REMEDIAL INVESTIGATION

EG&G KT AEROFAB

MISSOURI METALS PROPERTY

OVERLAND, MISSOURI

Volume I OF III

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Burns & McDonnell Waste Consultants, Inc.
Engineers-Geologists-Scientists
Overland Park, Kansas - St. Louis, Missouri

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Prepared by:

Bill Weis, P.E.
Environmental Engineer

Debbie Snodgrass
Risk Assessment Specialist

Reviewed by:

Leo Ebel, P.E.
Project Manager

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EXECUTIVE SUMMARY

This report presents the findings of a remedial investigation (RI) at the Missouri Metal property located in Overland, Missouri. The RI was performed by Burns and McDonnell Waste Consultants, Inc. (BMWCI) for EG&G Missouri Metal Shaping Company (EG&G), the current property owner. Past investigations of the property include a multi-phase site assessment performed by Groundwater Technology, Inc. (GTI) and a Property Audit performed by O'Brien and Gere. As a result of these investigations, 18 monitoring wells and 33 boreholes have been installed on this 3.5 acre property.

The goal of the RI is to define geologic and hydrogeologic site characteristics and better define the nature and extent of contamination on the property. This information was needed to evaluate potential risks to human health and the environment posed by the property in its current condition. The results of the field investigations are summarized in this report.

The geologic conditions beneath the property limit the potential for contaminant migration. The upper soils consist of fill, that has moderate to high permeability. Surface water entering the fill will primarily migrate laterally along this upper soil layer. Below the fill is a silty-clay loess soil demonstrated by field and laboratory tests to have a low permeability. Groundwater movement in the silty-clay native soil is low. Groundwater and contaminant migration potential in this soil unit is limited. Off-site migration of contaminants in this soil layer is not expected to occur.

Groundwater movement beneath the property occurs primarily in the sandstone and siltstone bedrock layers in the upper bedrock. Contaminant levels in this bedrock layer are considerably less than levels detected in the upper soil. The decrease with depth in contaminant levels is likely due to the limited recharge to the bedrock groundwater from the property soil layer compared to flow contributions from upgradient areas. Most flow in the bedrock groundwater does not originate from the EG&G property. Volatile organic compound (VOC) levels in the bedrock groundwater will continue to decrease as distance from the release

point increases. VOC losses from the groundwater during migration are expected to result from advection, diffusion, adsorption, and biodegradation.

Vertical movement of groundwater within the upper bedrock will be restricted by low permeability shale and clay layers present in the upper bedrock. No recharge from the upper bedrock into the uppermost regional aquifer is expected to occur. Due to the low quantity and quality of groundwater available from the Pennsylvanian cyclic deposits of the Pleasanton Group, the upper bedrock is considered to be insignificant as an aquifer. No current or future use of the upper bedrock groundwater as a source of potable water is anticipated. A well survey performed by MDNR determined no current use of groundwater from the upper bedrock is known to exist. Potable water in the area is provided by the St. Louis County Water Company.

Groundwater migrating from the property will ultimately flow toward the downgradient drainage channel, the River des Peres. Eventual discharge of the groundwater to surface water is anticipated; however, VOC levels at the point of discharge would not be expected to pose water quality concerns. The River des Peres is a intermittent flow storm water drainage channel. Drainage entering the channel is predominantly from urban areas. During storm events this channel also receives sewer bypasses in some areas of the Metropolitan Area.

No pattern of significant soil contamination is indicated by all current and past investigation results. VOC levels exceeding Missouri Department of Health (MDOH) recommended levels were detected in six of fifty-seven soil samples. In each case, sample analysis data from nearby locations indicated lower levels of VOCs. Based on this data, the horizontal and vertical extent of the elevated contamination levels is limited. Soil sampling data provides no evidence of a major surface release of solvents. Soil sample analytical data indicates that areas of shallow soil contamination on the property are small and scattered.

Migration potential for VOCs through the air and surface water pathway is low. Surface soil erosion due to wind and surface water runoff are effectively prevented by the concrete, asphalt, and gravel surfaces covering the property. Concrete and asphalt surfaces cover 90 percent of the property surface. Movement

of VOC vapors in the subsurface is restricted by the low permeability of the tight silty-clay loess soil covering the property.

Due to the low mobility of site contaminants in this tight geologic setting and the absence of shallow groundwater use, no potential for exposure to VOCs in soil and groundwater has been identified. The industrial nature of the site and the concrete, asphalt, and gravel surfaces covering the property surface effectively prevent exposures to the isolated areas of chemical concentrations detected on the property. Industrial, commercial, or residential use of the shallow perched groundwater is not expected due to low yield and quality of the upper bedrock groundwater. The risk assessment performed for the property identified no current or future exposure risks which would necessitate remedial action. No adverse impacts on public health or the environment were identified through the evaluation of remedial investigation results.

* * * * *

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

In accordance with its corporate environmental policy, EG&G has committed itself to conducting all of its operations in an environmentally responsible manner. Since the purchase of the Missouri Metal Facility in 1988, EG&G has taken immediate and consistent remedial measures to address contamination concerns identified at the property. The remedial measures taken to eliminate and reduce environmental risks include the following:

- Source Remediation

  The degreasing tank was refurbished, and the degreasing pit (which houses the tank) was sealed and equipped with a spill containment system consisting of a sump pump and overflow container.

- Preventative Measures
  - A accumulation area designed to insure proper containment of hazardous wastes and materials was constructed.
  - The pickle room was revamped to include Catch basins and new tankage, providing secondary containment.
  - An alternative degreaser study was initiated to identify and install a degreasing technology that utilizes nonhazardous substances.

- Institutional Measures
  - A waste minimization/pollution prevention program has been instituted.
  - Supplemental personnel training in the areas of hazardous waste management and pollution prevention has been completed.
  - Corporate due diligence procedures were developed to prevent future acquisition of environmental liabilities.

In addition to the above remedial measures, EG&G has performed an investigation of the property to assess pre-existing environmental conditions as initially identified by the due diligence assessment completed by O'Brien & Gere (O'Brien & Gere, 1988). This investigation was completed by GTI and Burns and McDonnell for EG&G.

The purpose of this document is to present results of the remedial investigation (RI) completed by Burns and McDonnell (BMWCI) and other past investigations at the Missouri Metal property (property). The remedial investigation activities performed by BMWCI were conducted from March to September 1992 for EG&G Missouri Metal Shaping Company (EG&G), the property owner. These remedial activities concentrated on evaluating hydrogeological conditions and defining the nature and extent of site contamination at the Missouri Metal property. Information obtained from this RI and past property assessments has been utilized to estimate the nature and extent of contamination and to evaluate potential exposure risks posed by current property conditions. The remedial investigation was performed generally in accordance with Environmental Protection Agency (USEPA) recommended methods, procedures, and protocols.

1.2 REPORT ORGANIZATION

The remainder of Section 1.0 of this report presents a summary of the property location and history. Section 2.0 describes geologic, hydrogeologic and other physical property features observed during the recent investigation. Section 3.0 presents an overview of the RI field activities and results. The nature and extent of contamination on the property is characterized in Section 4.0 of this report. Section 5.0 provides an evaluation of the potential mobility of detected contaminants in this property setting. Section 6.0 of this report presents the results of a risk assessment. Section 7.0 explains the conclusions of the remedial investigation.

In general, the scope of the RI for the Missouri Metal property included performing aquifer hydraulic conductivity tests, and collecting and analyzing surface soil, subsurface soil, and groundwater samples. Details regarding the specific procedures utilized to obtain this data are presented in Appendix A, the Field Technical Memorandum.

1.3 SITE LOCATION AND DESCRIPTION

The property is located at 9970 Page Boulevard in Overland, Missouri, near the center of Section 31, Township 46 North, Range 6 East in St. Louis County, Missouri. Downtown St. Louis, Missouri, is located approximately 10 miles to the southeast. (The property location is shown in Figure 1-1.) The property is a rectangular shaped parcel of land bounded by Moore Food Distributors to the north, commercial property to the west, Meeks Street to the south, and vacant land to the east (formerly the site of a drive-in theater). Residential housing is located southeast of Missouri Metal. Property access is from Page Boulevard to the north and Meeks Street to the south. Total property area is estimated to be about 3.5 acres. Structures on the property currently consist of two manufacturing buildings and a large storage shed.

A public water supply system is available at the EG&G facility and in the neighboring area. The City of Overland is served by the St. Louis County Water Company which draws water from surface water sources, the Missouri and Meramac Rivers.

1.4 PROPERTY HISTORY

1.4.1 Industrial Property Use

Throughout its recent history, this facility has manufactured aircraft components. The manufacturing activities have generally consisted of forming and finishing aircraft components from stock metals, primarily aluminum, stainless steel, and titanium alloys. Industrial use of this property reportedly began in 1957 when the facility was owned and operated by Missouri Metal Shaping Company (MMSC). The property and business were purchased from MMSC in 1979 by Alco Standard Corporation-Aerospace Division. In 1988, this property and business were purchased by the current owner, EG&G.

Data obtained from past sampling of soil and groundwater suggests that releases of solvents into the soil and groundwater have occurred at this property. Solvents are believed to have been used at the site throughout its industrial

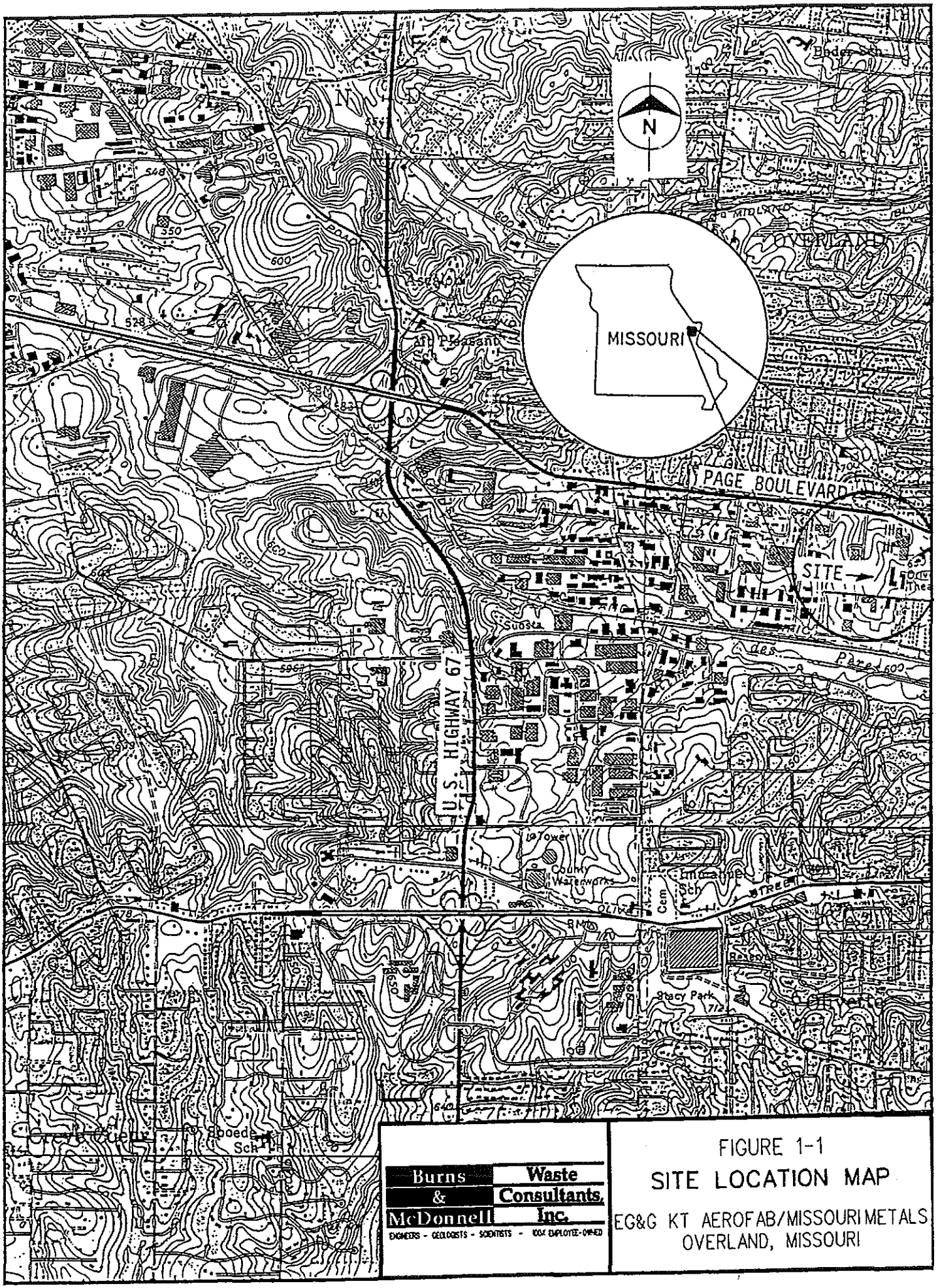


FIGURE 1-1

SITE LOCATION MAP

EG&G KT AEROFAB/MISSOURI METALS
OVERLAND, MISSOURI

history. Written records on plant chemical usage and waste disposal practices for this facility are available only for recent years. Although past releases are believed to have occurred, no historical facility spill reports are available documenting release information, such as location or date of releases. EG&G representatives have indicated that three long-term employees have been interviewed to determine if on-site waste disposal has occurred on the property. These employees have each worked at MMSC for thirty years or more. The long-time employees indicated no knowledge of past spills or on-site disposal of wastes at the facility. Due to the lack of historical supporting information, the location, manner, and volume of past chemical releases on the property are unknown.

1.4.2 Past Investigations

The materials underlying the site consist of unconsolidated overburden and bedrock. The overburden is composed of fill and loess (windblown silt) soils that are typically referred to as the shallow zone. The bedrock is referred to as the deep zone and consists of siltstone with minor shale and sandstone layers. In some instances, where interbedded shales are present, the bedrock zone is also referred to as an upper zone (above the shale) and a lower zone (below the shale). The past investigations focused on defining the shallow zone and assessing the nature and extent of contamination in the overburden.

Volatile organic compounds (VOCs), primarily solvents, were first detected on the property in soil and groundwater during an environmental audit conducted by O'Brien and Gere in 1988. This audit was performed prior to when EG&G purchased the property from Alco, which owned Missouri Metal since 1979. The O'Brien and Gere audit reported only "low levels" of VOCs in groundwater (less than 0.35 mg/l). VOC levels in four of the 15 soil samples exceeded 1 mg/kg.

Following EG&G's purchase of the facility, a property assessment was performed by Groundwater Technology, Inc. (GTI). The initial investigation consisted of a soil gas survey, which indicated a plume of VOC contamination located between the degreasing pit area and the southeast property corner. The soil gas data interpretation indicated the highest levels of VOCs were in the vicinity of the degreasing pit and the hazardous waste storage area. Based on this data, an

additional four monitoring wells were constructed on the property within the area of detected contamination. Levels of contaminants in these wells were significantly higher (5.0 to 104.9 mg/l) than had been detected by O'Brien and Gere.

As a result of these findings, an additional five monitoring wells were installed by GTI to better define the horizontal nature and extent of contamination. Data obtained from these monitoring wells corresponds with the soil gas survey results, indicating maximum VOC levels in the area of the degreasing pit and the southeast property corner. The assessment report for this property was completed in March 1991 by GTI. Detailed summaries of past property investigations are presented in Appendix B.

* * * * *

2.0 PHYSICAL SITE CHARACTERIZATION

2.1 TOPOGRAPHY

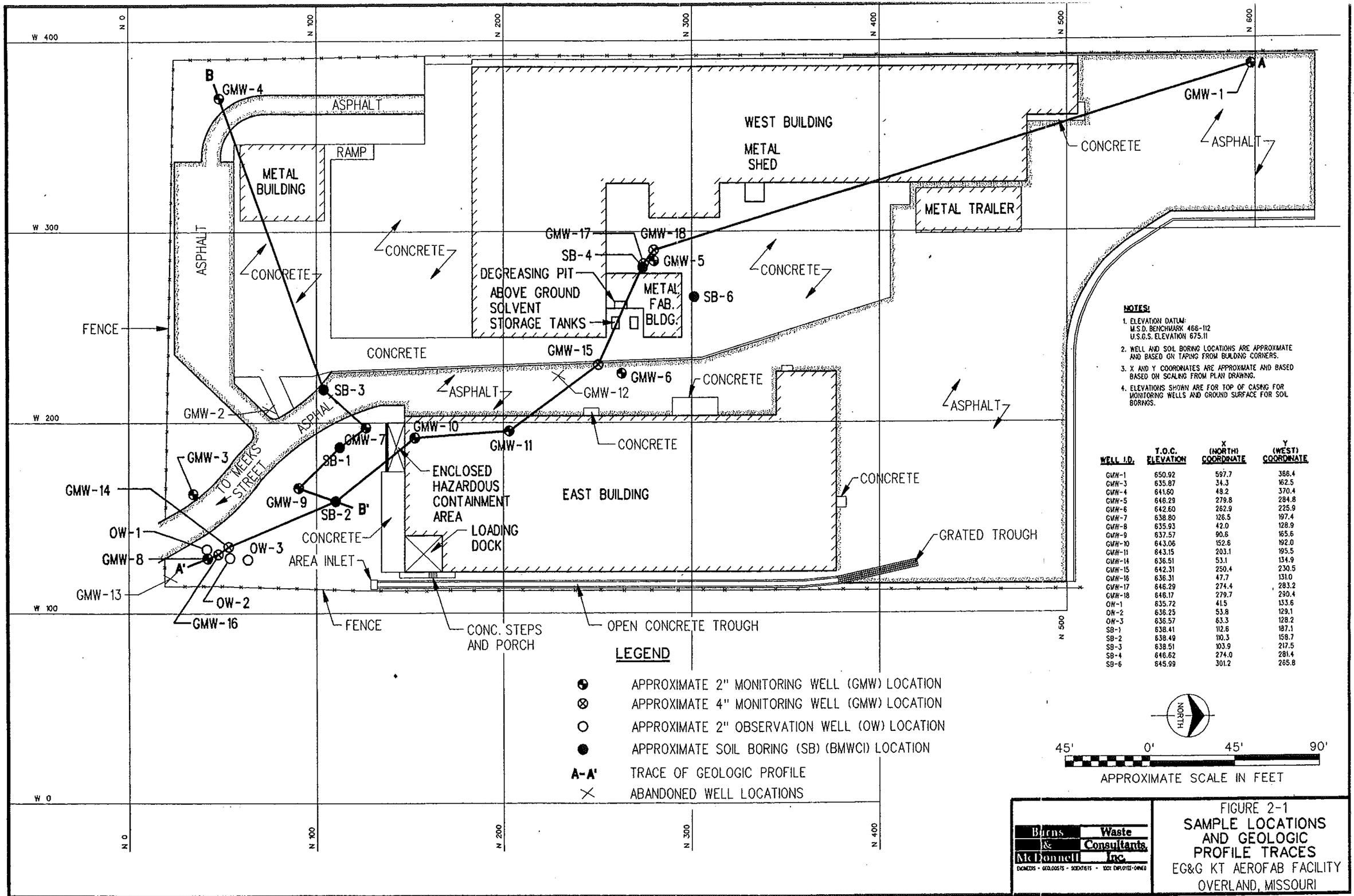
The Missouri Metal property is located in an area of rolling hills. The northwest corner of the property is approximately 15 feet higher than the southeast corner resulting in a ground slope of approximately 2 percent across the property. The majority of the ground surface (approximately 90 percent) is paved with asphalt or concrete, as shown in Figure 2-1. Small areas of grass, gravel, and bare soil are present in portions of the property. The ground slope, surfacing, and plant drainage control features all encourage rapid runoff of storm water and limit direct infiltration of precipitation on the property. Drainage from the property discharges to off-site storm sewers and eventually drains to the River des Peres, a major storm water drainage channel in the St. Louis metropolitan area.

2.2 GEOLOGY

2.2.1 Regional Geology

The Missouri Metal property is located in the upland area of St. Louis County. This area is generally characterized as having a loess soil overburden above the sedimentary bedrock of the Pennsylvanian system. Loess, a wind-blown silt, was deposited during glacial periods.

The upper bedrock unit in the Missouri Metal area consists of the Pennsylvanian age Pleasanton Group. The Pleasanton Group consists predominately of cyclic deposits comprised of layered shales with local layers and lenses of sandstone, siltstone, and limestone and occasional thin seams of coal and clay. The total thickness of the Pennsylvanian deposits in this area generally ranges from 55 to 120 feet. The bedrock surface is expected to generally follow the surface topography (MDNR, 1988). Structurally, the strata which make up the bedrock are relatively flat-lying with a slight regional dip toward the northeast. The dip has been modified by several minor northwest-southeast trending folds or warps in the bedrock.



NOTES:

1. ELEVATION DATUM:
   M.S.D. BENCHMARK 466-112
   U.S.G.S. ELEVATION 675.11
2. WELL AND SOIL BORING LOCATIONS ARE APPROXIMATE AND BASED ON TAPING FROM BUILDING CORNERS.
3. X AND Y COORDINATES ARE APPROXIMATE AND BASED BASED ON SCALING FROM PLAN DRAWING.
4. ELEVATIONS SHOWN ARE FOR TOP OF CASING FOR MONITORING WELLS AND GROUND SURFACE FOR SOIL BORINGS.

WELL I.D.	T.O.C. ELEVATION	X (NORTH) COORDINATE	Y (WEST) COORDINATE
GMW-1	650.92	597.7	386.4
GMW-3	635.87	34.3	162.5
GMW-4	641.60	48.2	370.4
GMW-5	646.29	279.8	284.8
GMW-6	642.60	262.9	225.9
GMW-7	638.80	128.5	197.4
GMW-8	635.93	42.0	128.9
GMW-9	637.57	90.6	165.6
GMW-10	643.06	152.6	192.0
GMW-11	643.15	203.1	195.5
GMW-14	636.51	53.1	134.9
GMW-15	642.31	250.4	230.5
GMW-16	636.31	47.7	131.0
GMW-17	646.29	274.4	283.2
GMW-18	646.17	279.7	290.4
OW-1	635.72	41.5	133.6
OW-2	636.25	53.8	129.1
OW-3	636.57	63.3	128.2
SB-1	638.41	112.6	187.1
SB-2	638.49	110.3	158.7
SB-3	638.51	103.9	217.5
SB-4	646.62	274.0	281.4
SB-6	645.99	301.2	265.8

LEGEND

- APPROXIMATE 2" MONITORING WELL (GMW) LOCATION
- APPROXIMATE 4" MONITORING WELL (GMW) LOCATION
- APPROXIMATE 2" OBSERVATION WELL (OW) LOCATION
- APPROXIMATE SOIL BORING (SB) (BMWCI) LOCATION
- A-A' TRACE OF GEOLOGIC PROFILE
- ABANDONED WELL LOCATIONS

NORTH

45' 0' 45' 90'

APPROXIMATE SCALE IN FEET

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FIGURE 2-1
SAMPLE LOCATIONS AND GEOLOGIC PROFILE TRACES
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OVERLAND, MISSOURI

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The Pennsylvanian cyclic deposits are underlain by rock assigned to the Upper Mississippian System which contains the Ste. Genevieve, St. Louis, and Salem formations as indicated in Figure 2-2, the Stratigraphic Column For the St. Louis Area. These formations are predominantly composed of limestone and minor sandstone. Total thickness of the Upper Mississippian unit is from 230 to 330 feet. A relatively thick shale unit in the Warsaw Formation, immediately below the Upper Mississippian, acts as a confining layer (MDNR, 1988).

2.2.2 Site Geologic Characteristics

The following sections describe the geologic features of the property. Figure 2-1 shows the locations of two geologic profiles constructed for this RI. Figure 2-3 is a representative geologic cross section of the property as viewed from the west. Figure 2-4 is a representative geologic cross section of the property as viewed from the south. These geologic profiles show that the shallow subsurface geology consists of three distinct layers, the fill soils (3 to 5 feet thick), the native silty clay soil (to depths of 19 to 24 feet) and the upper bedrock, consisting of layers of siltstone, sandstone, clay, and shale. Drilling logs produced during the subsurface investigation are located in Appendix B of this report. Appendix F contains the groundwater monitoring well construction diagrams of the five wells installed between March 30 and April 10, 1992. Appendix G contains photoionization detector (PID) readings recorded during drilling. The PID utilized to screen soil samples for VOC contamination and personnel protection monitoring during the RI drilling and sampling activities.

2.2.2.1 Overburden

The soil overburden or upper geologic unit typically consists of an upper layer of fill, a layer of silt or clay, followed by a clay and gravel layer. The gravel layer is comprised of weathered rock fragments. Vertical and horizontal variations were observed in the unconsolidated material. The variations include changes in thickness of individual layers and continuity of layers across the property.

