condition	• visual	• Material Delivery Inventory Inspection Sheet	• Upon delivery	• upon delivery • material is wet or has excessive moisture
	• is LLDPE stored properly	• visual	• manufacturer's recommendations	• Periodic during storage	• upon delivery
	• is the bedding soil free of ruts and harmful objects	• visual	• continuous	• none	• daily during placement
	• is the overlap distance sufficient at both the edges and ends	• visual	• continuous	• none	• daily during placement
	• is the proper amount of bentonite placed in the overlaps, if required	• visual	• continuous	• none	• daily during placement
	• is the LLDPE placed to prevent entrapment of damaging materials	• visual	• continuous	• none	• daily during placement
	• is proper care taken during trimming to prevent damage to liner	• visual	• continuous	• none	• daily during placement
	• are patches installed according to specifications	• visual	• continuous	• none	• daily during placement
	• is installed LLDPE approved before covering	• visual	• continuous	• none	• daily during placement
	• is the LLDPE covered before rain or snowfall	• visual	• continuous	• none	• daily during placement

TABLE E.6.1

SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
Cover System Construction (cont'd)					
	• is the soil being placed in direction of shingling	• visual	• continuous	• none	• daily during placement
	• is the cover soil placed so the LLDPE is not damaged or wrinkled	• visual	• continuous	• none	• daily during placement
	• is the cover soil placed so no excess tensile stress is developed in LLDPE	• visual	• continuous	• none	• daily during placement
• Geonet Installation	• does Geonet comply with specifications	• check manufacturer and supplier certifications • visual • check against Specifications	• see Table B.6.2	• suppliers and manufacturer's certification	• material does not meet specifications
	• has material arrived to Site undamaged	• visual	• upon delivery to Site	• none	• damaged materials
	• is the material properly stored to prevent accidental damage and UV exposure	• visual	• upon delivery to Site	• none	• improperly stored materials
	• has Contractor submitted required submittals	• check against Specifications	• prior to commencing material placement	• Contractor's submittals	• N/A
	• is base preparation free of ruts or harmful objects	• visual	• prior to placement	• none	• presence of ruts or sharp objects

TABLE E.6.1

**SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY**

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
C. Cover System Construction (cont'd)					
• Geonet Installation (cont'd)	• have materials been installed as specified	• visual	• continuous	• supplier-installer approval letter • manufacturers instructions	• material not installed as specified
	• are there any visible defects, holes, blisters, undispersed raw materials or any sign of contamination by foreign matter	• visual	• after installation is completed and prior to placement of overlying materials	• none	• visual defects
	• is the cover soil placed in direction of shingling	• visual	• continuous	• none	• N/A
• Common fill	• is imported material approved for application	• visual • geotechnical • chemical analysis	• prior to delivery to Site	• chemical results • geotechnical data	• does not meet specifications
	• does imported material contain unsuitable material	• visual • check against specification	• each source material	• none	• unsuitable material observed
	• hydraulic conductivity	• geotechnical testing	• each source material (see Table B.6.2)	• geotechnical results	• hydraulic conductivity > 1 x10-5 cm/s
	• has material been compacted to specification	• visual • check test results against specification	• see Table B.6.2	• geotechnical data	• does not meet specifications
	• horizontal and vertical control to confirm placement to design thickness and in proper lifts	• survey	• during and upon material placement [200-foot grid installation (maximum)]	• survey information	• 1-inch tolerance to design grades
• Topsoiling and Seeding	• is imported material approved for application	• visual • analytical • geotechnical	• prior to placement • for each source of topsoil and seeding material • for imported materials, prior to delivery to Site	• analytical results • gradation curves	• material out of specification
	• does material contain unsuitable material	• visual • check against Specifications	• each source of topsoil and seeding material	• none	• unsuitable material observed
	• horizontal and vertical control to confirm placement to design thickness	• survey	• during and on completion of topsoil placement	• survey information	• grading does not meet specification

TABLE E.6.1

**SUMMARY OF CONSTRUCTION QUALITY ASSURANCE INSPECTIONS
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY**

Work Task Component to be Inspected	*Items to be Checked During Inspection*	*Type of Inspection*	*Frequency of Inspection*	*Submittals to Resident Engineer*	*Rejection Criteria*
D Miscellaneous					
• Riprap	• does material meet specifications	• check supplier's specifications	• prior to delivery	• supplier's certification	• material does not meet specifications
	• proper location and depth	• survey	• continuous during work	• none	• material not installed in accordance with design
	• geotextile	• as per part C above			
• Culverts and Conduits	• does material meet specifications	• check supplier's specifications	• prior to delivery	• supplier's certification	• material does not meet specifications
	• does installation follow proper alignment	• survey and visual	• continuous	• none	• material not installed in accordance with specifications
	• bedding and backfill material meets specifications	• check supplier's gradation	• upon delivery to Site	• material certificates and gradations	• material does not meet specifications
• Ditches/Swales	• does material meet specifications	• check supplier's specifications	• upon delivery to Site	• supplier's certification	• material does not meet specifications
	• does installation follow proper alignment and grade	• survey and visual	• continuous	• none	• installation not installed in accordance with specification
	• does fill meet specifications	• as per part C above			
	• consolidation of sediment	• visual	• continuous during removal	• none	• N/A
• Fencing and Gates	• does material meet specifications	• check supplier's specifications	• upon delivery to Site	• supplier's certification	• material does not meet specifications
	• is alignment and size correct	• survey and visual	• continuous during installation	• none	• alignment/size incorrect
	• does installation conform to specifications	• as per specifications	• continuous during installation	• none	• installation does not conform to specifications
• Access Road	• does material meet Specifications	• check supplier's Specifications	• upon delivery to Site	• supplier's certification • delivery tickets	• does not meet Specification
	• is alignment correct	• survey and visual	• continuous during installation	• none	• alignment incorrect. Tolerance of ±6 inches
	• does installation conform to Specifications	• as per Specifications	• continuous during installation	• none	• does not meet Specification

TABLE E.6.2

SUMMARY OF QUALITY ASSURANCE TESTING PROCEDURES
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY

Work Task to be Inspected	*Type of Testing*	*Method of Testing*	*Frequency* [(1)]	*Acceptance/Rejection Criteria*
A. Cover System Construction				
• Grading Layer				
a) Material	• Particle Size Distribution	• ASTM D422	• in accordance with specifications	• 1 per 10,000 CY
	• Maximum Dry Density	• ASTM D698	• lab test to establish criteria	• 1 per 10,000 CY
	• Optimum Moisture Content	• ASTM D698	• lab test to establish criteria	• 1 per 10,000 CY
b) Compaction	• Moisture Content in Laboratory	• ASTM D2216	• ±2% of moisture content in place	• 1 per 5 acre/lift
	• Density in Place	• ASTM D2922	• 90% of maximum dry density	• 2 per acre/lift
	• Moisture Content in Place	• ASTM D3017	• compactible to specified density	• 2 per acre/lift
	• Placement Tolerance	• survey/measurement	• ±0.1 foot from design	• before and after placement
• Compacted Clay Layers				
a) Materials Received or at borrow pit if imported	• Moisture Content	• ASTM D-2216	• 1 per 1,500 CY	• lab test to establish criteria
	• Atterburg Limits	• ASTM D-4318	• 1 per 1,500 CY	• ML or CL per ASTM D-2487
	• Particle-size distribution	• ASTM D-422	• 1 per 1,500 CY	• minimum 25% <2 microns, min. 50% passing No. 200 Sieve of which min. is 15% clay
	• Maximum Dry Density	• ASTM D-698	• 1 per 1,500 CY	• lab test to establish criteria
	• Hydraulic Conductivity	• ASTM D-5084	• 1 per 10,000 CY	• 1 x 10-7 cm/s at accepted compaction zone
	• Soil Classification	• ASTM D-2487	• 1 per 1,500 CY	• CL or ML classification
b) Compaction	• Density in Place	• ASTM D-2922	• 5 /acre/lift	• 95% of Maximum Dry Density
	• Moisture Content in Place	• ASTM D-3017/2216	• 5 /acre/lift	• 0 - 5% above optimum
	• Number of Passes	• Observation	• continuous	• determined by compactor and desired %coverage
	• Plasticity Index	• ASTM D4318		• 10% to 30%
	• Bulk Wet Density in Place	• ASTM D2922		• per Specification
	• Depth of Layers	• Observation	• continuous	• equal continuous layers not exceeding 8 inches loose lift
	• Final Elevation	• Survey	• after placement	• tolerance of plus or minus 0.1 foot from design elevation
	• Chemical analysis to verify fill is clean	• TCL VOCs SW-846 8260B • TCL SVOCs SW-846 8270C • TCL Pest/PCBs SW-846 8081A • TAL Inorganics SW-846 6010/7000 Series • PCB SW-846 8082 • Herbicides SW-846 8151A • Cyanide SW-846 9010 or 9012A	• each source area, as required	• per Specification

TABLE E.6.2

**SUMMARY OF QUALITY ASSURANCE TESTING PROCEDURES
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY**

Work Task to be Inspected	*Type of Testing*	*Method of Testing*	*Frequency [(1)]*	*Acceptance/Rejection Criteria*
A. Cover System Construction (Cont'd)				
• Geonet Drainage Layer				
a) LLDPE Drainage Net Core	• Density	• ASTM D-1505 whichever is appropriate	• 1 per 50,000 SF	• 0.94 g/cc[(3)]
	• Carbon Black Content	• ASTM D1603	• As above	• 2.0 percent
	• Tensile strength in machine direction	• ASTM D-4595	• As above	• 450 lbs/ft
b) Drainage Geocomposite	• Transmissivity	• ASTM D-4716	• 1 per 200,000 SF	• 1×10^{-3} m^2/sec[(2)]
	• Ply adhesion	• ASTM F-904 Modified	• 1 per 100,000 SF	• 0.5 lbs/sf
c) Geotextile	• Permeability, k	• ASTM D4491	• As above	• 0.3 cm/s (minimum)
	• Permittivity	• ASTM D4491	• As above	• 0.5 sec^{-1} (minimum)
	• Apparent Opening Size (AOS)	• ASTM D4751	• As above	• 70 sieve size (maximum)
• LLDPE Liners				
a) Materials	• Carbon black content	• ASTM D-1603	• 1 per 20,000 lbs	• 2% to 3%
	• Thickness	• ASTM D-1593, ASTM D-751, ASTM D-5199, ASTM D-374, ASTM D-5994 or GRI GM-13, whichever is appropriate	• per roll	• 60 mils[(3)]
	• Density	• ASTM D-1505/792, GRI GM-13	• 1 per 200,000 lbs	• 0.939 g/cc[(3)] maximum
	• Tensile strength at yield	• ASTM D-638, GRI GM-13 Type IV	• 1 per 20,000 lbs	• 126 lbs/inch width
	• Tensile strength at break	• ASTM D-638, GRI GM-13 Type IV	• 1 per 20,000 lbs	• 90 lbs/inch width
	• Elongation at break	• ASTM D-638, GRI GM-13 Type IV	• 1 per 20,000 lbs	• 100%

TABLE E.6.2

SUMMARY OF QUALITY ASSURANCE TESTING PROCEDURES
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY

Work Task to be Inspected	*Type of Testing*	*Method of Testing*	*Frequency* [1]	*Acceptance/Rejection Criteria*
B. Vault Construction (Cont'd)	• Puncture resistance	• ASTM D-4833, GRI GM-13	• 1 per 45,000 lbs	• 66 lbs
	• Tear resistance	• ASTM D-1004, GRI GM-13	• 1 per 45,000 lbs	• 33 lbs
b) Test Seams	• Seam shear test	• ASTM D-4437	• Minimum two tests per day per seamer/equipment	• 1,500 psi
	• Seam peel test	• ASTM D-4437	• Minimum two tests per day per seamer/equipment	• 1,250 psi
c) Installation	• Destructive seam shear test	• Field tensiometer (ASTM D4437)	• Minimum 1 test per approximately 500 lineal feet of production seam or at least one per seam	• 1,500 psi, and seam must not delaminate. Four of 5 replicate samples must pass.
	• Destructive seam peel test	• Field tensiometer (ASTM D4437)	• Minimum 1 test per approximately 500 lineal feet of production seam or at least one per seam	• 1,250 psi, and seam must not delaminate. Four of 5 replicate samples must pass.
	• Non-destructive test	• GRI GM6	• 100% of production seams	• Test results shall meet or exceed the requirements of GM6
	• Asperity Height	• GM12	• As per GRI Standard GM17 (1/45,000 lbs), one near beginning of liner placement, and one additional test approximately half way through liner placement	• 10 mils MARV
	• Carbon Black Dispersion	• ASTM D5596	• As above (GM17 - 1/45,000 lbs)	
	9 out of 10			• Cat 1 or 2
	10 out of 10			• Cat 1, 2, or 3
	• Oxidation Induction Time	• ASTM D3895 (Standard) • ASTM D5885 (High Pressure)	• As above (GM17 - 1/200,000 lbs)	• 100 minutes • 400 minutes
	• Oven Aging at 85°C	• ASTM D5721 • ASTM D3895 • ASTM D5885		• NA • 35% • 60%
	• UV Resistance	• ASTM D5885		• 35%
	• Destructive seam shear test (if field test acceptable)	• ASTM D6392	• Minimum one test per approximately 1,000 lineal feet of production seam or at least one per seam	• 1,500 psi, and seam must not delaminate. Four of 5 replicate samples must pass.
	• Destructive seam peel test (if field test acceptable)	• ASTM D6392	• Minimum one test per approximately 1,000 lineal feet of production seam or at least one per seam	• 1,250 psi, and seam must not delaminate. Four of 5 replicate samples must pass.
• Common Fill				
a) Material	• Permeability	• ASTM D-5084	• 1 per 1,000 CY	• 1×10^{-5} cm/s
	• Maximum Dry Density	• ASTM D-698	• 1 per 1,000 CY	• lab test to establish criteria
	• Moisture Content	• ASTM D-2216	• 1 per 500CY	• lab test to establish criteria
	• Particle-size distribution	• ASTM D-422 or D-1140	• 1 per 4,500 CY	
	• Chemical analysis to verify fill is clean	• TCL VOCs SW-846 8260B • TCL SVOCs SW-846 8270C • TCL Pest/PCBs SW-846 8081A • TAL Inorganics SW-846 6010/7000 Series • PCB SW-846 8082 • Herbicides SW-846 8151A • Cyanide SW-846 9010 or 9012A	• 1 per 1,000 CY	• per Specification
	• Grain Size	• ASTM D-422	• 1 per 500CY	• lab test to establish criteria

TABLE E.6.2

SUMMARY OF QUALITY ASSURANCE TESTING PROCEDURES
OVER 50 mg/kg PCB SOIL SOURCE REMOVAL FOR WEST PLANT AREA
GM POWERTRAIN BEDFORD FACILITY

Work Task to be Inspected	*Type of Testing*	*Method of Testing*	*Frequency* [(1)]	*Acceptance/Rejection Criteria*
A. Cover System Construction (Cont'd)				
b) Placement	• Moisture Content in Place	• ASTM D-3017	• 1 per 4,800 SY	• +/- 2% of optimum
	• Compaction Density in Place	• ASTM D-2922	• 1 per 280 SY	• 95% of maximum dry density
	• Elevation	• Survey	• before and after placement	• tolerance of plus or minus 1 inch from design
	• Recompacted permeability	• ASTM D-5084	• 1 per 10,000 CY	• 1 x 10-5 cm/s
• Topsoil				
a) Material	• Acidity Range (pH)	• ASTM D4972	• 1 per 1,000 CY	• 5.5 to 7.5
	• Organic Matter	• ASTM D2974	• 1 per 1,000 CY	• 2% to 10%
	• Soil Classification	• ASTM D-2487	• 1 per 1,000 CY	• SP, SM, ML or OL
	• Chemical analysis to verify fill is clean	• TCL VOCs SW-846 8260B • TCL SVOCs SW-846 8270C • TCL Pest/PCBs SW-846 8081A • TAL Inorganics SW-846 6010/7000 Series • PCB SW-846 8082 • Herbicides SW-846 8151A • Cyanide SW-846 9010 or 9012A	• 1 per 1,000 CY	• per Specification
B. Miscellaneous				
• Culverts and Conduits	• Grain Size Distribution of Bedding and Backfill	• ASTM D-422	• 1 per 500 CY	• per Specification
	• Compaction of Bedding and Backfill	• ASTM D-2922	• 1 per 500 CY	• 95% of maximum dry density
• Catch Basins, Ditches/Swales,	• Grain Size Distribution of Bedding and Backfill	• ASTM D-422	• 1 per 500 CY	• per Specification
	• Compaction of Bedding and Backfill	• ASTM D-2922	• 1 per 500 CY	• 95% of maximum dry density
C. Access Roads				
a) Material	• Maximum Dry Density	ASTM D698	• 1 per 10,000CY	• Lab test to establish criteria
	• Grain Size	• ASTM D422 or D1140	• 1 per 5,000 CY	• per Specification
	• Chemical Characterization	• USEPA SW-846	• 1 per 10,000CY	• per Specification
b) Placement	• Moisture Content in Place	• ASTM D3017	• 6 tests per lift per acre	• +1/-3 percent of optimum
	• Compaction Density in Place	• ASTM D2922	• 6 tests per lift per acre	• 95 percent of maximum dry density
	• Elevation	• Survey	• before and after placement	• tolerance of plus or minus 1 inch from design

Notes:

1. Additional tests should be conducted for each change in material and when material is suspect. Type of test and frequency is minimum.
2. Gradient of 0.1, normal load of 1,000 psf, water at 70 degrees F, between stainless steel plate/uniform sand/geocomposite 60 mill liner/steel plate for 100 hrs.
3 Indicates typical material property. Testing must confirm a similar result.

APPENDIX F

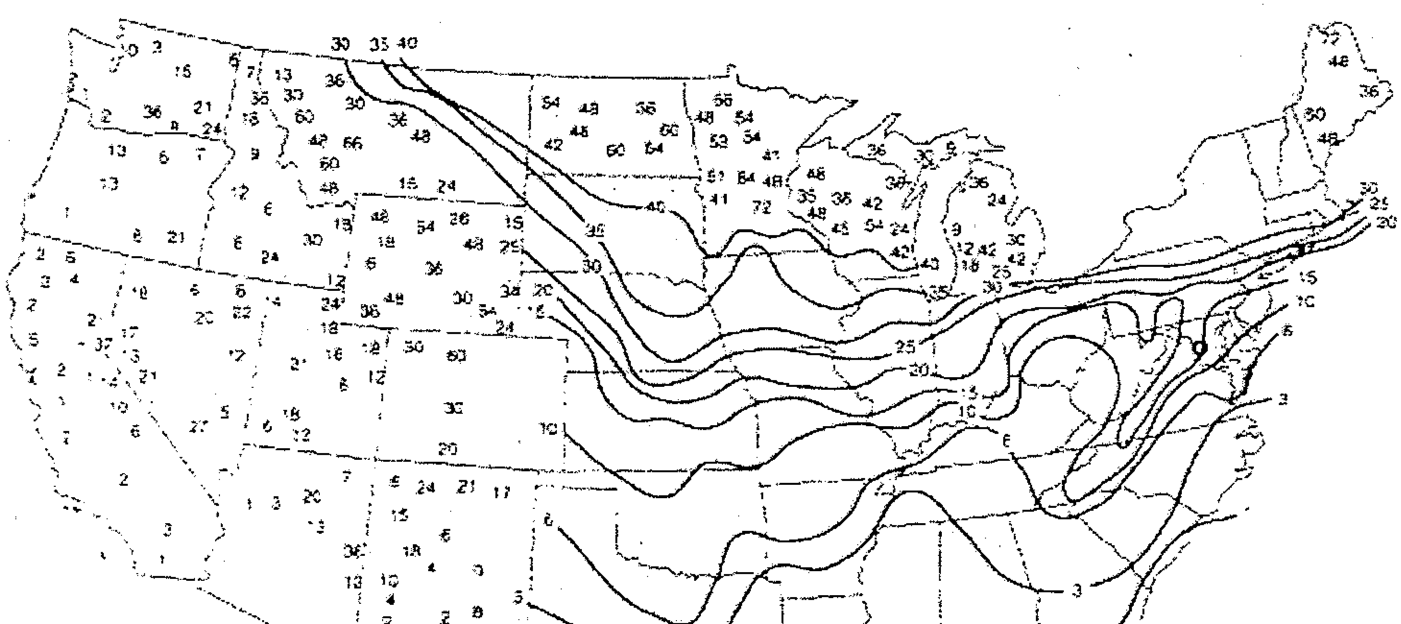
FROST DEPTH PENETRATION INFORMATION

CHAPTER 6 SUBPART F CLOSURE AND POST-CLOSURE
6.4 CLOSURE PLAN 40 CFR SECTION 258.60(c)-(d)

6.2 FINAL COVER DESIGN 40 CFR Section 258.60(a)

6.2.3 Technical Considerations

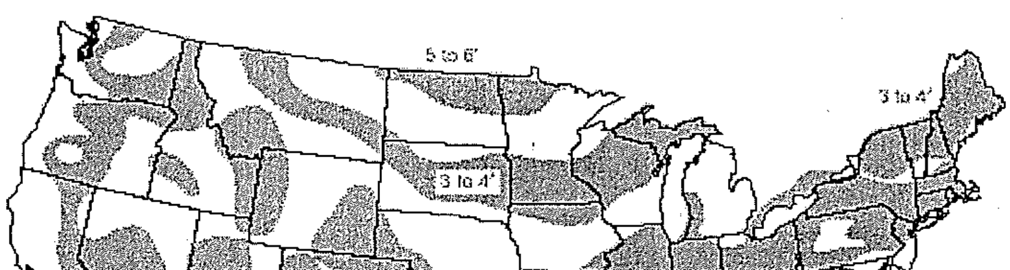
Membrane and clay layers should be placed below the maximum depth of frost penetration to avoid freeze-thaw effects (U.S. EPA, 1989b). Freeze-thaw effects may include development of microfractures or realignment of interstitial fines, which can increase the hydraulic conductivity of clays by more than an order of magnitude (U.S. EPA, 1990). Infiltration layers may be subject to desiccation, depending on climate and soil water retention in the erosion layer. Fracturing and volumetric shrinking of the clay due to water loss may increase the hydraulic conductivity of the infiltration layer. Figure 6-4 shows the regional average depth of frost penetration; however, these values should not be used to find the maximum depth of frost penetration for a particular area of concern at a particular site. Information regarding the maximum depth of frost penetration for a particular area can be obtained from the Soil Conservation Service, local utilities, construction companies, and local universities.



Frost protection layer thickness required for a compacted clay barrier

We first determined how much frost protection is required over the U.S. We used a freezing index map from TM 5-818-2, *Pavement Design for Seasonal Frost Conditions* (U.S. Army 1985), which shows contours of freezing index for the coldest year in 10 years of record or the 90 th percentile (Fig. 3-1 and 3-2 in TM 5-818-2). Examination of longer records of freezing index data showed that using a 95 th or greater percentile did not result in a significantly greater freezing index.

The thickness of frost protection required to prevent frost from penetrating into the hydraulic barrier was determined using the freezing index data in a frost depth model developed at CRREL (Aitken and Berg 1968). We assumed that a silt soil would be used as a frost protection layer, that the density of this layer would be about 110 lb/ft 3 (758 kPa), that the water content would be 17%, and that the surface would have a grass cover. The resulting map showing contours of equal frost protection layer thickness is given in Figure 16. It can be seen that the range of frost protection required is 1–6 ft (0.3–1.8 m) in the U.S., with any-where between 1 and 3 ft (0.3 and 1 m) of frost protection being required over the highly populated northern regions of the U.S.



ATTACHMENT A

EXTREME-VALUE CLIMATOLOGY OF MAXIMUM SOIL FREEZING DEPTHS IN CONTIGUOUS UNITED STATES

BY ARTHUR T. DEGAETANO AND DANIEL S. WILKS, JUNE 2002

Extreme-Value Climatology of Maximum Soil Freezing Depths in Contiguous United States

Arthur T. DeGaetano[1] and Daniel S. Wilks[2]

Abstract: Extreme-value statistics for the maximum depth of soil freezing are developed based on a physical soil freezing model and a semiphysical soil water budgeting scheme. The model uses only daily air temperature, snow depth, and precipitation data. These data are available from a relatively dense network of observing stations, permitting the development of a national climatology of extreme soil freezing levels. A set of adjustment factors is also presented that allows conversion between the mapped base-soil freezing depths and those associated with other soil conditions. Surface cover characteristics of bare soil with and without ambient snow cover and turf are analyzed. The deepest soil freezing levels within the United States are found across the Dakotas, where persistent subfreezing winter temperatures, and relatively little soil moisture and snow cover combine to maximize soil freezing. Ample winter snow cover mitigates soil freezing extremes in the Great Lakes, northern New England, and western mountains. Soil freezing is unlikely south of northern Florida and the immediate Gulf Coast, along the California coast, and in southern Arizona.

