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ANALYSIS OF BROWNFIELDS CLEANUP ALTERNATIVES
CITY OF MICHIGAN CITY, INDIANA'S
BROWNFIELDS CLEANUP PROJECT
FOR THE FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360
U.S. EPA ASSISTANCE ID NO. BF-00E63001-0
INDIANA BROWFIELDS PROGRAM SITE NO. 4071001

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LIST OF ACRONYMS

ABCA	Analysis of Brownfields Cleanup Alternatives
AST	Above ground storage tank
cis-1,2-DCE	cis-1,2-Dichloroethene
IDEM	Indiana Department of Environmental Management
IFA	Indiana Finance Authority
IDCL	Industrial default closure level
Michigan City	City of Michigan City
ppm	Parts per million
PAH	Polynuclear aromatic hydrocarbons
PCE	Tetrachloroethene
RDCL	Residential default closure level
RISC	Risk Integrated System of Closure
Site	Former Erincraft Facility, 742 East 8th Street, Michigan City, Indiana 46360
Semi-VOC	Semi-volatile organic compound
TCE	Trichloroethene
TPH-ERO	Total petroleum hydrocarbons-extended range organics
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

In July 2008, the City of Michigan City, Indiana (Michigan City) was awarded an United States Environmental Protection Agency (U.S. EPA) Brownfields Cleanup Grant and an Indiana Finance Authority (IFA) Federal Matching Funds Grant for the remediation of impacted soils at the Former Erincraft Facility located at 742 East 8th Street in Michigan City, Indiana 46360 (site). Figure 1 illustrates the location of the site. Figure 2 presents the location of the site in relation to adjacent properties. The site has been entered into the Indiana Brownfields Program. The objective of the project is to cleanup contaminated soils at the site. Note that funding for this U.S. EPA brownfields cleanup project is only for the remediation of impacted soils at the site. The constituents of concern detected in site groundwater will be addressed at a later date.

The purpose of this Analysis of Brownfields Cleanup Alternatives (ABCA) is to provide information regarding potential cleanup alternatives for contaminated soils at the site. Included within this ABCA is a description/history of the site, a summary of environmental assessment results, an evaluation of potential soil exposure pathways and soil cleanup alternatives, and the recommended alternative for implementation at the site.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Location/Description

The site is the Former Erincraft Facility, located at 742 East 8th Street in Michigan City, Indiana 46360. Figure 1 illustrates the location of the site. Figure 2 presents the location of the site in relation to adjacent properties. The 1.07-acre site was occupied by the Western Launch and Engine Works (a boat maintenance/repair facility) circa 1905 to 1925. From 1925 to 1975, the Joseph W. Hays Corporation (manufacturer of power plant/scientific instruments) was present at the site. Erincraft, Inc. (manufacturer of electric heaters) operated at the site from 1975 to 1986. The site, currently owned by the City of Michigan City, is vacant of structures and is unused. The site is bordered to the north by the Former Norfolk & Western Railroad Property (a current U.S. EPA Brownfields Cleanup Grant Site) with the Former Bensz Facility (a former U.S. EPA Brownfields Cleanup Grant Site) being further to the north. To the east of the

site is E Street followed by vacant land further to the east. To the south of the site is East 8th Street followed by vacant land (south of East 8th Street) with the Weber Sign Service Facility being adjacent to the site in a western direction. The site is zoned B-5, Marina Recreation (Michigan City Zoning Map, 2003).

2.2 Site History

The site was occupied by the Western Launch and Engine Works (a boat maintenance/repair facility) circa 1905 to 1925. From 1925 to 1975, the Joseph W. Hays Corporation (manufacturer of power plant/scientific instruments) was present at the site. Erincraft, Inc. (manufacturer of electric heaters) operated at the site from 1975 to 1986. The site, currently owned by the City of Michigan City, is currently vacant of structures and is unused.