Vertically, all of the soil units were generally present in the borings drilled for this investigation, except definable fill material (silt or clay mixed with debris). A distinctive olive-gray, silty clay was observed beneath the entire

Generalized stratigraphic column for St. Louis, St. Charles, and Jefferson Counties, Missouri

Aquifers most favorable as water sources are shaded

System	Series	Group	Formation	Aquifer group	Thickness (feet)	Dominant lithology	Water-bearing character
Quaternary	Holocene		Alluvium 1/		0-150	Sand, gravel, silt, and clay.	Some wells yield more than 2,000 gpm.
	Pleistocene		Loess		0-110	Silt	
			Glacial till		0-55	Pebbly clay and silt.	Essentially not water yielding
Pennsylvanian	Missourian	Pleasanton	Undifferentiated		0-75	Shales, siltstones, "dirty" sandstones, coal beds and thin limestone beds.	Generally yields very small quantities of water to wells. Yields range from 0-10 gpm.
		Marmaton	Undifferentiated		0-90		
	Desmoinesian	Cherokee	Undifferentiated		0-200		
	Atokan		Undifferentiated				
Mississippian	Meramecian		Ste. Genevieve Formation		0-160	Argillaceous to arenaceous limestone.	Yields small to moderate quantities of water to wells. Yields range from 5 to 50 gpm. Higher yields are reported for this interval locally.
			St. Louis Limestone		0-180		
			Salem Formation		0-180		
			Warsaw Formation		0-110		
	Osagean		Burlington-Keokuk Limestone	1	0-240	Cherty limestone	
			Fern Glen Formation		0-105	Red limestone and shale.	
	Kinderhookian	Chouteau	Undifferentiated		0-122	Limestone, dolomitic limestone, shale, and siltstone.	
Devonian	Upper	Sulphur Springs	Bushberg Sandstone		0-60	Limestone and sandstone.	
			Glen Park Limestone				
			Grassy Creek Shale		0-50	Fissile, carbonaceous shale.	
Silurian			Undifferentiated		0-200	Cherty limestone.	
Ordovician	Cincinnatian		Maquoketa Shale		0-163	Silty, calcareous or dolomitic shale.	Probably constitutes a confining influence on water movement.
			Cape Limestone		0-5	Argillaceous limestone.	
	Champlainian		Kimmswick Formation	2	0-145	Massive limestone	Yields small to moderate quantities of water to wells. Yields range from 3 to 50 gpm. Decorah Formation probably acts as a confining bed locally.
			Decorah Formation		0-50	Shale with interbedded limestone.	
			Plattin Formation		0-240	Finely crystalline limestone.	
			Rock Levee Formation		0-93	Dolomite and limestone, some shale.	
			Joachim Dolomite		0-135	Primarily argillaceous dolomite.	
			St. Peter Sandstone	3	0-160	Silty sandstone, cherty limestone grading upward into quartzose sandstone.	Yields moderate quantities of water to wells. Yields range from 10-140 gpm.
			Everton Formation		0-130		
	Canadian		Powell Dolomite	4	0-150	Sandy and cherty dolomites and sandstone.	Yields small to large quantities of water to wells. Yields range from 10 to 300 gpm. Upper part of aquifer group yields only small amounts of water to wells.
			Cotter Dolomite		0-320		
			Jefferson City Dolomite		0-225		
			Roubidoux Formation		0-177		
			Gasconade Dolomite Gunter Sandstone Member		0-280		
Cambrian	Upper		Eminence Dolomite	5	0-172	Cherty dolomites, siltstones, sandstone, and shale.	Yields moderate to large quantities of water to wells. Yields range from 10 to 400 gpm.
			Potosi Dolomite		0-325		
		Elvins	Derby-Doerun Dolomite		0-165		
			Davis Formation		0-150		
			Bonneterre Formation		245-385		
			Lamotte Sandstone		235+		
Precambrian						Igneous and metamorphic rocks.	Does not yield water to wells in this area.

1/ Basal part may be of Pleistocene age.

NOTE: Stratigraphic nomenclature may not necessarily be that of the U.S. Geological Survey.

Source: Water Resources St. Louis Area, Missouri (Miller, 1974)

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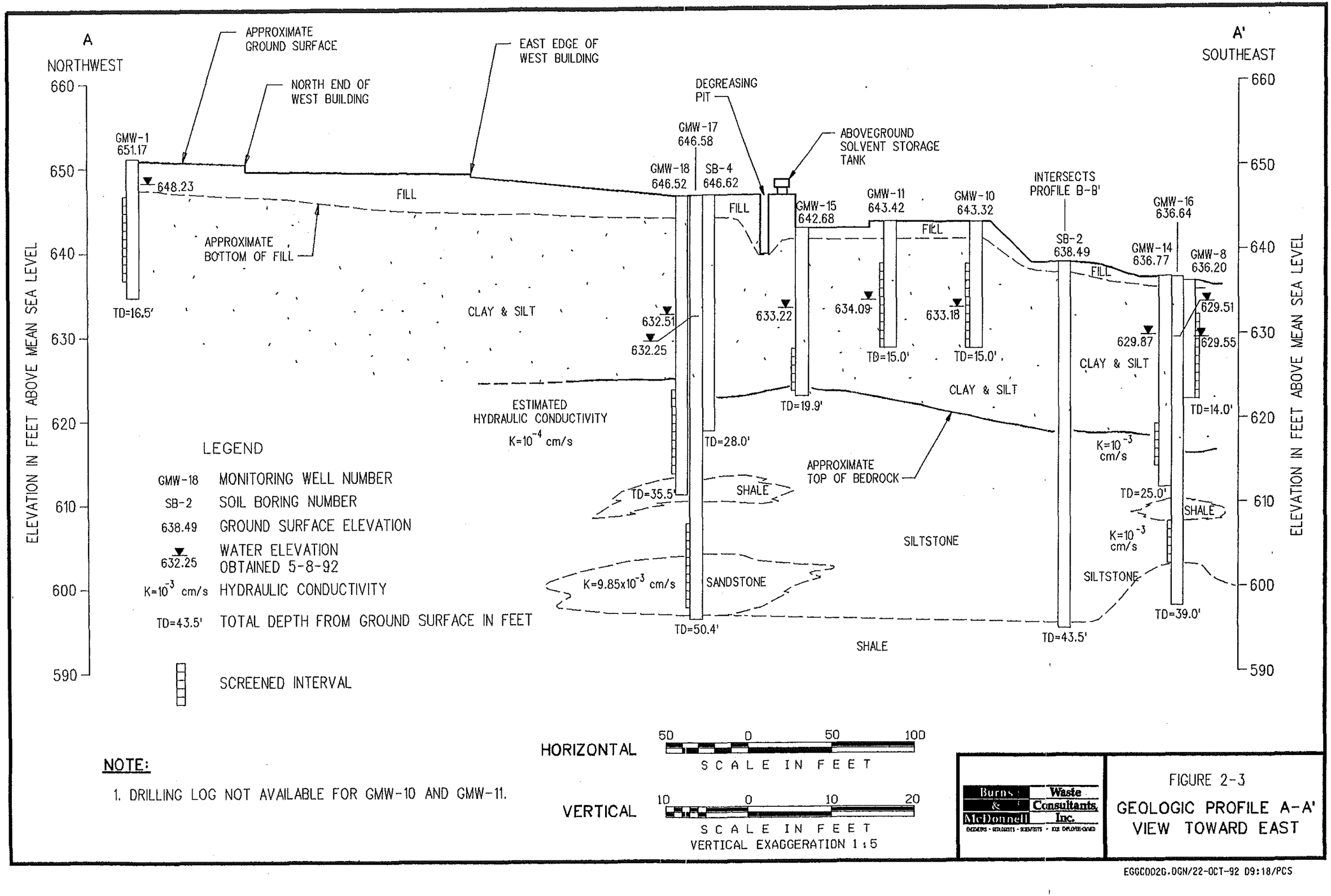
FIGURE 2-2

STRATIGRAPHIC COLUMN FOR THE ST. LOUIS AREA



NOTE:

1. DRILLING LOG NOT AVAILABLE FOR GMW-10 AND GMW-11.

HORIZONTAL 50 0 50 100
SCALE IN FEET

VERTICAL 10 0 10 20
SCALE IN FEET
VERTICAL EXAGGERATION 1:5

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FIGURE 2-3
GEOLOGIC PROFILE A-A'
VIEW TOWARD EAST

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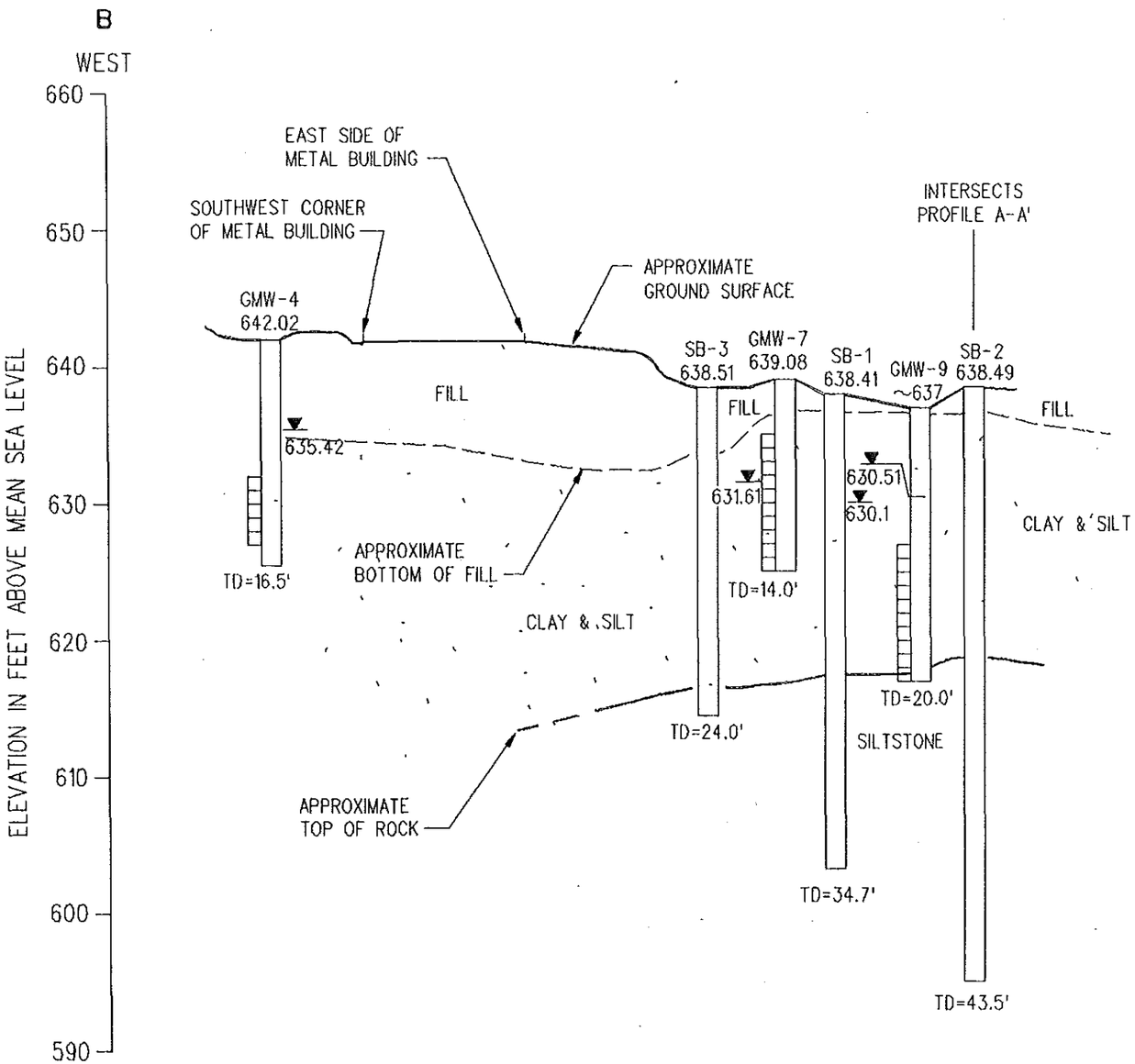

LEGEND

GMW-4	MONITORING WELL NUMBER
SB-2	SOIL BORING NUMBER
638.49	GROUND SURFACE ELEVATION
▼ 630.1	WATER LEVEL OBTAINED 5-8-92
TD=43.5'	TOTAL DEPTH FROM GROUND SURFACE IN FEET
	SCREENED INTERVAL

HORIZONTAL 50 0 50 100
SCALE IN FEET

VERTICAL 10 0 10 20
SCALE IN FEET
VERTICAL EXAGGERATION 1:5

NOTES:

1. DRILLING LOG NOT AVAILABLE FOR GMW-9
2. SOIL BORING SB-1 REMAINED OPEN FIVE DAYS TO OBTAIN WATER LEVELS PRIOR TO ABANDONMENT.

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FIGURE 2-4
GEOLOGIC PROFILE B-B'
VIEW TOWARD NORTH

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property at depths ranging from 3 to 5 feet. This silty clay layer contained an abundant amount of organic material (leaves, grass, wood, and roots). Portions of the grass were green, indicating obvious fill areas. This olive-gray, siltyclay layer also exhibited a consistently wet to saturated appearance. Based on these observations, it is assumed this olive-gray soil is the original surface soil and total fill depth ranges from 3 to 5 feet across the property. Secondary permeability features (cracks or voids) in the fill would be expected to result in higher permeability than present in the natural soil. The MDNR Division of Geology and Land Survey (DGLS) estimated the permeability of the upper fill to be in the range of 10^{-3} to 10^{-5} cm/sec (MDNR, 1988).

The silty clay layer underlying the organic-rich layer was typically yellowish brown to olive gray, dry to damp, stiff, and nonplastic to plastic. Iron stained spots or "birds eyes" and streaks occurred at depth. Macropores developed from root cases or animal burrows were observed in a number of the borings. Moisture and free water was often associated with the macropores exhibiting solvent odors in a number of soil borings.

A thin clay and gravel layer occurring within a few feet of the top of rock was observed in a number of borings across the property. The clay typically was soft, moist to wet, and contained rounded chert gravel. Below this layer, and immediately above the top of the siltstone bedrock, a residual clay layer was observed. This layer exhibited relict bedding, with a very fine grained sand and trace mica, and graded to a weathered siltstone.

2.2.2.2 Bedrock

The bedrock beneath the property consists of interbedded layers of sandy siltstone and shale. The initial bedrock observed beneath the property is a sandy siltstone. The top of the bedrock lies between 19 and 24 feet below and generally parallel to the ground surface. The uppermost position of the siltstone is weathered to highly weathered and typically grades upward into a residual clay layer. Siltstone is generally yellowish orange or brown, friable, with very fine grained sand and mica; it is massive in part but usually exhibited thin horizontal partings which were stained black. Boring SB-2 and Monitoring Wells GMW-16 and GMW-17 penetrated the siltstone which ranged in thickness from

10 to over 20 feet. The drilling logs for these borings indicate that the siltstone is interbedded with clay, sand, and shale. A thin shale unit separates the siltstone into two units at Monitoring Well locations GMW-16 and GMW-17. This shale unit was not observed in Boring SB-2 which lies on a diagonal line between Monitoring Wells GMW-16 and GMW-17. This indicates that the thin shale unit is not continuous across the property. A pale olive to olive gray shale occurs below the siltstone. This unit was not penetrated by drilling during this investigation. The shale and siltstone units were separated by a 2-foot clay and sand layer at Borings SB-2 and GMW-16. This layer was not present at Monitoring Well GMW-17 in which a 6-foot sandstone unit separated the shale from the siltstone.

2.3 HYDROGEOLOGY

2.3.1 Regional Hydrogeology

The uppermost and primary aquifer in this regional area is the Upper Mississippian aquifer. This aquifer consists mainly of limestone with some minor sandstone seams and extends from approximately 170 feet to between 400 and 500 feet below the ground surface. The thickness of the upper Mississippian aquifer is approximately 230 to 330 feet. The Mississippian aquifer is considered to be hydrogeologically interconnected throughout its extent with no intermediate confining beds. Directly beneath the Upper Mississippian aquifer is a relatively thick sequence of shales and shaley limestones (the Lower Salem and upper Warsaw Formations), that form an aquitard (MDNR, 1988 and Miller, 1974).

Wells penetrating the upper Mississippian aquifer have been reported to yield between 5 to 50 gallons per minute (GPM). The depth to static water level is estimated to range from about 100 to 150 feet below the ground surface during highest seasonal levels. Water quality in the Upper Mississippian aquifer is fair to good.

Approximately 170 feet of Pennsylvanian cyclic deposits overlay and confine the Upper Mississippian aquifer. The Pennsylvanian cyclic deposits consist of interbedded shale and siltstone with coal seams and thin limestone beds. Perched water horizons within the Pennsylvanian cyclic deposits yield very low quantities of poor quality groundwater. These deposits are not considered to be an aquifer.

Due to the low permeability of the Pennsylvanian age deposits, recharge potential from the perched groundwater horizons to the Upper Mississippian aquifer will be restricted by the thickness of the units and the low permeability interbedded shale layers.

A review of existing regional well installation records was performed by MDNR Division of Geology and Land Survey as part of the Hazard Ranking System scoring process. This review did not discover any records indicating the upper bedrock water horizons have been utilized as a source water. This well survey found no records of wells installed in the immediate vicinity at the property. Water supply wells installed upgradient of the property were reportedly installed into the regional aquifer (MDNR, 1988). Well survey information obtained by MDNR is presented in Appendix L.

2.3.2 Site Hydrogeology

2.3.2.1 General

All wells installed on the property monitor groundwater conditions within the uppermost groundwater bearing horizon (shallow soil/weathered bedrock interface zone). Geologic materials in this horizon consist of the unconsolidated loess (and fill) soils, residuum, and the upper 20 to 30 feet of weathered siltstone bedrock. Groundwater flow in the shallow soil/weathered bedrock interface zone will generally follows the local topography, which at Missouri Metal is directed to the southeast. This perched groundwater system is separated from the Upper Mississippian aquifer by approximately 150 feet of Pennsylvanian age shale and siltstone. Due to the low quantity and poor quality of groundwater contained in this zone, it is considered insignificant for use as an aquifer. Due to the low permeability of the bedrock material, the potential for upper bedrock groundwater horizons to recharge the Upper Mississippian aquifer is low.

The wells installed at the property monitor three intervals (either separately or combined) within the shallow soil/weathered bedrock interface zone; the fill, the loess silty clay soil, and the siltstone bedrock. The hydrogeologic characteristics of these three intervals are discussed in the following sections.

2.3.2.2 Fill Material

A fill layer, ranging from about 3 to 5 feet thick, was encountered in many of the borings drilled on the property. This fill layer is anticipated to be present over much of the property area; however, it may not be continuous. The hydraulic conductivity of the upper fill materials is variable, but is relatively high compared to natural soils. At least three of the monitoring wells (GMW-5, GMW-6, and GMW-8) have sand pack intervals that extend up into the fill layer. The water levels in these wells fluctuate widely during rainfall events. Water movement in the fill layer from the infiltration of precipitation and is not continuous.

2.3.2.3 Loess Soils

The uppermost natural geologic unit occurring on the property consists of windblown glacial clays and silt (loess). The loess soils range in depth from about 19.5 feet at GMW-16 to 24 feet at SB-4. Eight of the Monitoring Wells (GMW-1, GMW-3, GMW-4, GMW-7, GMW-9, GMW-10, GMW-11, and GMW-15) monitor groundwater conditions in the loess soil deposits.

Laboratory triaxial permeability testing on representative samples of the loess soils indicated that the hydraulic conductivity of the native soil is on the order of 2.7×10^{-7} cm/sec to 1.1×10^{-6} cm/sec. These low hydraulic conductivity values are supported by field data obtained during the RI. For example, significant differences in water elevation were observed at Monitoring Wells GMW-6 and GMW-15. Water levels in these two wells, which are adjacent (approximately 13 feet apart) but screened in different portions of the loess unit, consistently differed by as much as 3 to 5 feet. This large difference in water levels in adjacent wells confirms the low hydraulic conductivity of the loess soil. The laboratory results are also supported by pump test observations at Monitoring Well GMW-14. Water levels in Monitoring Well GMW-8, which is located within approximately 13 feet of GMW-14, were monitored during the pump test at GMW-14. During the pump test very little drawdown (approximately 0.1 feet) was measured in Monitoring Well GMW-8 despite achieving a drawdown of almost 14 feet within GMW-14. The low permeability and the thickness of the loess soils suggests that this soil unit limits the downward and lateral flow of groundwater.

The horizontal gradient (groundwater surface slope) for groundwater contained in the loess soil unit on the property is estimated to range from between 0.01 and 0.03 feet per foot toward the southeast. The gradient is variable over time and is dependent on recent rainfall events. The low permeability of the loess soils is the overriding factor controlling groundwater movement and indicates that very little or almost no groundwater flow is occurring through the loess soils on the site.

2.3.2.4 Siltstone Bedrock

Below the loess soils, very weathered, fine, sandy siltstone grading downward into more competent sandy siltstone is present. The siltstone encountered in borings drilled on the property range in thickness from approximately 6 feet in Boring GMW-16 to almost 20 feet in Boring SB-2. Results of pumping tests and field permeability tests (slug tests) performed in monitoring wells screened in the siltstone bedrock indicate hydraulic conductivities on the order of 1×10^{-3} cm/sec to 1×10^{-4} cm/sec with most of the values falling in the 1×10^{-3} cm/sec range. The horizontal groundwater gradient in the siltstone is estimated to range between 0.010 and 0.015 feet per foot. Using Darcy's law for groundwater flow through porous media, an assumed porosity of 30 percent, and an hydraulic conductivity of 5×10^{-3}, these gradient values yield an average linear groundwater flow velocities on the order of 170 to 260 feet per year. Groundwater velocities through the siltstone bedrock may vary over time depending on recharge upgradient of the site.

Generally the soil and bedrock materials have a low overall hydraulic conductivity which was indicated by pump tests. Maximum long term pumping yields achievable from monitoring wells installed into the siltstone and sandstone layers below the property were estimated to be 0.2 to 0.75 gpm, based on pumping results obtained during spring weather conditions. Long term yields obtainable during extended dry weather periods could be significantly less. Groundwater movement within the silty clay soil is more restricted. None of the shallow wells, which are screened totally within the soil profile, would be capable of producing a sustainable groundwater yield.

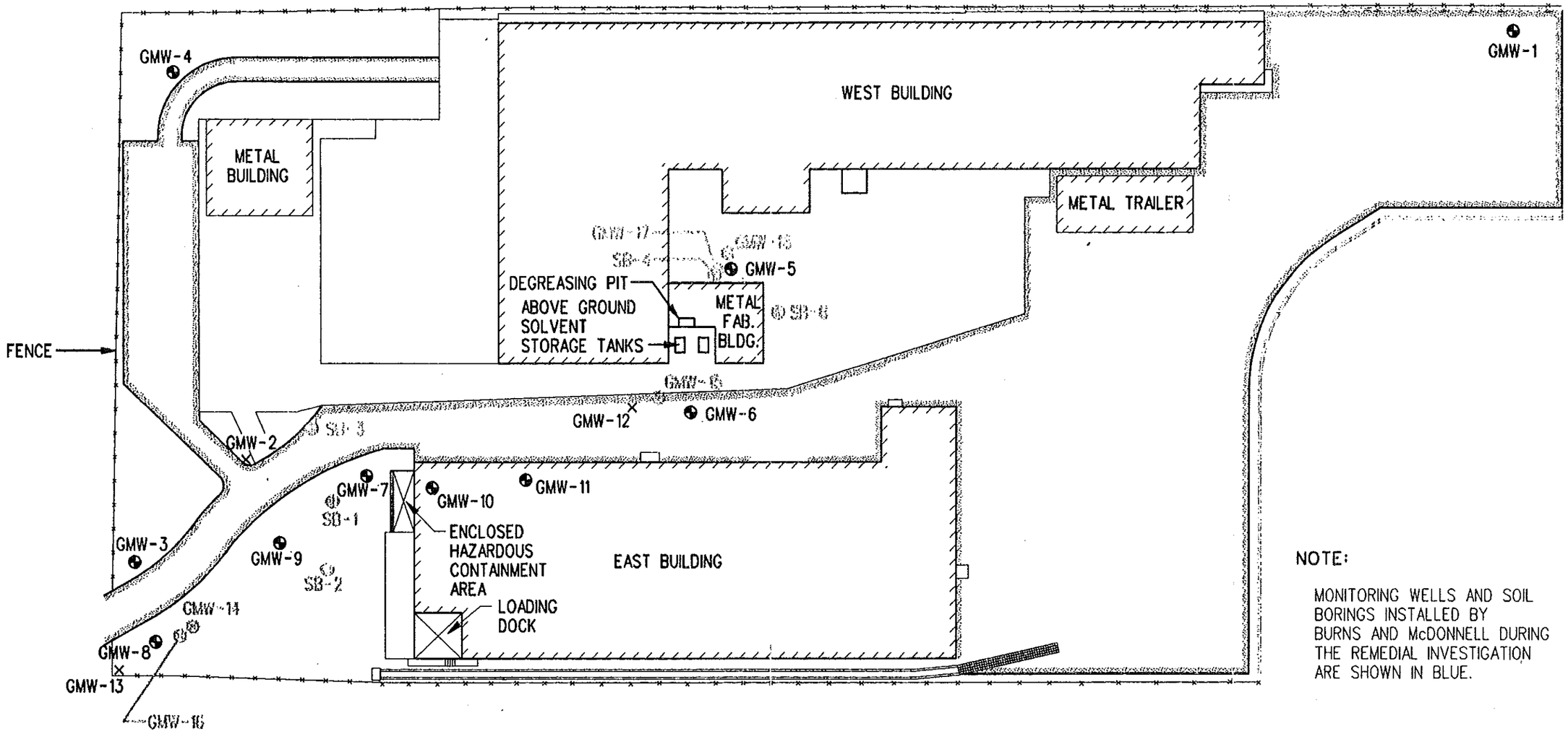
2.3.3 Conceptual Site Model

Due to the relatively higher hydraulic conductivity of the siltstone bedrock compound to the overlying loess, groundwater flow beneath the property occurs primarily in the siltstone. Results of the pump tests conducted on wells screened within the siltstone bedrock indicate relatively little recharge from the upper soils to the siltstone bedrock occurs. Recharge to the bedrock groundwater system occurs primarily from the topographically higher areas to the north and northwest of the property.