CE Database keywords: Climatology; Freezing; Soils; North Dakota; South Dakota.

Introduction

Extreme values of the maximum depth of soil freezing are of interest for engineering design specifications. Building codes must consider the maximum depth of frost penetration to ensure that footings and utilities are buried at the appropriate depths. If these specifications are too lax, freezing conditions may result in structural damage during the design lifetime of the building. Alternatively, codes that are too stringent inflate building costs unnecessarily due to increases in labor

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Note. Discussion open until November 1, 2002. Separate discussions must be submitted for individual papers. To extend the closing date by one month, a written request must be filed with the ASCE Managing Editor. The manuscript for this paper was submitted for review and possible publication on April 3, 2001; approved on September 18, 2001. This paper is part of the ***Journal of Cold Regions Engineering***, Vol. 16, No. 2, June 1, 2002.

and material costs. Despite this practical need, national climatologies of annual maximum soil freezing depth that appear in *Climate* (1941) and Sowers (1979) are generally antiquated or based on unofficial and/or undocumented measurements. Furthermore, these climatologies offer no information concerning the frequency of soil freezing extremes of different magnitudes, as they display only average or observed (inferred) maximum frost penetration depths.

More recently, Steurer (1996) presented a map of 100-year return period air freezing indexes (AFI), which can be used to derive empirical soil frost depth values. The AFI is based on the cumulative departure of the mean daily temperature above and below 0°C from July 1 through June 30. This value is tracked through the season, and the AFI is defined as the difference between the highest and lowest cumulative departures. However, these values neglect the effects of a changing winter snow cover, since they apply to static ground cover conditions. Steurer and Crandell (1995) show that this method of calculating AFI values is more representative of the freezing effect across the U.S. than two alternative Scandinavian methodologies.

Due to the lack of relevant climatological data, building codes concerned with soil freezing levels were often subjectively developed based on intuition, undocumented observations, and unrepresentative ground surface conditions. Although national building codes, such as those published by Building Officials and Code Administrators International, give detailed specifications for climate-dependent building codes such as roof snow loads and wind stress, the recommendation for footing depth is simply ‘‘below the local frost line.’’ The National Building Code of Canada is equally vague in its recommendation that footing depths be determined based on local experience. As a result, building codes often vary considerably across political boundaries. For instance, across the New York–Vermont border, local building codes for footing depths range from 1.83 m in Williston, Vt. to 1.21 m in Plattsburgh, N.Y., which is located 47 km to the west.

This disparity in regional building codes and the paucity of measured frost depth and soil temperature data led us to develop a one-dimensional heat flow model capable of estimating frost depths using only meteorological variables measured at Cooperative Observer Network weather stations (DeGaetano et al. 2001). This U.S. National Weather Service network is composed of volunteer observers who report daily values of temperature, precipitation, and snow depth. Since historical data from these sites extend from the late 19th century to the present, and given that approximately 8,000 stations are currently in operation nationwide, model-derived frost depths having a relatively high spatial resolution can be developed. Provided an adequate record of temperature and snow depth data (at least 30 years) is available, these values can then be used to produce extreme-value analyses for the maximum depth of soil freezing.

In the following section, we briefly reference several existing soil freezing models, before describing the model used to develop our climatology. We then discuss the data, statistical methods, and mapping procedures. A set of 10- and 100-year return period maps for the depth of annual maximum soil freezing are presented in the next section. These maps reflect surfaces characterized by bare soil and grass (with ambient snow cover) and snow-free bare soil conditions. Finally, we examine the sensitivity of our results to different soil characteristics.

Description of Model

Ironically, the lack of a national frost depth climatology does not stem from a paucity of soil freezing models. Numerous frost depth models of varying degrees of complexity have been described previously in the literature. Although highly accurate, the group of models described as physically based require detailed meteorological and soil data in addition to site-specific information concerning slope, aspect, and surface characteristics, which preclude their use on a national scale. Examples of such models are described by Flerchinger and Saxton (1989), Guymon et al. (1993), and Cary et al. (1978).

The more empirical models tend to require less detailed meteorological data. Perhaps the most widely used model of this type is the modified Berggren equation (Aldrich and Paynter 1953). Although Gel'fan (1989) shows that such equations provide fairly accurate maximum frost penetration estimates using commonly observed meteorological data, they are only useful for applications in which snow depth and soil moisture can be assumed constant. In temperate latitudes where snow covers are typically ephemeral, this assumption is unrealistic for most applications (except those related to paved surfaces from which snow is cleared); therefore, the usefulness of this and similar methods on a national scale is limited.

The model described by DeGaetano et al. (2001) [hereafter, the Northeast Regional Climate Center (NRCC) model] was designed as a compromise between the physical and empirical models. Thus, it incorporates the features of physically based models to the extent possible, given the limitations of meteorological measurements from a relatively dense network of stations. Although complete discussions of the model physics are given by DeGaetano et al. (1996, 2001), a brief outline of the model is included in the remainder of this section, since it provides the basis for this climatology.

The NRCC model is a one-dimensional heat flow model, similar to that described by Benoit and Mostaghimi (1985), with the theoretical basis that the process of soil freezing is driven primarily by thermal diffusion. Fig. 1 illustrates this principle. In this figure, depths below or above the soil surface are indicated by Z, and temperatures are indicated by T. Subscripts indicate snow (s), frozen soil (f), the soil surface (0), and the lower boundary (D). The subscript y refers to the value observed or estimated for the previous day. At the lower boundary, Z_D, which is set at a depth of 2 m, a daily ''deep'' temperature T_D is given as a function of the average air temperature over a period from the previous April through March of the current year, the 25th percentile January through March snow depth for the current year, and the combined thermal diffusivity of the snow and soil. Specifying T_D over the period from April through March ensured proper initialization of this boundary temperature prior to the start of the freezing season, while also accounting for the effects of the previous winter on the rate of summer warming. Because temperature data for the entire winter season are used to calculate deep temperatures on any day, the model is diagnostic rather than prognostic. The model assumes that the flux of heat through the lower boundary is negligible. In cases where the modeled soil freezing level extends beyond the

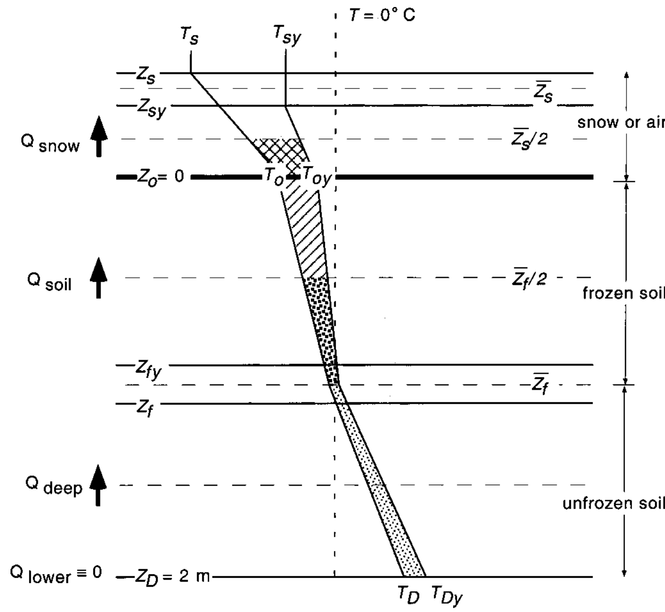

Fig. 1. Schematic diagram showing the Northeast Regional Climate Center model's frozen soil state (DeGaetano et al. 1996). Depths below or above the soil surface are indicated by Z and temperatures are indicated by T. Subscripts indicate snow (s), the soil surface (0), frozen soil (f), and the lower boundary (D). Subscript y refers to the value observed or estimated for the previous day. Heat fluxes through the centers of each layer are indicated by the bold arrows. The stippled and hatched areas represent the change in energy storage.

lower boundary, the depth of the soil profile is increased by 0.5 m and the soil freezing level is recomputed.

The upper boundary condition is given by the observed average daily air temperature. Here, the assumption is made that the average daily air temperature is representative of the temperature of the snow surface. The snow depth (Z_s) gives the thickness of the first layer in the snow/soil system (Fig. 1). In the absence of snow cover, the air temperature is assumed to equal the temperature at the upper surface of a 1.0×10^{-3} m laminar layer, the thermal properties of which are characteristic of still air. The incorporation of a laminar layer with an empirically specified depth into the model provided a more physically realistic alternative to the n-factors used by Aldrich and Paynter (1953). Progressing downward, soil layers of variable depth are defined by frozen and unfrozen zones, the boundaries of which are at 0°C (Fig. 1). A maximum of three soil layers (one frozen and two unfrozen) is allowed by the model.

Temperature gradients through each layer are assumed to be linear, and thus the heat fluxes at the middle of each layer, Q_x, are defined by the differences between the temperatures of the layer boundaries. Imbalances between the resulting vertical heat fluxes (i.e., heat flux convergence or divergence) are rectified through internal temperature changes and, when these changes cross 0°C, freezing or thawing of an appropriate depth of soil. In this process, the fluxes are balanced by accounting for the heat capacities of soil solids and soil water, and for the latent heat of fusion. Only one of three possible soil-freezing states is illustrated in Fig. 1. In this state, a layer of frozen soil extends from the surface to some depth, Z_f. The other possible states are that the soil may remain unfrozen from the surface to the lower boundary, Z_D, or that a layer of frozen soil may exist between two layers of unfrozen soil.

The model is initiated in the unfrozen state and continues in this manner until T_0 falls below 0°C. At this point, the transition to the frozen soil mode is activated. Provided the temperature remains below 0°C on subsequent days, the model operates in the frozen soil mode. In this state, both soil freezing and thawing occur at the bottom of the frozen layer. When T_0 exceeds 0°C, the model transitions to either the unfrozen or the surface thaw state. In the surface thaw state, a buried layer of frozen soil exists between unfrozen layers near the surface and above the lower model boundary. The layer of frozen soil is allowed to thaw from both its top and bottom. However, for simplicity, the temperature throughout the buried frozen layer is assumed to be a constant 0°C. For subsequent occurrences of $T_0 < 0°C$, freezing occurs at both the top and the bottom of the buried frozen layer.

Unlike other physical soil freezing models, the NRCC model ignores freeze-induced water migration to the freezing front. DeGaetano et al. (2001) show that this omission has little consequence within dry (<15% volumetric content) soil moisture profiles. Hydraulic conductivity is small at these water contents, and thus water movement is negligible at the hydraulic gradients normally encountered in the soil system. At higher water contents, water redistribution occurs more readily as hydraulic conductivity increases, allowing water to move more freely within the soil profile. Yet, under near-saturated conditions, correspondence between the NRCC model derived and observed soil freezing depths is exceptional (DeGaetano et al. 1996, 1997, 2001). It is possible that the absence of water migration in the NRCC model is offset by the assumption of complete soil water freezing at 0°C. Regardless, the necessity of describing the physical processes based on the available meteorological and soil data precluded the use of more complex model physics.

Although the migration of soil water can be ignored, DeGaetano et al. (2001) found that the quantity of soil moisture held within the soil profile has a significant effect on frost penetration through its influence on thermal conductivity and diffusivity and available latent heat. This requires that a soil water budgeting scheme be coupled with the soil freezing model.

As with soil freezing, a number of soil moisture models are described in the literature. However, few are consistent with the data constraints of the national climatological observation network. This limitation dictated the use of the methods of Palmer (1965) and Thornthwaite (1948) to compute the volumetric water content on the scale of climate divisions (Guttmann and Quayle 1996). Each state is divided into from one (Rhode Island) to 10 (at most) climate divisions, with divisions generally representing drainage basins or crop-reporting districts. For each division, an average soil profile is defined by two layers, with layers defined by their capacity to hold water rather than by depth. The top layer (*SS*) contains at most 2.5 cm of soil water, with the remaining soil water, which varies by division (Karl 1983), contained in the lower (*SU*) layer. Water first enters the top layer, which must fill to field capacity before any water infiltrates into *SU*. Monthly precipitation totals for climate divisions are the source of water input to the budget. These totals represent the average precipitation received at all reporting sites within a climate division. Climate division precipitation totals are updated operationally on a monthly basis and are archived starting in 1895.

Monthly evapotranspiration totals for climate divisions are obtained using the method of Thornthwaite (1948). This empirical procedure assumes a direct relationship between monthly average temperature and incoming solar radiation. Evapotranspiration is assumed to be negligible at $\overline{T}<0°\mathrm{C}$, and is set at the maximum potential rate when $\overline{T}>26.5°\mathrm{C}$ (Sellers 1965). At intermediate temperatures, monthly potential evapotranspiration, ET_p, is simply a function of monthly average temperature (Rosenberg 1974). DeGaetano et al. (2001) give a detailed account of Thornthwaite's *ET* method.

Based on these values of *ET* and precipitation, soil moisture recharge occurs when precipitation exceeds *ET*, with the new soil moisture simply expressed as the sum of the previous month's moisture content and the difference $(P-ET)$. When recharge exceeds the soils' capacity for holding water, any excess water is lost as runoff. Although this ignores the influence of the infiltration rate on runoff, this omission was dictated by data limitations at the national scale.

In months having $ET>$precipitation, water loss from *SS* is the smaller of the water held in *SS* or the difference $(ET-P)$. If $(ET-P)$ exceeds the water available in *SS*, the residual loss occurs from the *SU* layer at a rate proportional to S_{SU-1}/AWC, where S_{SU-1} is the amount of water present in the underlying layer during the previous month and *AWC* is the specified water capacity of the *SU* layer. In all cases, precipitation falling during months with an average temperature of $\overline{T}<0°\mathrm{C}$ is assumed to be frozen, and thus is not available for soil moisture recharge. This moisture is held in storage through the winter and becomes available during the month, *i*, in which the average of $\overline{T}_i$ and $\overline{T}_{i-1}$ exceeds 0°C.

Since detailed soil moisture profile data are unavailable nationally, water is assumed to be evenly distributed through the soil horizon; the volumetric water content, *q*, can be expressed by

$$q=[(S_{SS}+S_{SU})/AWC]\times 100\%;\quad 0<q\leq FC \tag{1}$$

where S_{SS} and $S_{SU}=$water storage in the surface and underlying layers during a given month, respectively. In near-saturation conditions, the soil usually drains quickly to field capacity (*FC*). Thus, this value, which can be obtained from U.S. Dept. of Agriculture (USDA) soil surveys, is used as an upper limit for *q*.

Use of the Palmer soil water budget requires information concerning the previous month's soil moisture storage. This is problematic when initializing the budget. To address this issue, an iterative scheme was developed to search through the precipitation and evapotranspiration data for the earliest month when

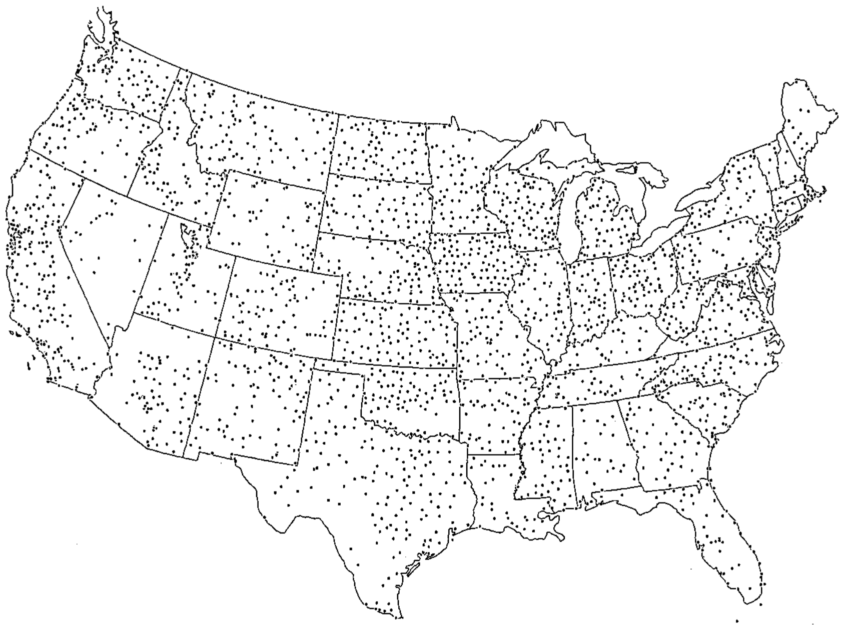

Fig. 2. Locations of climatological stations with sufficient data to calculate maximum soil freezing depth return periods

precipitation exceeded the sum of the available water capacity and monthly evapotranspiration. The budget could then be initialized at *AWC* during this month. When a single month meeting this criterion could not be identified, the search and initialization procedure were applied using two- or three-month precipitation and evapotranspiration totals. In all climate divisions, the water budget was initialized prior to 1930.

The use of the Palmer and Thornthwaite routines restricts changes in soil water content to a monthly time interval. Thus, soil moisture changes occur on the first day of each month, and are further restricted to months during which the average temperature exceeds 0°C. These changes are reflected in the model algorithms through a discrete change in soil thermal conductivity and the potential latent heat release per unit volume of soil. Thermal conductivity changes are given by a set of empirical equations given by Campbell (1985).

Maximum Frost Depth Climatology

Data

The NRCC model was used to calculate annual maximum frost depths for a set of 3,562 U.S. Cooperative Network stations (Fig. 2). All data were required to pass

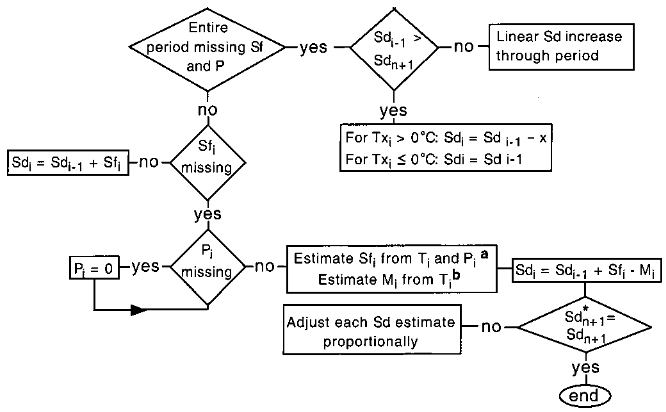

Fig. 3. Flow diagram for estimating snow depth. Snowfall, snow depth, liquid precipitation, and melt are given by *Sf*, *Sd*, *P*, and *M*, respectively. The first day of the missing data period is given by *i* and the last day, by *n*. Sd^*_{n+1} denotes an estimate of the first nonmissing snow depth. Superscripts *a* and *b* refer to ''Surface'' (1996) and the three degree-day melting models, respectively.

the quality-control procedure of Robinson (1993). Missing and suspect temperature values were estimated using the techniques of DeGaetano et al. (1995), providing a serially complete temperature database for the period of 1951–1997. Missing snow depth and precipitation data were estimated on a case-by-case basis, depending on the length of the missing data period and the availability of other variables during the missing period, and the previous and subsequent observed values. The set of monthly climate division precipitation and temperature data used to specify soil moisture is free of missing values.

In all cases missing precipitation, snowfall and snow depth data were set to zero from May through October. Outside of this period when the last nonmissing or estimated snow depth observation was zero, snow depth was also set to zero on days in which the average temperature exceeded 0°C or no precipitation was reported. Station-specific precipitation and snowfall data were necessary only to estimate snow density, not to specify soil moisture. Thus, missing values of these variables could be ignored on days when the observed or estimated snow cover was zero.

Any remaining missing snow depth observations were estimated based on the observations bracketing the missing period, and any observed precipitation and/or snowfall data during the missing period. An average of the two bracketing observations was used as an estimate during one-day missing periods. If the length of the missing snow depth period was between two and 15 days, the values were estimated using the procedure outlined in Fig. 3. Annual maximum frost depth values were not calculated in years in which a >15-day missing data period existed, excluding those in which the snow depth could be set to zero. When daily liquid precipitation observations, but not snowfall data, were available for a spe-

Table 1. Errors (cm) Associated with Estimating Snow Depth for Missing Data Runs of Various Lengths (days)

Length of missing period	Average error	Median error	Average absolute error	Standard deviation
1	0.25	0.00	2.03	3.81
2	0.51	0.00	2.03	3.81
4	0.76	0.00	2.54	5.84
8	1.02	0.25	3.81	6.96
15	1.52	0.76	4.58	8.00
20	0.72	0.76	6.10	12.93

cific missing snow depth period, daily snowfall was inferred based on the temperature-dependent relationship for new snow density given by the National Oceanic and Atmospheric Administration (''Surface'' 1996). Reductions in snow depth during these periods due to melting and subsequent runoff were estimated using the average of three degree-day based approaches (Bruce and Clark 1966; Carr 1988).

The choice of a 15-day limit for estimation was a compromise between minimizing the amount of missing data and the accuracy of the snow depth estimates. In general, the number of years excluded from the study reached a plateau as the length of the missing data period increased beyond 15 days. Furthermore, based on January data (1951–1997) from four sites (Ithaca, N.Y.; Decatur, Ill.; Minot, N.D.; and Pendleton, Ore.), estimation accuracy and variability became unreasonably large for periods exceeding 15 days (Table 1).

Computation of Return Periods

Smoothing and extrapolation of the modeled annual maximum frost depth data for all stations were accomplished by fitting Gumbel distributions (Gumbel 1941). In addition to it being analytically integrable, DeGaetano et al. (1997) showed that the Gumbel distribution was superior to 10 other candidate distributions, based on its ability to extrapolate the extreme right tail of the observed annual maximum frost depth distributions. Separate distributions are fit to the data for each station by maximum likelihood.

Gumbel probabilities can be obtained using

$$F(x) = \Pr\{X \leqslant x\} = \int_0^x f(x)\,dx = \exp\left\{-\exp\left[-\frac{(x-\xi)}{\beta}\right]\right\} \qquad (2)$$

where x = random variable (in this case, annual maximum frost depths); and parameters ξ and β = location and scale parameters, respectively (Wilks 1995). Average return periods, R, relate to cumulative probabilities, F, of the distributions of annual maximum data according to

$$R = \frac{1}{\omega[1 - F(x)]} \qquad (3)$$

where ω = average sampling frequency—in this case, 1 year^{-1}. Frost depths, x, corresponding to specified return intervals are obtained by solving Eq. (2) for x and substituting the expression $F(x) = 1 - 1/R$, obtained by the rearrangement of Eq. (3).

Return Period Mapping

Automated mapping of the station-specific soil freezing extremes required the interpolation of these values to a grid. Two methods were qualitatively evaluated for this purpose. A 15-min grid spacing was used for the initial mapping comparison based on the availability of digital elevation data at this resolution, and to facilitate the more complex interpolation analysis. The first relatively simple approach followed the methods of Cressman (1959). This method begins by setting the value at each grid point to the arithmetic average of all observations contained within a 10 grid unit radius. Four passes are then made through the grid at radii of 7, 4, 2, and 1 grid units. For each pass, the value at each grid was adjusted based on a distance weighted average of stations within the new radius.

The second, more complex, interpolation used *ANUSPLIN* version 4.1 (Hutchinson 2000). This method allows interpolation of noisy multivariate data using thin plate smoothing splines (Hutchinson and Gessler 1994). In the present case, trivariate (latitude, longitude, and elevation) splines were fit to the station-specific annual maximum frost depth values.

These two methods produced nearly identical interpolations across the country at 15-, 30-, and 60-min resolutions. Given this conformity, the national soil freezing maps presented in Figs. 4–6 are based on the Cressman method at 1° resolution. Despite the similarity between methods, the sparsity of data from sites in the mountainous regions of the western U.S. potentially introduces biases to the mapped frost depth values in this region. The magnitude and sign of these potential biases are difficult to quantify, due to the opposing effects of colder temperatures and deeper, more persistent snow cover that are likely at high elevations. To some degree, these factors counteract each other, probably mitigating elevation-induced biases. Presumably, this contributes to the similarity of the elevation and nonelevation dependent interpolations. Nonetheless, within the shaded region of Figs. 4–6, which depicts the area characterized by sharp ($>$125 m deg^{-1}) spatial elevation gradients, the interpolated soil freezing levels should be used with care. Similar regions are also present in the extreme southern (West Virginia through northern Georgia) and northern (northern New England) Appalachians. However, here elevation gradients are generally less steep and station density is somewhat higher.