2.3 Site Investigation Results

Prior to acquiring the site for future redevelopment, Michigan City, through its Redevelopment Commission, authorized environmental assessment activities to be conducted at the site to determine if the site had been impacted environmentally from past site activities. As a result of the assessment activities conducted at the site, several areas of environmental concern were identified. These identified areas of concern are bulletized below.

- Long term industrial use of the property by the Western Launch & Engine Works-boat maintenance/repair facility; the Hays Corporation-manufacturer of boiler room apparatus and gauges; and, Erincraft Inc.-manufacturer of electric heaters.
- Identification of former site tenant Erincraft, Inc. as being a generator of hazardous waste.
- Machine shop and painting shop were identified on historical fire insurance maps.
- Observations of a vapor degreaser above ground storage tank (AST) located within the former building at the site.

Because of the identification of these areas of concern, site soil and groundwater samples were collected and analyzed to determine if these media had been contaminated above Indiana Department of Environmental

Management's (IDEM) Risk Integrated System of Closure (RISC) Policy's residential default closure levels (RDCL) and/or industrial default closure levels (IDCL). The IDEM's RISC Policy provides both policy and technical guidance to ensure that environmental cleanup efforts achieve a consistent closure of contaminated sites working with rather than replacing existing programs. RISC is a non-rule policy that does not have the weight of the law but potentially offers flexible closure options for conducting site assessments, cleanup alternatives and consistent closure goals. In accordance with the IDEM's RISC Technical Resource Guidance Document (IDEM, February 15, 2001), a residential use scenario is a property used as a place of residence (i.e., house, condominium, apartment complex), land used for agricultural purposes or a commercial/industrial use property that is used in part for residential activities (i.e., a children's daycare center, etc.); and, a commercial/industrial land use scenario is a property that is used as a business (and not used for human habitation) or a vacant land not intended for future human habitation. Per the IDEM's RISC Policy, the default closure concentrations for the residential and industrial scenarios are protective of human health and the environment at any site and may be used as closure concentrations. If the commercial/industrial closure option is selected for a site, the property will be required to be used for non-residential operations, a deed restriction will be required to be placed on the property and property control for all site contamination must be demonstrated (i.e., site groundwater contamination can not be present on an off-site property unless the off-site property owner allows this circumstance).

Results of soil and groundwater samples collected from the site are discussed as follows.

2.3.1 Extent of Soil Contamination

A total of 16 soil samples were collected from the site and submitted for laboratory analysis for volatile organic compounds (VOCs), semi-VOCs [including polynuclear aromatic hydrocarbons (PAHs)] and metals. Eight of these samples were also analyzed for free cyanide. Figure 3 illustrates the soil sample locations, and Table 1 presents the parameters detected in each soil sample. The results were compared to the RISC Policy's IDCLs and the RDCLs (per the IDEM's RISC Technical Resource Guidance Document, January 31, 2006 Update Table). The results of select PAHs were compared to the IDEM's RISC Policy's PAH Interim Default Closure Levels (IDEM, August 2006). The results are summarized as follows.

VOCs

Nine of the soil samples had VOCs detected above the IDEM's RISC Policy's residential default closure level. Six samples (VB-S-2, VB-S-4 through VB-S-7 and VB-S-11) had methylene chloride detected above its RDCL. Samples VB-S-2, VB-S-13 and S-63-A had tetrachloroethene (PCE) detected above its RDCL, and sample VB-S-8 had naphthalene detected above its residential closure level.

Semi-VOCs

2,6-Dinitrotoluene and n-nitrosodi-n-propylamine were detected above the IDEM's RISC IDCL in soil sample VB-S-12.

Metals

Several metal constituents (arsenic, antimony, cadmium, chromium, copper, lead and mercury) were detected above the IDEM's default closure levels. In comparison to the residential cleanup standards, lead (samples VB-S-6, VB-S-7 and S-66-A), copper (sample VB-S-4), cadmium (samples VB-S-4, VB-S-8 and S-66-A), chromium (samples VB-S-4 and VB-S-11), arsenic (samples VB-S-13 and S-63-A) and antimony/mercury (sample VB-S-4) were detected above this cleanup criteria. Additionally, lead (samples VB-S-4, VB-S-8, S-63-A and S-65-A), antimony (sample VB-S-8) and arsenic (sample S-65-A) were detected above their respective IDCLs.