2.4 SITE CLIMATE DATA

Rainfall during the remedial investigation field activities was average for the spring months March and April. Rainfall during March totaled 3.41 inches compared to an average rainfall total of 3.18 inches. Of the monthly total, 1.61 inches of rain occurred after 1992 field activities on the property were initiated. Rainfall totals in April during the remedial investigation period (April 1 to April 21, 1992) were 2.32 inches compared with a normal average rainfall of 2.5 inches. The rainfall data is plotted with groundwater level measurements on graph summaries contained in Appendix G. Based on the comparison of average and actual rainfall totals for the investigation period, it is concluded that groundwater conditions observed at the site accurately reflect spring conditions. Groundwater recharge to this shallow perched system would be expected to be greatest during spring monthes of the year.

* * * * *



NOTE:

MONITORING WELLS AND SOIL BORINGS INSTALLED BY BURNS AND McDONNELL DURING THE REMEDIAL INVESTIGATION ARE SHOWN IN BLUE.

NORTH

45' 0' 45' 90'

APPROXIMATE SCALE IN FEET

LEGEND

- ⊗ APPROXIMATE 4" MONITORING WELL (BMWC) LOCATION
- ⊕ APPROXIMATE SOIL BORING (BMWC) LOCATION
- ● MONITORING WELLS INSTALLED BY OTHERS
- × ABANDONED MONITORING WELL LOCATIONS

Burns & McDonnell Waste Consultants, Inc.
ENGINEERS · GEOLOGISTS · SCIENTISTS · 100% EMPLOYEE-OWNED

FIGURE 3-1
REMEDIAL INVESTIGATION MONITORING WELLS AND BOREHOLE LOCATIONS
EG&G KT AEROFAB FACILITY
OVERLAND, MISSOURI

EGGS1002.DGN,DF=NONE

3.0 REMEDIAL INVESTIGATION FIELD ACTIVITIES

3.1 INTRODUCTION

This section provides a summary of field activities performed during the RI of the Missouri Metal property. During the RI phase, remedial activities included the collection and analysis of surface soil, subsurface soil, and groundwater samples, and the performance of aquifer hydraulic conductivity tests. Detailed procedures utilized for completing these field activities are summarized in the Field Operations Technical Memorandum presented in Appendix A of this report.

The field investigative activities were carried out in accordance with the following documents:

- Remedial Investigation Work Plan, (Burns & McDonnell, February 1992)
- Quality Assurance Project Plan, (Burns & McDonnell, December 1991)
- Site Health and Safety Plan, (Burns & McDonnell, December 1991)

The documents were prepared by BMWCI prior to initiation of field activities.

3.2 MONITORING WELL INSTALLATION

RI monitoring well locations and depths were selected to assess the distribution of contamination in groundwater vertically across the property. The locations of the five monitoring wells installed at the property during this remedial investigation phase are shown on Figure 3-1. Groundwater Monitoring Wells GMW-14 and GMW-15 were terminated and screened at the top of the siltstone bedrock layer underlying the property. Monitoring Wells GMW-16 and GMW-18 were screened within the upper siltstone layer and GMW-17 within a deeper sandstone layer in the vicinity of the degreasing pit. The sand pack around GMW-18 extends upward across the soil/bedrock interface to maximize its potential use as a recovery well during the groundwater pump tests. Drilling logs for the monitoring well boreholes are contained in Appendix C. Well completion diagrams for each monitoring well are provided in Appendix D. A summary of photoionization detector (PID) readings obtained during the RI drilling activities are contained in Appendix E.

Also as part of this investigation, existing Monitoring Wells GMW-2, GMW-12, and GMW-13 were plugged and abandoned. Monitoring Well GMW-2 was damaged by vehicle traffic and not useable for sampling. GMW-12 and GMW-13 were abandoned due to their inadequate design and construction features. Both GMW-12 and GMW-13 had screens and sand packs which extended from the upper bedrock into the shallow soil fill layer. Due to this design groundwater from these monitoring wells is not representative of groundwater quality within the upper bedrock. The extended well sand pack also provided a potential high permeability vertical pathway for shallow contaminants to reach the bedrock. Due to this construction deficiency these wells were abandoned in accordance with applicable Division of Geology and Land Survey requirements.

During the abandonment of Monitoring Well GMW-12, a groundwater sample containing visible oil was collected and analyzed for total petroleum hydrocarbon (TPH) constituents. This TPH analytical test indicated the oil, which appeared to be cutting oil, was a medium petroleum distillate present at a concentration of 248 mg/kg. Prior to the abandonment of GMW-12, water was baled from the well on two dates to remove visible oil. During this action, approximately 7.5 gallons of a water/oil liquid were removed from the well to a barrel for storage. This material and other wastes generated during the RI have been shipped offsite for proper disposal by EG&G KT Aerofab.

The presence of oil in GMW-12 likely resulted form the movement of oil from the surface into the well along the well casing. The sand pack around this well, which extends through the fill to about 1.5 feet below the ground surface, provides a potential migration pathway for liquids. Oil was not observed in other groundwater samples collected during the remedial investigation. Based on the RI data, the oil observed at GMW-12 is considered a localized occurrence. Oil residuals, if a significant site problem existed, would have been detected in samples from the numerous monitoring wells clustered on this small property.

3.3 SOIL BORINGS

Deep soil borings were installed at five locations during the 1992 investigation, as shown in Figure 3-1. Soil Borings 1, 2, and 3 were installed across the

southeast portion of the property between the southeast property corner and the degreasing pit area. Subsurface soil samples were obtained from each of the boreholes for laboratory analysis. The soil chemical data was obtained to evaluate potential migration pathways between the degreasing pit and the downgradient property boundary. Drilling logs for each of these boreholes are presented in Appendix C.

3.4 PUMP TESTS AND GROUNDWATER LEVEL MEASUREMENTS

Aquifer pump tests were performed on Monitoring Wells GMW-8, GMW-14, GMW-15, GMW-16, GMW-17, and GMW-18. Results of the pump tests are contained in Appendix F of this report and discussed in Chapter 4.1. Groundwater samples were collected for laboratory analysis from Monitoring Wells GMW-14, GMW-16, GMW-17, and GMW-18 before and after performance of the pump tests.

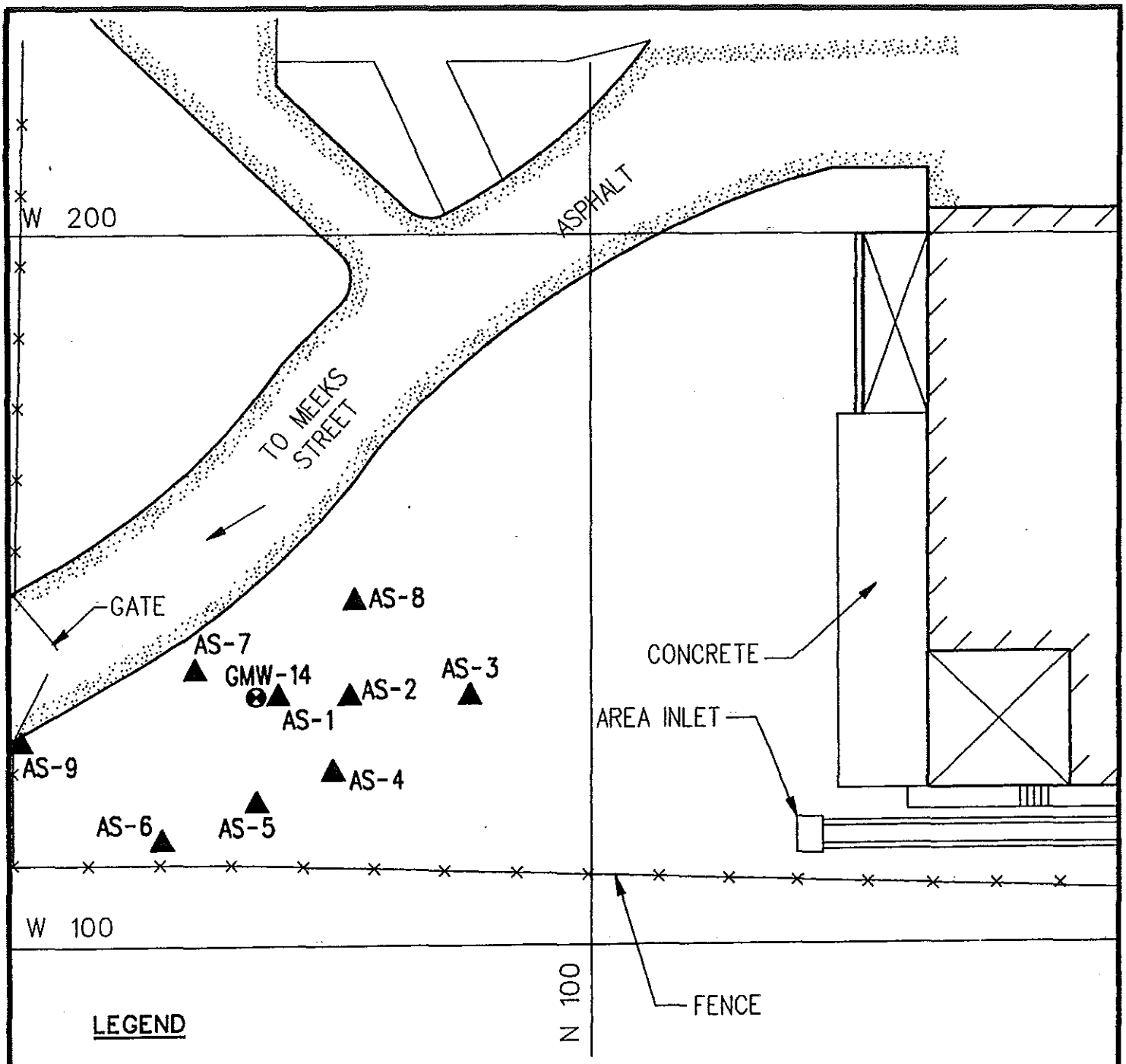
Water level measurements were taken throughout the RI field activity period. Graphs correlating these measurements with rainfall and the water level report forms are included in appendix G.

3.5 SHALLOW SOIL SAMPLING

Shallow subsurface soil samples were collected in the southeast portion of the property during a supplemental phase of the remedial investigation to further investigate the extent of shallow soil contamination in this portion of the property. These shallow soil samples were collected utilizing a hand auger. This supplemental soil investigation was performed in July 1992 after initial RI results indicated that elevated levels of volatile organic compounds were present in the shallow soil at GMW-14. Hand auger soil sample locations are shown in Figure 3-2.

3.6 SOIL AND GROUNDWATER SAMPLE COLLECTION

The collection of soil and groundwater samples for laboratory analysis was performed in accordance with the standard procedures outlined in Appendix A and in the RI work plan prepared prior to initiating the field activities. As indicated in Tables 3-1 and 3-2, a total of 21 groundwater samples and 39 soil samples were collected during the RI for laboratory analysis for volatile organic compounds.



LEGEND

- ⊗ MONITORING WELL (GMW) LOCATIONS
- ▲ HAND AUGER SOIL (AS) SAMPLE LOCATIONS

NORTH

20' 0' 20' 40'

APPROXIMATE SCALE IN FEET

Burns & McDonnell — Waste Consultants, Inc.

FIGURE 3-2
HAND AUGER SOIL SAMPLE LOCATIONS
EG&G KT AEROFAB FACILITY
OVEERLAND, MISSOURI

Table 3-1
Soil Sample Collection Summary

EG&G KT Areofab/Missouri Metals Property

Sampling Location	Date Drilled	Total Borehole Depth(feet)	Number of Soil Samples Collected for VOC Analysis
SB-1	3/25/92	34.65	3
SB-2	3/26/92	43.5	2
SB-3	3/31/92	24.0	2
SB-4	4/02/92	28.0	7 *
SB-6	3/31/92	24.9	3
GMW-14	3/27/92	25.0	3
GMW-15	4/01/92	20.0	7 **
GMW-16	4/06/92	39.0	3
GMW-17	4/07/92	50.4	5
GMW-18	4/09/92	35.5	0 ***
AS-3	7/14/92	4.4	1
AS-7	7/15/92	3.6	1
AS-8	7/15/92	3.9	1
AS-9	7/15/92	3.7	1

* Includes 2 duplicate samples
** Includes 1 duplicate and 1 triplicate sample
*** Installed adjacent to GMW-17, no additional sampling performed due to its proximity to a past sampling location

Note: A sample from GMW-14 was also analyzed for total metals, herbicides, pesticides, PCBs, and SVOCs.
SB: Soil boring location
GMW: Groundwater monitoring well location
AS: Hand auger sampling location

Table 3-2
Groundwater Sample Collection Summary

EG&G KT Areofab/Missouri Metals Property

Sampling Location	Investigation Phase Monitoring Well Installed	No. of Groundwater Samples Collected for VOC Analysis
GMW-1	OBG-Audit	1
GMW-3	OBG-Audit	1
GMW-4	OBG-Audit	1
GMW-5	GTI-SA	1
GMW-6	GTI-SA	1
GMW-7	GTI-SA	2 ***
GMW-8	GTI-SA	1
GMW-9	GTI-SA	1
GMW-10	GTI-SA	1
GMW-11	GTI-SA	1
GMW-14	BMWCI-RI	2 *
GMW-15	BMWCI-RI	1
GMW-16	BMWCI-RI	2 *
GMW-17	BMWCI-RI	3 **
GMW-18	BMWCI-RI	2 *

Notes: Monitoring Wells GMW-12, GMW-13, and GMW-2 have been abandoned. A sample from GMW-14 was also analyzed for total metals, herbicides, pesticides, PCBs, and SVOCs.

* Sample collected before and after pump test

** Includes duplicate sample; sample collected before and after pump test

*** Includes duplicate sample

OBG-Audit: Monitoring well installed during O'Brien and Gere audit

GTI-SA: Monitoring well installed during GTI site assessment

BMWCI-RI: Monitoring well installed during Burns and McDonnell remedial investigation

Chemical analysis for this project was performed primarily by NDRC Laboratories, Inc. (NDRC) of Richardson, Texas. Selected sample duplicates collected during the investigation were analyzed by American Technical and Analytical Services, Inc. (ATAS) of Maryland Heights, Missouri. Duplicate analytical data was obtained for select samples from a secondary laboratory at the request of EG&G to evaluate the accuracy of the data obtained from NDRC. Laboratory analytical data reports from the physical analysis of soil samples are contained in Appendix H. Chemical analysis reports for the RI samples are contained in Appendix I. Chemical analysis data reports for previous investigation phases are provided in Appendix J. A quality assurance review of the data obtained from NDRC during this investigation is presented in Appendix G of this report. This analytical data evaluation concludes that the volatile organic data obtained during this investigation does achieve the quality objectives established for this project.

3.7 REMEDIAL INVESTIGATION ANALYTICAL DATA RESULTS

3.7.1 Soil RI Data

During the remedial investigation, 39 subsurface soil samples were collected for laboratory analysis for the VOC parameters, identified as the primary contaminants of concern from earlier investigations. Five soil samples were analyzed for total organic carbon content. One soil sample was also analyzed for semivolatile organic compounds (SVOCs), metals, herbicides, pesticides, and polychlorinated biphenyls (PCBs). The laboratory results obtained from analysis of soil samples collected during the RI are summarized in Tables 3-3, 3-4, 3-5, and 3-6.

Generally, the levels of VOCs detected in soil samples were low. However, elevated VOC levels were detected in four of 39 samples taken from the southeast property corner and the degreasing pit areas. A relatively high total VOC concentration was reported in a shallow soil sample (1.0 to 1.5 foot depth) collected at GMW-14. As a result of this data, a supplemental soil investigation was performed in the southeast property corner near GMW-14 in July 1992.

The supplemental soil survey consisted of screening 18 soil samples, collected from two depths at nine locations, with a PID to evaluate relative volatile

Table 3-3
Subsurface Soil
Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Sampling Location:		GMW-15						
Sample Number:		CME-1	CME-2	CME-2*	CME-20***	CME-4	CME-7	CME-8
Sampling Interval:		1.2' - 1.5'	3.8' - 4.4'	3.8' - 4.4'	3.8' - 4.4'	9.0' - 9.6'	18.4' - 18.8'	19.0' - 19.4'
ANALYTICAL PARAMETER	UNITS							
1,2 Dichloroethylene	mg/kg	0.101	0.0072	0.007	ND (0.005)	0.0822	0.0062	0.0183
Trichloroethylene	mg/kg	0.0698	ND (0.005)	0.025	ND (0.005)	0.0763	0.84	5.5
Tetrachloroethylene	mg/kg	2.3	2.62	0.67	4.26	1.16	1.1	13.4
Methylene Chloride	mg/kg	ND (0.005)	ND (0.005)	0.075 B	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Acetone	mg/kg	ND (0.1)	ND (0.1)	0.035 J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
TICs	No.	0	0	0	0	0	0	0
Total Organic Carbon	mg/kg					940.0		

Sampling Location:		GMW-16			GMW-14		
Sample Number:		CME-1	CME-2	CME-3	CME-1	CME-4	CME-5
Sampling Interval:		19.0' - 20.2'	21.8' - 22.2'	29.5' - 29.8'	1.0' - 1.5'	12.0' - 12.4'	21.2' - 21.6'
ANALYTICAL PARAMETER	UNITS						
1,2 Dichloroethylene	mg/kg	0.0373	0.0734	ND(0.005)	426.0	0.0139	0.0139
Trichloroethylene	mg/kg	ND(0.005)	0.0156	ND(0.005)	215.0	ND(0.005)	ND(0.005)
Tetrachloroethylene	mg/kg	0.0325	ND(0.005)	ND(0.005)	656.0	ND(0.005)	ND(0.005)
TICs	No.	0	0	0	12**	0	0

* Triplicate sample analyzed by American Testing and Analytical Services.
** Soil analytical data also tentatively identified presence of petroleum - related VOCs in the soil at this location.
*** Blind duplicate of CME-2 submitted to NDRC for analysis.
ND: Analyte not detected in soil sample (level of detection shown in parentheses).
B: Analyte detected in blank as well as in sample.
J: Estimated value - analyte concentration is less than quantitation level but greater than zero.
TICs: Tentatively Identified Compounds; value shown is the number of compounds tentatively identified.
GMW: Groundwater Monitoring Well borehole location
CME: Borehole soil core number from which sample was obtained. (Samples were not collected from each soil core for laboratory analysis, therefore CME numbers presented on this table are not consecutive.)

Table 3-3 (continued)
Subsurface Soil
Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Sampling Location:		GMW-17				
Sample Number:		CME-1	CME-5	CME-7	CME-8	CME-9
Sampling Interval:		0.8' - 1.3'	24.6' - 25.0'	32.8' - 33.4'	39.4' - 39.8'	42.0' - 42.4'
ANALYTICAL PARAMETER	UNITS					
1,2 Dichloroethylene	mg/kg	0.490	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)
Trichloroethylene	mg/kg	304.0	0.0255	ND(0.005)	ND(0.005)	ND(0.005)
Tetrachloroethylene	mg/kg	1900.0	4.08	ND(0.005)	ND(0.005)	ND(0.005)
TICs	No.	10**	7**	0	0	0

** Soil analytical data also tentatively identified presence of petroleum-related VOCs in the soil at this location.
ND: Analyte not detected in soil sample (level of detection shown in parenthesis).
TICs: Tentatively Identified Compounds; value shown is the number of compounds tentatively identified.
GMW: Groundwater Monitoring Well borehole location
CME: Borehole soil core number from which sample was obtained. (Samples were not collected from each soil core for laboratory analysis, therefore CME numbers presented on this table are not consecutive.)

Table 3-3 (continued)
Subsurface Soil
Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Sampling Location:		SB-1				SB-2		SB-3	
Sample Number:		CME-1	CME-2	CME-3	CME-4	CME-1	CME-2	CME-1	CME-2
Sampling Interval:		3.2' - 3.6'	19' - 19.3'	24' - 24.6'	24' - 24.6'	1.4' - 1.8'	18.8' - 19.2'	6.6' - 7.0'	17'-18'
ANALYTICAL PARAMETER	UNITS								
1,2 Dichloroethylene	mg/kg		ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Trichloroethylene	mg/kg		ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Tetrachloroethylene	mg/kg		ND (0.005)	ND (0.005)	ND (0.005)	0.0143	ND (0.005)	ND (0.005)	ND (0.005)
Acetone	mg/kg		ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.223	ND (0.1)	ND (0.1)
TICs	No.		0	0	0	0	0	0	0
Total Organic Carbon	mg/kg	1480							585

Sampling Location:		SB-4						
Sample Number:		CME-1	CME-2	CME-3	CME-4	CME-40***	CME-5	CME-2*
Sampling Interval:		1.1' - 1.4'	5.5' - 5.7'	10.6' - 11'	19.6' - 20.0'	19.6' - 20.0'	24.3' - 24.7'	5.5' - 5.7'
ANALYTICAL PARAMETER	UNITS							
1,2 Dichloroethylene	mg/kg	ND(0.005)	0.197	1.1	ND(0.005)	0.0264	ND(0.005)	0.140
Trichloroethylene	mg/kg	ND(0.005)	ND(0.005)	0.0334	1.34	5.1	ND(0.005)	0.004 J
Tetrachloroethylene	mg/kg	684.0	ND(0.005)	0.137	227.0	636.0	158.0	0.002 J
Vinyl Chloride	mg/kg	ND(0.01)	ND(0.01)	0.184	ND(0.01)	ND(0.01)	ND(0.01)	0.005 J
Acetone	mg/kg	ND(0.1)	0.464	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.1)	0.220
2-butanone	mg/kg	ND(0.05)	0.137	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	0.047
Xylene	mg/kg	ND(0.005)	ND(0.005)	ND(0.005)	0.619	ND(0.005)	ND(0.005)	0.005
Benzene	mg/kg	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	0.001 J
Toluene	mg/kg	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	0.002 J
2-Hexanone	mg/kg	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	0.002 J
TICs	No.	11**	7**	1**	2**	10**	0	
Total Organic Carbon	mg/kg		1740					

* Duplicate sample analyzed by American Testing and Analytical Services.
** Soil Analytical data also tentatively identified presence of petroleum - related VOCs in the soil at this location.
*** Blind duplicate sample of CME-4 submitted to NDRC for laboratory analysis
ND: Analyte not detected in soil sample (level of detection shown in parentheses).
J: Estimated value - analyte concentration is less than quantitation level but greater than zero.
TICs: Tentatively Identified Compounds; value shown is the number of compounds tentatively identified.
CME: Borehole soil core number from which sample was obtained. (Samples were not collected from each continuous soil core for laboratory analysis, therefore CME numbers presented on this table are not consecutive.)
SB: Soil borehole sample location

Table 3-3 (continued)
Subsurface Soil
Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Sampling Location:		SB-6		
Sample Number:		CME-1	CME-2	CME-3
Sampling Interval:		2.0' - 2.6'	7.2' - 7.8'	13' - 14'
ANALYTICAL PARAMETER	UNITS			
1,2 Dichloroethylene	mg/kg	0.133	ND (0.005)	0.0744
Trichloroethylene	mg/kg	0.157	ND (0.005)	0.0198
Tetrachloroethylene	mg/kg	1.730	ND (0.005)	0.126
Total Organic Carbon	mg/kg		878	

ND: Analyte not detected in soil sample (level of detection shown in parentheses).
CME: Borehole soil core number from which sample was obtained. (Samples were not collected from each continuous soil core for laboratory analysis, therefore CME numbers presented on this table are not consecutive.)
SB: Soil borehole sample location

Table 3–4
Remedial Investigation
Supplememtal Soil Survey
PID Screening Data
Southeast Property Corner

EG&G KT AEROFAB/Missouri Metals Property

Sample Location	Sample Number+	Sample Interval*	Headspace° Reading
AS–1	S–1	1.8'–2.2'	30.4
AS–1	S–2	4.0'–4.4'	8.2
AS–2	S–1	1.2'–1.6'	50.6
AS–2	S–2	4.0'–4.4'	3.2
AS–3	S–1	1.7'–2.0'	0.2
AS–3	S–2	4.0'–4.4'	141
AS–4	S–1	1.0'–1.4'	0.0
AS–4	S–2	4.0'–4.4'	0.0
AS–5	S–1	1.0'–1.4'	0.0
AS–5	S–2	3.3'–3.8'	0.0
AS–6	S–1	1.0'–1.5'	0.0
AS–6	S–2	2.5'–3.0'	0.0
AS–7	S–1	1.3'–1.8'	152
AS–7	S–2	3.0'–3.6'	30.6
AS–8	S–1	1.2'–1.7'	9.4
AS–8	S–2	3.3'–3.9'	12.4
AS–9	S–1	1.5'–2.0'	11.5
AS–9	S–2	3.0'–3.7'	93.7

+ The S–1 samples were taken below the gravel fill and within the upper portion of clay fill. The S–2 samples were taken within the top of the natural clay soil.