Spatial Comparison of Maximum Freezing Depths

Figs. 4 and 5 show the 10- and 100-year return periods for the maximum annual frost depth under bare soil and turf, respectively. These two cases also reflect ambient snow cover conditions. In Fig. 6, these maps are shown for snow-free bare soil conditions. Maps depicting other return periods are available from the writers.

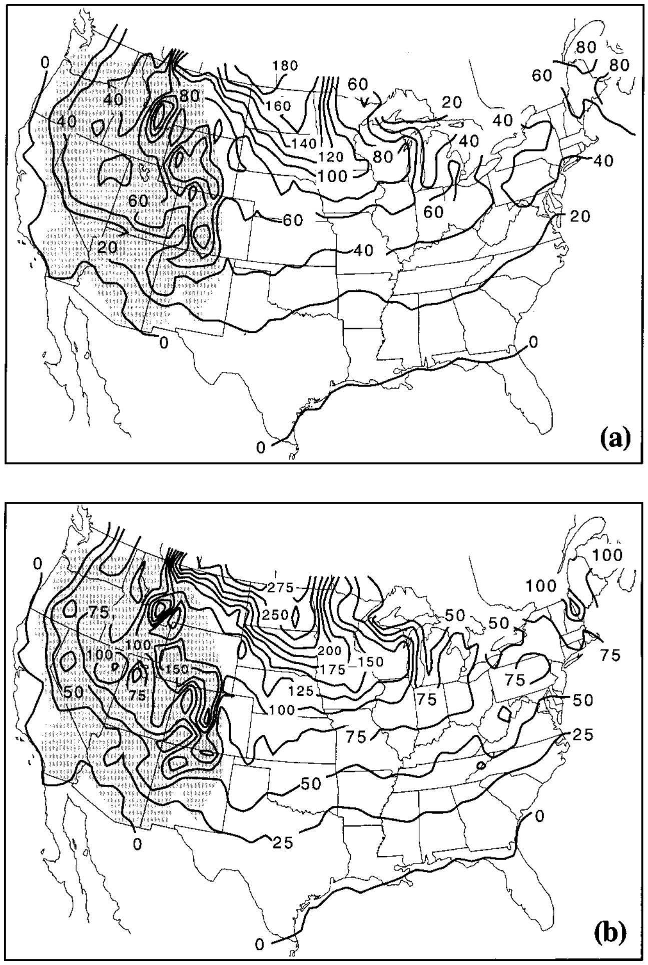

Fig. 4. Maps of: (a) 10-year; and (b) 100-year return period maximum annual soil freezing depths (cm) under bare soil with ambient snow cover. Marked variations in soil freezing are likely within the shaded regions due to large spatial gradients in elevation.

Across the contiguous U.S., the deepest annual maximum frost depths consistently occur across the Northern Plains. Along the North Dakota–Montana border, 100-year return period frost depths under bare soil with ambient snow cover exceed 250 cm. East of the Rocky Mountains, frost depths generally decrease steadily as latitude decreases, reaching zero along the Gulf Coast for all return periods. At a given latitude east of the Appalachian Mountains, frost depths tend to be shallower than those found over the midsection of the country. Modification of maximum frost depths is also apparent along the southern and eastern shores

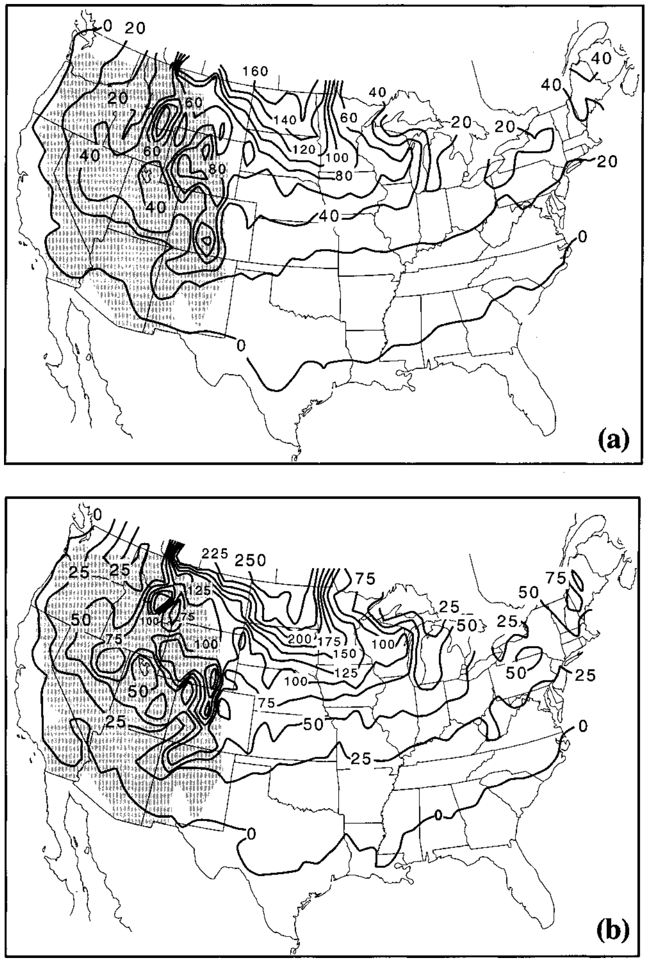

Fig. 5. As in Fig. 4, but for turf-covered surface with ambient snow cover

of the Great Lakes. Examination of Fig. 6 shows that the pattern around the Great Lakes can be attributed to enhanced and persistent winter snow cover, as the contours for snow-free conditions do not exhibit an analogous pattern. Orographic temperature and snow cover effects are also apparent in northern New England and to the south in eastern West Virginia.

Along and to the west of the Rocky Mountains, the contours of annual maximum frost depth fail to show a consistent spatial pattern. Rather, the influence of elevation (both on snow cover and air temperature) dominates the configuration of the contours. In this region, microclimatic and orographic effects result in sharp spatial gradients in the annual maximum frost depth. This precludes the precise mapping of frost depth return periods on a national scale in the shaded

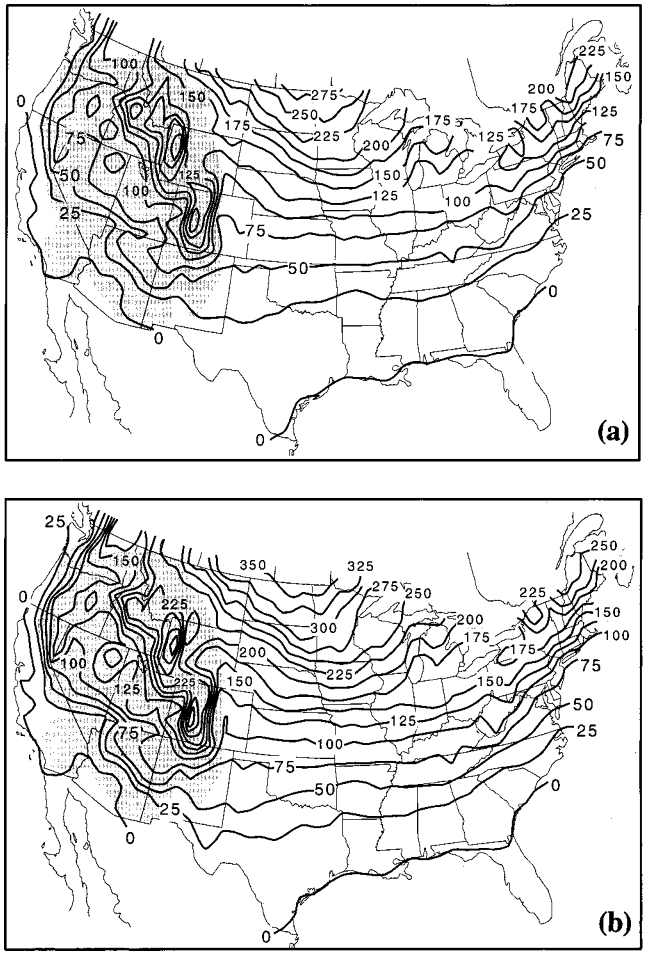

Fig. 6. As in Fig. 4, but for snow-free bare soil

area of Figs. 4–6. Nonetheless, given the validation of the NRCC frost depth model using data from this area, reliable station-specific soil freezing extremes can be obtained from the NRCC for sites in the intermountain west. Farther west, maximum soil freezing depths for all return periods reach zero along the Pacific Coast from central Oregon to southern California. This area of frost-free conditions extends inland over the San Joaquin Valley of central California and through southeastern California and most of southern Arizona.

Under turf (and ambient snow cover), the pattern of maximum soil freezing contours is similar to that for bare soil. However, the turf moderates the maximum depth of soil freezing by approximately 25 cm. This reduction in soil freezing depth is generally independent of the depth of frost penetration under bare soil. For instance, the 100-year return period frost depth under turf is reduced by a similar amount in North Dakota (250 versus 275 cm) and North Carolina (0 versus 25 cm).

The pattern (and, to some extent, magnitude) of soil freezing depths shown in Figs. 4–6 coincides with that of the previous soil freezing climatologies. The pattern of frost penetration depths presented by Sowers (1979) aligns quite well with the snow-free maps in Fig. 6. In both climatologies, the axes of deepest frost penetration extend through Minnesota and separately across western Wyoming and Colorado. A sharp north-south gradient in soil freezing depth is also depicted across the Midwest, extending east through Pennsylvania in both cases. The two climatologies also show an east-west soil freezing gradient along the Pacific Coast and a more subtle modification of soil freezing extremes along the Atlantic Coast. These features are also grossly replicated by the USDA map (*Climate* 1941).

Unfortunately, it is difficult to compare the climatologies based on the magnitude of soil freezing. The frost depths given by Sowers (1979) and the USDA (*Climate* 1941) are not expressed as return periods, but rather as an unqualified ''maximum'' in the case of Sowers and as an average depth in the USDA publication. Assuming snow-free conditions (as snow induced modification around the lake is not apparent), the magnitude of the contours presented in Sowers' map agrees with our 10- or 25-year return period values. The average values from the USDA (*Climate* 1941) agree favorably with our two-year (i.e., median of annual maxima) return period estimates.

Comparison of the 100-year soil freezing depth map [Fig. 6(b)] and the map of the 100-year AFI also shows several consistencies (Steurer 1996). In both cases, local maxima are found in northeastern North Dakota, western Wyoming, and south-central Colorado. In the East, minor maxima are located in northeastern and southwestern New York (coinciding with the Adirondack Mountains and the Allegheny Plateau). The frost depth and air freezing index contours also show a similar trough along the southern Appalachians. The zero contours (both frost depth and air freezing index) follow a similar path in Arizona and along the West Coast, but they diverge somewhat in the East. Here, the zero line for frost depth runs along the northern Florida border, while the corresponding air freezing index is displaced farther south. This is possibly related to the Steurer (1996) finding that the Gumbel distribution underestimated the AFI in warmer climates. A similar bias was not noted by DeGaetano et al. (1997) for the annual maximum soil freezing depth.

Despite these consistencies, Fig. 7 shows that the ratios of 100-year frost depths calculated using the AFI values as input to the Berggren equation to the depths given by the NRCC model with snow cover set to zero are consistently less than 1.0. On average, the AFI values are 73% of those given by the NRCC model across the range of 100-year AFI values experienced in the continental U.S. Although an n-factor equal to one (i.e., a value representative of snow cover) was used in the Berggren computations, the AFI-derived frost depths are consistently deeper than the NRCC modeled frost depths under ambient snow conditions (Fig. 7). At Burlington, Vt. and Duluth, Minn., the AFI-derived depths are almost double those given by the NRCC model. Thus, it appears that the AFI

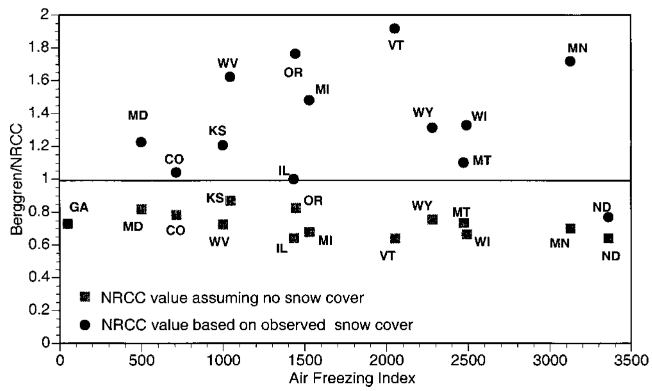

Fig. 7. Comparison of the ratios of 100-year return interval frost depths based on the Northeast Regional Climate Center (NRCC) model and modified Berggren equation values. The gray squares show the ratios based on NRCC model runs with snow cover set to zero. Observed snow cover is used in the cases shown by the black circles. Two-letter postal codes are used as a reference for station location.

estimates of soil freezing do not adequately capture the variations in soil freezing depth that result from ephemeral snow cover during the soil freezing season.

A final comparison of a modeled and observed soil freezing climatology is possible for Illinois. Wendland (1998) shows the maximum observed January frost depths for the period of 1980–1996 [Fig. 8(a)]. In his map, a pocket of 75 cm depths is centered on north-central Illinois. To the south, the reported soil

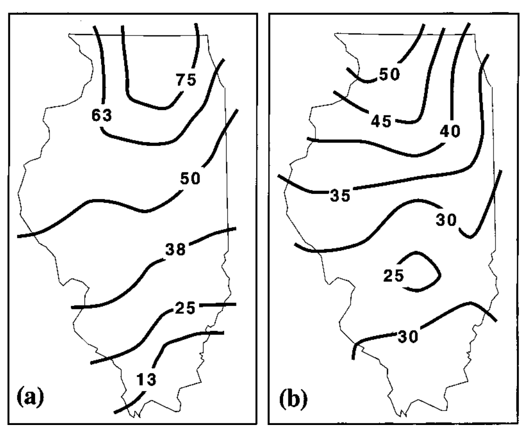

Fig. 8. Maximum frost depth (cm) during January for the period 1980–1996 based on: (a) cemetery observations given by Wendland (1998) and (b) Northeast Regional Climate Center (NRCC) model estimates.

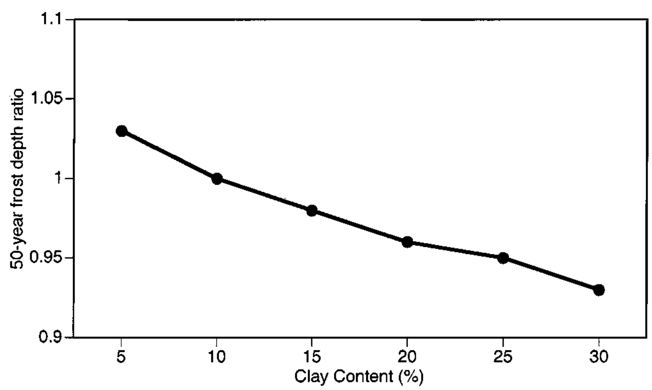

Fig. 9. Ratio of 50-return period soil freezing depths for various clay contents to that based on the standard clay content of 10%. In all cases a soil porosity of 0.45 and 30% field capacity are assumed.

freezing levels decrease from 50 cm in the Chicago area to less than 25 cm at the southern tip of the state. The modeled maxima for these years exhibit an analogous pattern in the north [Fig. 8(b)]. However, assuming a turf-covered surface to coincide with Wendland's cemetery data, the model values are shallower than the observed frost depths by almost 30%. Even when bare soil conditions are modeled, the observations exceed the modeled values by about 5%. Across southern Illinois, the patterns diverge. Although 25 cm frost depths occur in similar regions in the two climatologies, the modeled depths are much deeper in the southernmost part of the state. It is likely that these variations result from differences in the observing network, site exposures, and uncertainties as to the quality and precision of the cemetery data.

Sensitivity to Soil Characteristics

The frost depths shown in Figs. 4–6 depict conditions for soils having 10% clay content, 45% porosity, and 30% volumetric field capacity. This base case is characteristic of a medium textured loam, in which nonclay particles are assumed to be quartz based. The effect of differing clay contents, field capacities, and porosities was evaluated using a set of 401 stations, at which at least 40 annual maximum soil freezing depths could be modeled. This subset of stations was representative of the geographic distribution of the 3,562 original sites and encompassed the range of modeled soil freezing extremes. At each site, frost depths corresponding to the 2-, 5-, 10-, 25-, 50-, and 100-year return intervals were calculated for clay contents ranging from 5 to 30%. Similarly, frost depths were computed for different physically realistic combinations of porosity (25–55%) and field capacities (15–45%).

Fig. 9 shows that modification of the clay content had little effect on the depth

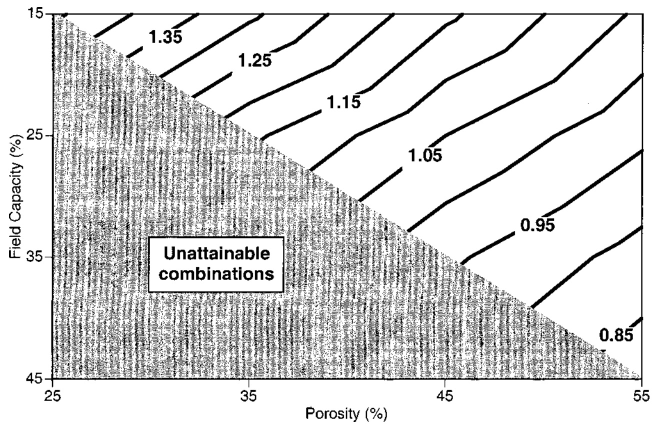

Fig. 10. Contour graph showing the ratio of the maximum frost depth using various combinations of porosity and field capacity to that for the standard of 0.45 porosity and 30% field capacity. A clay content of 10% is assumed in all cases.

of soil freezing. In general, the difference in the maximum soil freezing depth between the standard (10% clay content) and the highest clay content was less than 7%. These small differences can be attributed to a lower thermal conductivity for clay in relation to quartz-based soil particles (0.25 versus 0.30 $W\,m^{-1}K^{-1}$). More pronounced differences were associated with the changes in porosity and field capacity (Fig. 10). Frost depths increase in an approximately linear fashion as the soil becomes more compacted or better drained (i.e., as porosity and field capacity decrease). Thus, adjustment factors can also be computed using the equation

$$A = 1.86 + -1.2\varepsilon + -0.88FC \tag{4}$$

where ε = soil porosity; and FC = field capacity. At an extreme 15% field capacity and 25% porosity, soil freezing depths are over 40% higher than in the base case. Decreases in frost depth are experienced as the porosity and field capacity increase. These changes result from a decrease in the thermal conductivity of air as opposed to soil particles (in the case of porosity) and an increase in the maximum latent heat flux in soils with higher field capacities. In the most extreme case (55% porosity and 45% field capacity), the maximum soil freezing depths decrease by almost 20%.

The adjustments shown in Fig. 10 exhibit minimal variation with freezing depth. Hence, the curves are applicable to all return periods and geographic locations. Fig. 11 shows geographic variations in the adjustment factor for a soil characterized by a porosity of 35% and a 25% field capacity. Averaged over the 401 stations, this adjustment factor equals 1.16. Among the individual stations, this value varies between 1.09 and 1.22, with little consistent geographic bias.

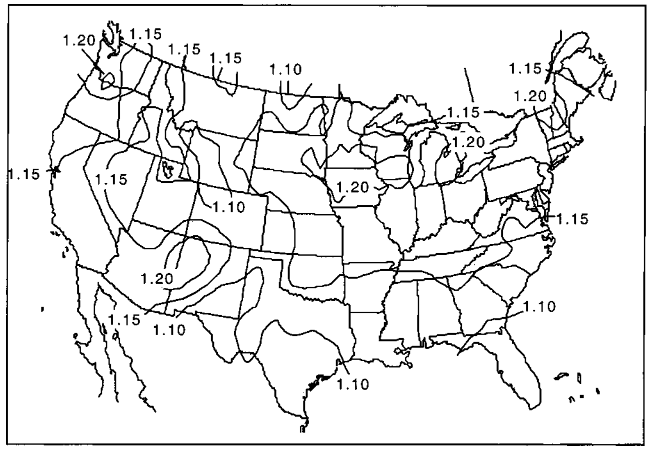

Fig. 11. Spatial distribution of ratios associated with 0.35 soil porosity and 25% field capacity used to compile Fig. 10

Summary

Measured soil freezing depths are not available at a network of stations that is sufficiently dense for most climatological applications. Therefore, a soil freezing model capable of estimating annual maximum soil freezing depths accurately using only those meteorological variables measured by the relatively dense cooperative observer network was used to develop an extreme-value climatology of annual maximum frost depths in the contiguous United States. Based on prior research, the Gumbel distribution was selected as the most appropriate probability distribution function to use in extrapolating modeled maximum frost depths.

East of the Rocky Mountains, extreme soil freezing depths generally decrease with decreasing latitude. At a given latitude, soil freezing extremes tend to be shallower to the east of the Appalachian Mountains. Soil freezing extremes are influenced by snow cover in the Great Lakes region. The insulating effect of snow cover is reflected by markedly shallower soil freezing at stations near the lake shores. To some extent, the effect of increased snow cover is also apparent in the northern Plains, as frost depths along a given latitude decrease from west to east across North Dakota and Minnesota. Mean annual snowfall nearly doubles from western North Dakota to central Minnesota.

In the mountains of the western United States, soil freezing extremes exhibit large spatial variations due to the effects of elevation on temperature and snow cover. It is hard to characterize the relationship between soil freezing depth and elevation. In more arid regions, deeper frost penetration is experienced at higher elevations, since the effects of colder temperatures dominate. On the wetter western peaks, soil freezing levels often become shallower with increased elevation, as increases in snow cover mitigate the reduction in temperature with elevation. In the Pacific Coast states, a sharp gradient of soil freezing extremes exists between the coast and western mountains. In northern California, 100-year return period frost depths increase from zero along the coast to over 125 cm in the eastern mountains under snow-free conditions.

Snow cover is the likely cause of this spatial pattern of maximum frost depth in the northern part of the domain. In the snow-free cases (Fig. 6), there is an overall pattern of increasing maximum frost depth with increasing latitude, similar to that which Steurer (1996) shows for the air freezing index. Shallower frost depths are also noted along the coast, and to some extent along the Great Lakes shores. This demonstrates the insulating ability of persistent snow cover, in that the presence of snow cover is associated with markedly shallower maximum frost depths, particularly over northern parts of the region. The opposing effects of colder temperatures (as inferred from latitude) and deeper, more persistent snow cover probably diminish elevation-induced biases in the mapped soil freezing depth fields.

The maximum soil freezing depth information contained in Figs. 4–6 along with supplemental maps depicting the 2-, 5-, 25-, and 50-year return periods that are available from the writers provide scientific guidance for the establishment of building codes concerning the burial depth for foundations and freeze-sensitive utilities. Use of these estimates in combination with knowledge of the statistical and microclimatic assumptions employed in their derivation provides a sound basis for the reevaluation of existing building codes, which are often based on intuition or nonrepresentative observations. Provided site-specific design details (particularly those pertaining to local snow accumulation) are considered, potential decreases in recommended foundation depths could result in reduced building costs, due to decreases in labor and material costs, with little increase in the risk of structural damage over the useful lifetime of the building.

Acknowledgments

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ATTACHMENT B

FREEZE-THAW CYCLING AND COLD TEMPERATURE EFFECTS ON GEOMEMBRANE SHEETS AND SEAMS
BY U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, MARCH 1996

R-96-03

FREEZE-THAW CYCLING AND COLD TEMPERATURE EFFECTS ON GEOMEMBRANE SHEETS AND SEAMS

Prepared in Cooperation with
U.S. Environmental Protection Agency
National Risk Management Research Laboratory

Under
Interagency Agreement EPA Reference No. DW14936139-01-0

March 1996

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
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UNITED STATES DEPARTMENT OF THE INTERIOR ★ BUREAU OF RECLAMATION

INTRODUCTION

Geomembranes are widely used in the construction, protection, and rehabilitation of dams and other water conveyance structures. Geomembranes are also used in waste storage and disposal facilities. An area of common concern for Reclamation (Bureau of Reclamation) and the EPA (Environmental Protection Agency) is the behavior of geomembranes when subjected to freeze-thaw cycles in cold climate conditions.

Geomembranes are widely used as barrier materials for seepage control in dam and canal rehabilitation. Geomembranes have also been used for protection against erosion on the upstream face of embankment dams, erosion caused by overtopping of existing dams, and erosion occurring in emergency spillway applications.

To reduce detrimental impacts on water users, geomembrane installations are typically performed in the fall and winter when water demands are at a minimum level. Unfortunately, this timing results in the direct exposure of the material to cold temperature extremes and an increased susceptibility to damage during installation. Additionally, in applications like seepage control for dams and canals, geomembranes either have been buried with minimal earth cover or left exposed to the ambient environment. For the covered case, Reclamation requires a protective layer of 300 to 450 mm (12 to 18 in) of cover soil to protect the geomembrane from damage caused by animal traffic, vandalism, and ultraviolet radiation. The soil is not designed for frost penetration protection. Thus, geomembranes in both covered and exposed situations are subjected to a wide variety of freeze-thaw cycles.