Free Cyanide

Free cyanide was detected above its residential default closure level in soil sample VB-S-11.

Summary

Approximately 6,800 cubic yards (9,500 tons) of impacted soils were identified at the site exceeding the IDEM RISC Policy's residential default closure concentrations. The estimated area of soil impacts (contamination above the RISC RDCLs) at the site is depicted on Figure 3.

2.3.2 Extent of Groundwater Contamination

To determine impacts to groundwater below the site and in the vicinity of the site, four water table groundwater monitoring wells were installed in on-site locations, eight water table groundwater monitoring wells were installed in off-site downgradient locations and twenty additional water table monitoring wells were installed in off-site upgradient/sidegradient locations. In addition, a total of seven groundwater monitoring wells, screened in the middle of the aquifer, were installed (two in on-site locations, four in off-site downgradient locations and one in an off-site upgradient location). Figure 4 depicts the locations of these wells. As indicated via the figure, groundwater flow below the site is to the north toward Trail Creek.

In August 2005, most of the groundwater monitoring well samples were analyzed for VOCs, semi-VOCs and metals. In June/August 2008, all of the groundwater monitoring wells were re-sampled with the samples being analyzed for VOCs. In addition, select wells were analyzed for semi-VOCs, metals and/or total petroleum hydrocarbons-extended range organics (TPH-ERO). TPH-ERO analysis is required by the IDEM to evaluate potential impacts from petroleum/fuel oil releases. Tables 2 and 3 present the parameters detected in the water table groundwater monitoring wells (upper aquifer) and middle of the aquifer wells, respectively. The detected groundwater concentrations were compared to the IDEM's RISC Policy IDCLs and the RDCLs (per the IDEM's RISC Technical Resource Guidance Document, January 31, 2006 Update Table). The results of select PAHs were compared to the IDEM's RISC Policy's PAH Interim Default Closure Levels (IDEM, August 2006). The TPH results were compared to the default closure levels presented in the IDEM's TPH Nonrule Policy Document (IDEM, June 15, 2006). The results are summarized as follows. Note that since groundwater below and in the vicinity of the site will be remediated to commercial/industrial closure level, only the results above the commercial/industrial level are presented herein. (As previously discussed, funding for this U.S. EPA brownfields cleanup project is only for the remediation of impacted soils at the site. The constituents of concern detected in site groundwater will be addressed at a later date.)

VOCs

Based on the June/August 2008 sampling event, PCE and trichloroethene (TCE) were detected above the IDEM's RISC IDCLs in on-site water table well MW-7, and vinyl chloride was detected above its IDCL in

on-site water table well MW-8R. Additionally, several chlorinated solvents (PCE, TCE and vinyl chloride) were detected above the IDEM's RISC industrial closure levels in several off-site upgradient and downgradient water table wells. VOCs were not detected within the middle of the aquifer wells above regulatory criteria with the exception of cis-1,2-Dichloroethene (cis-1,2-DCE) detected above its IDCL in on-site well MW-22.

Semi-VOCs

Semi-VOCS were not detected above RISC commercial/industrial concentrations within the wells located at or in the vicinity of the site.

Metals

Arsenic and lead were detected above the RISC Policy's IDCLs in one off-site sidegradient well (well MW-16 screened at the water table).

TPH-ERO

TPH-ERO concentrations were not detected above the IDEM's IDCL in samples collected from on-site water table well MW-9 nor in off-site downgradient wells MW-5 and MW-6.

Summary

The estimated extent of VOC groundwater impacts (VOC parameter concentrations above the RISC IDCLs) in the vicinity of the site is depicted on Figure 5. Groundwater contamination within the vicinity of the site appears to be the result of impacts from PCE and TCE (typical solvents used for metal-degreasing) probably from the past industrial activities conducted at the Former Erincraft Facility. Through natural degradation processes, PCE and TCE biodegrade to less chlorinated cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE then vinyl chloride and finally ethene (a benign end-product) via the removal of chlorine atoms from the chlorinated hydrocarbon contaminants. Therefore, the presence of elevated concentrations of vinyl chloride in site groundwater is most likely due to the degradation of PCE and/or TCE in on-site and upgradient groundwater.