* As measured from top of gravel fill.

° Parts per million VOCs as measured with a 10.6 eV PID within 15 minutes of sample acquisition.

Note: Shading indicates soil samples submitted to American Technical & Analytical Services, Inc. for laboratory analysis.

AS – Hand auger sampling location

organic vapor levels in soil samples from the area around GMW-14. (Results of soil sample vapor monitoring is summarized in Table 3-4.) Based primarily on the PID data, four soil samples were selected for VOC laboratory analysis. Results of the laboratory soil analysis are summarized in Table 3-5. This supplemental investigation did not detect elevated levels of VOC contamination in the area near GMW-14. Based on this data, no further investigaiton or remediation of soil contamination in this area was determined to be necessary.

Elevated VOC levels were also detected in two shallow soil samples from the upper two feet at sampling locations GMW-17 and SB-4, which are both located in the degreasing pit area. As indicated by data summarized in Table 3-3, elevated levels of these compounds were not detected in subsurface soil samples taken from deeper depths in the unsaturated zone or at other nearby sampling locations (SB-6 and GMW-15). This VOC distribution pattern indicates that the horizontal and vertical extent of shallow contamination in the vicinity of the degreasing pit is isolated, not indicatvie of significant contamination.

No other areas of elevated VOC levels were indicated by the analytical data from unsaturated soil samples collected during the remedial investigation. High VOC levels were detected in soil samples collected at depths below the water table only at SB-4, which is located in the vicinity of the degreasing pit. Two samples, collected at a depth of 19.6 to 20.0 feet and 24.3 to 24.7 feet, had elevated levels of PCE.

Metal levels present in the GMW-14 soil sample analyzed for total Contract Laboratory Program (CLP) Target Analyte List metals are near natural ranges, as indicated by information present in Table 3-6. No semivolatile organic, herbicide, pesticide, or PCB compounds were detected in the GMW-14 soil sample analyzed for these parameters.

3.7.2 Groundwater RI Data

Groundwater samples were collected from each of the monitoring wells during the RI and analyzed for VOCs. One groundwater sample from GMW-14 was also analyzed for CLP metals, pesticides, herbicides, PCBs, and SVOCs.

Table 3-5
Remedial Investigation Supplemental
Shallow Soil Survey Data Summary
Southeast Property Corner

EG&G KT AEROFAB/Missouri Metals Property

	Sample Location:	AS-3	AS-7	AS-8	AS-9
	Sample Number:	S-2	S-1	S-2	S-2
	Sample Interval:	4.0'-4.4'	1.3'-1.8'	3.3'-3.9'	3.0'-3.7'
Analyte	Units				
Acetone	mg/kg	0.038	0.015	0.030	0.093
Vinyl Choride	mg/kg	ND (0.010)	0.007 J	0.004 J	0.007 J
Methylene Chloride	mg/kg	0.013 B	0.011 B	0.016 B	0.014 B
1,1-Dichloroethylene	mg/kg	ND (0.005)	0.001 J	ND (0.005)	ND (0.005)
1,2-Dichloroethylene (Total)	mg/kg	0.001 J	2.800	0.060	0.14
Trichloroethylene	mg/kg	ND (0.005)	0.320 J	ND (0.005)	0.012
Tetrachloroethylene	mg/kg	ND (0.005)	0.200 J	ND (0.005)	0.019
1,1,2 Trichloroethylene	mg/kg	ND (0.005)	0.005	ND (0.005)	ND (0.005)
Toluene	mg/kg	0.003 J	0.003 J	0.004 J	0.002 J
Ethylbenzene	mg/kg	ND (0.005)	0.001 J	0.001 J	ND (0.005)
Xylenes (Total)	mg/kg	ND (0.005)	0.003 J	0.003 J	0.003 J
2-Butanone	mg/kg	0.01	1.200 J	ND (0.010)	ND (0.010)
Total Volatile Organic Compounds	mg/kg	0.065	4.566	0.118	0.290

ND: Analyte not detected in soil sample (level of detection shown in parentheses).
J: Estimated value-analyte concentration is less than quantitation level but greater than zero.
B: Analyte detected in method blank as well as sample.
NG: No Value Given.
AS: Hand auger sampling location
S-1: Shallow soil sample from augered hole
S-2: Deep soil sample from augered hole

Table 3-6
Soil Metal Levels
Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Analytical Parameter	Units	Detected Levels GMW-14 CME-3	Average Levels in Missouri Soil[1]	Nonspecific Location Average Soil Metals Levels[2]
Silver	mg/kg	< 1.0	NG	0.05
Aluminum	mg/kg	9600	41000	71000
Arsenic	mg/kg	9.0	8.7	5.0
Barium	mg/kg	118	580	430
Beryllium	mg/kg	< 1.0	0.8	6
Calcium	mg/kg	868	3300	13700
Cadmium	mg/kg	< 1.0	< 1.0	0.06
Cobalt	mg/kg	7.8	10	8.0
Chromium	mg/kg	7.0	54.0	6.0
Copper	mg/kg	10.9	13	30
Iron	mg/kg	16600	21000	38000
Mercury	mg/kg	0.03	0.039	0.03
Potassium	mg/kg	586	NG	8300
Magnesium	mg/kg	2040	2600	5000
Manganese	mg/kg	425	740	600
Sodium	mg/kg	81.9	5300	6300
Nickel	mg/kg	12.5	14	40
Lead	mg/kg	8.7	NG	10
Antimony	mg/kg	< 1.0	NG	NG
Selenium	mg/kg	< 0.4	0.28	0.3
Thallium	mg/kg	< 1.0	NG	NG
Vanadium	mg/kg	20.0	69	100
Zinc	mg/kg	32.5	49	50
Cyanide	mg/kg	< 0.1*	NG	NG

GMW- Groundwater Monitoring Well borehole location
CME- Soil core number from which sample was collected.
NG- Not Given

[1] Geophysical Survey of Missouri, Geological Survey Professional Paper 954 - H,I.

[2] A Compendium of Superfund Field Operations Methods, USEPA, December 1987.

* CME-2 soil sample from GMW-14 was analyzed for cyanide.

VOC levels were generally greatest in groundwater samples from the shallow wells installed by GTI and O'Brien and Gere (all screened within the soil). The highest levels of VOCs were detected at locations near the degreasing pit (GMW-6) and in the southeast property corner (GMW-8). Levels of VOCs detected in the nearby top of bedrock monitoring wells (GMW-14 and GMW-15) had the next highest levels of contamination. Levels of VOCs detected in bedrock monitoring wells (GMW-16, GMW-17, and GMW-18) were considerably lower, indicating a decrease in VOC levels with depth.

Metal levels detected in the groundwater sample from the top of bedrock monitoring well, GMW-14, are within typical natural levels for groundwater as indicated by the data summary provided in Table 3-7. No pesticides, herbicides, PCBs, or SVOCs were detected in the groundwater sample from GMW-14 analyzed for these parameters.

* * * * *

Table 3-7
Groundwater Metal Levels
Remedial Investigation Analytical Data Summary

EG&G KT AEROFAB/Missouri Metals Property

Analytical Parameter	Units	Detected Concentration GMW-14 GW-1	Natural Concentrations In Groundwater Nonspecific Location[1]	MCL Levels
Silver	µg/l	< 1.0	< 5.0	100 *
Aluminum	µg/l	511	5.0 - 1000.0	NE
Arsenic	µg/l	< 10	< 1.0 - 30.0	50.0
Barium	µg/l	63	10.0 - 500.0	2000.0
Beryllium	µg/l	< 0.1	< 10.0	1.0
Calcium	µg/l	87600	1000.0 - 150000.0	NE
Cadmium	µg/l	< 1.0	< 1.0	5.0
Cobalt	µg/l	< 50	< 10.0	NE
Chromium	µg/l	< 7.0	< 1.0 - 5.0	100.0
Copper	µg/l	< 6.0	< 1.0 - 30.0	1000.0 *
Iron	µg/l	70.0	10.0 - 10000.0	300.0 *
Mercury	µg/l	< 0.2	< 1.0	2.0
Potassium	µg/l	1440.0	1000.0 - 10000.0	NE
Magnesium	µg/l	323000.0	1000.0 - 50000.0	NE
Manganese	µg/l	311.0	< 1.0 - 1000.0	50.0 *
Sodium	µg/l	169000.0	500.0 - 120000.0	NE
Nickel	µg/l	< 10.0	< 10.0 - 50.0	100.0
Lead	µg/l	2.4	< 15.0	15.0
Antimony	µg/l	< 40.0	NG	NE
Selenium	µg/l	< 5.0	< 1.0 - 10.0	50.0
Thallium	µg/l	< 10.0	NG	291.0
Vanadium	µg/l	< 10.0	< 1.0 - 10.0	NE
Zinc	µg/l	10.5	< 10.0 - 2000.0	5000.0 *
Cyanide	mg/l	< 0.01	NG	200.0

GMW - Groundwater monitoring well number
NE - None Estimated
NG - Not Given
GW-1 - First groundwater sample collected from well on that date
MCL - Maximum contaminant level established by USEPA under Safe Drinking Water Act

[1] Dragun, James, The Soil Chemistry of Hazardous Materials, 1988.

* Value is secondary maximum contaminant level established for aesthetic purposes, not a health-based standard.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

Investigations have been conducted on this property in the past by Burns and McDonnell, GTI, and O'Brien and Gere. To demonstrate the coverage of past investigation activities and the extent of detected chemicals, all historical soil and groundwater data has been included in this data evaluation section.

The chemical compounds identified during past investigations consist primarily of volatile organic compounds. VOCs have been detected in soil and groundwater samples. Section 4.2 summarizes the specific chemical compounds detected during all past investigation activities to define the nature of chemicals present on the property.

The extent of chemical compounds on this 3.5-acre property has been evaluated through the installation of 18 monitoring wells and 33 boreholes. Section 4.3 summarizes data obtained to date from all property investigation activities to identify the extent of shallow soil, deep subsurface soil, and groundwater contamination across the property.

4.2 DETECTED CHEMICALS

4.2.1 Introduction

During past investigations on the property, volatile organic compounds (solvents) have been identified as the primary contaminants present in soil and groundwater. Samples have also been analyzed for asbestos, total metals, chromium EP toxicity, total organic carbon, oil and grease, PCBs, SVOCs, herbicides, and pesticides. Elevated levels of oil and grease and total chromium were detected at isolated surface soil locations; however, the areal extent of soils impacted by these materials is extremely low. VOCs have been detected at elevated levels in the shallow perched groundwater system and at isolated locations in the shallow and deep subsurface soil. Based on this data, the volatile organic compounds have been considered the contaminants of primary concern by all past investigators.

4.2.2 Volatile Organic Compounds

The primary VOCs detected in site soil and groundwater are tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE), and vinyl chloride. Each compound, TCE, 1,2-DCE, and vinyl chloride, may be produced during the natural degradation of PCE. TCE and PCE have historically been used on the property for industrial degreasing purposes. Low levels of other volatile compounds, including 1,1,1-trichloroethane, toluene, methylene chloride, benzene, 1,2-dichloroethane, acetone, and chloroform, have also been detected in the groundwater. However, as indicated on Table 4-1, the frequency and levels at which these other compounds were detected are much lower than the levels and frequency of detection for PCE and its degradation by-products. Laboratory data presented in this section is summarized as total volatile organic compound (TVOC) levels. PCE and their degradation products are the VOCs generally detected most frequently and at the highest levels.

PCE was detected at the highest concentrations in shallow groundwater and soil samples collected from the immediate vicinity of the degreasing pit. As indicated by Table 4-1, samples collected from the southeast property corner, downgradient of the degreasing pit, generally had less PCE and higher levels of its degradation products (TCE and 1,2-DCE). In both areas, the detected levels of volatile organic were generally below remediation levels recommended by the Missouri Department of Health (MDOH) for residential properties.

As the age of a PCE release increases, the level of PCE present in the soil and groundwater would naturally decrease while the levels of degradation compounds would be expected to increase. As a result of the natural degradation of organic chemicals, the levels of degradation products may increase as contaminants migrate downgradient of the original source.

The degreasing facilities and hazardous waste containment area were reconstructed by EG&G after they purchased the property. As a result, no releases of solvents from current manufacturing processes are expected to exist. Improvements to the degreasing pit facility and the hazardous waste storage area have been completed to improve solvent handling facilities on this property.

Table 4-1
Volatile Organic Compound Distribution In Groundwater*

EG&G KT Areofab/Missouri Metals Property

Compound	MCL (mg/L)	Degreasing Pit Area Monitoring Wells*** Range Detected(mg/l)	Frequency Detected	No. of Detections Above MCL	Southeast Property Corner Monitoring Wells**** Range Detected(mg/l)	Frequency Detected	No. of Detections Above MCL
Acetone**		ND	0/12	NA	ND-0.008	1/8	NA
Vinyl Chloride	0.002	ND-2.32	11/12	11	ND-21.0	6/8	6
Methylene Chloride**	0.005	ND-0.58	6/12	6	ND-0.155	2/8	2
1,1-Dichloroethene	0.007	ND-0.3	8/12	7	ND-0.19	5/8	5
1,2-Dichloroethene	0.07 *****	0.0124-70.0	11/12	11	0.282-190.0	8/8	8
Trichloroethylene	0.005	0.292-60.0	12/12	12	1.17-111.0	8/8	8
Tetrachloroethylene	0.005	0.0842-88.7	12/12	12	ND-6.0	6/8	6
Chloroform	0.1	ND-0.01	2/12	0	ND-0.006	1/8	0
Toluene	1.0	ND-0.133	7/12	0	ND-0.17	3/8	0
1,1-Dichloroethane		ND-0.25	5/12	NA	ND-0.053	1/8	NA
1,2-Dichloroethane	0.005	ND-0.007	2/12	2	ND-0.005	1/8	0
1,1,2-Trichloroethane	0.005	ND-0.018	3/12	3	ND-0.095	5/9	5
1,1,1-Trichloroethane	0.2	ND-0.37	6/12	1	ND	0/8	0
Benzene	0.005	ND-0.0194	3/12	3	ND	0/8	0
Chlorobenzene		ND-0.004 J	1/12	NA	ND-0.004 J	1/8	NA
Xylenes	10.0	ND-0.003 J	1/12	0	ND	0/8	0

* Based on review of all historical data, duplicate samples were combined and counted as one sample in calculating frequency. The maximum detected value of both samples was used to establish detected ranges.

** Suspected laboratory contaminant, frequently detected in only one of two duplicate samples sent to different laboratories.

*** Degreasing Pit Monitoring Wells are GMW-5, GMW-6, GMW-15, GMW-17, and GMW-18.

**** Southeast Property Corner Wells are GMW-8, GMW-14, and GMW-16.

***** MCL shown in for cis isomer of 1,2-Dichloroethene, MCL for trans isomer is 0.1

Notes

ND - Not detected
Frequency Detected indicates the number of samples in which the compound was detected/the total number of samples (an original and duplicate sample was counted as one sample).

MCL - Maximum contaminant level established by USEPA under Safe Drinking Water Act
If blank on MCL has not been established.

NA - Not Applicable, No MCL standard established

4.2.3 **Metals**

During past investigations, a total of five surface and 19 subsurface soil samples have been analyzed for total chromium. Levels of total chromium detected in 23 of 24 samples analyzed for this parameter ranged from 7 to 38.7 mg/kg. These levels are lower than the mean average chromium concentration for Missouri soils, 54 mg/kg (USGS, 1980). During the O'Brien and Gere audit an elevated level of total chromium, 732 mg/kg, was detected in a single soil sample (OS-1) collected from near the east property boundary. The level of chromium detected in a surface soil sample (OS-2) collected approximately 15 feet south of OS-1 was 38.7 mg/kg. Based on all of the soil data, the one area of elevated chromium levels appears to be isolated and not a significant property concern.

Subsurface samples collected during the July 1990 GTI assessment were also analyzed for arsenic, copper, lead, nickel, and zinc. One subsurface soil sample collected during the remedial investigation was analyzed for all 23 target analyte (CLP) metals. Metal levels were generally within average levels for Missouri; however, slightly elevated levels were detected at scattered locations. These areas of elevated detected metals are summarized in Table 4-2.

Total chromium levels detected in groundwater samples collected at the property ranged from below the level of detection to 0.223 mg/l. During the property audit, the maximum concentration detected, 0.112 mg/l, was present in a sample from an upgradient monitoring well, MW-1. During the May 1989 sampling by GTI, a total chromium concentration of 0.223 mg/l was detected in a groundwater sample from MW-3. Total chromium concentrations in the other three wells sampled on this date ranged from below the level of detection to 0.005 mg/l.

The four original wells and four new wells were sampled by GTI in July 1990. Groundwater samples from these eight wells were analyzed for selected dissolved metals. Levels of dissolved chromium in the water samples from all monitoring wells were below the level of detection. Based on this data, the elevated total

Table 4-2
Subsurface Soil Metal Level Summary

EG&G KT Areofab/Missouri Metals Property

Parameter	Locations Metal Levels Exceeding Missouri Typical Levels were Detected	Missouri Mean Average Level in Soil (mg/kg)	Range Detected at Other Sampling Points (mg/kg)	Total Number of Soil Samples Analyzed for Each Parameter
Arsenic	None	8.7	1.2-9.0	5
Chromium	OS-1 (732 mg/kg)	54.0	7.0-38.7	24
Copper	None	13.0	8.0-20.0	5
Lead	GMW-7 (120 mg/kg)	NG	8.7-21.0	5
Nickel	GMW-8(33 mg/kg) SB-1 (71 mg/kg)	14.0	12.5-19.0	5
Zinc	SB-1 (75 mg/kg) SB-3 (120 mg/kg) SB-4 (200 mg/kg)	49.0	26.0-54.0	5

Notes:

Table data is obtained from GTI, January 31,1991, Site Assessment Report and BMWCI RI data based on a total of nine samples. Chromium data also includes O'Brien and Gere results from 15 samples.

Mean average metal levels for Missouri soil obtained from Geophysical Survey of Missouri, Geological Survey Professional Paper 954-H,I.

Typical metal levels for Missouri assumed to be 150% of the mean average established by United States Geological Survey (USGS).

Metal levels detected at locations exceeding estimated typical levels are shown in parentheses following the sampling location.

NG-Not Given
OS-O'Brien and Gere surface soil sample
GMW-Groundwater monitoring well borehole sample
SB-Soil borehole sample

chromium levels detected in samples from an upgradient and downgradient monitoring well, MW-1 and MW-3, do not reflect dissolved chromium contamination. The chromium detected in these groundwater samples likely reflects soil particulates contained in the groundwater sample. Chromium is not considered a significant contaminant on the Missouri Metal property.

Levels of other metals detected in the dissolved groundwater samples collected in July 1990 were low and within the range of potential natural levels for this shallow aquifer. Metals detected were cadmium, 0.002 mg/L; copper, 0.03 to 0.09 mg/L; lead, not detected to 0.008 mg/L; and zinc, 0.02 to 0.1 mg/L. The detected levels of these metals are within drinking water standards. Based on this data, metals are not considered a concern on the Missouri Metal property.

4.2.4 Total Petroleum Hydrocarbons (TPH)

Isolated areas of potential oil contamination were observed during the O'Brien and Gere, GTI, and BMWCI investigations at the Missouri Metal property. Five surface soil samples were analyzed for oil and grease during the O'Brien and Gere audit. Data obtained from the audit indicated that oil and grease levels in surface soil ranged from 0.2 to 20.48 percent. The highest levels of oil and grease were detected in samples from OS-3 (20.48 percent) and OS-1 (13.57 percent). Surface soil sampling locations selected during the audit were reportedly based on area use and visually apparent stains. As a result, surface soil data likely reflects worst case conditions. Oil and grease levels in subsurface soils ranged form 0.005 to 0.014 percent.

Stained soil was observed by GTI in the degreasing pit area during the installation of SB-3G and GMW-6. The TPH level detected at the 1- to 3-foot depth at SB-3 was 72 mg/kg. For GMW-6 at the 6- to 9-foot depth, the detected level was 890 mg/kg. A groundwater sample from GMW-6 had a TPH level of 12 mg/L.

Due to the property's history as an industrial facility, it is likely that oil releases have occurred in isolated locations and in small quantities over the years. Isolated small areas of staining, however, are not surprising and do not alone indicate a major problem. Groundwater data obtained during the RI does not indicate significant levels of petroleum-related hydrocarbons in the groundwater.

Based on these observations, TPH levels detected on the property are considered characteristic of small releases common to industrial activities. These historical, small spills are not impacting off-site groundwater quality. A significant oil contamination problem is not indicated on the Missouri Metal property.

4.2.5 Other Parameters

During the audit and RI, no PCBs, herbicides, pesticides, or SVOCs were detected in samples analyzed for these parameters. Total organic carbon data, since it may reflect natural conditions, is not utilized to assess site contamination concerns.

4.3 EXTENT OF CONTAMINATION

4.3.1 Shallow Soil

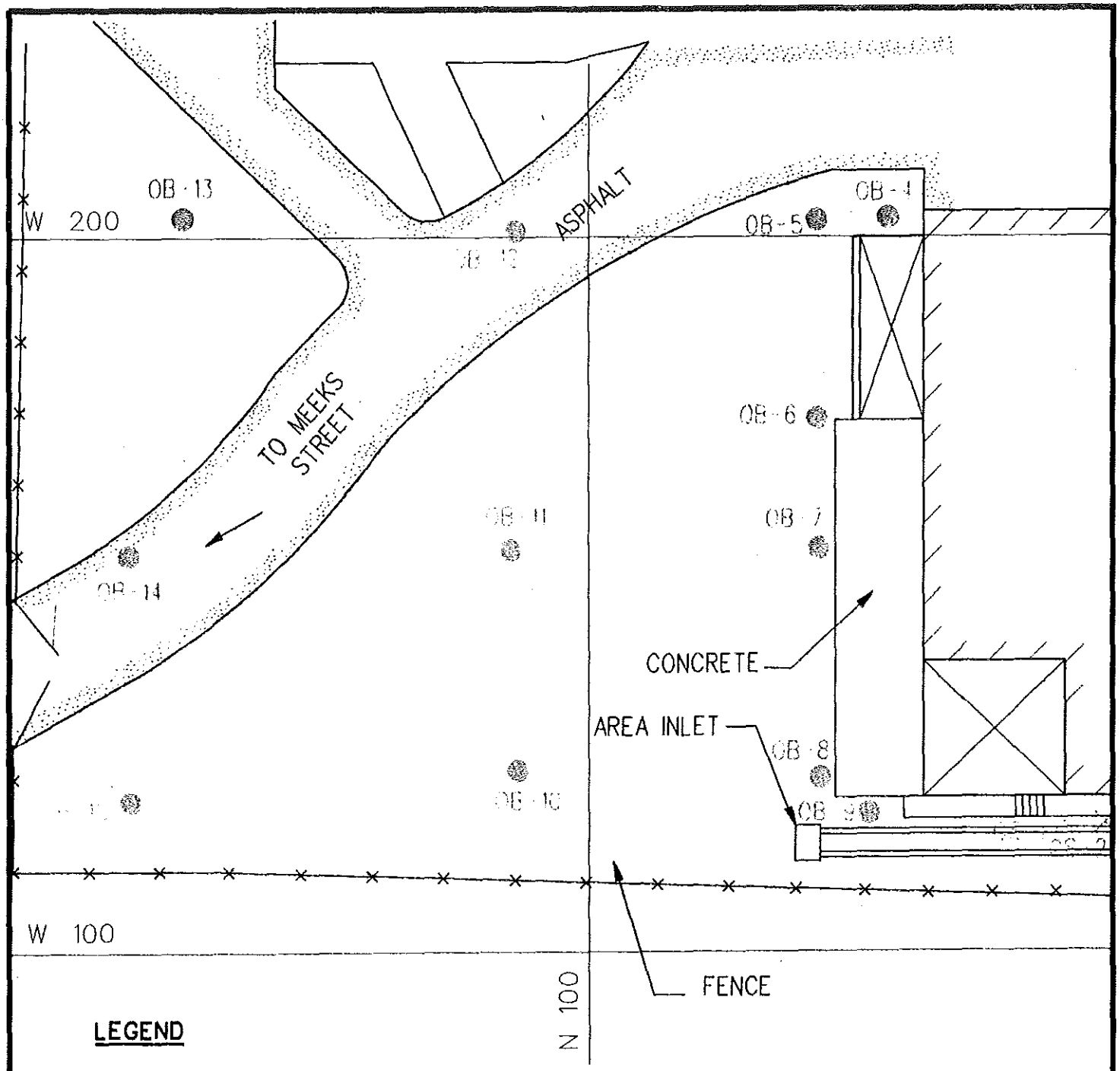
4.3.1.1 Introduction

The extent of shallow soil (0 to 5 feet) and deep soil (greater than 5 feet) contamination was assessed separately, since the extent of contamination in the upper soil provides an indication of the nature and extent of past surface releases. Deeper subsurface sampling data could characterize process leakage from subsurface piping, structures, or subsurface migration from upgradient sources. Due to the magnitude of past shallow soil sampling locations on the property, activities in the southeast property corner and the degreasing pit area have been assessed separately.