Insofar as environmental applications, geomembranes are used in landfill caps and surface impoundments. In freezing climates, the geomembranes will experience freeze-thaw cycles unless the depth of cover soil is greater than the maximum frost penetration depth, which ranges from 0 to 3.0 m (10 ft) in the continental United States. As with canals, geomembranes in surface impoundments are often left uncovered or with only a thin veneer of cover soil.

As stated above, geomembranes will be subjected to freeze-thaw cycles in many situations. However, the impact of such cyclic temperature effects on the long-term behavior of geomembranes is largely unknown. In this research project, the effects of freeze-thaw cycling on the tensile behavior of 19 different types of geomembrane sheets and 31 combinations of seams were investigated. The study consisted of four parts using different experimental conditions:

Part I — Incubating unconstrained geomembrane sheet and seam specimens to freeze-thaw cycles between -20 °C and +20 °C and then performing tensile tests at +20 °C. The maximum number of cycles was 200.

Part II — Incubating unconstrained geomembrane sheet and seam specimens to freeze-thaw cycles between -20 °C and +20 °C and then performing tensile tests at -20 °C. The maximum number of cycles was 200.

Part III — Incubating constrained geomembrane sheet and seam specimens to freeze-thaw cycles between -20 °C and +30 °C and then performing tensile tests at +20 °C. The maximum number of the cycles was 500.

Part IV Evaluating the tensile induced cyclic stress acting on the constrained geomembrane sheet and seam specimens while the incubation temperature changed from -20 °C to +30 °C under the Part III experimental conditions.

The tensile test data were analyzed graphically by plotting percent change of tensile strength and elongation from the incubated material versus the number of freeze-thaw cycles.

CONCLUSIONS

For the effects of freeze-thaw cycles on geomembrane sheets and seams, test results showed no statistically significant change in any of the tested materials in Parts I, II, and III of the study.

The cold temperature induced tensile stress of constrained tested specimens was evaluated in Part IV of the study. The magnitude of the induced stress was the same for each polymer type regardless of the thickness, surface features, and seam types. The repeatability of the induced stress suggested that the constrained specimens in Part III of the study were subjected to the same magnitude of stress in each cold cycle of the freeze-thaw cycling.

Thus, tested specimens in Part III were exposed to both freeze-thaw cycling and thermally induced cyclic stresses. The tensile behavior of the geomembrane sheets and seams was not affected in a statistically significant manner after 500 cycles.

The effects of cold temperature testing were investigated by comparing Part II to Part I of the study. As anticipated, the strength of sheet and seam specimens increased and the elongation decreased.

The impact of cold temperature induced cyclic stress on the constrained geomembrane sheets and seams was examined by comparing Part III to Part I. No statistically significant difference existed between the two sets of data.

The general conclusion of the various parts of this study is that currently available geomembranes and their respective seaming methods are not sensitive to freeze-thaw cycling under constrained and unconstrained conditions within the limits of this study. However, as anticipated, a gradual stiffening of the geomembrane materials will occur with decreasing temperature. Thus, the cold temperature tensile behavior should be evaluated if the material is used in a sub-ambient environment.

LITERATURE REVIEW

The study of cold temperature effects on geomembranes (and their seams) can be considered in two different categories. The first is the sustained cold temperature effect on the stress/strain properties of the materials. Several studies are available on this topic. The second is the effect of freeze-thaw cycling on the subsequent stress/strain properties of the material. Only a few studies are available on this topic. Most of the studies in these two categories have been conducted on geomembranes that are no longer currently available. Thus, the data are of limited value but will nevertheless be reviewed so as to gain perspective for the work to follow.

Early Canadian Studies

In the 1970s, petroleum companies began investigating the possibility of using geomembranes in the construction of the spill containment areas and dike walls in northern Canada. At some sites where geomembranes were installed, the Canadian EPS (Environmental Protection Service) performed inspections. A report by Thornton and Blackall (1976) describes their concerns for geomembranes in cold regions.

Seven sites were investigated in the Mackenzie Delta (a section of the Canadian Western Arctic) where geomembranes had been installed by four different companies. Two main concerns were expressed for geomembranes used in such applications. The importance of cushioning material above and below geomembranes to prevent puncturing was discussed. The authors also noted that this cushion is less important for materials with high puncture resistance. They then discussed the ductile-brittle transition temperature of geomembranes. For fall, winter, and spring geomembrane installations (as are most Reclamation installations), they recommended using materials with "good" low temperature ductility. They pointed out that for oil resistant PVC geomembranes, the ductile to brittle transition temperature was -18 °C in the laboratory, but the same material showed brittle fractures at 5 °C in the field. They surmised that this apparent upward shift in the ductile-brittle transition temperature was caused by tensile strain imposed on the liner in its field application.

Of the seven sites inspected by EPS in the Thornton and Blackall (1976) report, only one used a type of geomembrane that is currently available. They evaluated a 0.25-mm (10-mil) thick polyethylene liner that was placed over a gravel base. A 900-mm (35-in) thick cushion of polyurethane foam was placed between the liner and the base. A fine gravel cover was placed directly over the geomembrane. Upon inspection, this site showed no punctures or other damage to the relatively thin geomembrane.

Effects of Sustained Cold Temperatures on Geomembranes

Rollin et al. (1984) conducted a study to evaluate different geomembranes for use in dams and dikes in northern climates. They determined that geomembranes in the field could be exposed to a temperature variation of 23 °C to -35 °C. The geomembranes would be exposed to subfreezing temperatures throughout the winter and to freeze-thaw cycles during fall and spring. Laboratory testing was conducted on 21 types of geomembranes at 23 °C, -5 °C, -15 °C, -25 °C, and -35 °C. The types of geomembranes that were tested included elastomers, bitumens, and thermoplastics. The incubated geomembranes were evaluated for tensile and burst strength, puncture resistance, and friction resistance. The results for thermoplastics showed tensile strength increasing with decreasing test temperatures. At 23 °C, the thermoplastics showed lower strengths than elastomers and bitumens, but at -35 °C, the thermoplastics showed higher strengths than the elastomers and bitumens. At -35 °C, the elastomers remained the most ductile material. Also, at -35 °C, -15 °C, and +23 °C, the strength of thermoplastic seams was slightly higher than the sheet strength.

Richards et al. (1985) also performed a study of cold temperature effects on geomembranes. They tested 0.5-mm (20-mil) and 0.8-mm (30-mil) PVC (polyvinyl chloride), 0.5-mm (20-mil) cold formulated PVC, 1.9-mm (75-mil) HDPE (high density polyethylene), and 0.8-mm (30-mil) CPE (chlorinated polyethylene) geomembranes. Strips in the form of 150 by 25 mm (6 by 1 in) were used for tensile strength at temperatures of 23 °C, -7 °C, and -26 °C. The

PVC geomembranes showed an increase in breaking stress and a decrease in breaking strain with decreasing temperatures. The CPE showed a slight increase in break stress and a decrease in break strain between 23 °C and -7 °C and generally behaved similarly to PVC. At -26 °C, the CPE behavior changed, showing an intermediate peak (or yield point) and then an increase in break stress and a decrease in break strain with the decreased temperature. The HDPE geomembranes showed a similar increase in yield and break stress and a decrease in yield strain. However, the break strain showed an increase at -7 °C and a decrease at -26 °C. Regarding the modulus, the PVC and CPE geomembranes showed an increase with decreasing temperature. The HDPE geomembranes showed no change.

A cold temperature laboratory study was performed by LaFleur et al. (1985). Their testing included a 1.7-mm (65-mil) CSPE (chlorosulfonated polyethylene) and a 1.8-mm (70-mil) PVC composite. Each membrane was adhesively bonded to a needle-punched, nonwoven geotextile. Seamed samples were also included. The results showed that the percentage of stress carried by the geomembrane portion increased with decreasing temperature until failure occurred at about -35 °C. They determined that the strength contribution of the geotextile portion was not significantly changed at low temperatures. Thus, the low temperatures resulted in higher strength in the geomembranes but not in the geotextiles.

A study by Peggs et al. (1990) included laboratory cold temperature testing on HDPE. Tensile testing was performed at 25 °C and -30 °C, and burst tests were performed at 25 °C, -26 °C, and -38 °C. The tensile tests showed increases in yield and break strength and decreases in the yield and break elongation at the low temperature. Burst testing also showed increasing strength at decreasing temperatures.

Giroud et al. (1993) tested HDPE at both low and high temperatures. Geomembrane thicknesses from 0.5 to 3.0 mm (20 to 120 mil) and from five different manufacturers were tensile tested in dumbbell shape according to ASTM D 638 at 50 mm/min (2 in/min). As in Richards et al. (1985) and Peggs et al. (1990), these results showed an increase in yield stress and a decrease in yield strain with decreases in temperature. Similar results were obtained for textured HDPE geomembranes.

Effects of Freeze-Thaw Cycling on Geomembranes

The cold temperature study by LaFleur et al. (1985) included freeze-thaw testing. The following seamed geomembranes were strained to 10-percent strain, subjected to 150 freeze-thaw cycles, and then tensile tested: solvent seamed EPDM (ethylene propylene diene monomer), solvent seamed isobutylene rubber, solvent seamed CSPE, and hot air seamed PVC. None of the specimens showed a decrease in strength because of the freeze-thaw cycling. It was concluded that the seams were not affected by the freeze-thaw cycling.

Hsuan et al. (1993) and Comer et al. (1995) presented the early portions of freeze-thaw test data from this study. Results of the first 50 freeze-thaw cycles in Parts I, II, and III of the study were included in both papers. They will be presented later in this report.

Budiman (1994) conducted a freeze-thaw study of 1.0-, 1.5-, and 2.0-mm (40-, 60- and 100-mil) HDPE geomembranes. Square samples of 300-mm (12-in) size were subjected to freeze-thaw cycles under both restrained and unrestrained conditions. The modes of restraint were the following: cross-machine direction restrained, machine direction restrained, and both the cross-machine direction and the machine direction strained. One freeze-thaw cycle consisted of 12 hours at 65 °C and 12 hours at -20 °C. After incubation, the samples were cut into dumbbell shaped specimens for tensile testing. As-received specimens were tested as well as incubated specimens from 1, 5, 30, 60, and 150 freeze-thaw cycles. Testing was conducted at 20 °C, 0 °C, -10 °C, and -20 °C.

With respect to cold temperature testing effects, the Budiman (1994) results showed patterns of increasing strength at yield and break and decreasing strain at yield and break with decreasing testing temperature for all specimens. These results are similar to other studies mentioned in the previous section. The type of restraint used during incubation of the samples was found to "have no impact on the characteristics of the stress-strain diagrams" for any of the samples at any test temperature. The freeze-thaw cycling was determined to have had "no detrimental effect on the tensile load-elongation characteristics" of the specimens. Furthermore, Budiman (1994) concluded that "HDPE can be safely said to survive and perform acceptably for a long period of time under conditions involving repetitive temperature fluctuations within the range of -20 °C to 60 °C.

Although the above referenced studies showed no freeze-thaw effects, many of the geomembranes involved in these studies are not currently used by Reclamation, nor do they appear in designs evaluated by the EPA. Furthermore, the seaming was of different and largely unknown methods. Lastly, the studies referenced were not systematic in that cross-over analyses could not be made from one to another. Thus, this testing program was felt to be necessary.

TEST MATERIALS

This study involved 19 different sheet materials and 31 seam types. All are commercially available and are used on Reclamation and EPA projects.

Geomembrane Types

Seven different resin types were studied in this research. All are thermoplastic and currently available from a number of manufacturers. They are as follows: PVC (polyvinyl chloride), VLDPE (very low density polyethylene), HDPE (high density polyethylene), fPP (flexible polypropylene), CSPE (chlorosulfonated polyethylene), EIA (ethylene interpolymer alloy) and FCEA (fully crosslinked elastomeric alloy).

Additives which varied according to the type of polymer included: plasticizers, stabilizers, and fillers. Plasticizers are used to make PVC flexible by lowering the glass transition temperature. Stabilizers used in HDPE, VLDPE, and fPP commonly refer to antioxidants and UV (ultraviolet) protectors. Antioxidants protect polymers against oxidative degradation. UV protectors such as carbon black help to prevent UV damage. Fillers used in PVC and CSPE are incorporated to lower manufacturing costs and to increase flexibility.

Other ways in which geomembranes can be varied besides their composition include thickness, texture, and reinforcement. Because of such differences, 19 geomembrane sheet types were included in Parts I and III of the study. Only 6 of the 19 geomembranes were selected to be included in Part II. Part IV of the study used 12 different geomembranes. Table 1 lists the various types of geomembranes.

Table 1. - Type of geomembrane sheets and seams.

Part(s) of Study	Sample No.	Geomembrane Type (i.e., Polymer)	Thickness* (mm)	Style	Seam Type
I, II, III, IV	1(a)	PVC-R cold temperature formula	1.1	Scrim reinforced	Chemical
I, II, III	1(b)				Hot Wedge
I, III	2(a)	PVC	0.5	Smooth	Chemical
I, III, IV	2(b)				Hot Wedge
I, III	2(c)				Dielectric
I, II, III	3(a)	PVC	1.0	Smooth	Chemical
I, II, III, IV	3(b)				Hot Wedge
I, II, III	3(c)				Dielectric
I, II, III	4	VLDPE	1.0	Smooth	Hot Wedge
II, IV	4(a)				Fillet Extrusion
I, II, III	5	VLDPE	1.0	Textured	Hot Wedge
II	5(a)				Fillet Extrusion
I, III, IV	6	VLDPE	1.5	Smooth	Hot Wedge
I, III, IV	7	VLDPE	1.5	Textured	Hot Wedge
I, III	8	HDPE	1.0	Smooth	Hot Wedge
I, III	9	HDPE	1.0	Textured	Hot Wedge
I, II, III, IV	10	HDPE	1.5	Smooth	Hot Wedge
II	10(a)				Fillet Extrusion
I, II, III, IV	11	HDPE	1.5	Textured	Hot Wedge
II	11(a)				Fillet Extrusion

Table 1. - Type of geomembrane sheets and seams (continued).

Part(s) of Study	Sample No.	Geomembrane Type (i.e., Polymer)	Thickness* (mm)	Style	Seam Type
I, III, IV	12	fPP	1.0	Smooth	Thermal
I, III, IV	13	fPP-R	1.1	Scrim reinforced	Hot Wedge
I, III	14(a)	CSPE-R	0.9	Scrim reinforced	Chemical
I, III, IV	14(b)				Thermal
I, III, IV	15(a)	EIA	0.8	Smooth	Chemical
I, III	15(b)				Thermal
I, III	16(a)	EIA-R	0.9	Scrim reinforced	Chemical
I, III	16(b)				Thermal
I, III	17	FCEA	0.8	Smooth	Thermal
I, III	18	FCEA-R	0.8	Geotextile supported	Thermal
I, III	19	EIA-R	0.8	Scrim coated	Thermal

* Because this study consists of relative behavior within the same sheet or seamed material, only nominal values of thickness were used.

Key to Abbreviations:

PVC = polyvinyl chloride
VLDPE = very low density polyethylene
HDPE = high density polyethylene
fPP = flexible polypropylene
CSPE = chlorosulfonated polyethylene
EIA = ethylene interpolymer alloy
FCEA = fully crosslinked elastomeric alloy

t = textured
R = scrim reinforced

Seam Types

The above mentioned geomembranes were seamed using various seaming techniques. All seaming was performed by the geomembrane manufacturer that made the respective sheet or fabricators that made the respective panels. Five seaming techniques were used in this study: chemical seams, hot wedge seams, fillet extrusion seams, hot air seams (thermal seams), and dielectric seams. Figure 1 shows schematic diagrams of the seams. Parts I and III included 27 different combinations of seams. Part II included 13 seams, and Part IV included 12 seams. The various seam types are listed in table 1.

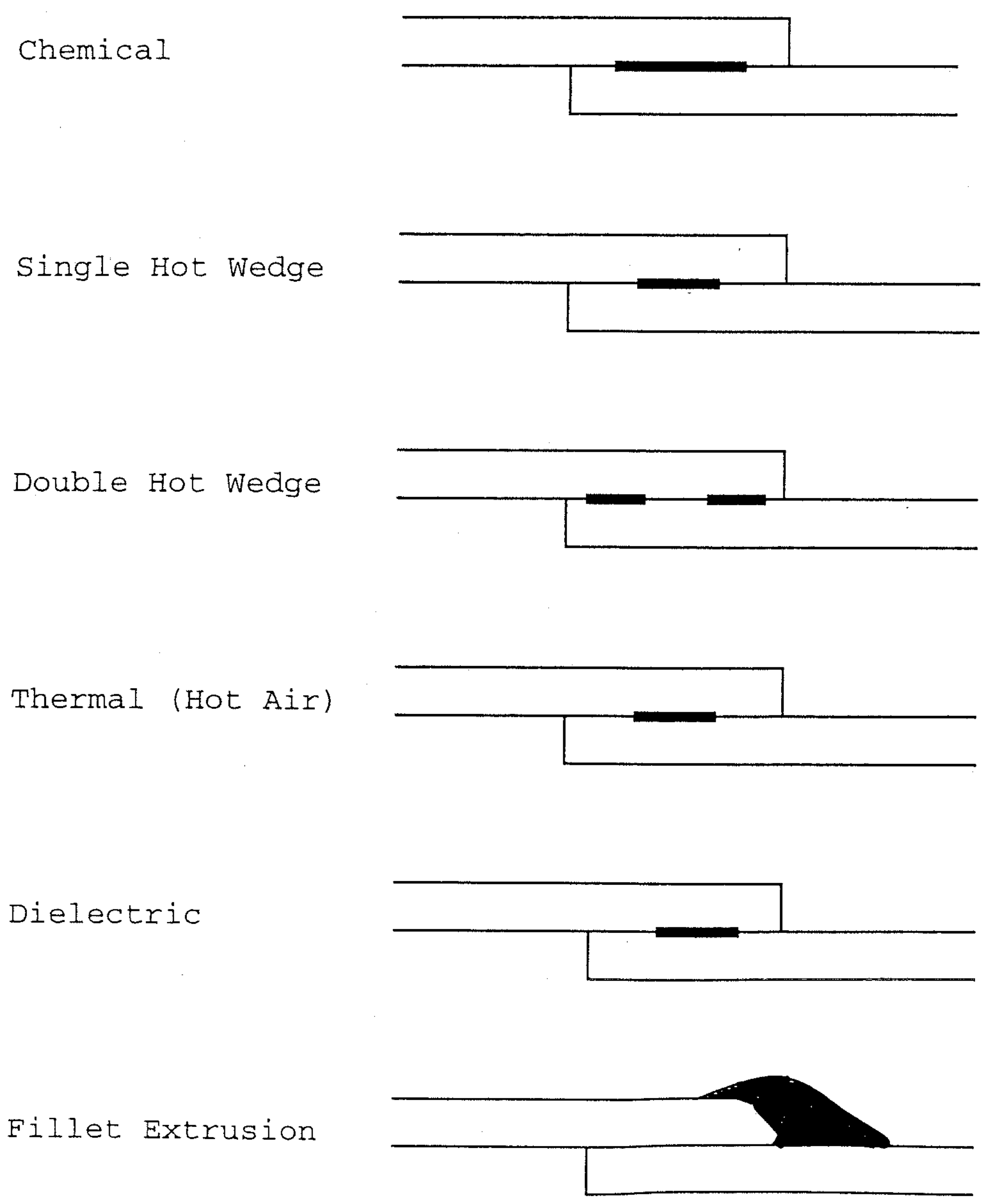

Figure 1. - Schematic diagrams of various geomembrane seams.

EXPERIMENTAL DESIGN

Sheet and seam samples from the respective manufacturers were cut into rectangular shaped specimens 25 mm (1.0 in) wide by 150 mm (6 in) long. Three specimens were included in each set for each designated test cycle.

The four parts of the study each had a different experimental design. Parts I, II, and III involved subjecting test specimens to a series of freeze-thaw cycles under different stress conditions and testing conditions as shown in table 2. Part IV was to investigate the cold temperature induced tensile stress. The specifics of each part are described in sections to follow.

Table 2. - Experimental design of different parts of study.

Part	Cyclic Temperature Range	Maximum Cycles	Incubation Condition	Tensile Test Temperature
I	+20 °C to -20 °C	200	relaxed	+20 °C
II	+20 °C to -20 °C	200	relaxed	-20 °C
III	+30 °C to -20 °C	500	constrained	+20 °C
IV	+30 °C to -20 °C	2	relaxed	varied

Part I—Incubation and Testing

Part I of the study consisted of 19 geomembrane sheets and 27 seamed materials (see table 1) that were tested at room temperature after freeze-thaw incubation. The freeze-thaw cycles were created by placing the specimens in a household freezer set at -20 °C for about 16 hours. They were then removed to room temperature (about +20 °C) conditions for about 8 hours. All specimens were incubated in a dry condition. However, condensation was observed on the specimens inside the plastic bag that contained them during the thaw cycle. Thus, the specimens experienced some amount of wet/dry exposure.

Following a pre-defined number of freeze-thaw cycles, i.e., 1, 5, 10, 20, 50, 100, and 200, the specimens were dried and equilibrated at room temperature for 24 hours before being tested at room temperature (about +20 °C).

Part II—Incubation and Testing

Part II of the study consisted of a group of 6 geomembrane sheets and 13 seamed materials (see table 1) that were tested at -20 °C after freeze-thaw cycling between +20 °C and -20 °C. Once a pre-defined number of freeze-thaw cycles, i.e. , 1, 5, 10, 20, 50, 100, and 200, was reached, the specimens remained in the freezer until they were tested.

The -20 °C tensile tests were conducted inside an environmental chamber. The equipment configuration allowed both the test specimens and the test grips to be contained within the chamber. The interior of the chamber can be seen on figure 2. A set of 100-mm (4-in) box grips was used for the sheet and seam shear tests; a set of jaw grips was used for the seam peel tests. These grips are shown on figures 3 and 4. The height of the chamber was limited to 460 mm (18 in).

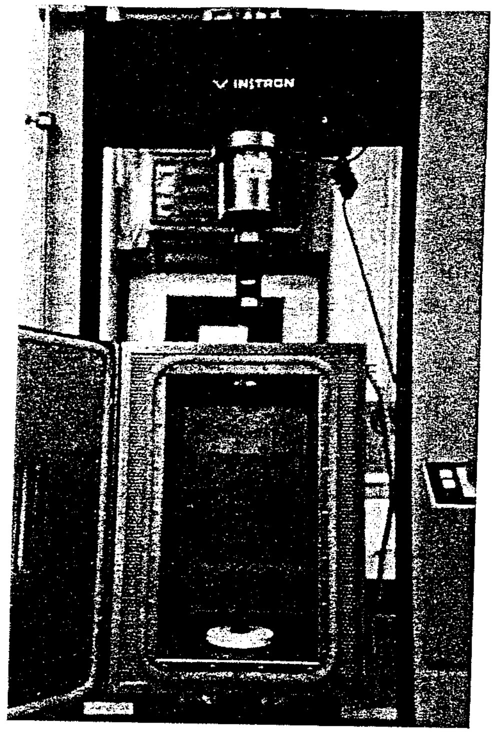

Figure 2. - Environmental chamber used in Part II testing.

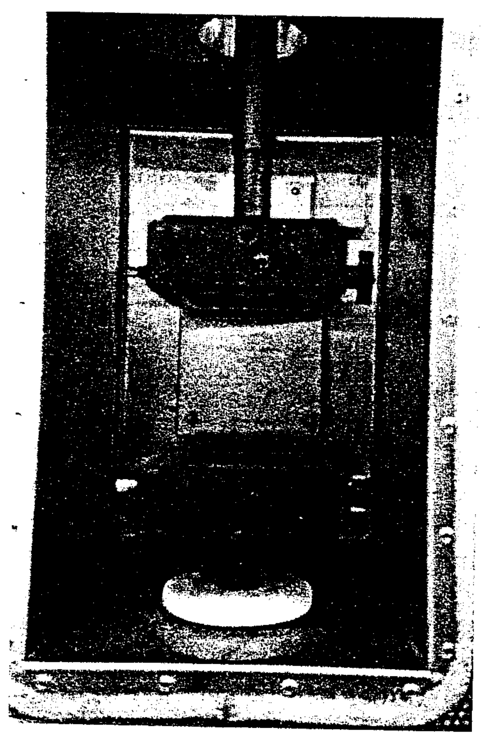

Figure 3. - Box grips used in Part II testing.