2.3.3 Trail Creek Surface Water Sampling Results

To evaluate potential impacts from the site and adjacent sites to the surface water of Trail Creek, four surface water samples were collected from the southern bank of Trail Creek (to the north of the former Bensz Facility) and analyzed for VOCs, semi-VOCs and RISC metals. Figure 5 illustrates the locations of sample collection. The results of the four surface water samples indicated that constituents were not detected above the laboratory's reporting limits.

2.3.4 Summary of Site Investigation Results

Based on the results of the soil samples collected from the site, approximately 6,800 cubic yards (9,500 tons) of soils have been contamination above the IDEM's RISC Policy's RDCLs. Specifically, the contaminants of concern in site soil are the select VOCs (PCE, naphthalene and methylene chloride), semi-VOCs (2,6-dinitrotoluene and n-nitrosodi-n-propylamine), metals (arsenic, antimony, cadmium, chromium, copper, lead and mercury) and free cyanide which have been detected above their respective RDCLs. Site groundwater has also been impacted with contaminants; however, these groundwater contaminants will be addressed at a later date.

Based on the constituents detected at the site, three potential sources exist: (1) a release(s) of chlorinated solvents potentially from metal degreasers (elevated concentrations of PCE and TCE detected) and from paint and varnish strippers (methylene chloride); (2) a release(s) of metallic constituents (arsenic, antimony, cadmium, chromium, copper, lead and mercury) potentially from paint/enamels, welding, wood preserving and/or degreasing operations or instrument manufacturing formerly conducted at the Former Erincraft Facility.; and, (3) additional soil impacts also appear to be present based on the detection of 2,6-dinitrotoluene (used in surface coatings and explosives), n-nitrosodi-n-propylamine (used for research) and naphthalene. These identified impacts to soils and groundwater at the site appear to be the result of past operations at the Former Erincraft Facility (historical industrial activities since 1905 of past property owners/tenants including the Western Launch and Engine Works, the Joseph W. Hays Corporation and Erincraft, Inc.).

3.0 ANALYSIS OF POTENTIAL SOIL EXPOSURE PATHWAYS

A potential soil exposure pathway is defined as a potential course a contaminant present in site soils takes from the contaminated soil area to the point of contact with an exposed organism (receptor). Per the IDEM's RISC Policy, exposure to soil contamination present at the site may occur by three main pathways:

- Direct Contact
- Migration to groundwater
- Construction Worker

Direct contact routes (skin contact, dust inhalation, volatilization and soil consumption) are associated with direct exposure to contaminated soils. Because the four direct contact routes often exist simultaneously for any potential receptor, their evaluation is often performed as one operation. The migration to groundwater pathway considers the leaching of chemical constituents from soil into groundwater. Once in groundwater, exposure to contaminants can occur via volatilization, direct contact and consumption. The construction worker pathway considers a worker exposure that could potential result from trenching or excavation activities conducted at the site.

The following section presents an analysis of cleanup alternatives for contaminated soils at the site. These cleanup alternatives were evaluated in regards to the elimination of the above summarized potential exposure pathways (along with other evaluation criteria).

4.0 ANALYSIS OF SOIL CLEANUP ALTERNATIVES

4.1 Site Redevelopment/Cleanup Goals

The site (and adjacent properties) is tentatively anticipated to be redeveloped as the Trail Creek Water Front Redevelopment Area which could include several public use facilities (creation of parks, walkways and public spaces), residential usage (i.e., construction of townhouses, condominiums, etc.), the expansion of the municipal marina (addition of boat slips/storage, repair and service shops and parking) and the potential development of a mixed-use commercial and entertainment center (retail shopping, service and restaurants).