4.3.1.2 Southeast Property Corner

The southeast property area, due to its past use as a storage area for production materials and drummed wastes, has been extensively investigated during past investigations. Soil borings have been installed in this portion of the property by O'Brien and Gere, GTI, and Burns and McDonnell. These shallow subsurface and the O'Brien and Gere surface soil sampling locations are shown in Figure 4-1.

During the investigation by O'Brien and Gere, 11 shallow soil borings were installed in this area. The report prepared for this audit investigation



LEGEND

- MONITORING WELL (GMW) LOCATIONS
- APPROXIMATE SOIL BORING (OB AND SB) LOCATION
- HAND AUGER SOIL (AS) SAMPLE LOCATIONS
- SURFACE SOIL (OS) SAMPLE LOCATION.

LOCATIONS SHOWN IN [illegible] SAMPLED BY O'BRIEN & GERE

LOCATIONS SHOWN IN [illegible] SAMPLED BY GROUNDWATER TECHNOLOGY, INC.

LOCATIONS SHOWN IN [illegible] SAMPLED BY BURNS & McDONNELL

NORTH

20' 0' 20' 40'

APPROXIMATE SCALE IN FEET

Burns & McDonnell Waste Consultants, Inc.
ENGINEERS - GEOLOGISTS - SCIENTISTS - 100% EMPLOYEE-OWNED

FIGURE 4-1
SHALLOW SOIL SAMPLING LOCATIONS - SOUTHEAST PROPERTY CORNER
MISSOURI METALS PROPERTY
OVERLAND, MISSOURI

indicates that the soil borings were installed to detect any observable subsurface soil staining or contamination. Samples that appeared to be stained or exhibited an odor were reportedly delivered to the laboratory for analysis.

Sampling by GTI and Burns and McDonnell was performed in conjunction with installing groundwater monitoring wells or deep soil borings. During both investigations, soil samples from the boreholes were field screened utilizing a PID to detect volatile organic vapors. Samples were selected for laboratory analysis based on the VOC vapor readings as well as visual appearance and odors. PID readings obtained during RI drilling activities are summarized in Appendix E.

The analytical data and soil vapor screening results from these investigations are summarized in Table 4-3. This data indicated that shallow soil contamination levels in this portion of the property are low. However, at an isolated location, GMW-14, elevated level of VOCs (PCE, 656.0 mg/kg; TCE, 215 mg/kg; and 1,2-DCE, 426 mg/kg) were detected in a shallow soil sample collected during the RI. The area was further investigated during a supplemental soil investigation by collecting shallow soil samples from the area surrounding GMW-14. Data obtained from this follow-up sampling investigation confirmed that shallow soil contaminant levels in this area are low. The elevated level detected at GMW-14 is apparently a single isolated occurrence.

4.3.1.3 Degreasing Pit Area

Solvent use during the past operation of this industrial facility has occurred primarily in the area of the degreasing pit. The degreasing pit has reportedly been at this same location during the entire history of this industrial facility. Adjacent to the degreasing pit are two elevated 500-gallon, PCE storage tanks. Temporary storage of waste solvents in barrels may also have occurred on this portion of the property in the past. Due to its past use, extensive shallow soil sampling was performed in this portion of the property by O'Brien and Gere, GTI, and Burns and McDonnell to determine whether releases or spills during past

Table 4-3
Shallow Soil Investigation Data Summary Table
Southeast Property Corner

EG&G KT Areofab/Missouri Metals Property

Sample Location	Sampling Date	Sample Depth Interval (feet)	VOC Vapor Reading (ppm)*	TVOC Analytical Results (mg/kg)**
AS-1	7/92	1.8-2.2	30.4	
AS-1	7/92	4.0-4.4	8.2	
AS-2	7/92	1.2-1.6	50.6	
AS-2	7/92	4.0-4.4	3.2	
AS-3	7/92	1.7-2.0	0.2	
AS-3	7/92	4.0-4.4	141	0.065
AS-4	7/92	1.0-1.4	0	
AS-4	7/92	4.0-4.4	0	
AS-5	7/92	1.0-1.4	0	
AS-5	7/92	3.3-3.8	0	
AS-6	7/92	1.0-1.5	0	
AS-6	7/92	2.5-3.0	0	
AS-7	7/92	1.3-1.8	152	4.566
AS-7	7/92	3.0-3.6	30.6	
AS-8	7/92	1.2-1.7	9.4	
AS-8	7/92	3.3-3.9	12.4	0.118
AS-9	7/92	1.5-2.0	11.5	
AS-9	7/92	3.0-3.7	93.7	0.29
GMW-14	3/92	1.0-1.5	118	1297
SB-1	3/92	0.0-5.0	0	
SB-2	3/92	1.4-1.8	0	0.0143
SB-3	3/92	0.0-5.0	0	
GMW-16	4/92	0.0-5.0	1.9	

Notes:

NR - None Reported
ND - None Detected
* - VOC vapor level measured with PID.
** - Blank spaces indicate sample was not selected for laboratory analysis based on visual apperance, odor, and/or vapor readings screening performed in field.
OB - O'Brien and Gere soil boring location
SB - Burns and McDonnell soil boring location
AS - Hand auger soil sample location
GMW - Groundwater monitoring well boring location
OS - O'Brien and Gere surface soil sample location

Table 4-3 (continued)
Shallow Soil Investigation Data Summary Table
Southeast Property Corner

EG&G KT Areofab/Missouri Metals Property

Sample Location	Sampling Date	Sample Depth Interval (feet)	VOC Vapor Reading (ppm)*	TVOC Analytical Results (mg/kg)**
OB-4	2/88	3.5-4.5	NR	ND
OB-5	2/88	0.0-5.0	NR	
OB-6	2/88	3.0-4.5	NR	ND
OB-7	2/88	2.5-4.0	NR	6.73
OB-8	2/88	0.0-5.0	NR	
OB-9	2/88	2.5-4.0	NR	ND
OB-10	2/88	0.0-5.0	NR	
OB-11	2/88	2.5-4.0	NR	ND
OB-12	2/88	0.0-5.0	NR	
OB-13	2/88	3.0-4.5	NR	5.24
OB-14	2/88	0.0-5.0	NR	
OB-15	2/88	3.0-5.0	NR	7.61
GMW-7	7/90	1-3	24.6	
	7/90	3-6	23.6	
GMW-8	7/90	1-3	7.1	
	7/90	3-6	23.7	
OS-1	2/88	0-0.5	NR	ND
OS-2	2/88	0-0.5	NR	4.92

Notes:

NR - None Reported
ND - None Detected
* - VOC vapor level measured with PID.
** - Blank spaces indicate sample was not selected for laboratory analysis based on visual apperance, odor, and/or vapor readings screening performed in field.
OB - O'Brien and Gere soil boring location
SB - Burns and McDonnell soil boring location
AS - Hand auger soil sample location
GMW - Groundwater monitoring well boring location
OS - O'Brien and Gere surface soil sample location

operations have created the current property concerns. Sampling locations utilized during these investigations are shown in Figure 4-2.

O'Brien and Gere and GTI each installed three soil borings. Burns and McDonnell installed two soil borings in the degreasing pit area to evaluate shallow soil contamination extent. Soil sampling was also performed by GTI and Burns and McDonnell during installation of monitoring wells. Soil sample analytical and vapor screening data obtained from these investigation activities are summarized in Table 4-4.

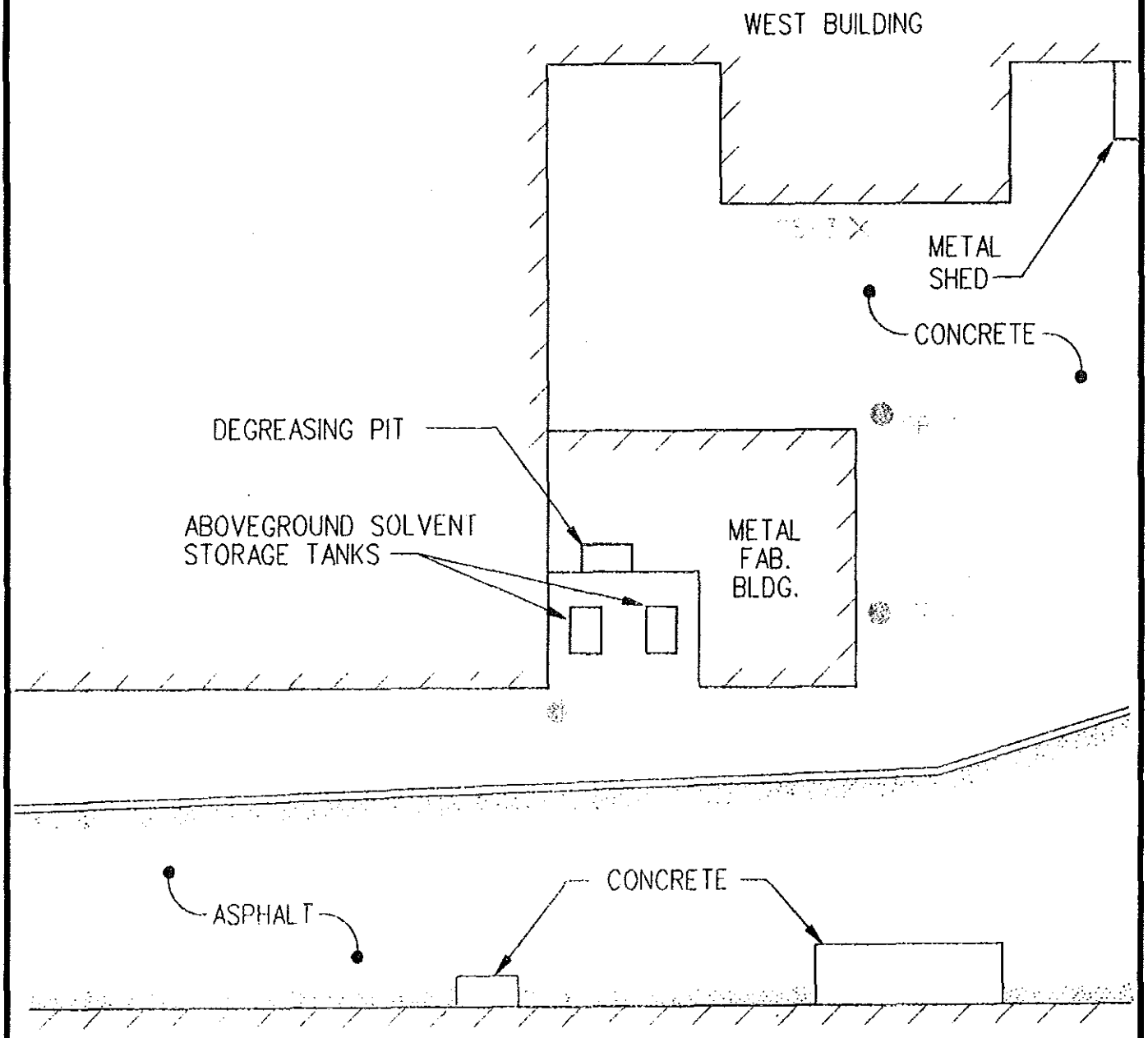
Results of the shallow investigation on this portion of the property indicate that VOCs were detected in 13 of 14 soil samples submitted for laboratory analysis. However, at most locations, the detected concentrations were within health-based limits. Total VOC levels reported for shallow soil samples from SB-4, GMW-17, and SB-4G (684.0, 2204.5, and 290.33 mg/kg, respectively) did exceed the health-based recommended soil levels for residential areas. PCE was the VOC primarily detected at each of these sampling points.

These sampling points are located in the vicinity of the degreasing pit (SB-4 and GMW-17) and the PCE storage tanks (SB-3G). At other nearby sampling locations, significantly lower levels of VOCs were detected in the soil.

The occurrence of shallow soil contamination in this portion of the property is assumed to have resulted from past spillage of PCE or TCE during normal chemical handling. Current data indicates these elevated contaminant locations are of small lateral extent and depth not indicative of a significant pattern of contamination necessitating further action. Based on this data, current surface releases and shallow soil contamination are not contributing to the groundwater or deep soil contamination detected on the property.

4.3.2 Deep Soil

Deep soil samples were collected and analyzed by GTI and Burns and McDonnell during past investigations. The cross section trace used to display the distribution of VOCs in the deep soil is shown on Figure 4-3. VOC soil data obtained from past investigations is summarized in Figure 4-4.



1. LOCATIONS SHOWN IN RED SAMPLED BY O'BRIEN AND GERE
2. LOCATIONS SHOWN IN GREEN SAMPLED BY GROUNDWATER TECHNOLOGY, INC.
3. LOCATIONS SHOWN IN BLUE SAMPLED BY BURNS AND McDONNELL

NORTH

20' 0' 20' 40'

APPROXIMATE SCALE IN FEET

LEGEND

MONITORING (GMW) WELL LOCATION
SHALLOW SOIL BORING (SB OR OB) LOCATION
SURFACE SOIL SAMPLE (OS) LOCATION

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ENGINEERS - GEOLOGISTS - SCIENTISTS - 100% EMPLOYEE-OWNED

FIGURE 4-2
SHALLOW SOIL SAMPLING LOCATIONS - DEGREASING PIT AREA
MISSOURI METALS PROPERTY
OVERLAND, MISSOURI

EGCS1003.DGN, OF=NONE

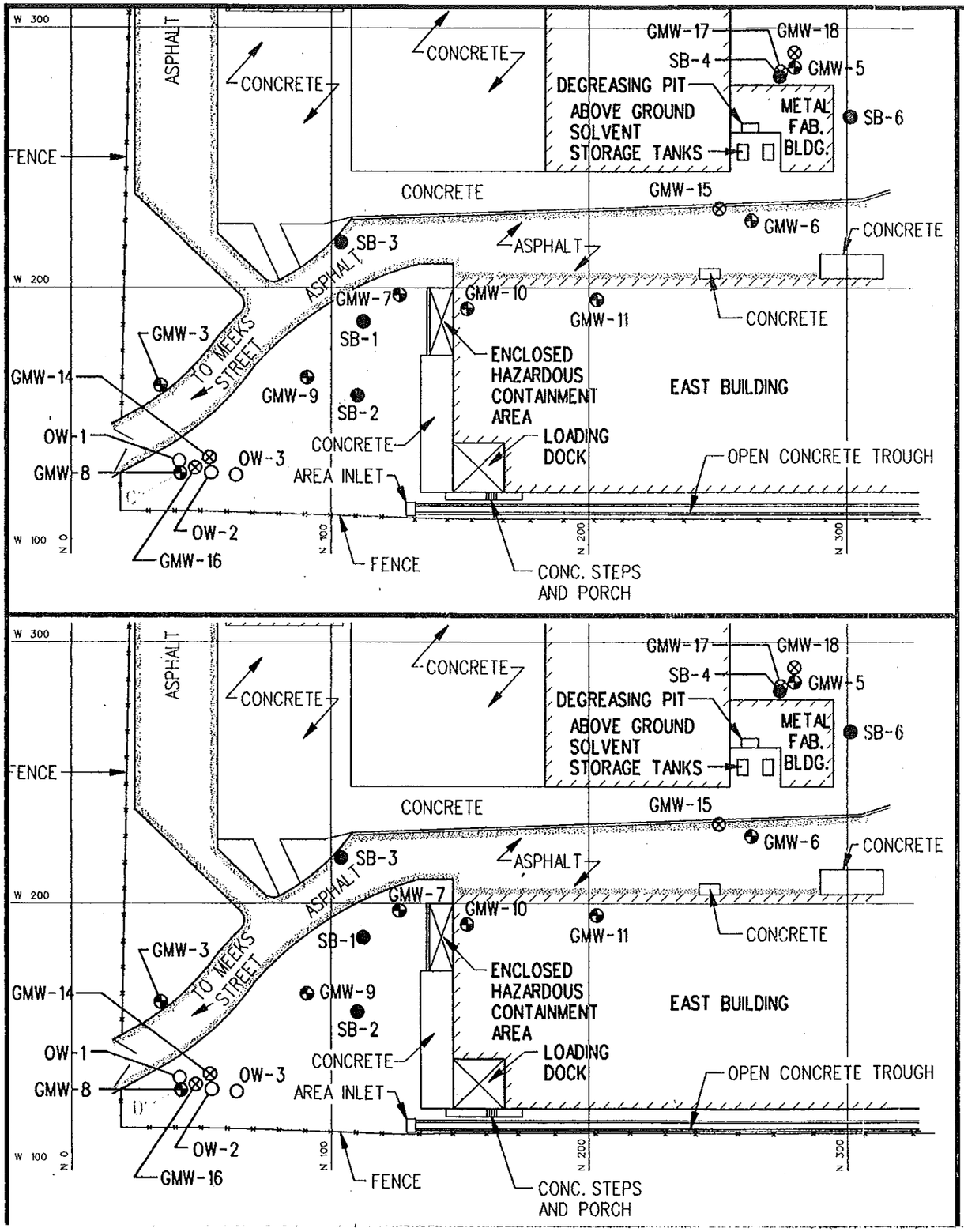
Table 4-4
Shallow Soil Investigation Data Summary Table
Degreasing Pit Area

EG&G KT Areofab/Missouri Metals Property

Sample Location	Sampling Date	Sample Depth Interval (feet)	VOC Vapor Reading (ppm)*	TVOC Analytical Results (mg/kg)**
SB-4	4/92	0.0-0.6	250	
SB-4	4/92	1.1-1.4	NR	684
SB-4	4/92	5.0	2	
SB-1	4/92	5.5-5.7	10	0.8
SB-6	4/92	2.0-2.6	6	2.02
GMW-17	4/92	0.8-1.2	1453	2204.5
GMW-17	4/92	2.0	387.7	
GMW-17	4/92	4.0	124.6	
GMW-15	3/92	1.2-1.5	76.9	2.5
GMW-15	3/92	3.8-4.4	134.7	4.26
GMW-5	7/90	1-3	201	
GMW-5	7/90	3-6	209	ND
GMW-6	7/90	2-3	239	
GMW-6	7/90	3-6	633	
SB-2G	7/90	2-3	43.5	0.28
SB-2G	7/90	3-6	34.2	
SB-3G	7/90	1-3	998	290.33
SB-3G	7/90	3-4.5	921	
SB-4G	7/90	1-3	41.3	
SB-4G	7/90	3-6	118	0.17
OB-1	2/88	3.5-5.0	NR	1.31
OB-2	2/88	3.5-5.0	NR	34.5
OB-3	2/88	2.5-4.0	NR	20.4
OS-3	2/88	0.0-0.5	NR	2.16

Notes:

NR - None reported by investigation
ND - None Detected
* - VOC vapor level measured with PID.
** - Blank spaces indicate sample was not selected for laboratory analysis based on visual apperance, odor, and/or vapor readings screening performed in field.
OS - O'Brien and Gere surface soil sampling location
SB - Burns and McDonnell or GTI soil boring location
OB - O'Brien and Gere soil boring location
GMW - Groundwater monitoring well borehole location



NOTES:

1. ELEVATION DATUM:
   M.S.D. BENCHMARK 466-112
   U.S.G.S. ELEVATION 675.11
2. WELL AND SOIL BORING LOCATIONS ARE APPROXIMATE AND BASED ON TAPING FROM BUILDING CORNERS.
3. X AND Y COORDINATES ARE APPROXIMATE AND BASED BASED ON SCALING FROM PLAN DRAWING.
4. ELEVATIONS SHOWN ARE FOR TOP OF CASING FOR MONITORING WELLS AND GROUND SURFACE FOR SOIL BORINGS.

LEGEND

- APPROXIMATE 2" MONITORING WELL LOCATION
- APPROXIMATE 4" MONITORING WELL (BMWCI) LOCATION
- APPROXIMATE 2" OBSERVATION WELL LOCATION
- APPROXIMATE SOIL BORING (BMWCI) LOCATION

TRACE OF GEOLOGIC/SUBSURFACE SOIL CONTAMINATION PROFILE

TRACE OF GEOLOGIC/SUBSURFACE WATER CONTAMINATION PROFILE

WELL I.D.	T.O.C. ELEVATION	X (NORTH) COORDINATE	Y (WEST) COORDINATE
GMW-1	650.92	597.7	386.4
GMW-3	635.87	34.3	162.5
GMW-4	641.60	48.2	370.4
GMW-5	646.29	279.8	284.8
GMW-6	642.60	262.9	225.9
GMW-7	638.80	126.5	197.4
GMW-8	635.93	42.0	128.9
GMW-9	637.57	90.6	165.6
GMW-10	643.06	152.6	192.0
GMW-11	643.15	203.1	195.5
GMW-14	636.51	53.1	134.9
GMW-15	642.31	250.4	230.5
GMW-16	636.31	47.7	131.0
GMW-17	646.29	274.4	283.2
GMW-18	646.17	279.7	290.4
OW-1	635.72	41.5	133.6
OW-2	636.25	53.8	129.1
OW-3	636.57	63.3	128.2
SB-1	638.41	112.6	187.1
SB-2	638.49	110.3	158.7
SB-3	638.51	103.9	217.5
SB-4	646.62	274.0	281.4
SB-6	645.99	301.2	265.8

NORTH

45' 0' 45' 90'

APPROXIMATE SCALE IN FEET

Burns & McDonnell Waste Consultants, Inc.

FIGURE 4-3

SOIL AND GROUNDWATER CONTAMINATION PROFILE TRACES FOR C-C' AND D-D'

PLOTG=SCREEN.PLT, PEN 12 = 06, PEN 13 = 01
EGGSITBA.DGN, DF=NONE

C

NORTHWEST

C'

SOUTHEAST

ELEVATION IN FEET ABOVE MEAN SEA LEVEL

660
650
640
630
620
610
600
590

PIT
PCE TANK
SOUTHWEST CORNER OF EAST BUILDING
APPROXIMATE GROUND SURFACE
GMW-17 646.58
SB-4 646.62
GMW-5 ~646.5
GMW-15 642.68
GMW-6 ~642.6
GMW-7 639.08
SB-2 638.49
GMW-16 636.64
GMW-14 636.77
GMW-8 636.21
ND
FILL
632.80
632.25
633.22
636.04
631.61
629.87
629.51
629.55
APPROXIMATE BOTTOM OF FILL
CLAY & SILT
TD= 17.5'
TD=28.0'
TD=15.0'
TD=19.9'
TD=14.0'
TD=14.0'
APPROXIMATE TOP OF BEDROCK
SILTSTONE
APPROXIMATE TOP OF BEDROCK
SILTSTONE
TD=25.0'
SHALE
SHALE
ND
ND
SANDSTONE
TD=39.0'
TD=50.4'
TD=43.5'
SHALE

LEGEND

GMW-18 MONITORING WELL NUMBER
SB-2 SOIL BORING NUMBER
TD TOTAL DEPTH
SCREENED INTERVAL
ND NOT DETECTED
633.22 WATER ELEVATION OBTAINED 5-8-92

NOTE:

MDOH ANY-USE LEVELS ARE ESTABLISHED FOR RESIDENTIAL PROPERTIES AND ARE NOT APPLICABLE TO THIS INDUSTRIAL LOCATION. THESE STANDARDS ARE UTILIZED FOR COMPARISON PURPOSES BECAUSE THEY ARE THE ONLY STANDARDS AVAILABLE.