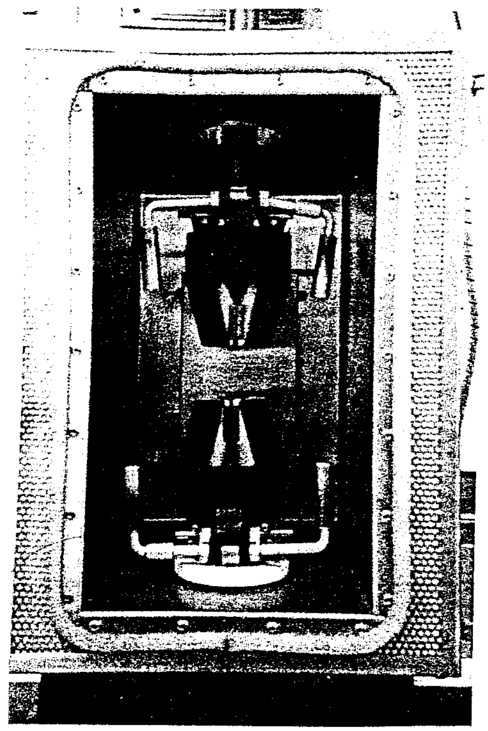

Figure 4. - Jaw grips used in Part II testing.

The environmental test chamber was cooled by liquid nitrogen. Amounts of liquid nitrogen entering the chamber were controlled by a computerized temperature monitoring device. The chamber was set at -20 ±2 °C for testing. The specimens were taken directly from the -20 °C freezer into the cooled test chamber.

Part III—Incubation and Testing

In Part III of the study, test specimens consisted of the same group of 19 geomembrane sheet and 27 seam materials tested in Part I and listed in table 1. All specimens, however, were under a constant strain condition while they were subjected to freeze-thaw cycling in the environmental chamber.

Strips of 25-mm (1-in) wide geomembrane sheet or seam specimens were placed in metal racks designed to hold three sets of three specimens. Hence, each rack held 9 specimens as shown on figures 5 and 6. The amount of displacement that was induced into the specimens corresponded to 25 percent of the sheet peak load or seam shear peak load. Table 3 shows the displacement values for each type of sheet and seam specimen. The specimens were tensioned to their appropriate displacement length by tightening the upper grip of the rack as illustrated on figure 7. The racks with strained specimens were placed vertically in two holding boxes as seen on figure 8. These boxes were then placed in an environmental chamber as shown on figure 9. The incubation temperatures were set for 16 hours at -20 °C and 8 hours at +30 °C. It should be noted that the constrained specimens experienced an induced tensile stress while the chamber temperature decreased from +30 °C to -20 °C.

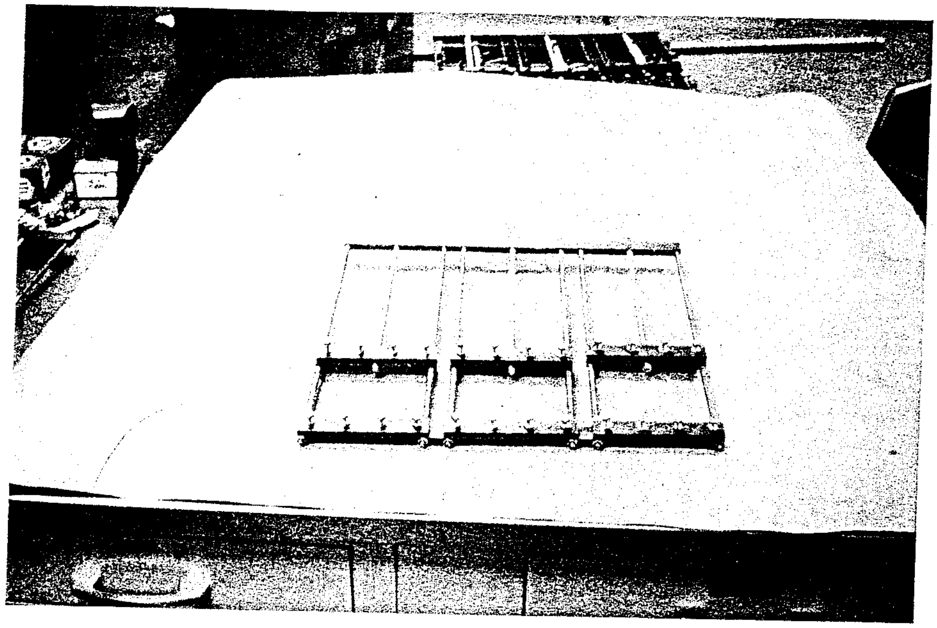

Figure 5. - Empty geomembrane holding racks used in Part III tests.

Figure 6. - Test specimen placed in geomembrane racks used in Part III tests.

Table 3. - Displacement values applied to the constrained specimens in Part III.

No.	Geomembrane (Polymer Type)	Thickness mm (mil)	Style	Seam Type	Displacement mm (inch)
1	PVC-R cold temp. formula	1.1 (45)	Scrim reinforced	Sheet	1.3 (0.05)
1(a)				Chemical	1.5 (0.06)
1(b)				Hot Wedge	1.3 (0.05)
2	PVC	0.5 (20)	Smooth	Sheet	14 (0.55)
2(a)				Chemical	13 (0.50)
2(b)				Hot Wedge	15 (0.60)
2(c)				Dielectric	17 (0.65)
3	PVC	1.0 (40)	Smooth	Sheet	12 (0.48)
3(a)				Chemical	20 (0.77)
3(b)				Hot Wedge	13 (0.50)
3(c)				Dielectric	10 (0.40)
4	VLDPE	1.0 (40)	Smooth	Sheet	1.7 (0.07)
				Hot Wedge	2.3 (0.09)
5	VLDPE	1.0 (40)	Textured	Sheet	2 (0.08)
				Hot Wedge	2.3 (0.09)
6	VLDPE	1.5 (60)	Smooth	Sheet	2 (0.08)
				Hot Wedge	2.3 (0.09)
7	VLDPE	1.5 (60)	Textured	Sheet	2 (0.08)
				Hot Wedge	2 (0.08)
8	HDPE	1.0 (40)	Smooth	Sheet	1.3 (0.05)
				Hot Wedge	1 (0.04)
9	HDPE	1.0 (40)	Textured	Sheet	1.5 (0.06)
				Hot Wedge	1 (0.04)
10	HDPE	1.5 (60)	Smooth	Sheet	1.5 (0.06)
				Hot Wedge	1.3 (0.05)
11	HDPE	1.5 (60)	Textured	Sheet	1.8 (0.07)
				Hot Wedge	1.5 (0.06)
12	fPP	1.0 (40)	Smooth	Sheet	2.8 (0.11)
				Thermal	2.5 (0.10)
13	fPP-R	1.1 (45)	Scrim reinforced	Sheet	2.5 (0.10)
				Hot Wedge	1.5 (0.06)

Table 3. - Displacement values applied to the constrained specimens in Part III (continued).

No.	Geomembrane Type (i.e. Polymer)	Thickness mm (mil)	Style	Seam Type	Displacement mm (inch)
14	CSPE-R	0.90 (36)	Scrim reinforced	Sheet	4.3 (0.17)
14(a)				Chemical	1.7 (0.07)
14(b)				Thermal	2.5 (0.1)
15	EIA	0.80 (30)	Smooth	Sheet	11 (0.45)
15(a)				Chemical	6.4 (0.25)
15(b)				Thermal	6.9 (0.27)
16	EIA	0.80 (30)	Scrim reinforced	Sheet	5.1 (0.20)
16(a)				Chemical	5.6 (0.22)
16(b)				Thermal	6.6 (0.27)
17	FCEA	0.80 (30)	Smooth	Sheet	2 (0.08)
				Thermal	1.7 (0.07)
18	FCEA	0.80 (30)	Fabric Supported	Sheet	2 (0.08)
				Thermal	1.5 (0.06)
19	EIA-R	0.80 (30)	Scrim Coated	Sheet	4.8 (0.19)
				Thermal	4.6 (0.18)

After the pre-defined number of freeze-thaw cycles, which were 1, 10, 50, 100, 200, and 500, the constrained specimens were removed from the racks, dried, and equilibrated at room temperature (about +20 °C) for at least 24 hours before being tested. Subsequently, they were tested at +20 °C.

Part IV—Testing

The purpose of Part IV of the study was to investigate the cold temperature induced tensile stress of the constrained specimens of the Part III tests during freeze-thaw cycles. Eight of the 19 geomembrane sheets and 8 of 27 geomembrane seams used in Part III were evaluated as listed in table 1. Test specimen strips 25 mm (1.0 in) wide were placed in the same type of grips and environmental chamber used in the Part II testing. Each specimen was elongated under a constant strain rate to the pre-determined displacements listed in table 3. Once the elongation was reached, the specimen was locked into position. Simultaneously, the load and time were recorded until the test was terminated. The specimen was equilibrated at room temperature (about +20 °C) for a half hour. It was then heated to 30 °C for 12 hours. The chamber temperature was then cooled to -20 °C for 2 hours and then was increased to +30 °C for 2 hours. The -20 °C and +30 °C temperature cycle was repeated a second time before the test was concluded. Figure 10 illustrates the temperature versus time profile of the test.

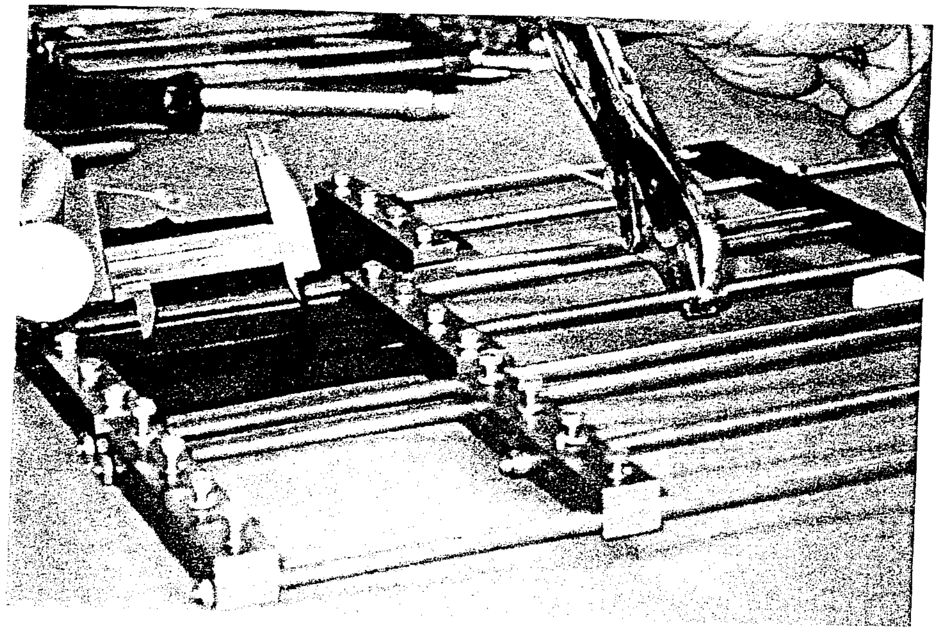

Figure 7. - Method of applying tensile load to test specimens in Part III tests.

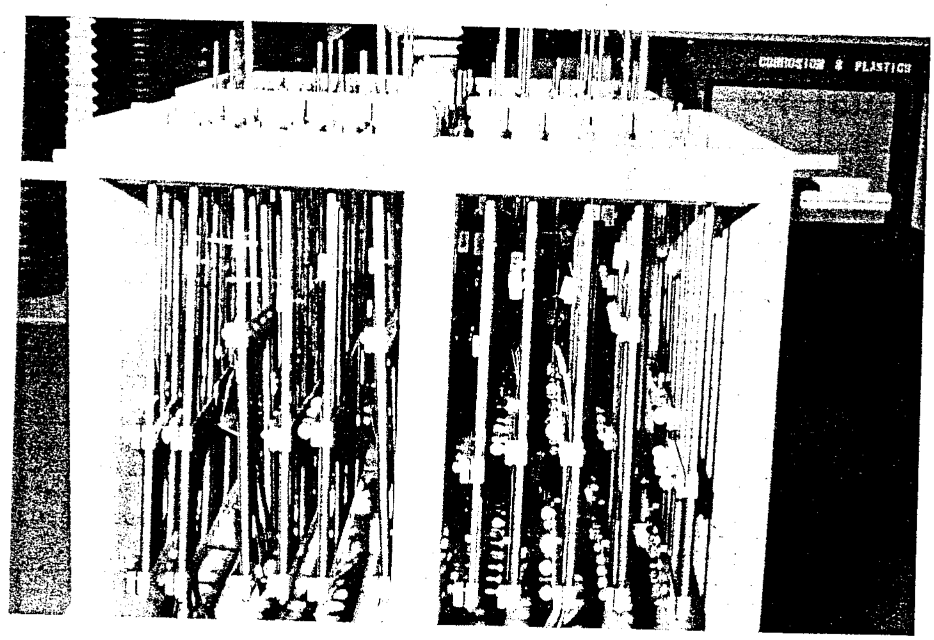

Figure 8. - Geomembrane racks in holding box used in Part III tests.

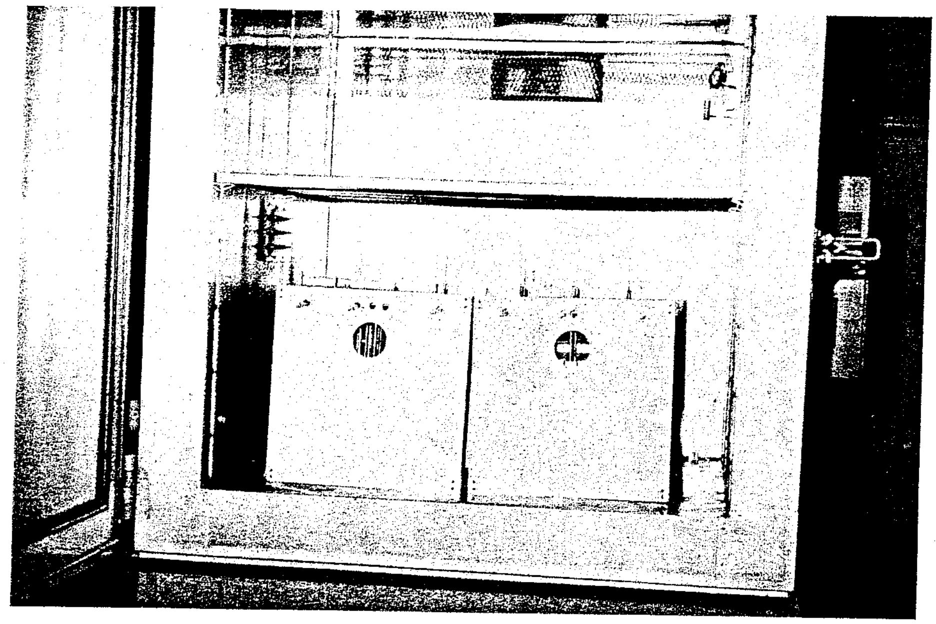

Figure 9. - Environmental chamber used in Part III tests.

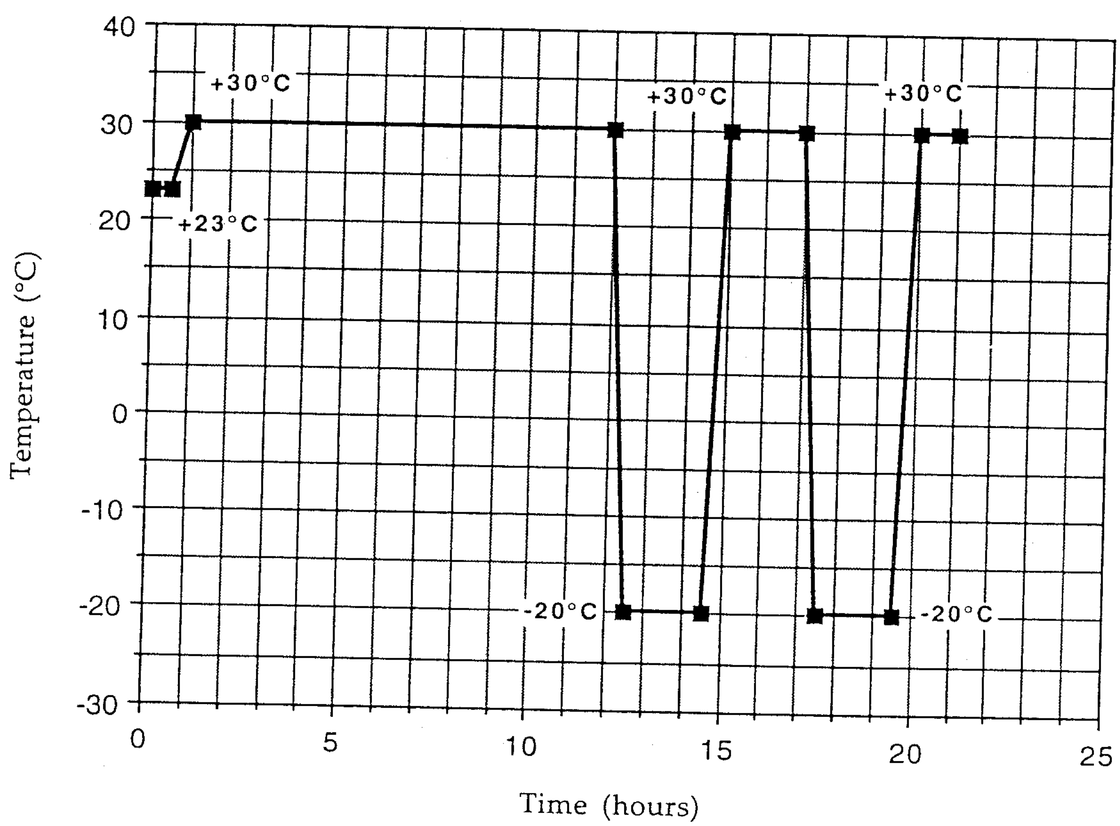

Figure 10. - Temperature profile of Part III tests.

The following items were investigated in this Part IV study:

- The stress relaxation behavior was determined within the first 12 hours after the predetermined strain was applied to the specimen at room temperature.
- The magnitude of the induced stress was calculated as the temperature decreased from +30 °C to -20 °C.
- The magnitude of the induced stress was determined for each freeze-thaw cycle.

TENSILE TEST METHODS

The geomembrane sheet tensile tests for Parts I, II, and III were evaluated using either 25-mm (1.0-in) strip or dumbbell shaped test specimens. Uniform 25-mm (1.0-in) strips were used for both seam shear and peel tensile tests. It should be noted that certain variations of current practice in sheet and seam testing were made. However, testing within a given material was consistent throughout, hence the resulting comparisons should be valid.

Tensile Tests for Geomembrane Sheets

Strip tensile tests were performed on PVC, CSPE, EIA, and FCEA test specimens. Dumbbell tensile tests were performed on VLDPE, HDPE, and fPP test specimens. Both the strip and dumbbell tensile test procedures followed NSF (National Sanitation Foundation) Standard No. 54 recommendations. ASTM D882 and ASTM D638 Type VI specimens are recommended for strip tensile tests of non-reinforced geomembranes and dumbbell specimens, respectively. Those materials not presently included in the standard were tested using methods for similar materials. Thus, fPP was tested under the same conditions as VLDPE; whereas, the EIA and FCEA were evaluated in the same way as PVC. All scrim reinforced geomembrane sheet specimens were tested using a 25-mm (1-in) wide strip test instead of the customary 100-mm (4.0-in) grab tensile test. All strip tests were performed using 100-mm (4.0-in) gage length and a 5-mm/sec (12-in/min) strain rate. Details of the tensile test procedures are given in table 4.

Shear Tests for Geomembrane Seams

The test procedure for seam shear strength followed NSF No. 54 recommendations. ASTM D3803 was used to test PVC, EIA, and FCEA geomembrane seams. HDPE, VLDPE, and fPP seams were tested according to ASTM D4437, but a strain rate of 8.5-mm/sec (20-in/min) was used for testing VLDPE and fPP. For reinforced materials, a 25-mm (1.0-in) wide strip tensile test was used instead of the 100-mm (4.0-in) grab tensile test, thus following the same procedure as the sheet test. Table 4 contains details of the seam shear tests.

Peel Tests for Geomembrane Seams

The test procedures for peel strength of seams generally followed NSF No. 54 recommendations. ASTM D4437 was used to test HDPE, VLDPE, and fPP; however, a strain rate of 8.5-mm/sec (20-in/min) was used for testing VLDPE evaluated in Part I. All other materials were tested according to ASTM D413. Because NSF No. 54 does not recommend the gage length for any of the tests, the 25-mm (1.0-in) gage length which is defined in ASTM D4437 was used throughout. Table 4 contains details of the seam peel tests.

Table 4. - Test conditions for geomembrane sheet tensile test and shear and peel seam tests.

Sample		Sheet Tensile Tests			Seam Type	Seam Tests			
						Shear Test		Peel Test	
No.	Material	Specimen Shape	Strain Rate mm/sec. (in./min)	Gage Length mm (in.)		Strain Rate mm /sec (in./min)	Gage Length mm (in.)	Strain Rate mm/sec (in./min)	Gage Length mm (in.)
1(a)	PVC-R (cool temperature)	strip	5.0 (12)	100 (4.0)	Chemical	5 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
1(b)					Hot Wedge	5 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
2(a)	Smooth PVC	strip	8.5 (20)	50 (2.0)	Chemical	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
2(b)					Hot Wedge	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
2(c)					Dielectric	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
3(a)	Smooth PVC	strip	8.5 (20)	50 (2.0)	Chemical	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
3(b)					Hot Wedge	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
3(c)					Dielectric	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
4	Smooth VLDPE	dumbbell	8.5 (20)	64 (2.5)	Hot Wedge	8.5 (20)	100 (4.0)	0.8 (2.0)*	25 (1.0)
5	Textured VLDPE	dumbbell	8.5 (20)	64 (2.5)	Hot Wedge	8.5 (20)	100 (4.0)	8.5 (20)*	25 (1.0)
6	Smooth VLDPE	dumbbell	8.5 (20)	64 (2.5)	Hot Wedge	8.5 (20)	100 (4.0)	8.5 (20)*	25 (1.0)
7	Textured VLDPE	dumbbell	8.5 (20)	64 (2.5)	Hot Wedge	8.5 (20)	100 (4.0)	8.5 (20)*	25 (1.0)

* In Part III study a strain rate of 0.8 mm/sec (2.0 in/min) was used for all peel tests.

Table 4. - Test conditions for geomembrane sheet tensile test and shear and peel seam tests (continued).

Sample		Sheet Tensile Test			Seam Type	Seam Tests			
						Shear Test		Peel Test	
No.	Material	Specimen Shape	Strain Rate mm/sec. (in./min)	Gage Length mm (in.)		Strain Rate mm/sec. (in./min)	Gage Length mm (in.)	Strain Rate mm/sec. (in./min)	Gage Length mm (in.)
8	Smooth HDPE	dumbbell	0.8 (2.0)	64 (2.5)*	Hot Wedge	0.8 (2.0)	100 (4.0)	0.8 (2.0)	25 (1.0)
9	Textured HDPE	dumbbell	0.8 (2.0)	64 (2.5)*	Hot Wedge	0.8 (2.0)	100 (4.0)	0.8 (2.0)	25 (1.0)
10	Smooth HDPE	dumbbell	0.8 (2.0)	64 (2.5)*	Hot Wedge	0.8 (2.0)	100 (4.0)	0.8 (2.0)	25 (1.0)
11	Textured HDPE	dumbbell	0.8 (2.0)	64 (2.5)*	Hot Wedge	0.8 (2.0)	100 (4.0)	0.8 (2.0)	25 (1.0)
12	fPP	dumbbell	8.5 (20)	64 (2.5)	Thermal	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
13	fPP-R	strip	5.0 (12)	100 (4.0)	Hot Wedge	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
14(a)	CSPE-R	strip	5.0 (12)	100 (4.0)	Chemical	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
14(b)					Thermal	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
15(a)	Smooth EIA	strip	8.5 (20)	100 (4.0)	Chemical	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
15(b)					Thermal	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
16(a)	EIA-R	strip	5.0 (12)	100 (4.0)	Chemical	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
16(b)					Thermal	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
17	Smooth FCEA	strip	8.5 (20)	100 (4.0)	Thermal	8.5 (20)	100 (4.0)	0.8 (2.0)	25 (1.0)
18	FCEA-R (fabric support)	strip	5.0 (12)	100 (4.0)	Thermal	5.0 (12)	100 (4.0)	0.8 (2.0)	25 (1.0)
19	EIA-R (scrim coated)	strip	5.0 (12)	100 (4.0)	Thermal	5.0 (12)	100 (4.0)	no test	no test

* The gage length used to calculate the percent elongation values was 33 mm (1.3 in.)