Therefore, the proposed soil cleanup goals are IDEM's RISC RDCLs in order to allow for unrestricted future use of the site. Remediating contaminated soils to below residential levels allows for the site to be redeveloped for unrestricted end use since the residential closure levels are considered protective of human health and the environment. Additionally, since the exact re-use of the site is currently unknown, remediation of soils to the most stringent cleanup level (RDCLs) will ensure that additional soil remedial activities will not be required once the redevelopment plans for the Trail Creek Water Front Redevelopment Area (which includes the site) are finalized and implemented.

4.2 Potential Cleanup Alternatives

Based on the identification/screening of potential soil remedial alternatives for implementation at the site, no action, off-site landfilling, ex-situ soil washing and ex-situ and in-situ solidification/stabilization are potential remedial alternatives which were further evaluated. The following sections present an evaluation of these potential alternatives for the remediation of impacted soils at the site and recommends the most effective, implementable and cost efficient method of soil cleanup. Due to the soil contaminants of concern at the site being VOCs, semi-VOCs, heavy metals and free cyanide, several typical soil remedial alternatives (i.e., soil vapor extraction, bioremediation, thermal treatment) were not evaluated due to their inability to treat the sites contaminants. Additionally, institutional controls/actions were not evaluated because the sites remedial objective for impacted soil would not be attained.

4.2.1 No Action

The no action alternative would involve no remedial activities to be conducted at the site and would leave the site in its current condition. This alternative would not provide for mitigation of the actual and potential risks posed by the contaminated soils existing at the site, would allow for further leaching of contaminants from site soils into groundwater and would not be protective of public health and the environment.

4.2.2 Off-Site Landfilling

Off-site landfilling is a removal technology in which contaminated soils are excavated from the site and

transported to a permitted off-site disposal facility. This technology initially involves the permitting of the impacted soils to an appropriate off-site landfill, followed by the excavation of soils within the estimated impacted soil area using mechanized equipment and loading the soils into semi-dump trailers for transportation to the landfill. Following the removal of these soils, confirmatory soil samples will be collected and analyzed to confirm that the soils with concentrations above the RISC Policy residential cleanup concentrations have been removed from the site. Once it is established that contaminated soils have been removed, the excavation will be backfilled/compacted with clean backfill material, and the site will be restored to its approximate original condition.

4.2.3 Ex-Situ Soil Washing

Ex-situ soil washing is a water and/or solvent based process for scrubbing soils ex-situ to remove contaminants. The process removes contaminants from soils in one of two ways: (1) by dissolving or suspending them in a specifically formulated wash solution; and, (2) by concentrating them into a smaller volume of soil through particle size separation, gravity separation, and attrition scrubbing (similar to those techniques used in sand and gravel operations). Contaminants sorbed onto fine soil particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment or chelating agent to help remove organics and heavy metals.

Initially, a treatability study/pilot test will be conducted to formulate a single suitable washing solution that will consistently and reliably remove all of the types of contaminants existing in site soils (VOCs, semi-VOCs and metals). Contaminated soils are excavated from within the estimated area of impacted soils using mechanized equipment and initially screened to separate the different type (size) of soil particles to be treated. The screened soils are then washed in a scrubbing unit in which the soil and wash water are passed through wash water sprays, mixing blades and sieves which washes the silt and clay from the larger-grained soil (i.e., sand) and separates them. The wastewater is captured and will need to be treated. Confirmatory samples of the treated soils (i.e., silt and clay particles which will contain most of the contaminants) are collected and analyzed for contaminant concentrations. Additionally, confirmatory soil samples are collected and analyzed to confirm that soils above the cleanup concentrations are no longer present at the site. Once

it is established that treated soils have been remediated to below the site cleanup concentrations, the treated soils are placed into the original excavation and compacted, and the site is restored to its approximate original condition.