HORIZONTAL 30 0 30 60 SCALE IN FEET

VERTICAL 10 0 10 20 SCALE IN FEET

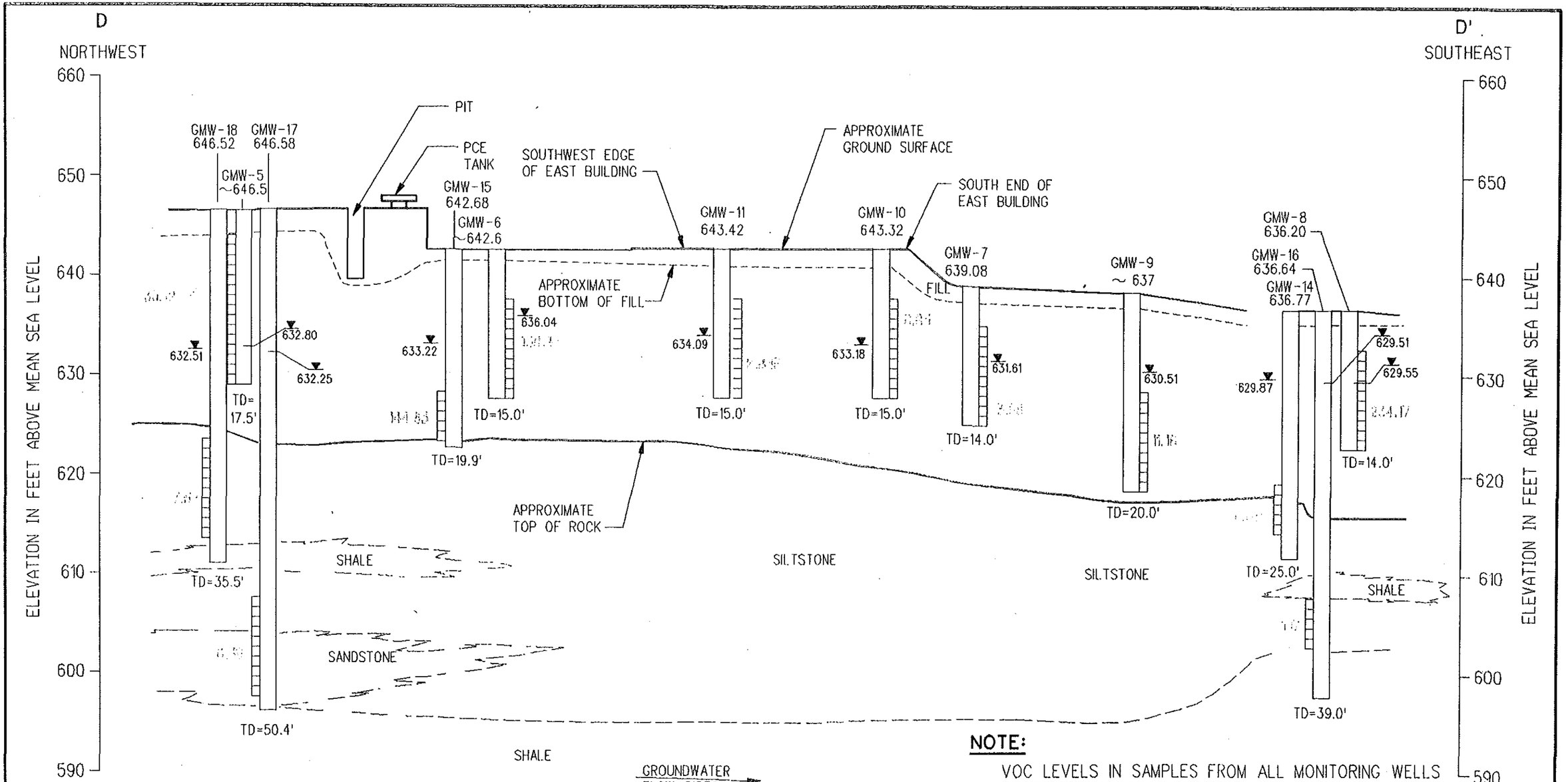
VERTICAL EXAGGERATION- 1 : 3

Burns & McDonnell Waste Consultants, Inc.

FIGURE 4-4

VERTICAL EXTENT OF SUBSURFACE SOIL CONTAMINATION PROFILE C-C'

PLTCFG=SCREEN.PLT, PEN 12 = 65, PEN 13 = C1



NOTE:

VOC LEVELS IN SAMPLES FROM ALL MONITORING WELLS EXCEEDED MAXIMUM CONTAMINANT LEVELS (MCLs). HOWEVER, SINCE THE SHALLOW GROUNDWATER IS NOT UTILIZED AS A SOURCE OF POTABLE WATER, THE MCLs ARE NOT APPLICABLE.

DRILLING LOG NOT AVAILABLE FOR GMW-10 AND GMW-11 GMW-11

LEGEND

GMW-18	MONITORING WELL NUMBER		
SB-2	SOIL BORING NUMBER		
TD	TOTAL DEPTH	ND	NOT DETECTED
	SCREENED INTERVAL	633.22	WATER ELEVATION OBTAINED 5-8-92

HORIZONTAL 30 0 30 60
SCALE IN FEET

VERTICAL 10 0 10 20
SCALE IN FEET
VERTICAL EXAGGERATION 1:3

Burns & McDonnell Waste Consultants, Inc.
ENGINEERS - GEOLOGISTS - SCIENTISTS - 100% EMPLOYEE-OWNED

FIGURE 4-5
VERTICAL DISTRIBUTION OF CONTAMINATION IN SUBSURFACE WATER
MARCH 1992
PROFILE D-D'

EGGC002E.DGN/23-OCT-92 16:23/PCS

TVOC levels detected on the Missouri Metal property were highest at SB-4, which is located immediately north of the degreasing pit building. The soil TVOCs levels were highest near the ground surface, low at intermediate depths, but increased again at deeper depths to 641 mg/kg at a depth of 20 feet.

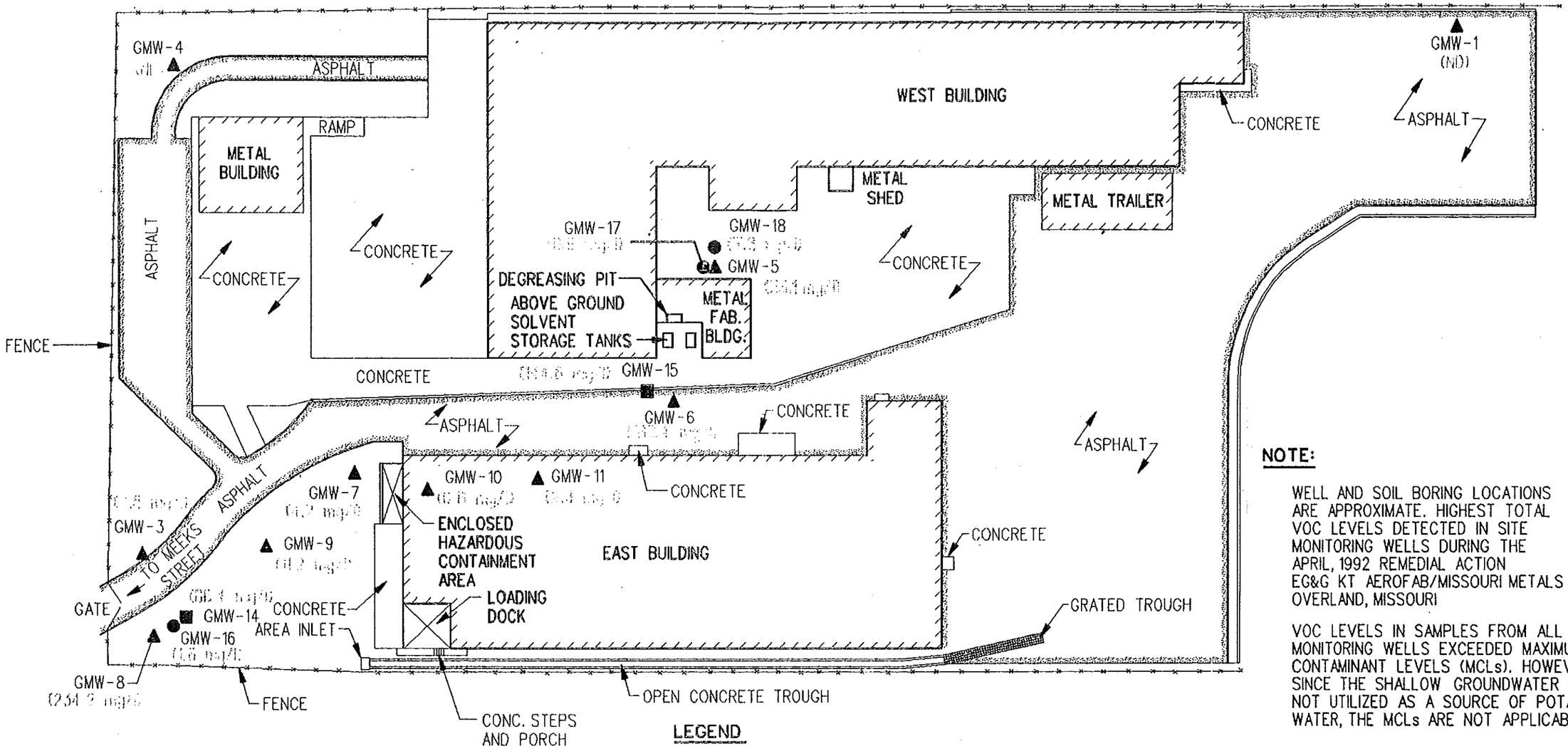
Levels of TVOCs detected in deep soil samples from boreholes near SB-4 were low, ranging from below the level of detection to 18.91 mg/kg. Based on the observed vertical distribution of contamination indicated from available data, it is suspected that past leakage from the degreasing pit is the principal source of contamination detected in deep soil and groundwater samples. Current data has not identified a chemical migration pathway from the ground surface to the deeper soils. Based on this assumption, the only significant area of soil contamination on the property is expected to be immediately below the degreasing pit.

Levels of TVOCs detected in deeper soil samples collected from the southeast property corner are consistently low, ranging from below the level of analytical detection to 0.09 mg/kg.

4.3.3 Groundwater

During past investigations, VOC contamination has been detected in the shallow perched water horizon immediately beneath the property. Initial groundwater data obtained by O'Brien and Gere and GTI was limited to an evaluation of the groundwater quality within the low permeability silty clay soils. Burns and McDonnell investigation activities concentrated on evaluating the vertical extent of contamination in lower bedrock units. The horizontal and vertical extent of contamination observed at the property during the April investigation is indicated in Figures 4-5 and 4-6. Tabular summaries of the RI groundwater data is presented in Table 4-5, provided at the end of this section.

Analytical data from the April 1992 investigation indicates that the highest levels of groundwater contamination are present in the well screened totally within the silty clay soils, primarily in the vicinity of the degreasing pit (MW-6) and the southeast property corner (MW-8). VOC levels in the shallow wells



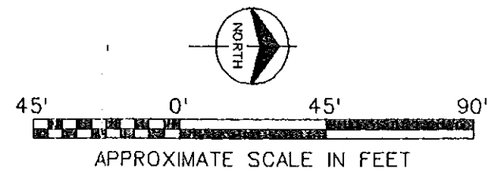
NOTE:

WELL AND SOIL BORING LOCATIONS ARE APPROXIMATE. HIGHEST TOTAL VOC LEVELS DETECTED IN SITE MONITORING WELLS DURING THE APRIL, 1992 REMEDIAL ACTION EG&G KT AEROFAB/MISSOURI METALS OVERLAND, MISSOURI

VOC LEVELS IN SAMPLES FROM ALL MONITORING WELLS EXCEEDED MAXIMUM CONTAMINANT LEVELS (MCLs). HOWEVER, SINCE THE SHALLOW GROUNDWATER IS NOT UTILIZED AS A SOURCE OF POTABLE WATER, THE MCLs ARE NOT APPLICABLE.

LEGEND

- ▲ SHALLOW WELLS: EXCLUSIVELY SCREENED IN SOIL PROFILE
- ■ INTERMEDIATE WELLS: SCREENED AT TOP OF BEDROCK
- ● DEEP WELLS: SCREENED IN BEDROCK EXCLUSIVELY
- ND NO VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLE



APPROXIMATE SCALE IN FEET

Burns & McDonnel Waste Consultants, Inc.
ENGINEERS - GEOLOGISTS - SCIENTISTS - 100% EMPLOYEE-OWNED

FIGURE 4-6

TVOC LEVELS IN GROUNDWATER

EGGSITE6.DGN.OF=18.20-24.61-62

EGGSITE6.DGN/26-OCT-92 09:49/DFJ (SOS) (PCS)

situated between these two locations were over 20 times lower, supporting hydrogeologic assumptions that lateral movement of groundwater through the natural soil has been low.

Levels of TVOCs detected at the top of bedrock ranged from 66.4 to 144.6 mg/l in the southeast property corner (GMW-14) and the degreasing pit areas (GMW-15), respectively. Within the higher permeability bedrock material, the levels of contamination decreased. Detected levels of TVOCs were 1.6 (GMW-16) and 7.6 mg/l (GMW-18) in groundwater from the upper siltstone layer and 0.9 mg/l (GMW-17) in groundwater from a deeper sandstone layer. This data suggests that interconnections between the soil, siltstone, and sandstone layers exist; however, the groundwater mobility between these units is limited. The limited hydrogeologic communication between these layers implied by the available chemical groundwater data was confirmed during performance of pump tests. Despite the large drawdowns caused by pumping, the corresponding influence observed in adjacent wells screened in different geologic units was small. This data and an evaluation of local geologic conditions indicates that further vertical migration of groundwater will be limited within this perched groundwater system. VOC contamination is effectively prevented from reaching the regional aquifer by the low permeability layers present within the upper bedrock.

The lateral extent of groundwater contamination appears to be limited to a narrow path from the degreasing pit area to the southeast property corner. This contaminant configuration is indicated by available groundwater monitoring well data (Figure 4-6) and soil gas survey data obtained by GTI and presented in their Site Assessment Report. Horizontal migration of contaminants in the upper bedrock is the primary lateral pathway for site contaminants. However, movement of VOCs through the upper soils is expected to be less likely. As a result, the lateral extent of VOCs in groundwater within the native soil is expected to be restricted to the source area.

* * * * *

Table 4–5
Summary of Remedial Investigation
Groundwater Monitoring Results

EG&G KT Areofab/Missouri Metals Property

	Monitoring Well:		GMW–1	GMW–3	GMW–4	GMW–5	GMW–6
	Total Depth:		16.5'	16.5'	16.5'	17.5'	15.0'
	Screen Length:		5.0'	5.0'	5.0'	15.0'	10.0'
	Sampling Date:		4/2/92	4/2/92	4/2/92	4/2/92	4/2/92
Analytical Results	Units	MCL*	NDRC	NDRC	NDRC	NDRC	NDRC
Acetone	mg/L						
Vinyl Chloride	mg/L	0.002		0.0314		2.32	0.801
Methylene Chloride	mg/L	0.005					0.0798
1,1–Dichloroethylene	mg/L	0.007				0.01	0.266
1,2 Dichloroethylene (total)	mg/L	0.07		1.43		3.54	35.7
Trans 1,2 Dichloroethylene	mg/L	0.1					
Chloroform	mg/L	0.1					
Trichloroethylene	mg/L	0.005		0.963		2.81	54.6
Tetrachloroethylene	mg/L	0.005		0.062		24.4	88.7
Toluene	mg/L	1.0		0.0093		0.0171	0.0275
1,1 Dichloroethane	mg/L						0.0922
1,2 Dichloroethane	mg/L	0.005					0.0051
1,1,2 Trichloroethane	mg/L	0.005					0.0292
1,1,1 Trichloroethane	mg/L	0.2					0.111
Benzene	mg/L	0.005					0.0086
Total Volatile Organic Compounds	mg/L		ND	2.50	ND	33.10	180.42

Note: Blanks indicate that the parameter was not detected.

B: Analyte detected in blank as well as in sample.
NDRC: NDRC Laboratories, Inc. provided laboratory analysis.
J: Estimated value – parameter concentration is less than quantitation level but greater than zero.
*MCL: Maximum Contaminant Level – Safe Drinking Water Act (health-based) acceptable chemical limit for drinking water. Where blank, an MCL for that chemical has not been established.

Table 4-5 (continued)
Summary of Remedial Investigation
Groundwater Monitoring Results

EG&G KT Areofab/Missouri Metals Property

	Monitoring Well:		GMW-7	GMW-7	GMW-8	GMW-9	GMW-10	GMW-11
	Total Depth:		14.0'	14.0'	14.0'	20.0'	15.0'	15.0'
	Screen Length:		10.0'	10.0'	10.0'	10.0'	10.0'	10.0'
	Sampling Date:		4/2/92	4/2/92	2/26/88	4/2/92	4/2/92	4/2/92
Analytical Results	Units	MCL*	ATAS	NDRC	NDRC	NDRC	NDRC	NDRC
Acetone	mg/L		0.160 J					
Vinyl Chloride	mg/L	0.002	0.041 J	0.0318	9.91			
Methylene Chloride	mg/L	0.005	0.026 JB					
1,1-Dichloroethylene	mg/L	0.007			0.0732			
1,2 Dichloroethylene (total)	mg/L	0.07	0.520	0.573	113.0	0.686	0.144	2.42
Trans 1,2 Dichloroethylene	mg/L	0.1						
Chloroform	mg/L	0.1						
Trichloroethylene	mg/L	0.005	3.10	3.36	111	9.25	0.587	0.465
Tetrachloroethylene	mg/L	0.005		0.0102	0.0133	1.23	0.0994	
Toluene	mg/L	1.0			0.0229			
1,1 Dichloroethane	mg/L							
1,2 Dichloroethane	mg/L	0.005						
1,1,2 Trichloroethane	mg/L	0.005			0.136			
1,1,1 Trichloroethane	mg/L	0.2						
Benzene	mg/L	0.005	0.021 JB					
Total Volatile Organic Compounds	mg/L		3.87	3.97	234.16	11.17	0.83	2.89

Note: Blanks indicate that the parameter was not detected.

ATAS: American Technical & Analytical Services, Inc. provided laboratory analysis.
B: Analyte detected in blank as well as in sample.
NDRC: NDRC Laboratories, Inc. provided laboratory analysis.
J: Estimated value - parameter concentration is less than quantitation level but greater than zero.
*MCL: Maximum Contaminant Level - Safe Drinking Water Act (health-based) acceptable chemical limit for drinking water. Where blank, an MCL for that chemical has not been established.

Table 4–5 (continued)
Summary of Remedial Investigation
Groundwater Monitoring Results

EG&G KT Areofab/Missouri Metals Property

			Monitoring Well:	GMW-14	GMW-14	GMW-15	GMW-16	GMW-16	GMW-17
			Total Depth:	23'	23'	19.9'	38.16'	38.16'	48.8'
			Screen Length:	4.5'	4.5'	4.5'	5'	5'	10'
			Sampling Date:	4/2/92	4/2/92	4/2/92	4/8/92	4/9/92	4/14/92
Analytical Results	Units	MCL*		NDRC	NDRC	NDRC	NDRC	NDRC	NDRC
Acetone	mg/L								
Vinyl Chloride	mg/L	0.002		1.73	1.3	0.153			
Methylene Chloride	mg/L	0.005				0.0289			
1,1-Dichloroethylene	mg/L	0.007			0.0242	0.0809			
1,2 Dichloroethylene (total)	mg/L	0.07		0.021	18.4	7.32	0.282	0.286	0.0124
Trans 1,2 Dichloroethylene	mg/L	0.1		17.6					
Chloroform	mg/L	0.1							
Trichloroethylene	mg/L	0.005		42.5	46.5	60.0	1.17	1.3	0.292
Tetrachloroethylene	mg/L	0.005		0.233	0.168	76.8		0.0253	0.0842
Toluene	mg/L	1.0				0.01			
1,1 Dichloroethane	mg/L					0.009			
1,2 Dichloroethane	mg/L	0.005							
1,1,2 Trichloroethane	mg/L	0.005		0.0279	0.0289				
1,1,1 Trichloroethane	mg/L	0.2				0.128			
Benzene	mg/L	0.005				0.0154			
Total Volatile Organic Compounds	mg/L			62.11	66.42	144.55	1.45	1.61	0.39

Note: Blanks indicate that the parameter was not detected.

ATAS: American Technical & Analytical Services, Inc. provided laboratory analysis.
B: Analyte detected in blank as well as in sample.
NDRC: NDRC Laboratories, Inc. provided laboratory analysis.
J: Estimated value – parameter concentration is less than quantitation level but greater than zero.
*MCL: Maximum Contaminant Level – Safe Drinking Water Act (health-based) acceptable chemical limit for drinking water. Where blank, an MCL for that chemical has not been established.

Table 4-5 (continued)
Summary of Remedial Investigation
Groundwater Monitoring Results

EG&G KT Areofab/Missouri Metals Property

			Monitoring Well:	GMW-17	GMW-17	GMW-18	GMW-18
			Total Depth:	48.8'	48.8'	33.4'	33.4'
			Screen Length:	10'	10'	10'	10'
			Sampling Date:	4/14/92**	4/14/92**	4/16/92	4/16/92
Analytical Results	Units	MCL*		NDRC	NDRC	NDRC	NDRC
Acetone	mg/L						
Vinyl Chloride	mg/L	0.002				0.0902	0.141
Methylene Chloride	mg/L	0.005					
1,1-Dichloroethylene	mg/L	0.007					
1,2 Dichloroethylene (total)	mg/L	0.07		0.0264	0.034	0.94	1.48
Trans 1,2 Dichloroethylene	mg/L	0.1					
Chloroform	mg/L	0.1					
Trichloroethylene	mg/L	0.005		0.756	0.648	1.51	1.64
Tetrachloroethylene	mg/L	0.005		0.162	0.149	4.84	4.31
Toluene	mg/L	1.0					
1,1 Dichloroethane	mg/L						
1,2 Dichloroethane	mg/L	0.005					
1,1,2 Trichloroethane	mg/L	0.005					
1,1,1 Trichloroethane	mg/L	0.2					
Benzene	mg/L	0.005					
Total Volatile Organic Compounds	mg/L			0.94	0.83	7.38	7.57

Note: Blanks indicate that the parameter was not detected.

ATAS: American Technical & Analytical Services, Inc. provided laboratory analysis.
B: Analyte detected in blank as well as in sample.
NDRC: NDRC Laboratories, Inc. provided laboratory analysis.
J: Estimated value - parameter concentration is less than quantitation level but greater than zero.
*MCL: Maximum Contaminant Level - Safe Drinking Water Act (health-based) acceptable chemical limit for drinking water. Where blank, an MCL for that chemical has not been established.
**: Sample and sample duplicate collected after pump test.

5.0 CONTAMINANT TRANSPORT AND FATE

5.1 INTRODUCTION

The evaluation of contaminant mobility must consider the opportunity for property contaminants to be released into the groundwater, air, and surface water pathways. Risk assessment conclusions will be based on the levels of contaminants present in these media and the opportunity for exposure to impacted media to occur. For the Missouri Metal property, the groundwater pathway has been identified as the primary pathway of concern. However, each migration pathway is evaluated in this section.

5.2 AIR PATHWAY

Releases into the air pathway can result from the vaporization of pure chemicals or by blowing of contaminated dust. Although VOCs are extremely volatile, releases through vaporization are not expected to pose significant concerns at the property due to location of the chemicals primarily below the groundwater table. Levels of contaminants in shallow soil were generally low, except in small isolated areas.

Vaporization of chemicals from the groundwater into the soil gas is expected to occur; however, the expected low mobility of chemical vapors through the tight, silty clay soils will limit the rate at which these compounds can be released to the atmosphere. The limited mobility of vapors in this setting is demonstrated by the soil gas results obtained by GTI during their initial assessment. Maximum concentrations of TVOCs (PCE, TCE, and 1,2-DCE) detected by GTI during the soil gas survey were 540.3 ppm, at a sampling location near the degreasing pit and 40.8 ppm near the hazardous waste storage area. As the distance from these peak detection locations increased, the levels of detected TVOCs decreased. Nondetectable levels of TVOCs were reported in soil gas samples obtained within 100 feet of these areas of maximum detected TVOC levels. Soil vapor TVOC levels reported for 4-foot deep soil vapor monitoring points located near the southeast property corner were 1.41 and 0.37 ppm.

As a result, vapor releases are limited primarily to the Missouri Metal property. Movement of chemicals to the atmosphere is further restricted at the property by

the asphalt and concrete surfaces which cover 90 percent of the property. Low rate releases of the levels detected in soil gas on the property do not pose a concern.

Blowing of contaminated soils is effectively prevented by the gravel, asphalt, and concrete surfaces that cover the majority of the property. Based on the collected data and the low potential mobility of VOCs through this pathway, the air pathway was eliminated as a current concern for this property.

5.2 SURFACE WATER PATHWAY

Releases into the surface water pathway can result from migration of contaminated groundwater to a surface release point, the leaching of soluble contaminants into runoff, or through the erosion of contaminated soil. The potential from surface water releases for the Missouri Metal property is minimized by drainage control features and the asphalt, concrete, and gravel surfacing which cover the majority of site. The surface water drainage structure, located along the eastern boundary of the property, and the ground cover provide for rapid runoff drainage, effectively preventing erosion and reducing the potential for surface water to contact contaminated soils. As a result, no contaminant releases through surface water runoff are likely at this property.

Groundwater in the upper bedrock is expected to migrate primarily laterally toward the River des Peres. During subsurface migration, contaminant level reductions would result from adsorption, biological degradation, and dilution due to advection and diffusion. The River des Peres, the nearest downgradient stream, is a concrete-lined drainage channel located approximately 2,000 feet south of the property. The River des Peres receives stormwater runoff from the drainage area which includes the Missouri Metal property and in some areas, sanitary sewer bypasses during wet weather periods.

Flow in the River des Peres in the vicinity of the property is intermittent. It is suspected the concrete channel lining reduces the potential for groundwater recharge into the drainage channel. No downgradient permanent flow streams or lakes are present in the vicinity of the property.

5.4 GROUNDWATER PATHWAY

Releases into the shallow perched groundwater system beneath the Missouri Metal property have been identified. Levels of TVOCs detected in the shallow groundwater range from 234 mg/L (GMW-8) detected in the low permeability silty clay soil underlying the property to 0.39 mg/L detected in a lower sandstone unit located near the degreasing pit.