EFFECTS OF FREEZE-THAW CYCLING ON THE TENSILE BEHAVIOR OF GEOMEMBRANE SHEETS AND SEAMS

In this section, the tensile test results of Parts I, II, and III of the study are analyzed and presented. All parts focus on the effect of freeze-thaw cycling on the particular geomembrane sheets and seams stated earlier.

Data Analysis Approach

The potential effect of freeze-thaw cycling on the various geomembrane sheet and seam specimens was evaluated based on the magnitude of percent change of the specific measured property from its corresponding initial value. In Part I, the initial values were the test results of non-incubated original sheet and seam specimens. In Part II, the initial values were data of non-incubated sheet and seam specimens that were obtained by testing at -20 °C temperature. For Part III, the initial values were data of the first freeze-thaw cycle. These data were used because it was necessary to compare specimens that were also constrained.

The tensile properties of geomembrane sheets that were used in the analyses are listed in table 5. For seam specimens, shear and peel strength values were examined.

For each examined property, the percent change was plotted against the logarithm of number of freeze-thaw cycles (fig. 11). In addition to the average value, the maximum and minimum values of the three tests conducted at each freeze-thaw cycle were displayed as indicated by the solid squares on figure 11. As expected, the length of the error bar varies because of the following factors:

- variation in the geomembrane material
- variation in the seaming process (for seams)
- variation in the cutting of test samples or test specimens
- variation in the number of yarns per sample (for reinforced materials)

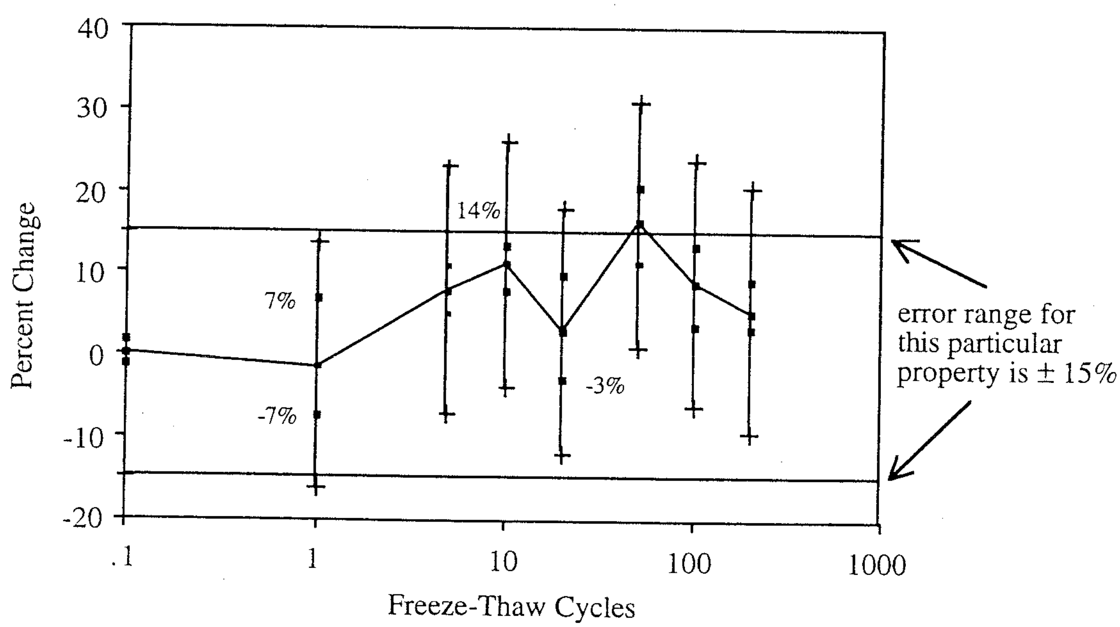

Figure 11. - Illustrating the data analysis to obtain the total error range.

Table 5. - Tensile properties of geomembrane sheets being evaluated.

No	Geomembrane Type	Thickness mm (mil)	Sheet Tensile Property
1	PVC-R cold temperature formula	1.1 (45)	Peak Strength Peak Elongation
2	PVC	0.5 (20)	Break Strength Break Elongation
3	PVC	1 (40)	Break Strength Break Elongation
4	VLDPE	1(40)	Break Strength Break Elongation
5	VLDPE-Textured	1 (40)	Break Strength Break Elongation
6	VLDPE	1.5 (60)	Break Strength Break Elongation
7	VLDPE-textured	1.5 (60)	Break Strength Break Elongation
8	HDPE	1 (40)	Yield Strength Yield Elongation
9	HDPE-textured	1 (40)	Yield Strength Yield Elongation
10	HDPE	1.5 (60)	Yield Strength Yield Elongation
11	HDPE-textured	1.5 (60)	Yield Strength Yield Elongation
12	fPP	1(40)	Break Strength Break Elongation
13	fPP-R	1.1 (45)	Peak Strength Peak Elongation
14	CSPE-R	0.9 (36)	Peak Strength Peak Elongation
15	EIA	0.8 (30)	Break Strength Break Elongation
16	EIA-R	0.9 (36)	Peak Strength Peak Elongation
17	FCEA	0.8 (30)	Break Strength Break Elongation
18	FCEA-R (textile supported)	0.8 (30)	Peak Strength Peak Elongation
19	EIA-R (scrim coated)	0.8 (30)	Break Strength Break Elongation

It should be noted that none of the ASTM test methods used has an associated established precision and bias statement. In addition, only three tests were performed at each cycle; therefore, a rigorous statistical analysis could not be performed. Hence, the error limits for each graph were arbitrarily developed. For each graph, two sources of variation were considered; they were caused by internal and external factors. The summation of the two factors was considered to be the upper and lower error limits. The cumulative limits were used as the reference to define a possible changing trend. The two variations are described as follows:

1. Internal variation - This type of variation was represented by the error bar of each freeze-thaw cycle. It included variations in material, seaming process (for seams), specimen preparation, and incubation error associated with these features. For each evaluated property, the largest error bar was selected because this variation was the greatest possible of the three tests.

2. External variation - This variation was reflected by the magnitude of fluctuation in the data. It was based on the assumption that changes in the polymer structure or seam structure were not reversible as the number of freeze-thaw cycles increased. This variation probably was attributable to the test environment, such as temperature, humidity, and machine and human error associated with these features.

As an illustration of the above variations, the largest error bar on figure 11 occurs at the first cycle, where maximum and minimum values of +7 and -7 percent are seen. The total is 14 percent, which is the greatest internal variation in the three replicate tests for this particular evaluated property, i.e., ±7 percent. For the external variation, the fluctuation in the data is from the maximum of the tenth cycle (14 percent) down to the minimum of the twentieth cycle (-3 percent). Hence, the maximum oscillation of the data caused by external variation is assumed to be 17 percent, i.e., ±8.5 percent. The summation of these two variations—internal (±7 percent) and external (±8.5 percent)—equals ±15.5 percent, which is considered to be the upper and lower error limit. Note that each data set could potentially have the same amount of total variation, in this case ±15.5 percent. Thus, this error range should be applied to every freeze-thaw set of data by adding 15 percent and subtracting 15 percent from the average value. Using this criterion on figure 11 results in the solid vertical line shown at each data set. Then, to consider a possible changing trend, the minimum or maximum value of any data set needs to fall outside the error range of the original data set. This error range is indicated by the two horizontal lines on figure 11 at either +15 percent or -15 percent. It can then be seen that all vertical lines have a portion falling within the error range of acceptability. Hence, the behavior shown on this curve would be judged as "no change."

In contrast, "change" is defined as when the percent change in the property being evaluated exceeds the error limits as described. These criteria were used to judge all of the response graphs.

RESULTS

Based on the analysis described above, the effects of freeze-thaw cycling in different incubation and test conditions are now presented.

Part I Results

This section presents the results of Part I of the study. After test specimens were exposed to a maximum of 200 freeze-thaw cycles in a relaxed condition, they were tested at +20 °C.

Tensile Tests of Geomembrane Sheets. - Nineteen different geomembrane sheets were evaluated. The analyzed percent change graphs are included as appendix A. The results show no change in either the peak strength or peak elongation of any of the tested materials.

Shear Tests of the Seams. - Twenty-seven geomembrane seams were evaluated in the shear mode. The analyzed percent change graphs are included as appendix B. The results show no change in shear strength of any of the tested seam materials. In addition, all seams passed typical QC/QA (quality control/quality assurance) criteria, i.e., they failed in the FTB (film tear bond) mode.

Peel Tests of the Seams. - Twenty-six different seams was evaluated for their peel strength. The analyzed percent change graphs are included as appendix C. The results show no change in peel strength of any of the tested seam materials. The majority of these peel tests passed typical QC/QA criteria. Although some of seams failed as non-FTB, they did fail in a manner consistent with the as-received to the 200th cycle. This result suggests that the non-FTB failure of these seams probably was not caused by freeze-thaw effects, rather, they were poorly fabricated seams from the start.

Part II Results

This section presents the results of Part II of the study. After test specimens were exposed to a maximum of 200 freeze-thaw cycles in a relaxed condition, they were then tested at -20 °C temperature.

Tensile Tests of Geomembrane Sheets. - Six different geomembranes were tested. However, it should be pointed out that ultimate breakage was not reached for VLDPE and HDPE materials because of the limited environmental chamber height. Thus, the initial peak strength and elongation were considered in the analyses. The analyzed percent change graphs are included as appendix D. The results show no change in either the peak strength or peak elongation of any of the tested materials.

Shear Tests of the Seams. - Twelve seams were tested in shear tensile mode. Similar to the sheet tensile tests, ultimate breakage was not reached for the VLDPE seams and HDPE seams because of the limited environmental chamber height. Thus, the initial peak strength and elongation were considered in the analyses. The analyzed percent change graphs are included as appendix E. The results show no change in shear strength of any of the tested seam materials. In addition, seams that failed all passed the typical QC/QA criteria, i.e., they failed in an FTB mode.

Peel Tests of the Seams. - Thirteen seams were tested in the peel mode. It should be pointed out that ultimate breakage was not reached for the VLDPE seams because of the limited environmental chamber height. On the other hand, HDPE seams were able to reach ultimate breakage. The analyzed percent change graphs are included as appendix F. The results show no change in peel strength of any of the tested seam materials. The majority of these peel tests passed typical QC/QA criteria, i.e., FTB mode. Although some of seams failed as non-FTB, they did fail in a consistent manner from the as-received to the 200th cycle. This result suggests that the non-FTB failure of these seams probably was not caused by freeze-thaw effects, rather, they were poorly fabricated seams from the start.

Part III Results

This section presents the results of Part III of the study. After the test specimens were exposed to a maximum of 500 freeze-thaw cycles in a constrained condition, they were then tested at +20 °C.

Tensile Tests of Geomembrane Sheets. - Nineteen different geomembranes were evaluated for tensile strength and elongation. The analyzed percent change graphs are included as appendix G. Sample 1, PVC-R, exhibited grip slipping during testing of the 500-cycle specimens; hence, their peak strength and elongation values were not detected. The results show no change in either the peak strength or peak elongation of any of the tested materials.

Shear Tests of the Seams. - Twenty-six different seams were tested for shear strength. The analyzed percent change graphs are included as appendix H. The results show no change in any of the seam shear strengths.

Peel Tests of the Seams. - Twenty-five seams were tested in the peel mode. The analyzed percent change graphs are included as appendix I. The results show no change in peel strengths of any of the tested seam materials. The majority of these peel tests passed typical QC/QA criteria. Although some of the seams did not fail as FTB, they did fail in a manner consistent with the as-received to the 500th cycle. This result indicates that the non-FTB failure of these seams was not caused by freeze-thaw effects, rather, they were poorly fabricated seams from the start.

COLD TEMPERATURE INDUCED TENSILE STRESS IN CONSTRAINED GEOMEMBRANE SHEET AND SEAM SPECIMENS

This section presents the results of the Part IV study. Eight of the 19 geomembrane sheets and 8 of the 27 geomembrane seams used in Part III were evaluated. Tests were performed by gripping the test specimen inside an environmental chamber in a tensile machine. A pre-defined displacement was introduced to the specimen using a constant strain rate. Once the displacement value was reached, the specimen was locked in that position. Simultaneously, the load values were recorded with time. The temperature of the specimen was changed following the temperature profile shown on figure 10. The data were presented by plotting load values versus time for both the geomembrane sheets and seams as shown on figure 12. Three items were investigated and they are presented as follows:

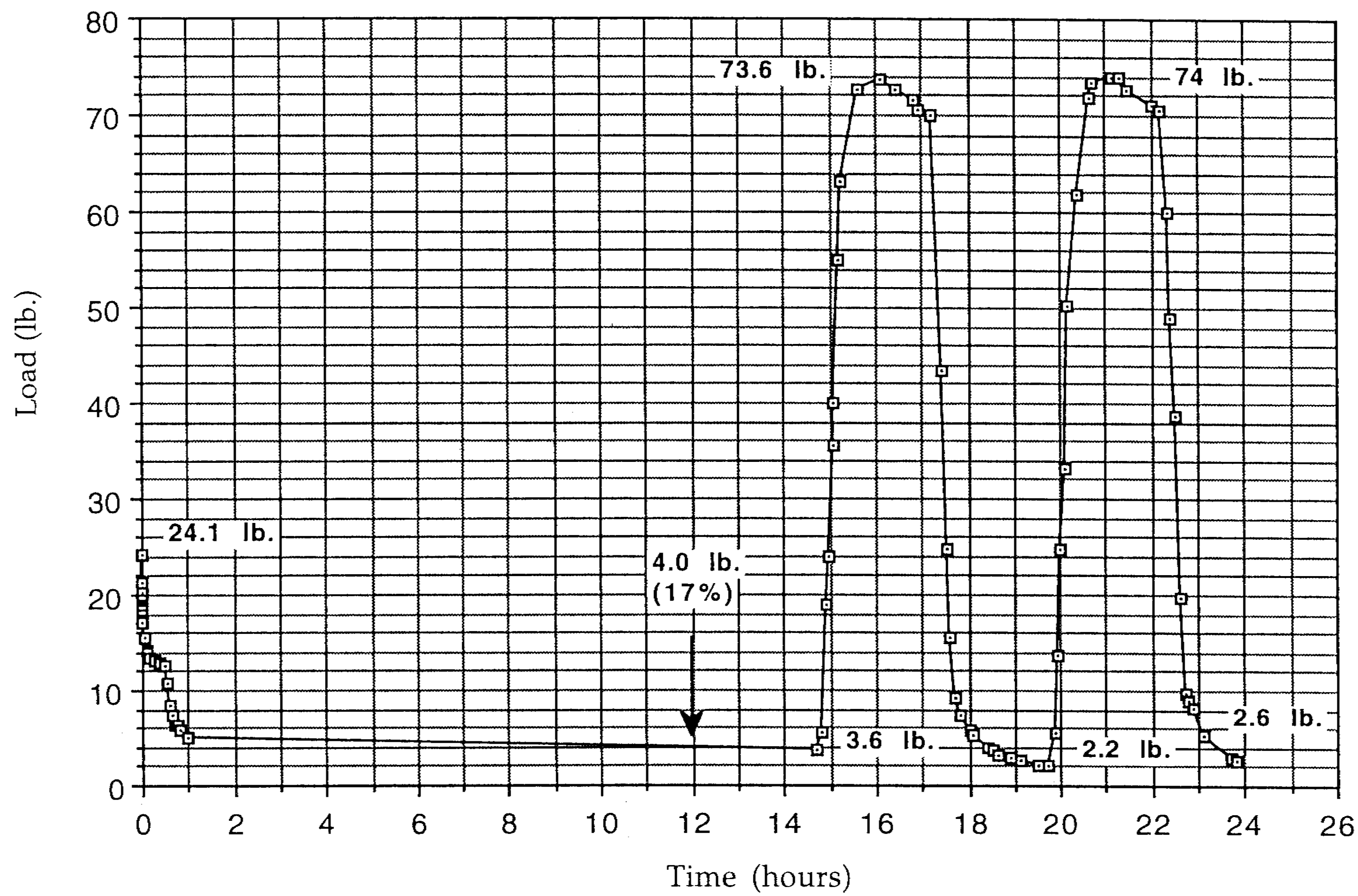

Figure 12. - An example of load versus time plot (1.5-mm [60-mil] HDPE-smooth sheet).

Stress Relaxation Within the First 12 Hours

The reduction of load with time within the first 12 hours of the experiment was evaluated to obtain insight into the stress relaxation behavior of different geomembrane sheets and seams. The load values were then converted to stress. For comparison purposes, the effects of variation in strain rate, gauge length, and displacement that were used in the tests were minimized by normalizing all stress data to the corresponding initial stress value (i.e., the stress at time zero). The normalized stress data were then plotted against the logarithmic of time as illustrated on figure 13. All stress relaxation plots are included in appendix J.

Following are the observations made from the results:

1. In the first 12 hours of the test, the specimens were exposed to room temperature for 30 minutes and then heated to +30 °C for 12 hours. Both the geomembrane sheets and seams showed a significant amount of stress relaxation. For the non-reinforced geomembrane sheets and seams, 70 to 80 percent of the initial stress was relaxed. For the reinforced geomembrane sheets and seams, the values were around 40 to 75 percent, as can be seen in table 6.

2. For non-reinforced geomembranes, the stress relaxation behavior of sheets and seams is very similar, as shown on figure 14. In contrast, the seams of reinforced geomembranes exhibited a greater stress relaxation than the corresponding sheet materials, as indicated on figure 15.

3. Overall, non-reinforced geomembranes exhibited a greater relaxation than reinforced geomembranes, as can be seen on figure 16. This difference is attributable to the scrim in the reinforced geomembranes, which has less relaxation tendency than the membrane component and thus restricts the total relaxation of the geomembrane.

Magnitude of Cold Temperature Induced Tensile Stress

As the chamber temperature cooled from +30 °C to -20 °C, a tensile load was induced in the specimens. The magnitude of this induced load was calculated by subtracting the minimum load value at +30 °C before onset of the cooling from the maximum load value at -20 °C. The induced stress was obtained by dividing the load by the thickness and width of the respective test specimens. Table 6 lists the induced load and induced stress values of all tested materials. All cold temperature induced tensile stress curves are included as appendix K.

Following are comments that can be made from observing the values listed in table 6:

1. For non-reinforced geomembranes, similar induced stresses were obtained in the same type of polymer, regardless of the variation in the thickness, surface finishing, and seam types. For example:

   - The PVC group consists of an induced stress around 250 lb/in^2.
   - The VLDPE group consists of an induced stress around 550 lb/in^2.
   - The HDPE group consists of an induced stress around 1200 lb/in^2.

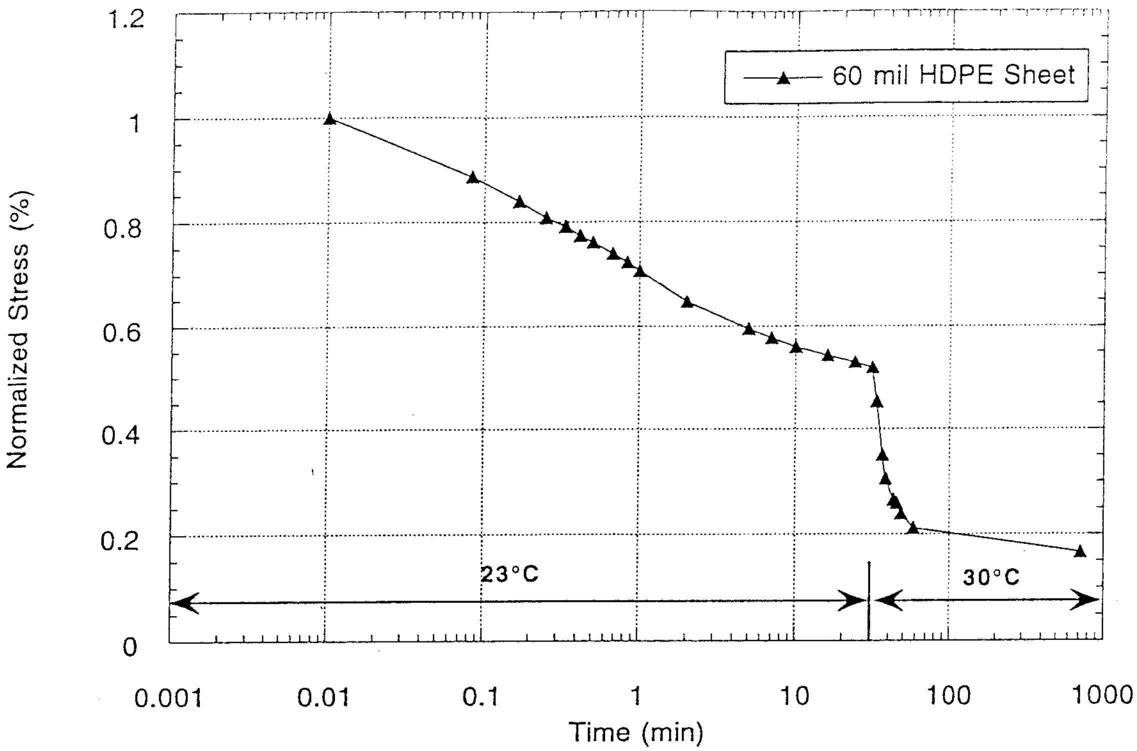

Figure 13. - Stress relaxation behavior in first 12 hours of the test.

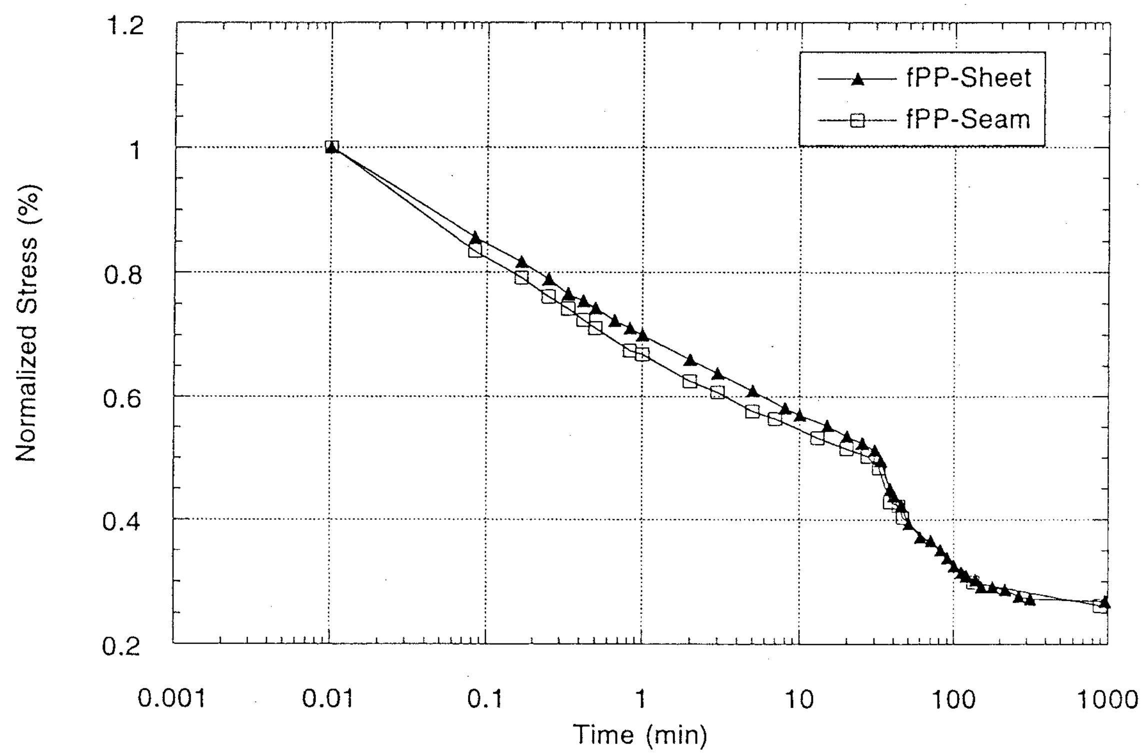

Figure 14. - An example of stress relaxation behavior of non-reinforced geomembrane sheets and seams.

Table 6. - Stress relaxation values and cold temperature induced stress values for sheets and seams.