4.2.4 Ex-Situ Solidification/Stabilization

Ex-situ solidification/stabilization is a well utilized process to immobilize contaminants (i.e., change the physical or chemical compositions that impact the leaching characteristics of a treated waste or decrease its bioavailability and concentration). This treatment process locks contaminants within a solidified matrix (solidification) and/or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Initially, a treatability study/pilot test will be conducted to determine the type of reagent (usually cement kiln dust, proprietary agents, fly ash, etc.) required to solidify/stabilize the soil contaminants. Site activities involve the excavation of contaminated soils within the estimated area of impacted soils using mechanized equipment and mixing the soils with the selected reagent in a pug mill and generally solidifying the materials. Confirmatory samples of the treated soils are collected and analyzed for contaminant concentrations/leachability. Additionally, confirmatory soil samples are collected and analyzed to confirm that soils above the cleanup concentrations are no longer present at the site. Once it is established that treated soils have been remediated to below the site cleanup concentrations, the treated soils are placed into the original excavation, and the site is restored.

4.2.5 In-Situ Solidification/Stabilization

In-situ solidification/stabilization is a process to solidify/immobilize contaminants. It is similar to ex-situ solidification/stabilization in that the process locks contaminants within a solidified matrix (solidification) and/or converts the waste constituents into a more immobile form, usually by chemical reaction (stabilization). A treatability study/pilot test will be conducted to determine the type of reagent (usually cement kiln dust, proprietary agents, fly ash, etc.) required to solidify/stabilize the soil contaminants. The process involves the use of a large diameter auger drill rig which mixes the contaminated soils in place (i.e., in-situ) within the estimated area of impacted soils with the selected reagent to stabilize/solidify the contaminants in the soil media. Confirmatory in-situ samples of the treated soils are collected and analyzed

for contaminant concentrations/leachability. Additionally, confirmatory soil samples are collected and analyzed to confirm that soils above the cleanup concentrations are no longer present at the site. Once it is established that treated soils have been remediated to below the site cleanup concentrations, the site is restored.

4.3 Evaluation of Cleanup Alternatives

The potential alternatives were evaluated for their technical and economical feasibility, protectiveness of human health and the environment, cost, need for treatability/pilot testing, ability to achieve the proposed cleanup criteria, community acceptance, time frame for implementation and overall advantages/disadvantages. Table 4 presents a summary of the evaluation of the potential soil remedial alternatives, and Table 5 provides estimated costs for implementation of each cleanup alternative at the site. These remedial options are further evaluated as follows.

The main objective of this project is to cleanup soils to allow for future redevelopment of the site. Since the no action alternative does not accomplish this goal, this alternative is eliminated from the selection process.

Off-site landfilling is a well-proved, well-established physical removal/disposal alternative for impacted soils. The major advantage of landfilling is that this alternative will allow for the site to be redeveloped for unrestricted end use. Other advantages of landfilling is that contaminated soils are removed from the site and properly disposed, and the site is restored in a relatively short period of time. This alternative eliminates the three main soil exposure pathways (direct contact, migration to groundwater and construction worker). Additionally, overall implementation costs are medium (compared to the other remedial options). However, liability for the contaminated soils still exists with landfilling of the soils (although this liability is minimal). In addition, clean backfill material needs to be brought to the site, and the transportation of the impacted soil through populated areas may affect community acceptability.

Ex-situ soil washing is a well-proven, well-established physical/chemical treatment alternative for impacted soils. Site soils, mainly a fine to coarse grained sand with trace (0-10%) amounts of fine grained gravel, silt and clay, should be amenable to soil washing [smaller amount of fines (i.e, silt and clay) as compared to

coarser materials (i.e., sand)]. This alternative will successfully eliminate the three main exposure pathways, and allows the site to be restored in a moderate period of time. However, due to the sites complex mixture of soil contaminants (a mixture of metals, volatile organics and semi-VOCs), formulating a successful washing fluid will be difficult; and, additional soil washings, using different wash formulations and/or different soil to wash fluid ratios, may be required. Additionally, the contaminated water (wastewater) generated from the soil washing procedure will require capture and off-site treatment.