Groundwater movement in the affected perched water horizon occurs primarily in the sandstone and siltstone bedrock units below the property. Due to the low permeability of the silty clay soil (approximately 10^{-6} cm/sec), groundwater movement in the upper soil profile is expected to be restricted. The total VOC level in a groundwater sample from the upper siltstone unit at a monitoring well (GMW-16) located near the downgradient property boundary was approximately 1.61 mg/L in April 1992. Monitoring Well GMW-16 is located approximately 30 feet north and 20 feet west of the south and east property lines, respectively. This groundwater TVOC level will decrease due to losses associated with adsorption, biological degradation, and dilution (advection and diffusion) as the distance from the source increases horizontally and vertically.

The shale layer in the local bedrock below the upper siltstone layer has had a demonstrated impact on the vertical migration of VOCs. In wells located near the degreasing pit (GMW-17 and GMW-18), a reduction of groundwater VOC levels from approximately 7.38 mg/L to 0.39 mg/L was observed over a 15-foot vertical distance. The geologic layers screened by these wells were separated by shale layer approximately 3 feet thick. Further vertical migration at the property is expected to be limited. Regional hydrogeological information for this area indicates that little potential exists for contaminant migration from the Pennsylvanian-aged water horizons to reach the highest regional aquifer, the Upper Mississippian Formation.

Lateral migration is expected to be possible toward the River des Peres as permitted by the orientation of the higher permeability sandstone and siltstone units located beneath the area. Groundwater near the River des Peres could recharge to the drainage channel through cracks in the channel concrete lining or migrate beneath the channel within the shallow groundwater system. Maximum

concentrations of VOCs in the groundwater would decrease continually throughout the migration pathway due natural losses (adsorption, degradation, and dilution).

The releases of volatile compounds from the upper clay soils into the bedrock system is controlled by diffusion and local recharge. Groundwater level measurements taken from property wells during storm events indicate infiltration and inflow into the shallow wells creates an immediate groundwater level response to rainfall (GMW-3, GMW-6, etc.). This rapid shallow well response likely results from the inflow of storm water from the upper fill zone into the screen or sandpack of the shallow wells. Due to the low permeability of the local soil and the surface cover which limits percolation of rainfall, immediate groundwater recharge from infiltration would not be expected.

Groundwater level response of the deeper wells to rainfall events was low, indicating that recharge to these deeper zones was less immediate and predominately from upgradient areas. Recharge of groundwater from the upper soil into the bedrock system would be expected to be greatest during wet weather periods and decrease during dry periods of the year. When groundwater recharge from the upper soils to bedrock is low, diffusion controls the rate at which contaminant migration into the perched bedrock groundwater system occurs.

* * * * *

6.0 BASELINE RISK ASSESSMENT

6.1 INTRODUCTION

6.1.1 Purpose

This section presents the findings of a risk assessment conducted for EG&G Missouri Metal Shaping Company at the former Alco Standard Corporation property in Overland, Missouri. The purpose of the risk assessment is to evaluate potential human health and environmental risks, if any, associated with contamination at the property related to activities of previous property owners. The risk assessment follows the EPA's most recent guidance for assessing human health risk (EPA,1989).

6.1.2 Organization

The risk assessment is organized in the following sections:

- Introduction - The first section states the purpose of the risk assessment and explains the organization of the report.

- Property Background - This section reviews the history of the property and presents a summary of investigations previously conducted. Also, briefly discussed is the physical setting of the property as it relates to the potential for migration of contaminants and the probability of exposure.

- Chemicals of Potential Concern - Chemicals positively detected are identified. Special emphasis is placed on chemicals that exceed Missouri Department of Health (MDOH) Recommended Safe Levels. The mobility and toxicities of the chemicals are discussed.

- Exposure Assessment - Potential for risk exists only if there is a completed pathway for exposure. A completed pathway is one where there is direct contact between a potential human or environmental receptor and chemicals that may pose a health concern. In this section, possible receptor populations and any potential complete pathways are identified.

- Risk Characterization - Risk characterization describes the nature and magnitude of health risks. Risks are evaluated using exposure information in conjunction with chemical toxicity information. Uncertainties which may impact the evaluation are also described.

- Summary and Recommendations - The final section summarizes the risk assessment process and findings. Appropriate recommendations are made regarding remediation of the property.

6.2 PROPERTY BACKGROUND

6.2.1 Property Description

The EG&G Missouri Metal Shaping Company property is located at 9970 Page Boulevard in Overland, Missouri, near the center of Section 31, Township 46 North, Range 6 East, St. Louis County, Missouri. The property location is shown in Figure 1-1 (Section 1.2).

The property is approximately 3-1/2 acres in size. There are two main buildings on the property with several smaller metal structures. Most of the property boundary is fenced (5- or 7-foot chain link with barbed wire on top). The exception is on the north end of the property where there is a retaining wall restricting access. Concrete and asphalt are the predominant ground cover (90%) with only small areas that are either graveled or covered with vegetation.

Topographically, the property is located on the side of a prominent hill sloping to the south-southeast with a gradual grade of 2 percent. Local groundwater movement is predominantly controlled by the surface topography with flow to the south-southeast. Approximately 2,000 feet south of the property is a concrete lined drainage ditch– the channelized River des Peres. Because of urban and industrial impact on water quality, and because of seasonal low flow, the River Des Peres is not considered a potential source of drinking water.

The original surface topography at the property has been altered by filling. Fill material, which consists primarily of clay and gravel, varies in depth across the site from 3 to 5 feet. Permeability of the upper fill is variable depending upon fill material characteristics and the extent of compaction.

Native soils on the property are silty-clays (loess) having a low permeability. Beneath the clay soils, the upper bedrock is composed of intermittent layers of sandstone, siltstone, and shale. Sandstone and siltstone layers are moderately permeable. Shale layers restrict vertical groundwater movement, effectively preventing migration of the perched groundwater in the upper bedrock from reaching the uppermost regional aquifer.

Lateral groundwater movement across the property occurs primarily within the sandstone and siltstone units present in the upper bedrock. Recharge to these layers is principally from upgradient areas. Groundwater recharge from the property soils to the upper bedrock would be during wet weather periods. However, due to the low permeability of the native clay soils, recharge to this perched groundwater system from the property will comprise a limited portion of the total groundwater flow. Due to the poor quality and quantity of water available from this perched groundwater system, the upper bedrock groundwater is insignificant as an aquifer (MDNR, 1988).

6.2.2 Property History

Industrial use of this property reportedly began in 1957, when the facility was owned and operated by Missouri Metal Shaping Company. The property and business were purchased in 1979 by Alco Standard Corporation-Aerospace Division. In 1988, the property and business were purchased by the current owner, EG&G.

Throughout its recent history, the property has been utilized for light manufacturing, generally consisting of the forming and finishing of aircraft components from stock metals (primarily aluminum, stainless steel, and titanium alloys). Solvents and other metal treating chemicals are believed to have been used at the property throughout its industrial history. Written records on chemical usage and waste disposal practices for this facility are available only for recent years.

6.2.3 Summary of Investigations

A property audit (preliminary environmental assessment) was performed by O'Brien & Gere, an environmental consulting company, in March 1988 prior to EG&G's purchase of the property from Alco Standard Corporation. In order to evaluate

potential environmental concerns, numerous soil and groundwater samples were taken in and around the facility. Four groundwater monitoring wells were installed and sampled, five surface soil samples (0 to 6 inches) were collected, and samples were taken from 10 of 15 subsurface borings. These samples were analyzed for VOCs, total chromium, chromium by the EP toxicity test, total organic carbon, and oil and grease. The environmental audit identified the presence of VOCs in soil and groundwater. (Laboratory data from the O'Brien & Gere report are reprinted in Appendix J.)

An additional investigation to evaluate the nature and extent of contamination was completed by Groundwater Technology, Inc. (GTI) after EG&G's purchase of the property. During the phased RI activities (which took place in May 1989, July 1990, October 1990, and January 1991), samples of soil vapor, groundwater, and subsurface soil were collected by GTI for laboratory analysis. The existing four monitoring wells were sampled and nine additional wells were installed and sampled for VOCs and metals. Eight subsurface soil samples were collected and analyzed for VOCs and metals. Data obtained from these investigations identified the primary area of contamination to be between the degreasing equipment area and the southeast property corner. The primary contaminants were VOCs. (Laboratory data from the GTI investigations are reprinted in Appendix J.)

Burns & McDonnell Waste Consultants, Inc. (BMWCI) continued the investigation and sampled soil and groundwater during April and July 1992 to better define the nature and extent of contamination. BMWCI installed five additional monitoring wells in April. Three former wells were properly sealed and abandoned— two because of inadequate construction features and the other because of vehicle damage. Each groundwater sample collected was analyzed for VOCs. One of the groundwater samples was also analyzed for metals. In addition, 34 soil samples were collected at various depths in April and submitted for VOC analysis. One of these samples was also analyzed for metals. Another one of the 34 samples was analyzed for SVOCs and pesticides to confirm the absence of these compounds at the property. In July, additional soil samples were collected in the southeast corner of the property, four of which were selected for VOC analysis based on organic vapor readings using a PID in the field. During the BMWCI investigations, VOCs and metals were detected in both soil and groundwater. No

SVOCs or pesticides were detected. (BMWCI laboratory data are presented in Appendix I, with a more detailed discussion of results in Section 2.0 of this report.)

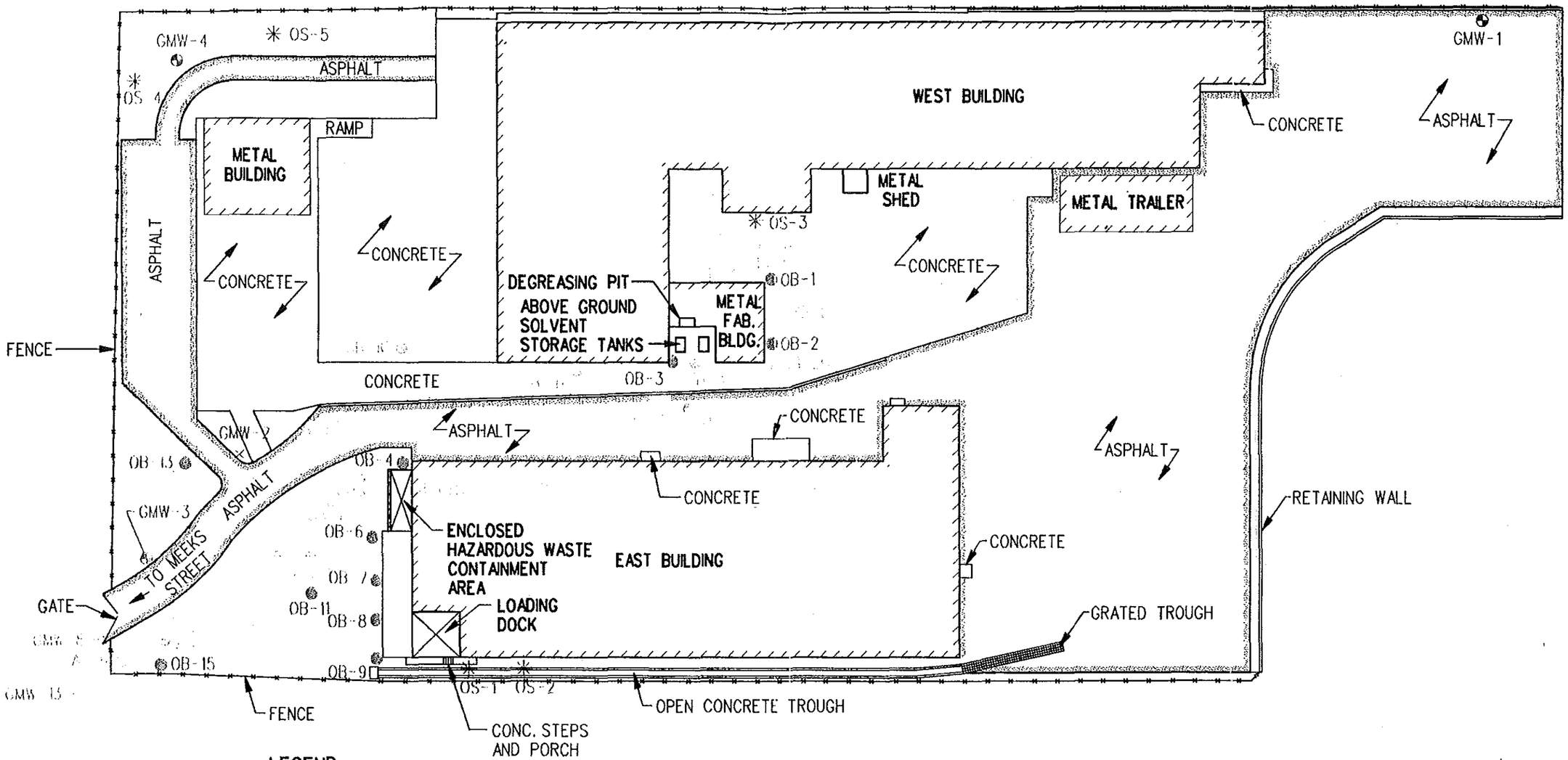
6.3 CHEMICALS OF POTENTIAL CONCERN

6.3.1 Identification of Chemicals of Potential Concern

All chemicals positively detected in any media were included for consideration. Chemicals of concern were determined by comparing reported concentrations to MDOH levels recommended specifically for this property (MDOH, 1991). If a chemical-specific recommended level was not available, other appropriate standards or guidelines were used for comparison [i.e. MDOH proposed any use soil levels (ASLs) (MDOH, 1992), maximum contaminant levels (MCLs) (EPA, 1992), and/or Resource Conservation and Recovery Act (RCRA) Subpart S action levels for soil and groundwater (FR, 1990)]. As a conservative approach, all chemicals exceeding the safe level were considered as chemicals of potential concern in the risk assessment. These risk-based limits are established assuming that residential use exposures could occur. Since no potable use of the shallow groundwater has been identified and site use is industrial, these soil and groundwater levels are not applicable to the Missouri Metals Property. However, they are being utilized for comparison purposes since no other standards exist.

For a few chemicals, namely 2-hexanone and several metals, there are no recommended safe levels or action levels available. 2-Hexanone is not significantly toxic, and because of the low concentration of the one isolated detection, 2-hexanone is not considered a chemical of potential concern. Most of the metals are naturally occurring (see Table 2-6) and many are considered human nutrients. For these reasons, those metals were dropped from further consideration.

Figure 6-1 shows the locations of all sampling events.
Tables 6-1 through 6-6 summarize the comparisons of all analytical results by investigation and media. Tables 6-1 and 6-2 show the O'Brien & Gere investigation surface soil and subsurface soil sampling, respectively, and any



LEGEND

- GROUNDWATER MONITORING WELL (GMW) LOCATION
- SOIL BORING (SB OR OB) LOCATION
- SURFACE SOIL (OS) SAMPLE LOCATION
- HAND AUGERED SOIL (AS) SAMPLE LOCATION
- ABANDONED MONITORING WELL LOCATION

CHAPEL & CERE INVESTIGATION SAMPLING POINT

NOTES:

1. WELL AND SOIL BORING LOCATIONS ARE APPROXIMATE
2. SOIL SAMPLES TAKEN IN BORINGS BY BMWCI HAVE A "CME" NOTATION IN LABORATORY ANALYTICAL RESULTS, INDICATING DEPTH OF SAMPLE
3. SAMPLE LOCATION CODING DIFFERS FROM LABORATORY IDENTIFICATION

NORTH

45' 0' 45' 90'

APPROXIMATE SCALE IN FEET

Burns & McDonnell Waste Consultants, Inc.
ENGINEERS - GEOLOGISTS - SCIENTISTS - 100% EMPLOYEE-OWNED

FIGURE 6-1

LOCATION MAP OF ALL HISTORICAL ANALYTICAL SAMPLING POINTS

PLTCFG=SCREEN.PLT, PEN 10= CS, PEN 12 = CS, PEN 13 = C1

EGGSIT6A.DGN, DF=62

Table 6–1
Surface Soil Samples (0 to 6–inch depth)
O'Brien & Gere Investigation[1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level[2] (ppm)	Frequency of Detection	Highest Concentration Detected (ppm)	Number of Samples Exceeding Safe Level
VOCs				
Chlorobenzene	1600 **	1/5	3.35	0
1,2 Dichloroethane	55 *	1/5	1.57	0
1,1,1 Trichloroethane	9000	1/5	2.16	0
METALS				
Chromium (total)	500	5/5	732	1

[1] O'Brien & Gere, March 1988 (laboratory data reprinted in Appendix J of the Remedial Investigation report).

[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then MDOH proposed (1992) Any–Use Soil Levels (ASLs) are shown (*). If ASLs are not available, then RCRA Subpart S action levels are given (**).

These risk–based levels are not applicable since residential exposures would not occur on this industrial property; however, the standards are presented since no other guidelines exist.

Table 6–2
Subsurface Soil Samples (greater than 2.5–foot depth)
O'Brien & Gere Investigation [1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level[2] (ppm)	Frequency of Detection	Highest Concentration Detected (ppm)	Number of Samples Exceeding Safe Level
VOCs				
Bromodichloromethane	39 **	1/10	1.09	0
Chloroform	820 *	1/10	3.87	0
1,2 Dichloroethene (trans)	1100	1/10	9.34	0
Trichloroethene	70	1/10	12.85	0
1,1,1 Trichloroethane	9000	2/10	3.89	0
Tetrachloroethylene	98	6/10	21.30	0
METALS				
Chromium (total)	500	10/10	35.9	0

[1] O'Brien & Gere, March 1988 (Laboratory data reprinted in Appendix J) of the Remedial Investigation report.

[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then MDOH proposed (1992) Any–Use Soil Levels (ASLs) are shown (*). If ASLs are not available, then RCRA Subpart S action levels are given (**).

These risk–based levels are not applicable since residential exposures would not occur on this industrial property; however, the standards are presented since no other guidelines exist.

Table 6–3
Subsurface Soil Samples (greater than 2–foot depth)
GTI Investigations[1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level[2] (ppm)	Frequency of Detection	Highest Concentration Detected (ppm)	Number of Samples Exceeding Safe Level
VOCs				
1,2 Dichloroethene (trans)	1100 *	3/8	0.27	0
Trichloroethene	70	4/8	0.56	0
Tetrachloroethylene	98	4/8	290	1
METALS				
Arsenic	100	8/8	8.4	0
Chromium	500	8/8	23	0
Copper	18571	8/8	20	0
Lead	238	8/8	21	0
Nickel	2000	8/8	71	0
Zinc	2100	8/8	200	0

[1] GTI, March 1991 (Laboratory data reprinted in Appendix J of the Remedial Investigation report).

[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then MDOH proposed (1992) Any-Use Soil Levels (ASLs) are shown (*). If ASLs are not available, then RCRA Subpart S action levels are given (**).

These risk-based levels are not applicable since residential exposures would not occur on this industrial property; however, the standards are presented since no other guidelines exist.

Table 6-4
Surface Soil Samples (0 to 2-foot depth)
Burns & McDonnell Investigations[1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level[2] (ppm)	Frequency of Detection	Highest Concentration Detected (ppm)	Number of Samples Exceeding Safe Level
VOCs				
Acetone	5600 *	1/6	0.15	0
2 Butanone	1400 *	1/6	1.2	0
1,1 Dichloroethylene	8.3 *	1/6	0.001 J	0
1,2 Dichloroethylene (total)	560 (cis)[3]	4/6	426	0
Ethylbenzene	5600 *	1/6	0.001	0
Methylene Chloride	667	1/6	0.011 B	0
Tetrachloroethylene	98	6/6	1900	3
Toluene	9000	1/6	0.005	0
1,1,2 Trichloroethylene	70	5/6	304	2
Trichloroethylene	3000	1/6	0.003 J	0
Vinyl Chloride	287 **	1/6	0.007 J	0
Xylenes (total)	11000 *	1/6	0.003 J	0

B - Compound detected in associated laboratory blank.
J - Estimated value less than contract required quantitation limit.

[1] Laboratory data available in Appendix I of the Remedial Investigation report.
[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then MDOH proposed (1992) ASLs are shown (*). If ASLs are not available, then RCRA Subpart S action levels are given (**). These risk-based levels are not applicable since residential exposures would not occur on this industrial property; however, the standards are presented since no other guidelines exist.
[3] A safe level is not available for total 1,2-dichloroethylene. The cis isomer is more toxic than the trans isomer and more likely to be present in soil as a degradation product. For risk assessment purposes, it is assumed that the detected concentrations are the cis isomer.

Table 6-5
Subsurface Soil Samples (greater than 2-foot depth)
Burns & McDonnell Investigations[1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level [2] (ppm)	Frequency of Detection	Highest Concentration Detected (ppm)	Number of Samples Exceeding Safe Level
VOCs				
Acetone	5600 *	4/28	0.464	0
2 Butanone	1400 *	2/28	0.137	0
1,2 Dichloroethylene (total)	560 * (cis) [3]	13/28	426	0
Ethylbenzene	5600 *	1/28	0.001	0
2-Hexanone	NA	1/28	0.001	-
Methylene Chloride	667	3/28	0.016 B	0
Toluene	3000	3/28	0.004 J	0
Trichloroethylene	70	8/28	0.014	0
Tetrachloroethylene	98	10/28	636	1
Vinyl Chloride	287	2/28	0.007 J	0
Xylenes (total)	11000 *	2/28	0.003 J	0
METALS				
Aluminum	NA	1/1	9600	-
Arsenic	100	1/1	9	0
Barium	3900 *	1/1	118	0
Calcium	NA	1/1	868	-
Cobalt	NA	1/1	7.8	-
Chromium	500	1/1	7	0
Copper	18571	1/1	10.9	0
Iron	NA	1/1	16600	-
Mercury	17 *	1/1	0.03	0
Potassium	NA	1/1	586	-
Magnesium	NA	1/1	2040	-
Manganese	5600 *	1/1	425	0
Sodium	NA	1/1	81.9	-
Nickel	2000	1/1	12.5	0
Lead	238	1/1	8.7	0
Vanadium	170 *	1/1	20	0
Zinc	2100	1/1	32.5	0

B - Compound detected in associated laboratory blank.
J - Estimated value less than contract required quantitation limit.

NA - Not Available

[1] Laboratory data available in Appendix I of the Remedial Investigation report.
[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then MDOH proposed (1992) ASLs are shown (*).
If ASLs are not available, then RCRA Subpart S Action levels are given (**).
These risk-based levels are not applicable since residential exposures would not occur on this industrial property; however, the standards are presented since no other guidelines exist.
[3] A safe level is not recommended for total 1,2-dichloroethylene. The cis isomer is more toxic than the trans isomer and more likely to be present in soil as a degradation product. For risk assessment purposes, it is assumed that the detected concentrations are the cis isomer.

Table 6-6
Historical Groundwater Data[1]

EG&G Missouri Metals Shaping Property

Parameter Positively Detected	MDOH Recommended Safe Level [2] (ppm)	Highest Concentration Detected (ppm)	Exceeds Recommended Level	Monitoring Well with Highest Detection	Depth of Well Screen
VOCs					
Acetone	35 **	1	No	GMW11	Shallow
Benzene	0.005	0.0154	Yes	GMW15	Intermediate
Chlorobenzene	0.1 *	0.15	Yes	GMW16	Shallow
Chloroform	0.01	0.01	No	GMW5	Shallow
1,4 Dichlorobenzene	0.075	0.0004	No	GMW8	Shallow
1,2 Dichloroethane	0.005 *	0.018	Yes	GMW12	Deep
1,1 Dichloroethylene	0.007	0.3	Yes	GMW6	Shallow
1,2 Dichloroethylene (total)	0.07 (cis)	120	Yes	GMW13	Deep
1,2 Dichloroethylene (trans)	0.1	38	Yes	GMW8	Shallow
1,2 Dichloropropane	0.005 *	0.0173	Yes	GMW8	Shallow
1,1,2,2 Tetrachloroethane	0.002 **	0.088	Yes	GMW15	Intermediate
Tetrachloroethylene	0.005	88.7	Yes	GMW6	Shallow
Toluene	2.0	0.011	No	GMW2	Shallow
1,1,1 Trichloroethane	0.2	0.37	Yes	GMW5	Shallow
1,1,2 Trichloroethane	0.005 *	0.136	Yes	GMW8	Shallow
Trichloroethylene	0.005	111	Yes	GMW6	Shallow
Vinyl Chloride	0.002	9.91	Yes	GMW6	Shallow
Xylenes	10 *	0.005	No	GMW13	Shallow
METALS					
Aluminum	NA	0.511	-	GMW14	Intermediate
Barium	2 *	0.063	No	GMW14	Intermediate
Cadmium	0.005	0.002	No	GMW8	Shallow
Calcium	NA	87.6	-	GMW14	Intermediate
Copper	1.3	0.09	-	GMW8	Shallow
Iron	NA	0.07	-	GMW14	Intermediate
Lead	0.015 *	0.0024	No	GMW14	Intermediate
Zinc	5.0	0.0105	No	GMW14	Intermediate

NA - Not Available

[1] Based on data provided in all previous investigations (laboratory data reprinted in Appendices I and J of the Remedial Investigation report).
- O'Brien & Gere, March 1988 Report
- GTI, July 1989 Report
- GTI, March 1991 Report
- Burns & McDonnell, May 1992 Report

[2] MDOH, May 24, 1991. If a safe level was not recommended for a parameter, then proposed and final Maximum Contaminant Levels (MCLs) are provided (*). If an MCL is not available, then RCRA Subpart S action levels are given (**). The MCLs are not applicable since potable use of the shallow groundwater is not occuring; however, the standards are presented since no other guidelines exist.

exceedances of safe levels. Table 6-3 lists the results of the GTI investigation and any exceedances of safe levels. Tables 6-4 and 6-5 show the BMWCI investigation surface soil and subsurface soil sampling, respectively, and any exceedances of safe levels. Table 6-6 is a summary of all historical groundwater sampling results and shows which chemicals exceed the recommended safe levels for water.