No.	Geomembrane	Thickness mm (mil)	Seam Type	% relaxation after 12 hrs.	Induced Load (lb)	Induced Stress (lb/in-sq.)
1	PVC-R	1.1 (45)	Sheet	56	46.0	1020
1(a)			Chemical	70	52.0	1160
2	PVC	0.5 (20)	Sheet	75	6.0	300
2(b)			Hot Wedge	71	5.0	250
3	PVC	1.0 (40)	Sheet	76	9.0	220
3(b)			Hot Wedge	81	8.4	210
4	VLDPE	1.0 (40)	Sheet	77	20.0	500
			Extrusion	83	23.0	570
6	VLDPE	1.5 (60)	Sheet	82	33.0	550
			Hot Wedge	80	33.0	550
7	VLDPE-textured	1.5 (60)	Sheet	76	34.0	560
			Hot Wedge	79	33.0	550
10	HDPE	1.5 (60)	Sheet	83	71.0	1200
			Hot Wedge	83	73.0	1200
11	HDPE-textured	1.5 (60)	Sheet	84	72.0	1200
			Hot Wedge	89	76.0	1300
12	fPP	1.0 (40)	Sheet	73	14.6	370
			Thermal	74	11.8	290
13	fPP-R	1.1 (45)	Sheet	52	18.0	400
			Hot Wedge	67	17.0	380
14	CSPE-R	0.90 (36)	Sheet	43	18.0	500
14(b)			Hot Air	62	18.0	500
15	EIA	0.80 (30)	Sheet	87	12.0	400
15(a)			Chemical	80	15.0	500

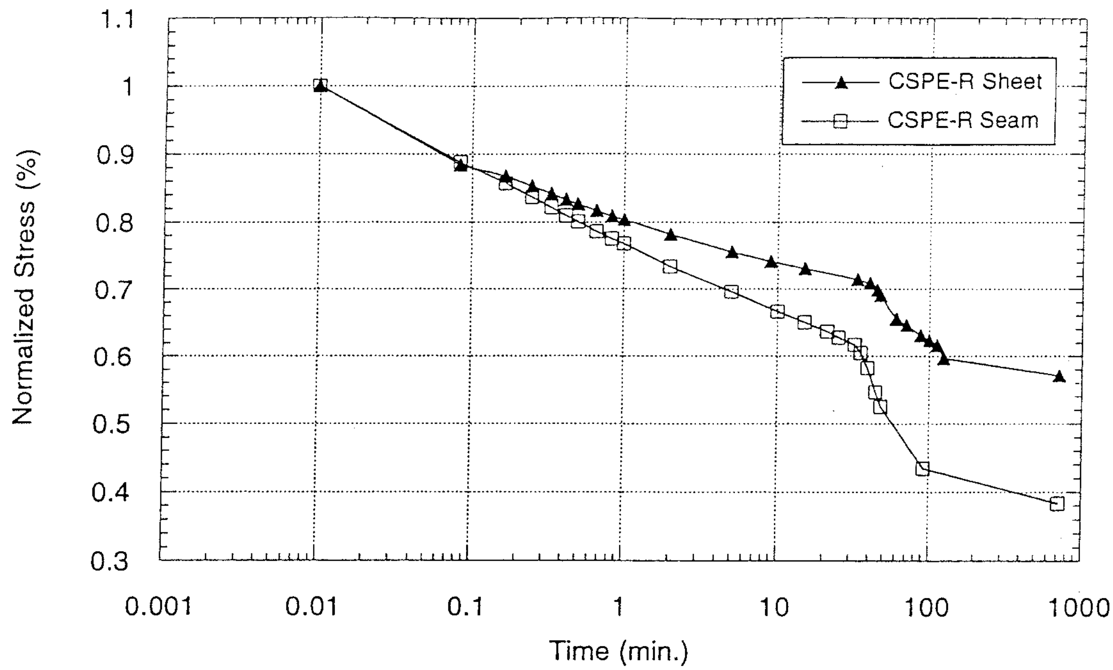

Figure 15. - An example of stress relaxation behavior of reinforced geomembrane sheets and seams.

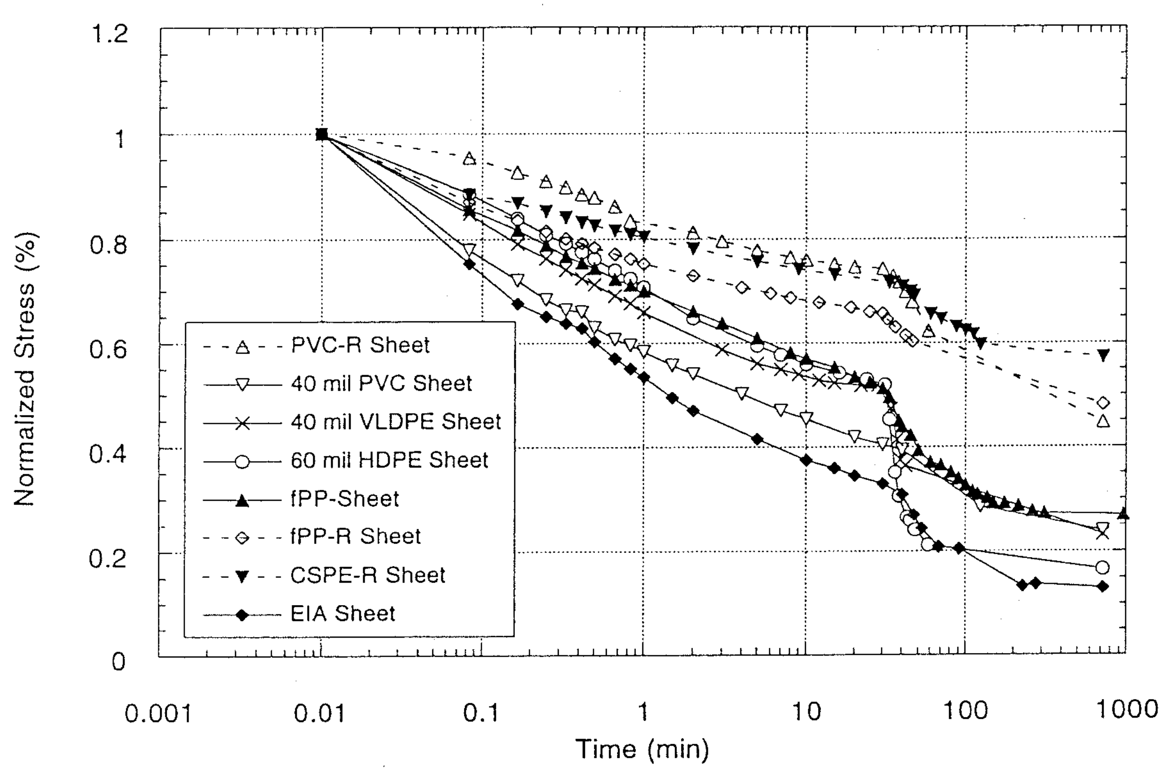

Figure 16. - Stress relaxation behavior of geomembrane sheets for each polymer type.

2. For the seven polymer types involved in this test, HDPE exhibited the highest induced stress. HDPE has a high linear thermal expansion coefficient in addition to a high tensile modulus. Based on the equation below, a comparably high induced stress was expected.

$$\sigma = \alpha * \Delta T * E$$

where: σ = induced stress
α = linear thermal expansion coefficient
ΔT = temperature difference
E = tensile modulus

This equation also explains the low induced stress exhibited by the VLDPE materials. Although VLDPE has a higher linear thermal expansion coefficient than HDPE, it has a much lower tensile modulus.

3. A large difference exists in the induced stress between non-reinforced PVC and reinforced PVC. For non-reinforced PVC geomembranes, about 250 lb/in^2 was induced from +20 to -20 °C. In contrast, the induced stress of PVC-R material was 4 times higher. This stress is probably caused by the relatively high T_g (glass transition temperature) of PVC-R geomembrane, which is -30 °C, whereas the T_g of PVC is -45 °C. See figures 17 and 18 for PVC-R and PVC thermal curves, respectively. At -20 °C testing temperature, the PVC-R geomembrane was approaching a glassy state. Thus, the modulus of the material increased as demonstrated by the E' curve on figure 15, resulting in a high induced stress.

Repeatability in the Magnitude of the Cold Temperature Induced Tensile Stress

The repeatability of the induced stress was investigated by repeating the cooling and heating cycle from +30 °C to -20 °C twice, as illustrated in the temperature profile graph on figure 10. From the load versus time graphs included as appendix K, the magnitude of the induced stresses in both cooling cycles was very similar for all tested materials. This similarity suggests that the constrained specimens in Part III of the study were subjected to the same magnitude of cyclic loading during each of the 500 freeze-thaw cycles.

DISCUSSION OF FREEZE-THAW EFFECTS

In this section, the results of Parts I, II, and III are separately discussed so that the effects of freeze-thaw cycling can be clearly described.

Part I

After the 19 geomembrane sheet and 27 geomembrane seam specimens were exposed to 200 freeze-thaw cycles in a relaxed stage and then were tested at room temperature, no changes were detected in any of the sheet tensile behavior and seam shear and peel strengths.

Part II

Six geomembrane sheet and 13 geomembrane seam specimens were exposed to 200 freeze-thaw cycles in a relaxed state and then were tested at -20 °C. If defects were created in the tested materials during freeze-thaw cycling, they probably would be more sensitive to cold temperature testing than the +20 °C testing of Part I. However, no changes were observed in either the sheet tensile behavior or the seam shear and peel strengths.

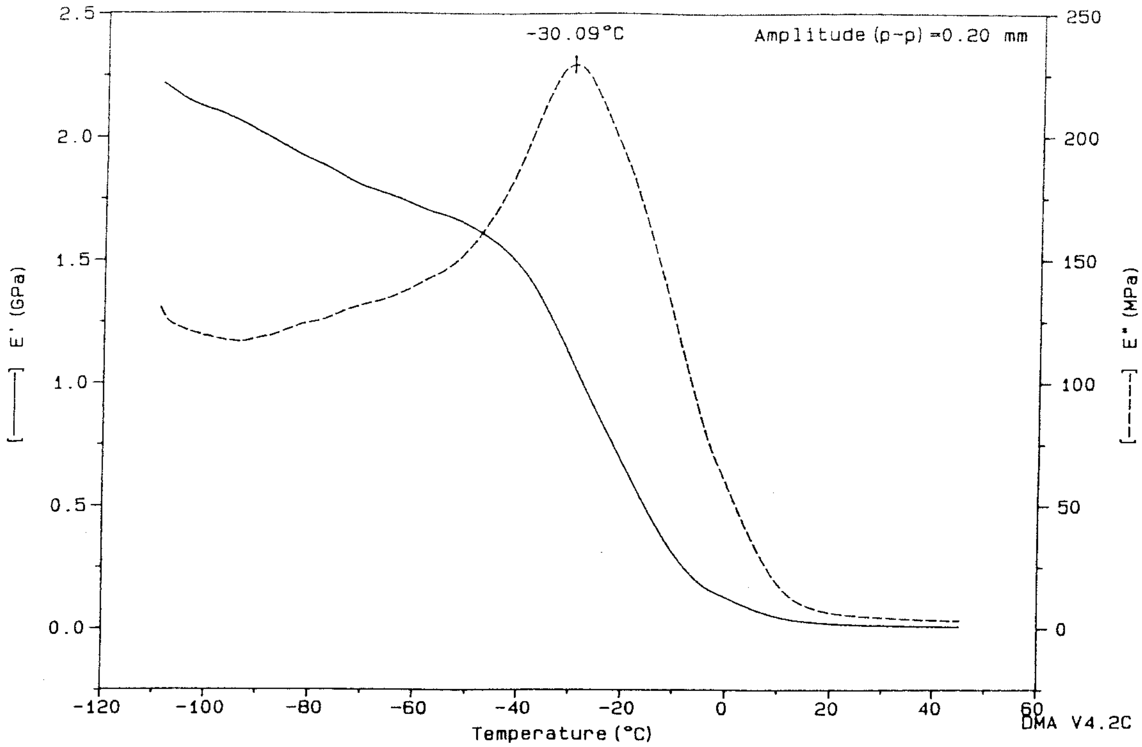

Figure 17. - Thermal curve of PVC-R indicating its T_g is at -30 °C.

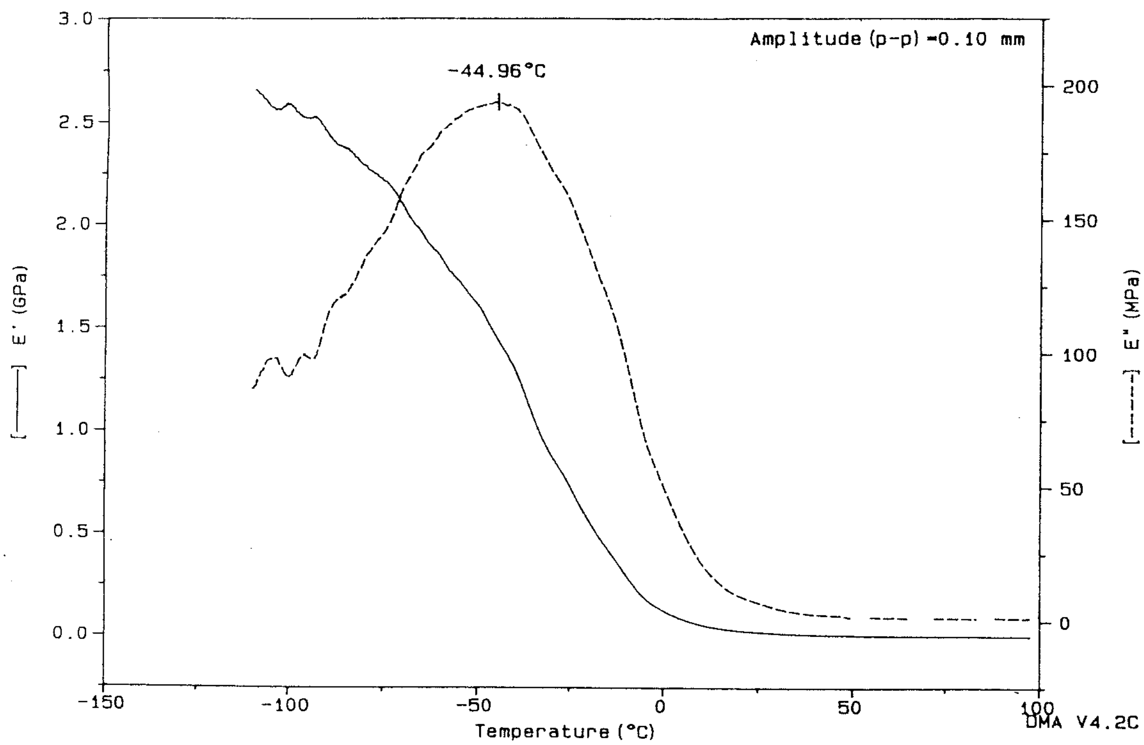

Figure 18. - Thermal curve of PVC indicating its T_g is at -45 °C.

Part III

The same 19 geomembrane sheet and 27 seam specimens as used in Part I were exposed to 500 freeze-thaw cycles in a constrained condition. As indicated in the results of Part IV, a repeatable thermal induced stress was also imposed onto the constrained specimens during each freeze part of the cycles. The magnitude of the induced stresses depended on the type of the polymer. In addition, the cold temperature induced stress remained in the specimen until the temperature of the specimen was changed, as proved by Lord et al. (1995). Thus, tested specimens of this part of the study were subjected to a more severe incubation condition than those in Part I. In spite of this difference, no changes were observed in any of the sheet tensile properties or seam shear and peel strengths.

DISCUSSION OF THE EFFECTS OF COLD TEMPERATURE TESTING

The effects of cold temperature testing can be evaluated by comparing data of Part II tests to data of Part I tests. The evaluation included strength and elongation of 6 geomembrane sheets and 9 geomembrane seam shear and peel strengths.

Sheet Testing

For the PVC, HDPE, and HDPE-T geomembranes, strength values at -20 °C were all higher than those at +20 °C. In contrast, corresponding elongation values were lower.

However, a different type of tensile behavior was observed in the PVC-R geomembrane sheet. Only a single breaking peak was detected at -20 °C instead of the customary two peaks at +20 °C, which corresponded to the breaking of the reinforcing scrim and membrane, respectively. The change in the tensile behavior is probably attributable to the high T_g of PVC-R. At -20 °C, the PVC membrane component, which was approaching its T_g, became stronger than the reinforcing scrim. The glass transition temperature of PET (polyethylene terephalate) reinforcing scrim is +70 °C; thus, the strength of the PET scrim would have less change between +20 and -20 °C).

For the VLDPE and VLDPE-T materials, direct comparison was unable to be performed because of the different tensile behavior. A pronounced yielding was detected at -20 °C which was not observed at +20 °C. However, at -20 °C testing, breaking strength was not measured because of limited chamber height. Nevertheless, the overall tensile load at -20 °C seems to be higher than that at +20 °C, at least over the evaluated elongation range.

Seam Testing

In the seam shear tests, all other seams showed a higher strength at -20 °C than at +20 °C, except VLDPE materials. For the VLDPE seams, the shear strength from Parts I and II could not be directly compared for the same reasons as explained in the sheet testing. However, a higher shear tensile load was observed at -20 °C than at +20 °C over the tested elongation range.

In the seam peel tests, the seam strengths of PVC-R, PVC, and VLDPE materials were greater at -20 °C than at +20 °C. On the other hand, no significant changes were detected in the peel strength of HDPE materials.

DISCUSSION OF THE EFFECTS OF TEMPERATURE INDUCED CYCLIC STRESS

The influence of the cold temperature induced cyclic stress during the freeze-thaw cycling on the tensile behavior of the test specimens was investigated by comparing data of Part III tests to those of Part I tests. The evaluation included strength and elongation of geomembrane sheets and seam shear and peel strengths.

Sheet Testing

The tensile strength and elongation of 19 geomembrane sheet materials in Parts I and III of the study were compared. No significant difference exists between the two sets of data. In addition, the initial straining was also evaluated by comparing the first cycle data of Part III to the as-received data. The tensile behavior was not affected, probably because of the rapid stress relaxation in the material as explained in the previous section. Therefore, neither the initial straining nor cold temperature induced cyclic stress altered the tensile properties of the geomembrane sheet after 500 freeze-thaw cycles.

Seam Testing

The shear strengths of 27 geomembrane seams in Parts I and III of the study were compared. No substantial difference existed between the two sets of data. In addition, the initial straining did not show an influence in the shear strength.

For the peel strength, 25 geomembrane seams were compared between Parts I and III. Overall, no significant difference was observed. Although the peel tests of VLDPE in Part I were performed using a strain rate of 8.5 mm/sec (20-in/min) instead of the 0.8-mm/sec (2-in/min) rate used in Part III tests, the seam peel strength values were very similar. The initial straining also did not affect the peel strength of the seams.

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APPENDIX G

EAST PLANT AREA COVER SYSTEM DESIGN
SUPPORTING CALCULATIONS

(TO BE UPDATED FOR WEST PLANT AREA PENDING DESIGN COMPLETION
EAST PLANT AREA CALCULATIONS PRESENTLY ASSUMED TO BE APPLICABLE)

ENGINEERING DESIGN CALCULATION

PROJECT IDENTIFICATION

Client: GM Powertrain ` 013968

Project: East Plant Area Cover System Location: Bedford,Indiana

CALCULATION IDENTIFICATION

Calculation Ref. No.: ______ No. Pages: 10
(Including calculation cover sheet)

Calculation Description:

CAP DRAINAGE LAYER HYDRAULICS

Design: A.Wesolowski Date: Aug 22/05

Checked: R.Hoekstra Date: Aug 22/05

RECORD OF REVISION

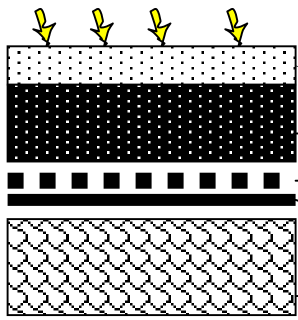
Revision No.	Revision Date	Design	Checked	Supervised	Project Control	Detail of Revision
0	--	--	--	--	--	Original (per above)
1	Sept 26/06	A.W.	R.H.			Liner revised; drainage net product revised.

CAP DRAINAGE LAYER HYDRAULICS

1. GEOCOMPOSITE DRAINAGE NET HYDRAULICS

1.1 Data input

-cap design:



- soil layer permeability: k = 0.00001 cm/s (1×10^{-7} m/s)

- Slope gradient and length for selected critical paths:

  a) 5:1 approx. 250 ft = 76.2 m
  b) 4:1 approx. 150 ft = 45.7 m
  c) 3:1 approx. 75 ft = 22.9 m

- reduction factors for drainage composite
  for intrusion RF_{in} = 1.5
  for creep RF_{cr} = 1.4
  for chemical clogging RF_{cc} = 1.2
  for biological clogging RF_{bc} = 1.6
  overall FS = 2
  Total Fs = 8

- criteria for Lateral Drainage for Final Cover Side Slope, Landfill Drainage System www.landfilldesign.com Unit Gradient Method (see attached).

1.2 Infiltration into drainage layer Q_{in}

Calculated infiltration rates , based on length along the slope L_s , given soil permeability k and vertical seepage gradient = 1, for selected critical paths.

$$Q_{in} = L_s \times k \times 1 \quad (\text{m}^3/\text{sec per meter width})$$

a) $Q_{in} =$ 76.2 m x 0.0000001 m/s x 1 = 0.0000076 m^3/s for 5:1
b) $Q_{in} =$ 45.7 m x 0.0000001 m/s x 1 = 0.0000046 m^3/s for 4:1
c) $Q_{in} =$ 22.9 m x 0.0000001 m/s x 1 = 0.0000023 m^3/s for 3:1 slope.

1.3 Required transmissivity of the geocomposite Y_{ult}

Required (ultimate) geocomposite transmissivities for selected paths have been calculated utilizing software program , Unit Gradient Method, (see attached).

a) Y ult = 0.000313 m^2/s for 5:1 slope
b) Y ult = 0.000152 m^2/s for 4:1 slope
c) Y ult = 0.000059 m^2/s for 3:1 slope

1.4 Available transmissivity of the geocomposite Y_{avail}

Available transmissivities for SKAPS TN-330-2-6 geocomposite product, according to attached manufacturer chart for given (design) gradients and normal pressure of approximately 1000 psf at given cap design configuration.

a) Yavail = 0.00095 m2/s for 5:1 slope

b) Yavail = 0.00085 m2/s for 4:1 slope

c) Yavail = 0.0007 m2/s for 3:1 slope

1.6 Conclusion

According to the results as shown above, available transmissivities of SKAPS product are fully satisfactory, and no lateral drains are required. Flow generated from the cap infiltration will be fully contained within the drainage layer.