6.3.2 Summary of Chemicals Identified

6.3.2.1 Chemicals in Soil

Tetrachloroethylene (PCE) exceeded the recommended level of 98 ppm in six soil samples:

- SB-3G, 290 ppm at 1.0- to 3.0-foot depth (GTI data)
- GMW14/CME-1, 656 ppm at 1.0- to 1.5-foot depth (BMWCI data)
- GMW17/CME-1, 1,900 ppm at 0.8- to 1.3-foot depth (BMWCI data)
- SB4/CME-1 684 ppm at 1.1- to 1.4-foot depth (BMWCI data)
- SB4/CME-4, 227 ppm at 19.6- to 20.0-foot depth (and 636 ppm in duplicate sample SB4/CME40) (BMWCI data).
- SB4/CME-5, 158 ppm at 24.3- to 24.7-foot depth (BMWCI data).

Trichloroethylene (TCE) exceeded the recommended soil level of 70 ppm in two samples:

- GMW14/CME-1, 215 ppm at 1.0- to 1.5-foot depth (BMWCI data)
- GMW17/CME-1, 304 ppm at 0.8- to 1.3-foot depth (BMWCI data).

Chromium exceeded the recommended soil level of 500 ppm in one sample:

- 732 ppm (total) in OS-1, at 0.0 to 0.5 foot depth (O'Brien and Gere data).

To summarize, recommended soil levels for TCE and PCE were exceeded at two locations. The first location was near the degreasing pit area, where TVOCs were consistently detected, and the other was in the southeast corner, where only one sample (SB4/CME-4) out of 13 analyzed showed high concentrations of TVOCs. The recommended soil chromium level was exceeded in only one of the 24 samples analyzed for chromium at the property (the sample, SB-1, was one of two taken in close proximity to the south corner of the east building, near the property fence). The one exceedance noted is isolated and is not indicative of a widespread contamination problem.

6.3.2.2 Chemicals in Groundwater

All groundwater data were reviewed and collectively presented in Table 6-6. Exceedances of either MDOH recommended levels, proposed ASLs, MCLs, or RCRA Subpart S groundwater action levels are noted in the table. Fourteen VOCs, including aromatic hydrocarbons and halogenated aliphatic hydrocarbons (primarily PCE degradation products) were identified. There were no metals found in exceedance of applicable groundwater standards.

6.3.3 Toxicity Information

The toxicities of the chemicals of potential concern were evaluated in terms of known or suspected carcinogenic activity and ability to cause other adverse health effects. At the very low doses typical of incidental environmental exposure, carcinogenic activity is frequently the principal concern.

Although the specific toxicological effects of halogenated hydrocarbons vary from one compound to another, generally, most cause central nervous system depression at high doses. Effects include decreased alertness, headaches, sleepiness, and possible loss of consciousness. Prolonged skin contact with the halogenated hydrocarbons may cause defatting of the skin, which can in turn lead to dermatitis. Upon inhalation of high concentrations of vapors, liver or kidney injury may occur. It should be noted that some compounds may have no effect, others may affect only one organ, and still others may affect both. Pulmonary

irritation and damage to the hematopoietic system may also occur after exposure to certain compounds. Vinyl chloride is a known human carcinogen, several others in this group are potential human carcinogens (NIOSH, 1977 and 1985).

Aromatic hydrocarbons can cause central nervous system depression or other effects and, depending on the compound, hepatic, renal, or bone marrow disorders. Vapors are typically absorbed through the lungs and liquids may be absorbed through the skin. Repeated or prolonged skin contact may cause defatting of the skin, which leads to dermatitis. Benzene suppresses bone marrow function, causing blood changes. Chronic exposure to benzene can cause leukemia (NIOSH, 1977 and 1985).

A small amount of chromium is considered an essential nutrient that helps maintain normal metabolism of glucose, cholesterol, and fat in humans. Of the major forms of chromium, the +3 valence state of chromium is of a low order of toxicity. In the +6 state, chromium compounds are irritants and corrosive at high exposure levels. Chromium can enter the body by ingestion, inhalation, and through the skin. Occupational exposure to chromium (+6) in the chromate-producing industry has been known to increase risk of lung cancer (ATSDR, 1989).

6.3.4 Mobility of Chemicals of Potential Concern

VOCs have a high volatilization potential, moderate solubility in water, and a moderate adsorption potential in soil. As a result of these physical characteristics, VOCs can migrate in a free liquid phase in subsurface media, in the soluble phase in groundwater and/or surface water, as chemical vapor in air, and on contaminated soils through erosion processes.

Chromium released to the environment in the +6 state can be reduced by organic matter in soil or water to an oxidation state of +3 (chromium III). Chromium III in soil tends to be in an insoluble form and absorbed strongly to clay particles and organic matter. (ATSDR, 1989). Chromium at the property is therefore expected to be immobile. For a more detailed discussion of mobility, refer to Section 5.0, Contaminant and Transport and Fate.

6.4 EXPOSURE ASSESSMENT

6.4.1 General

In the exposure assessment, possible receptor environmental and human populations are identified. Receptor populations are those persons or groups who may come into contact with chemicals of potential concern. Populations likely to be at or near a site are largely determined by land use patterns in the area. The exposure assessment includes consideration of both current and potential future land uses in order to identify populations which may be at risk.

Pathways (i.e. ingestion, inhalation, or dermal contact) by which exposure may occur are identified. Only completed pathways pose potential risk. Table 6-7 summarizes populations and pathways discussed in detail in the following sections.

6.4.2 Potential Receptor Populations

6.4.2.1 On-site Populations

The EG&G property has been used for industrial purposes since the 1950s. Much of the surrounding area is currently zoned for commerce or industry. No sensitive or endangered environment or wildlife habitat have been identified in the vicinity of the property. Zoning by the city of Overland and by the County of St. Louis in the unincorporated area to the south are shown in Figure 6-2. It is not likely that land use at the property will change in the future.

Access to the property is limited to workers. Sensitive subpopulations, such as infants, children, pregnant or nursing mothers, elderly people, or people with predisposing conditions, are not expected to be at the property. EG&G employs approximately 85 workers, who spend most if not all of their time indoors.

Since the property is fenced and the gates secured when the facility is not operating, access to trespassers is restricted. If trespassing did occur, it would likely be infrequent, of short duration, and limited to teenagers and adults. Therefore, only workers are identified as a potential receptor population.

6.4.2.2 Off-site Populations

Most of the property is surrounded by commercial or industrial operations; however, residences are located to the south and southeast (Figure 6-2). The potential for migration of contaminants in groundwater to an exposure point for this population group is not possible since there are no private water wells used in the area. The County of St. Louis serves the surrounding community with public drinking water and is expected to continue serving the community in to the future. Therefore, off-site residents are not considered a receptor population.

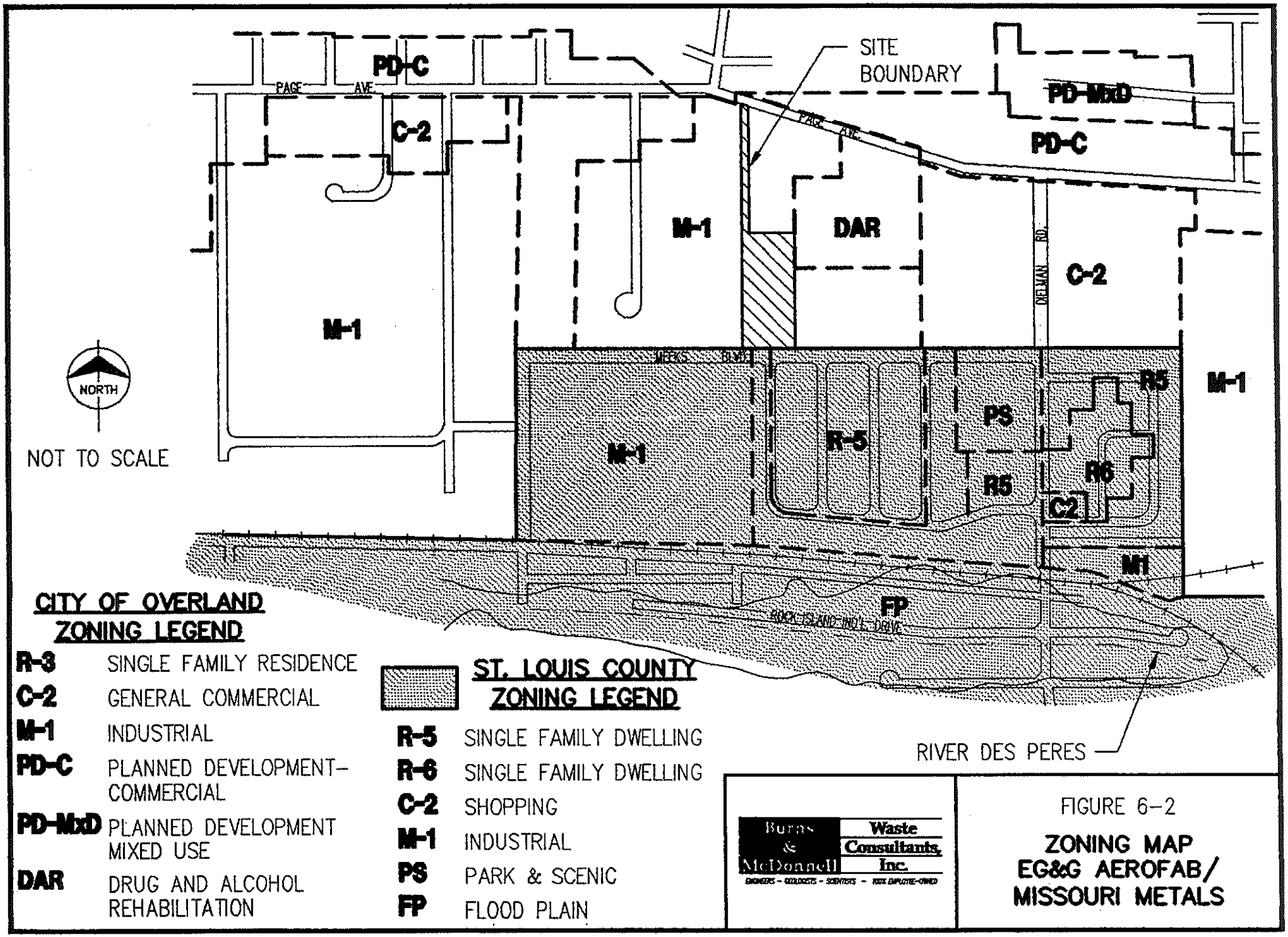
6.4.3 Potential Exposure Pathways

The potentially exposed receptor population at EG&G, the workers, must either ingest, inhale, or dermally absorb contaminants to experience a potential health risk. Workers at the property do not have direct contact with soil; therefore, dermal absorption or incidental ingestion of soil contaminants is not occurring. The concrete in the area of the degreasing pits effectively precludes this type of exposure to PCE found in soil. This surface covering also acts as a barrier to air release of vapors or of contaminated soil particles, eliminating inhalation as an exposure pathway.

Workers do not routinely visit nor spend more than a minimal amount of time in the southeast corner of the property, where one sample exceeded the recommended levels for TCE and PCE in soil. In addition, covering the soil is a 1- to 2-foot thick layer of new gravel underlain by asphalt, which together act as a barrier to the generation of dust and minimize release of vapors to the air.

In the area of the one chromium concentration exceedance between the east building and fence there is a concrete trough (approximately 2 feet wide) with vegetation on either side. Generation of dust is not likely and none of the workers spend appreciable time at this location.

Future excavation on the property is unlikely, except possibly in the event of an underground utility repair. If this should be necessary in a contaminated area, limited worker exposure might occur. However, it would be subject to the Occupational Safety and Health Administration (OSHA) standards for protection of worker health and safety and would not be expected to be significant.



CITY OF OVERLAND ZONING LEGEND

R-3	SINGLE FAMILY RESIDENCE
C-2	GENERAL COMMERCIAL
M-1	INDUSTRIAL
PD-C	PLANNED DEVELOPMENT–COMMERCIAL
PD-MxD	PLANNED DEVELOPMENT MIXED USE
DAR	DRUG AND ALCOHOL REHABILITATION

ST. LOUIS COUNTY ZONING LEGEND

R-5	SINGLE FAMILY DWELLING
R-6	SINGLE FAMILY DWELLING
C-2	SHOPPING
M-1	INDUSTRIAL
PS	PARK & SCENIC
FP	FLOOD PLAIN

Burns & McDonnell Waste Consultants, Inc.
ENGINEERS – GEOLOGISTS – SCIENTISTS – 100% EMPLOYEE-OWNED

FIGURE 6–2

ZONING MAP
EG&G AEROFAB/
MISSOURI METALS

K:\EGGKTA\ACAD\EGCP001.DWG 10–22–1992 11:15 PCS

Table 6-7
Summary of Pathways Considered

EG&G Missouri Metals Shaping Property

Potentially Exposed Population	Potential Exposure Pathway	Pathway Selected for Further Evaluation	Reason for Selecting or Excluding Pathway
Current Scenario			
Onsite Industrial Workers	· Ingestion of groundwater	No	1. Groundwater is not used.
	· Incidental Ingestion of soil	No	2. All areas of soil contamination are under ground covers which provide a barrier to direct contact with soil, generation of contaminated dust, or volatilization from subsurface to the air.
	· Dermal contact with soil	No	
	· Inhalation of fugitive dust	No	
	· Inhalation of volatiles from soil	No	
Trespassers	· Incidental Ingestion of soil	No	3. Security measures reduce chances of successful trespassing.
	· Dermal contact with soil	No	
	· Inhalation of fugitive dust	No	4. All areas of soil contamination are under ground covers which provide a barrier to direct contact with soil, generation of contaminated dust, or volatilization from subsurface to the air.
	· Inhalation of volatiles from soil	No	
Offsite Residents	· Ingestion of groundwater	No	5. Groundwater is not used.
	· Inhalation of volatiles from household groundwater use.	No	
Future Scenario			
Onsite Industrial Workers	· Ingestion of groundwater	No	6. With public water available it is unlikely that private wells will be installed.
	· Incidental ingestion of soil	No	7. Future excavation (such as repair of underground utilities) is not expected in contaminated areas. If excavation does occur, protective measures can be taken to minimize exposure.
	· Dermal contact with soil	No	
	· Inhalation of fugitive dust	No	
	· Inhalation of volatiles from soil	No	

Table 6–7 (continued)
Summary of Pathways Considered

EG&G Missouri Metals Shaping Property

Potentially Exposed Population	Potential Exposure Pathway	Pathway Selected for Further Evaluation	Reason for Selecting or Excluding Pathway
Trespassers	· Incidental ingestion of soil	No	8. All areas of soil contamination are under ground covers which provide a barrier to direct contact with soil, generation of contaminated dust, or volatilization from subsurface to the air.
	· Dermal Contact with soil	No	
	· Inhalation of fugitive dust	No	9. Security measures reduce chances of successful trespassing.
	· Inhalation of volatiles from soil	No	
Offsite Residents	· Ingestion of groundwater	No	10. With public water available it is unlikely that private wells will be installed.
	· Inhalation of volatiles from household groundwater use	No	

Since there are no groundwater wells used for potable water, ingestion of contaminants in water cannot occur at the property. No other contact with the groundwater is likely.

From this review, it is concluded there are no currently completed pathways for exposure. Further, none of significance are expected in the future.

6.5 RISK CHARACTERIZATION

6.5.1 Risk Evaluation

Risk can only occur if a receptor comes into contact with a contaminant. If contact occurs, the potential health risk is then evaluated by comparing contaminant exposure doses to health standards and values. Exposure doses, based upon detected chemical concentrations and the frequency and duration of exposure, are only pertinent to completed or potentially completed exposure pathways. There are no currently completed pathways for exposure and none are anticipated in the future. Risk from the subsurface contamination at the property is therefore not occurring nor is it expected to occur in the future.

After purchase of the property in 1988, EG&G took immediate steps to prevent further releases of solvents into the environment. These facility improvements, which include the physical upgrading of industrial solvent handling facilities and administrative actions, (such as waste minimization and personnel training), have prevented additional releases from occurring. At this time no release of liquid solvents exists on the property. Past corrective actions by EG&G have eliminated the potential for leakage from the degreasing pit to occur.

6.5.2 Uncertainties

At any site, there is usually a possibility that more individual chemical substances are present than were identified in the sampling and analytical effort. However, given the nature and size of this property and the level and identity of the chemicals detected in the sampling effort, it is unlikely that significant contamination went undetected. Therefore, there is little uncertainty associated with chemical identification at the property.

In evaluating exposure, probable scenarios are reviewed in order to estimate the conditions and duration of human contact with the chemicals of potential concern. Exposure scenarios are based on observations and/or assumptions about current and future activities at the property. It is unlikely that assumptions made about current and continued activities at the property and surrounding community are inaccurate. Therefore, the exposure assessment generates little uncertainty.

6.6 SUMMARY AND RECOMMENDATIONS

The risk assessment for EG&G was conducted in order to assess the risk, if any, associated with residual contamination remaining from previous activities at the property. The exposure assessment determined there are no completed exposure pathways for exposure to contaminants in soil or groundwater. Based upon the continued commercial/industrial land use and availability of a public water supply, there is minimal potential for exposure to occur in the future. Therefore, the property poses no current or future risk to human health or the environment from the residual contamination. Also, corrective actions performed by EG&G have prevented further releases of solvents on the property. No additional remedial is appears necessary to protect human health or the environment and none is recommended. Risk assessment results for this property indicate no adverse impact to human health or the environment exists.

6.7 HAZARD RANKING SYSTEM EVALUATION

A Hazard Ranking System (HRS) score for this property was calculated as a check to the qualitative risk evaluation process. The HRS score calculated for the Missouri Metal Shaping Company property correlates with the low level of risk predicted through the qualitative assessment of potential exposure pathways. Utilizing conservatively protective estimates of waste quantities and potential future groundwater use, a possible HRS score range of 0.53 to 3.32 was estimated for this property. Background information on the assumptions used to calculate this HRS score are presented in Appendix M. Considering the limited extent of elevated soil contamination actually detected on the property and the low potential for groundwater from the shallow groundwater system to be used, an HRS score of zero is likely most representative of current property conditions.

* * * * *

7.0 SUMMARY AND CONCLUSIONS

7.1 PROPERTY CHARACTERISTICS

This report presents the results of an RI performed at the Missouri Metal property during the period between March and August 1992. The purpose of this RI was to define the geologic and hydrogeologic property characteristics and the nature and extent of VOCs in soil and groundwater on the property. As part of all investigation activities, 18 monitoring wells and 33 boreholes have been installed on this 3.5-acre property.

Soil borings and hydraulic conductivity testing confirmed previous estimates by GTI regarding the low permeability of native silty clay soils on the property. Pump tests performed on the bedrock monitoring wells caused little groundwater level response in adjacent wells in the upper clay soil. Based on the field data and laboratory permeability tests, recharge from the upper clay to the bedrock groundwater system is expected to be low. Recharge potential would be greatest during wet weather periods and would be expected to be low during periods of dry weather.

Deep borings installed during the RI demonstrated that beneath the property is the sedimentary bedrock of the Pennsylvanian system. This unit is composed of siltstone, sandstone, and shale layers having varying permeabilities. The shale layers restrict vertical groundwater movement resulting in an overall low vertical permeability in the upper bedrock. As a result, little potential exists for perched water in the upper groundwater horizons to recharge the regional aquifer.

Lateral groundwater movement in the hydrogeologic system beneath the property occurs in the relatively permeable sandstone and siltstone layers in the upper bedrock. Groundwater flow velocity in this unit is expected to range from 170 to 260 ft/year. Lateral groundwater movement within the saturated soil profile is restricted by the low permeability of the natural silty clay soils.

Hydrogeologic information obtained from the Missouri Department of Natural Resources (MDNR) indicates that no known wells are currently using the shallow

perched water system as a source of groundwater. The MDNR geologic evaluation indicates Pennsylvanian cyclic deposits yield a very small quantity of poor quality water and are considered to be insignificant as an aquifer.

Analytical data indicates that the highest levels of VOCs were present in groundwater from monitoring wells screened within the upper soil profile. During the RI, the highest levels of VOCs within the soil profile were detected at two locations on the Missouri Metal property, near the degreasing pit (GMW-6, 180.47 mg/L) and in the southeast property corner (GMW-8, 234.17 mg/L). Groundwater VOC levels within the bedrock layer beneath the property are lower, ranging from 0.39 mg/L (GMW-17) to 7.38 mg/L (GMW-18). This decrease in VOC contamination with sampling depth likely reflects the limited recharge from the clay soils into the bedrock materials and verifies the expected low vertical mobility of groundwater in this geologic setting.

Surface and subsurface soil samples collected during past investigations have not identified a significant area of VOC contamination in soils on the property. Of the fifty-seven soil samples analyzed, elevated VOC levels were detected in only one sample from the southeast property corner and in five isolated samples from the degreasing pit area. This data indicates that areas of elevated soil VOC levels are isolated and of limited horizontal and vertical extent. Due to the absence of soil analytical data identifying a major surface release location, leakage from the bottom of the degreasing pit appears to be the most likely contaminant source on the property. VOC levels in soils beneath the degreasing pit structure may be elevated.

7.2 MIGRATION AND FATE

VOC migration in this setting is possible through the groundwater pathway. VOCs are expected to migrate laterally with groundwater through the relatively permeable bedrock layers. Off-site migration, if it occurs, will be in the upper bedrock at a depth of 20 feet below the ground surface. Migration potential for VOCs in groundwater within the silty-clay soil is restricted by the low permeability of the native soil.

Movement of groundwater within this unit is indicated by laboratory and field permeability tests to be low.

Groundwater in the bedrock is expected to flow toward the downgradient drainage channel, the River des Peres. Along this migration pathway, levels of VOCs in the groundwater would be expected to decrease due to advection, diffusion, adsorption, and biodegradation. Groundwater flow recharge to downgradient surface water is expected to be limited. No impact on surface water use or significant exposure concerns have been identified at the River des Peres.

VOC releases into the air and surface water migration pathways are limited by the depth of contamination below the ground surface and the asphalt and concrete barriers covering the property. The asphalt and concrete surfaces prevent erosion of contaminated soils and minimize leaching of soluble chemicals into surface runoff. As a result, on-site releases into surface water are not expected to occur.

Blowing of contaminated soils is effectively prevented by the asphalt, concrete, and gravel surfacing covering the property surface. Volatilization of subsurface chemicals into soil gas is demonstrated by the results of the GTI soil gas survey. This survey indicates soil gas migration within the silty clay soil is also restricted by the low soil permeability. Maximum VOC levels detected in soil gas decrease rapidly as the distance from the area of maximum contamination increases. As a result, a low potential for off-site releases of VOCs through the air pathway exists.

7.3 RISK ASSESSMENT

Based on the location of contamination detected at the Missouri Metal property, no exposures to elevated contaminant levels have been identified. Levels of PCE and TCE in soil samples from six sampling locations exceeded residential use health-based standards developed by MDOH. One surface soil sample exceeded recommended total chromium levels for soil in residential areas. However, due to the concrete, asphalt, and gravel surfaces which cover the property and the industrial property use, the potential for exposures to these contaminants to occur is limited.

Facility improvements have been constructed by EG&G since the property was purchased in 1988 to prevent past releases to the environment from continuing. Due to these improvements, no releases from current industrial activities on the property exist. Environmental improvements enacted at this facility also include additional employee training and a study of potential waste minimization practices.

Levels of VOCs in the groundwater horizon beneath the property exceed drinking water standards. However, hydrogeologic evaluations of the area indicate this groundwater horizon is insignificant as an aquifer due to its low groundwater yield and quality. No wells utilizing this perched groundwater unit were identified by a MDNR well survey. The City of Overland and neighboring St. Louis County is provided potable water from the St. Louis County Water Company. The St. Louis County Water Company draws water from surface water sources, namely the Missouri and Meramac Rivers. As a result, no exposures to the VOCs in the groundwater are anticipated. Therefore, the property in its current condition poses no current or future risk to human health or the environment. Based on this risk assessment, remedial actions on the property are not necessary to protect public health or the environment.

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