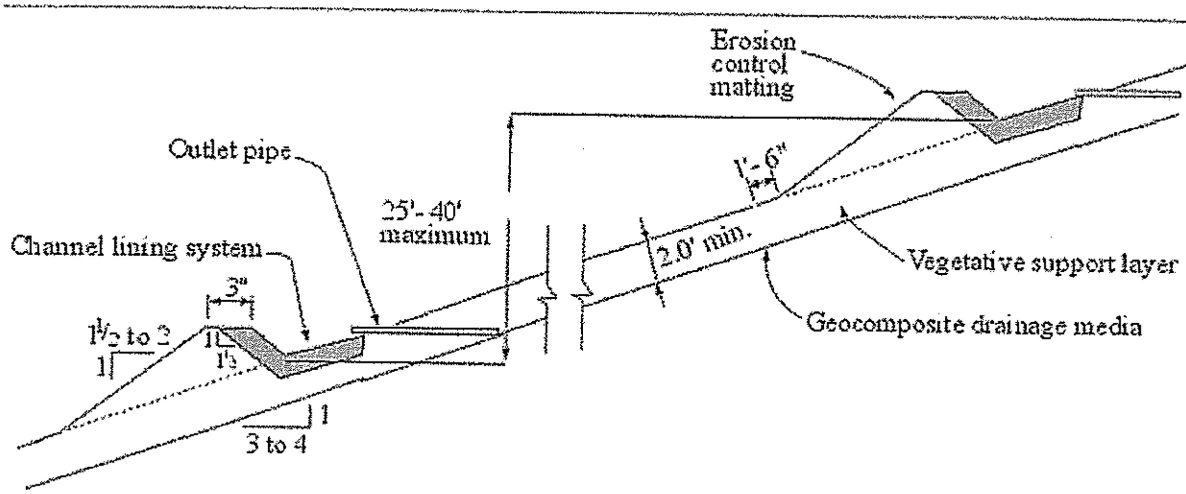
Y avail = 0.00095 m2/s > Y ult = 0.000313 m2/s for 5:1 slope
Y avail = 0.00085 m2/s > Y ult = 0.000152 m2/s for 4:1 slope
Y avail = 0.00077 m2/s > Y ult = 0.000059 m2/s for 3:1 slope

For areas where the design slope is 5% to 10% SKAPS drainage net is still able to perform at the capacity of approximately 0.0012 m2/s, which should be more than sufficient, providing that the length of the slope is no more than 30 to 40 ft or 9 to 12 m.

landfilldesign.com

Unit Gradient Method - Design Calculator

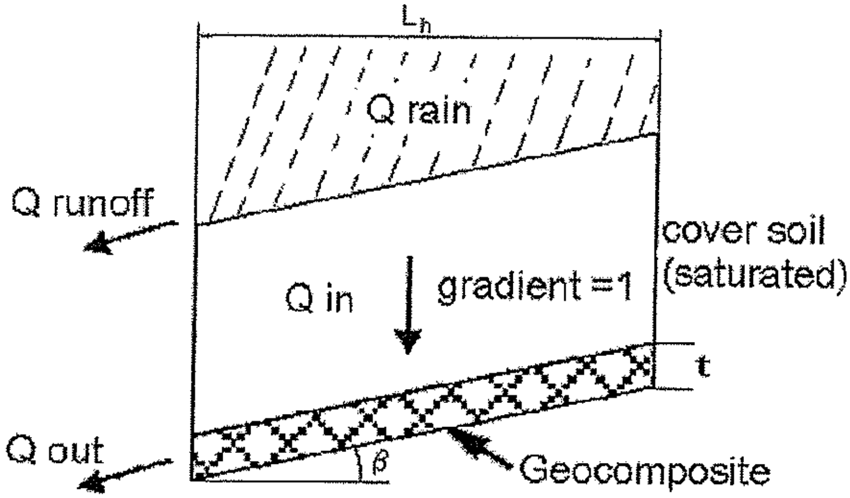
Problem Statement



The transmissivity of a drainage geocomposite must be great enough to carry all of the infiltrating flow from the soil layer(s) above. If the drainage geocomposite can not carry all the infiltrating water (very long slope, or very permeable cover soil,...); swales can be placed as shown in the above figure. The three conditions for stability are:

1. The interface shear strength of all interfaces is adequate
2. Pore water pressures do not build up and reduce the contact stress between the geomembrane and the soil. The Seepage Force Stability Calculator can be used to determine the factor of safety of a landfill cover with consideration of seepage forces
3. Landfill gas pressures beneath the liner are vented properly.The Landfill Gas Pressure Relief Calculator can be used to determine the gas transmissivity of the relief layer. The Landfill Gas Stability Calculator can be used to verify the factor of safety of a landfill cover subject to landfill gas pressure underneath a geomembrane liner.

This webpage determines the ultimate transmissivity sufficient to transmit all incoming flow within the thickness of the geocomposite; i.e. maximum head < geonet thickness; therefore seepage forces in the cover soil will be zero.



With Darcy's law:

$$Q = k * i * A$$

Inflow of water in the geocomposite

$$Q_{in} = k_{veg} * i * A = k_{veg} * 1 * L_h * 1$$

Outflow of water from the geocomposite at the toe of the slope

$$Q_{out} = k_{comp} * i * A = k_{comp} * i * t * 1 = \theta_{required} * \sin\ \beta$$

Inflow equals outflow (Factor of Safety = 1)

$$Q_{in} = Q_{out}$$

This results in a required transmissivity of the geocomposite of:

$$\theta_{required} = \frac{k_{veg} * L_h}{\sin\ \beta}$$

Which results in the ultimate transmissivity after multiplying by the Total Serviceability Factor (TSF)

$$\theta_{ultimate} = \theta_{required} * FS_g * RF_{in} * RF_{cr} * RF_{cc} * RF_{bc}$$

Required Data

Symbol	Name	Dimensions
L_h	Drainage pipe spacing or length of slope measured horizontally	Length
k_{veg}	Permeability of the vegetative supporting soil	Length/Time
S	The liner's slope, S = tan b	-
FS_{slope}	Minimum factor of safety against sliding, for soil/geocomposite or geocomposite/geomembrane interfaces	-

FS_d	Overall factor of safety for drainage
RF_{in}	Intrusion Reduction Factor
RF_{cr}	Creep Reduction Factor
RF_{cc}	Chemical Clogging Reduction Factor
RF_{bc}	Biological Clogging Reduction Factor

Input Values

Note: If you do not wish to perform calculations for 3 cases, please leave default data as is.

	Case 1		Case 2		Case 3	
S	20	%	25	%	33	%
L_h	76.2	m	45.7	m	22.9	m
k_{veg}	0.00001	cm/sec	0.00001	cm/sec	0.00001	cm/sec
FS_{slope}	1.5		1.5		1.5	

Reduction Factors and Safety Factor

	Case 1	Case 2	Case 3		Surface Water Drains
RF_{in}	1.5	1.5	1.5	[1]	1.0 - 1.2
RF_{cr}	1.4	1.4	1.4	[2]	Calculate RF_{CR}
RF_{cc}	1.2	1.2	1.2	[3]	1.0 - 1.2
RF_{bc}	1.6	1.6	1.6	[3]	1.2 - 3.5
FS_d	2	2	2	[4]	2.0 - 10.0

Calculate Transmissivity

[1] Intrusion reduction factor from 100 hour to design life. Giroud et. al (2000)

[2] Creep reduction factor from 100 hour to design life (for instance, 30 years). RF_{CR} is determined from 10,000 hour compressive creep test, extrapolated to design life, GRI-GC8 (2001). RF_{CR} is product and normal load specific.

[3] GRI-GC8

[4] FS value = 2-3. Giroud, et. al (2000)
FS value > 10 for filtration and drainage. Koerner (2001)

[5] Note: The calculated transmissivity is corresponding to the case where the seating time is 100 hours and the boundary conditions due to adjacent materials are simulated in the hydraulic transmissivity test.

Solution

Symbol	Name	Dimensions
gradient	Gradient	
$\theta_{ultimate}$	Ultimate Transmissivity	$Length^2/Time$
$\delta_{req'd}$	Minimum interface friction angle	degrees

	Case 1		Case 2		Case 3	
gradient	0.20		0.24		0.31	
$\theta_{ultimate}$	3.13E-004	m^2/s	1.52E-004	m^2/s	5.89E-005	m^2/s
$\delta_{req'd}$	16.70	degrees	20.56	degrees	26.34	degrees

Material Selection

Follow the GFR link to view our extensive database of geosynthetic materials reprinted with permission of IFAI

Additional Assistance

If you would like to have Advanced Geotech Systems provide material specifications that meet your performance criteria, please fill in the following fields and click the submit button. All information is kept strictly confidential.

Name *

Company

Email Address *

Phone

Project Reference

Comments

*required fields

Submit Design Results

Sponsored by

The following companies can service any of your geosynthetic drainage material selection needs.

TENAX Engineered for Life GSE POLYFLEX, INC.

References

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SKAPS Industries
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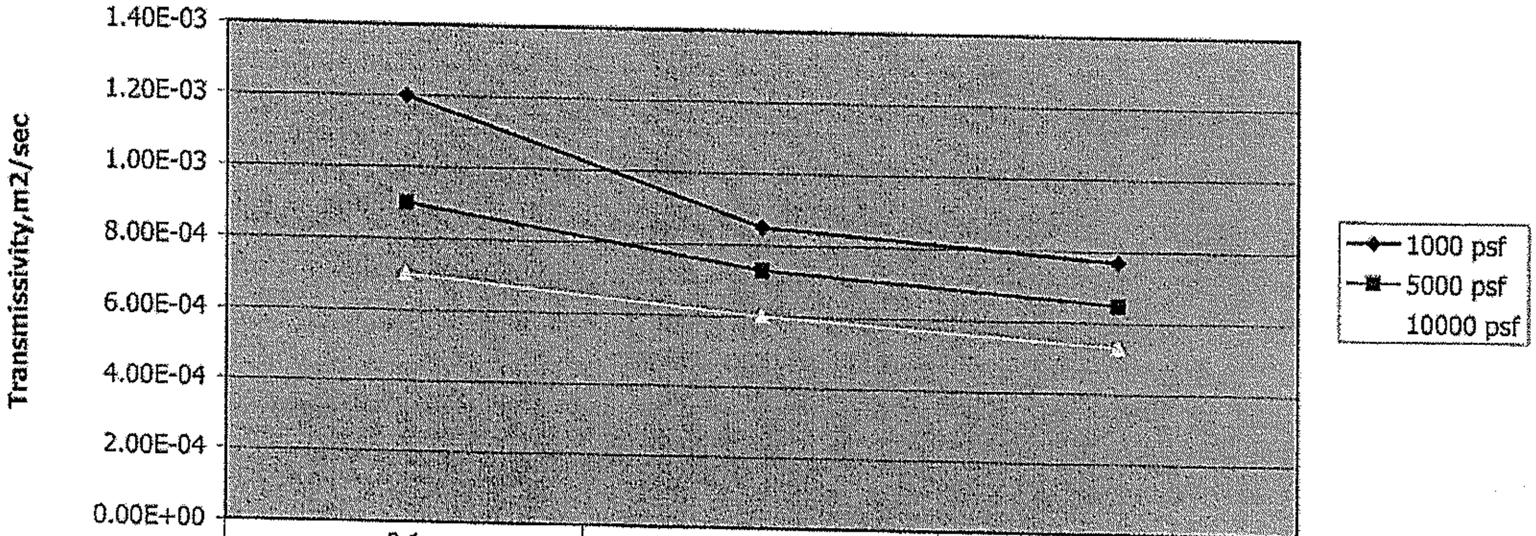
E-mail: info@skaps.com

Transmissivity vs Gradient for TN 330-2-6 for Boundary Conditions of sand & liner



	0.1	0.25	0.33
1000 psf	1.20E-03	8.50E-04	7.70E-04
5000 psf	9.00E-04	7.30E-04	6.50E-04
10000 psf	7.00E-04	6.00E-04	5.30E-04

Gradient

Setting Time 100 hrs..

Engineered Synthetic Products, Inc.
Tel (770) 564-1857
Fax (770) 564-1818
www.espgeosynthetics.com

SKAPS Nonwoven
ENVIRONMENTAL GEOTEXTILES

PROPERTY	UNIT	ASTM TEST METHOD	GE-140 4 oz	GE-160 6 oz	GE-170 7 oz	GE-180 8 oz	GE-110 10 oz	GE-112 12 oz	GE-114 14 oz	GE-116 16 oz
Weight	oz/yd² (g/m²)	ASTM D 5261	4.0 (135)	6.0 (203)	7.0 (237)	8.0 (271)	10.0 (339)	12.0 (407)	14.0 (475)	16.0 (542)
Thickness*	mils (mm)	ASTM D 5199	70 (1.77)	85 (2.16)	90 (2.29)	100 (2.5)	110 (2.79)	120 (3.05)	135 (3.43)	175 (4.45)
Grab Tensile	lbs (kN)	ASTM D 4632	105 (0.467)	160 (0.711)	200 (0.889)	225 (1.0)	270 (1.20)	330 (1.47)	390 (1.73)	425 (1.89)
Grab Elongation	%	ASTM D 4632	50	50	50	50	50	50	50	50
Trapezoid Tear	lbs (kN)	ASTM D 4533	45 (0.20)	65 (0.29)	75 (0.33)	90 (0.40)	100 (0.44)	125 (0.556)	135 (0.60)	150 (0.667)
Puncture Resistance	lbs (kN)	ASTM D 4833	65 (0.289)	95 (0.42)	115 (0.511)	130 (0.578)	165 (0.733)	190 (0.844)	210 (0.930)	240 (1.07)
Mullen Burst	psi (kPa)	ASTM D 3786	230 (1585)	330 (2274)	370 (2549)	425 (2928)	525 (3617)	625 (4306)	700 (4823)	800 (5512)
Permittivity*	sec⁻¹	ASTM D 4491	2.00	1.63	1.41	1.26	0.94	0.90	0.64	0.57
Permeability*	cm/sec	ASTM D 4491	0.55	0.48	0.46	0.30	0.30	0.30	0.25	0.25
Water Flow*	gpm/ft² (1/min/m²)	ASTM D 4491	160 (6518)	125 (5080)	110 (4470)	100 (4074)	75 (3055)	70 (2544)	50 (2037)	45 (1833)
A.O.S.*	U.S. Sieve (mm)	ASTM D 4751	70 (0.212)	70 (0.212)	70 (0.212)	80 (0.180)	100 (0.150)	100 (0.150)	100 (0.150)	100 (0.150)
U.V. Resistance	%/hrs	ASTM D 4355	70/500	70/500	70/500	70/500	70/500	70/500	70/500	70/500

* At time of manufacturing. Handling, storage, and shipping may change these properties.

PACKAGING								
Roll Dimensions (ft)	15 x 1350	15 x 900	15 x 780	15 x 690	15 x 570	15 x 480	15 x 390	15 x 360
Square Yards/Roll	2250	1500	1300	1150	950	800	650	600
Estimated Roll Weight (lbs)	620	620	620	620	620	620	620	620

ENGINEERING DESIGN CALCULATION

PROJECT IDENTIFICATION

Client: GM Powertrain ` 013968

Project: East Plant Area Capping Location: Bedford, Indiana

CALCULATION IDENTIFICATION

Calculation Ref. No.: ____________ No. Pages: 3
(Including calculation cover sheet)

Calculation Description:

BURIED PIPING STRUCTURAL

Design: A.Wesolowski Date: Sept 27/06

Checked: R.Hoekstra Date: Sept 27/06

RECORD OF REVISION

Revision No.	Revision Date	Design	Checked	Supervised	Project Control	Detail of Revision
0	--	--	--	--	--	Original (per above)

CRA	PROJECT NO: 013968	DESIGNED BY: A.W.
	PROJECT NAME: East Plant area Cap	CHECKED BY:R.H.
	DATE : Sept 27/06	PAGE 2 OF 3

1. BUIRED PIPING STRUCTURAL

Data Given

- depth of bury 40 ft below grade
- soil density 120 lbs/cf
- water table above pipe 1 ft
- soil modulus 2000 psi
- pipe material HDPE SDR 17, pipe series 1000 (Driscopipe)

Ring Deflection

Based on Phillips Driscopipe Burial software, calculated ring deflection = 1.67 %, which is acceptable, (see attached results).

Phillips Driscopipe
2929 N. Central Expwy, #300
Richardson, TX 75080
1-800-527-0662
www.driscopipe.com

Burial Calculation

Calculated by : aw
Company : cra
Address :
State :
Phone :
Fax :
E-mail :

Calculated For : GM Bedford
Company :
Project : 013968

Input Variables were as follows:

Using Driscopipe 1000

SDR = 17
Burial Depth to Crown of Pipe = 40
Soil Density = 120
Water Table (feet above crown of pipe) = 1
Other Loads = 0
Soil Modulous = 2000
Conservative Long Term Pipe Modulous @ 23 Deg C = 35000

Allowable Ring Deflection @ 1.0% strain = 4.25
S(A) (Stress in Pipe Wall) = 267.78
P(T) (Pressure at Crown of Pipe = 33.47
P(CB) (Critical Buckling Pressure = 145.45
Calculated Ring Deflection (%) = 1.67
Crushing Design Safety Factor = 5.6 to 1
Wall Buckling Design Safety Factor = 4.3 to 1
Ring Deflection = acceptable

Comments :

DRAFT FOR REVIEW

INSPEC-SOL INC. **651 Colby Drive, Waterloo, Ontario N2V 1C2**
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MEMO

TO :	Andrew Wesolowski/ Rick Hoekstra, P. Eng.	**DATE :**	August 05, 2005 (revised November 23, 2006)
FROM :	Bruce Polan/Hassan Gilani/mw/255	**REFERENCE #:**	013968-00
SUBJECT :	Cap Veneer Stability East Plant Area Cover System GM Powertrain Bedford Facility, Bedford, Indiana		

1.0 INTRODUCTION

This memo provides a summary of the cap veneer stability analyses of the proposed cover system in the East Plant Area, GM Powertrain Facility, Bedford, Indiana.

Based on the information provided by Mr. Wesolowski, the cap structure placed at a maximum gradient of 4 Horizontal: 1 Vertical (25 percent) will comprise of the following (from top to bottom):

- 6 inch thick topsoil layer;
- 12 inch thick common fill layer;
- Geonet;
- 60-mil LLDPE textured liner; and
- 12 inch thick clay layer.

2.0 CAP VENEER STABILITY ANALYSES

The critical interface layers in the cap will be the common fill versus geonet, geonet versus liner, and liner versus the underlying clay layer. The frictional stability of these three interfaces has been analyzed for both drained and undrained conditions. The undrained conditions assumes a conservative value of 6-inches of water head on the geonet. The stability of the cap system has also been evaluated for seismic loading conditions through a pseudo-static analyses. A value of 0.13 g has been used based on United States Geological Survey Seismic Hazard Map for Indiana showing peak acceleration (percent of earth's gravitational force, or g) contours with a 2 percent probability of exceedance in 50 years.

MEMO (continuous)

3.0 CONCLUSIONS

The attached Table 1 presents the interface friction stability results of the cap components. The factors of safety for static-drained conditions range from 2.13 to 4.89, and for static-undrained conditions range from 1.80 to 4.15. The factors of safety for pseudo static-drained conditions range from 1.35 to 3.14, and for pseudo-static-undrained conditions range from 1.14 to 2.65. The calculated factors of safety are considered acceptable and show that the proposed cover system design will be stable.

As noted in Table 1, the interface frictional properties for the various materials in the cap have been assumed based on a CRA database compiled from published literature on interface friction testing.

TABLE 1

COVER SLIDING STABILITY ANALYSES
PROPOSED LANDFILL CAP
GM POWERTRAIN BEDFORD FACILITY
BEDFORD, INDIANA

Option	Layer Thickness (ft)		Critical Interface (1)	Weighted Avg. Cover Density γ (pcf) (2)	Depth to Failure Plane z (ft) (3)	Depth to Water d_w (ft) (3)	Interface Shear Strength (4)		Landfill Slope β		Factor of Safety		K_y
	Topsoil	Common Fill					Cohesion c (psf)	Angle of friction (ϕ)	Degrees	H:V	Static	Pseudo-static	
Dry Slope	0.5	1.0	Topsoil and Fill Soil Vs Geonet	116.7	1.55	1.55	0	28	14.04	4:1	2.13	1.35	0.25
	0.5	1.0	Geonet Vs Textured Liner	116.7	1.55	1.55	0	32	14.04	4:1	2.50	1.59	0.32
	0.5	1.0	Textured Liner Vs Clay	116.7	1.55	1.55	55	42	14.04	4:1	4.89	3.14	0.79
Slope with 6" of water	0.5	1.0	Topsoil and Fill Soil Vs Geonet	137.5	1.55	1.03	0	28	14.04	4:1	1.80	1.14	0.18
	0.5	1.0	Geonet Vs Textured Liner	137.5	1.55	1.03	0	32	14.04	4:1	2.12	1.34	0.24
	0.5	1.0	Textured Liner Vs Clay	137.5	1.55	1.03	55	42	14.04	4:1	4.15	2.65	0.64

$$\text{Factor of Safety (FS)} = \frac{c/(\gamma.z.\cos^2\beta) + \tan\phi\,[1-\gamma_w(z-d_w)/(\gamma.z)] - k_s \tan\beta \tan\phi}{k_s + \tan\beta}$$

$$\text{yield acceleration } k_y = \frac{c/(\gamma.z.\cos^2\beta)+\tan\phi\,[1-\gamma_w(z-d_w)/(\gamma.z)] - \tan\beta}{1+ \tan\phi \tan\beta}$$

γ_w (density of water pcf) = 62.4
Seismic coefficient k_s = 0.13
Static Factor of Safety k_s = 0

1) Geonet and GCL interface surfaces assumed to comprise non-woven geotextile
2) Vegetative organic soil density = 100 pcf.cover. On-site non-compacted soil density = 125 pcf.
3) Depth to critical surface/water measured vertically from the ground surface
4) Interface shear properties have been assumed based on literature review and CRA's past experience.

ENGINEERING DESIGN CALCULATION

PROJECT IDENTIFICATION

Client: GM Powertrain — 013968

Project: Landfill vault — Location: Bedford,Indiana

CALCULATION IDENTIFICATION

Calculation Ref. No.: ______ No. Pages: 5 (Including calculation cover sheet)

Calculation Description:

VAULT BEARING CAPACITY CHECK

Design: A.Wesolowski — Date: Aug 31/05

Checked: R.Hoekstra — Date: Aug 31/05

RECORD OF REVISION

Revision No.	Revision Date	Design	Checked	Supervised	Project Control	Detail of Revision
0	--	--	--	--	--	Original (per above)
1	Jan 12/07	A.W.	R.H.	--	--	Sump height revised to 75′

VAULT BEARING CAPACITY CHECK

1.Data Input

- depth of material on top of geomembrane, max. d = 75 ft;
- density of material approx. q = 110 pcf;
- concrete sump height approx. 75 ft ;
- concrete sump 6 ft dia. sections weight 1500 lbs per lf;
- allowable bearing pressure for clay material approx. Pallow=6000 psf , (at the surface application);
- sump bottom area approx. 38.5 sf

2. Check at sump location

Bearing pressure available:

Pavail = 75 ft x 1500 lbs/lf / 38.5 sf =
= 2922 psf < Pallow (6000psf)
(conservative approach , not including overburden reaction – backfill control).

Design OK. Manhole will not "punch through" clay base.

2. Check at the deepest point

Bearing pressure available:

Pavail = 75 ft x 110 pcf = 8250 psf

CRA	PROJECT NO:013968	DESIGNED BY: A.W.
	PROJECT NAME: GM Powertrain	CHECKED BY: R.H.
	DATE : Aug 31/05	

Bearing pressure allowable including overburden reaction – backfill control

P'allow = Pallow + (q x d x N)/FS

N – depth factor = 1
FS – factor of safety, use = 2

P'allow = 6000psf + (110 pcf x 75 ft x 1) / 2 =
= 10125 psf > Pavail (8250 psf)

Design OK. Vault contents will not exceed allowable bearings pressure of clay sub-base, thus preventing soil displacement and "punch through" of bottom liner system.

GEOTECHNICAL ENGINEERING TECHNIQUES AND PRACTICES

ROY E. HUNT
Consulting Engineer

McGraw-Hill Book Company
*New York St. Louis San Francisco Auckland
Bogotá Hamburg London Madrid
Mexico Montreal New Delhi Panama Paris
São Paulo Singapore Sydney Tokyo Toronto*
1986

TABLE 6.1
NOMINAL VALUES FOR ALLOWABLE BEARING PRESSURE FOR SPREAD FOUNDATIONS*

Type of bearing material	Consistency in place	Allowable bearing pressure, tsf: Ordinary range	Allowable bearing pressure, tsf: Recommended value for use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Hard, sound rock	60 to 100	80
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Medium hard sound rock	30 to 40	35
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Medium hard sound rock	15 to 25	20
Weathered or broken bedrock of any kind except highly argillaceous rock (shale)	Soft rock	8 to 12	10
Compaction shale or other highly argillaceous rock in sound condition	Soft rock	8 to 12	10
Well-graded mixture of fine and coarse-grained soil: glacial till, hardspan, boulder clay (GW-GC, GC, SC)	Very compact	8 to 12	10
Gravel, gravel-sand mixtures, boulder-gravel mixtures (GW, GP, SW, SP)	Very compact	6 to 10	7
	Medium to compact	4 to 7	5
	Loose	2 to 6	3
Coarse to medium sand, sand with little gravel (SW, SP)	Very compact	4 to 6	4
	Medium to compact	2 to 4	3
	Loose	1 to 3	1.5
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very compact	3 to 5	3
	Medium to compact	2 to 4	2.5
	Loose	1 to 2	1.5
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very compact	3 to 5	3
	Medium to compact	2 to 4	2.5
	Loose	1 to 2	1.5
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very stiff to hard	3 to 6	4
	Medium to stiff	1 to 3	2
	Soft	0.5 to 1	0.5
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard	2 to 4	3
	Medium to stiff	1 to 3	1.5
	Soft	0.5 to 1	0.5

*From NAVFAC (1982).[13]

NOTES:

1. Variations of allowable bearing pressure for size, depth, and arrangement of footings are given in the text.
2. Compacted fill, placed with control of moisture, density, and lift thickness, has allowable bearing pressure of equivalent natural soil.
3. Allowable bearing pressure on compressible fine grained soils is generally limited by considerations of overall settlement of structure (Fig. 6.9).
4. Allowable bearing pressure on organic soils or uncompacted fills is determined by investigation of individual case.
5. Allowable bearing pressure for rock is not to exceed the unconfined compressive strength.