Ex-situ solidification/stabilization is a well-proven, well-established physical/chemical treatment alternative for impacted soils. The major advantages of ex-situ solidification/stabilization are: (1) the contaminants within the soil are solidified/stabilized, therefore, potentially eliminating future liability; and, (2) the treated soils can be used as backfill material. Ex-situ solidification/stabilization will enable the site to be restored in a moderate period of time, and this technology eliminates the three main exposure pathways (direct contact, migration to groundwater and construction worker). Disadvantages to this remedial technology include: (1) Environmental conditions (i.e., weathering) may affect the long-term reliability of the stabilization process (continued immobilization of contaminants).; (2) The process results in a significant increase in volume (20-30%) of treated material.; (3) Organics are difficult to immobilize.; (4) The solidified material may hinder the implementation process of the future remedial activities for site groundwater; and, (5) The solidified material may hinder/limit future site end use.

In-situ solidification/stabilization is a less frequently used physical/chemical treatment alternative for impacted soils. The major advantages of in-situ stabilization are: (1) the contaminants within the soil are solidified/stabilized, therefore, potentially eliminating future liability; and, (2) the soils are treated in-place. This cleanup alternative allows a site to be restored in a moderate period of time, and this technology eliminates the three main soil exposure pathways. Disadvantages to this remedial technology include: (1) Concerns regarding the uniformity of treatment and long-term reliability of the stabilization process (continued immobilization of contaminants).; (2) The process results in a significant increase in volume (20-30%) of treated material.; (3) Organics are difficult to immobilize.; (4) Reagent delivery and effective mixing are more difficult than for ex-situ applications.; (5) As with all in-situ treatments, confirmatory sampling can be more difficult than for ex-situ treatments.; (6) The solidified material may hinder the implementation process of the future remedial activities for site groundwater; and, (7) The solidified material may

hinder/limit future site end use.

4.4 Recommended Cleanup Alternative

Based on the evaluation of potential soil remedial alternatives, off-site landfilling is the recommended soil remedial alternative for implementation at the site. As previously presented, the major advantage of landfilling is that this alternative will allow for the site to be redeveloped for unrestricted end use. Since the exact re-use of the site is currently unknown, the cleanup of soils via off-site landfilling will allow for the soils to be remediated to the most stringent cleanup level (RDCLs) which will ensure that additional soil remedial activities will not be required once the redevelopment plans for the Trail Creek Water Front Redevelopment Area (which includes the site) are finalized and implemented. Additional advantages of landfilling are that contaminated soils are removed from the site and properly disposed; and, the site is restored in a relatively short period of time.

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Parameter	Sample No.						IDEM RISC Soil IDCLs [1]	IDEM RISC Soil RDCLs [2]
	VB-S-2	VB-S-4	VB-S-5	VB-S-6	VB-S-7	VB-S-8		
Depth of Sample (feet bgl)	0.5-1.5	0.5-1.5	1-2	1-2	0.5-1.5	0.5-1.5		
VOCs								
tert-Butylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.0868	390 [4]	390 [5]
sec-Butylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	1.48	220 [4]	220 [5]
cis-1,2-Dichloroethene (c-DCE)	0.0266	ND [3]	ND [3]	0.0081	ND [3]	ND [3]	5.8	0.4
Ethylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.417	170	13
Isopropylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.869	42	11
n-Propylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	2.06	300	36
Methylene chloride	**0.0298**	**0.0513**	**0.117**	**0.109**	**0.131**	ND [3]	1.8	0.023
Naphthalene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	**12.7**	170	0.7
Tetrachloroethene (PCE)	**0.0934**	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.64	0.058
Trichloroethene (TCE)	0.0081	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.35	0.057
Toluene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.108	96	12
1,2,4-Trimethylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.844	170	2.5
1,3,5-Trimethylbenzene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.272	68	0.61
Xylenes (Total)	ND [3]	0.0313	ND [3]	ND [3]	ND [3]	1.25	170	170
Semi-VOCs								
Phenanthrene	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	7.71	170	13

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Parameter	Sample No.						IDEM RISC Soil IDCLs [1]	IDEM RISC Soil RDCLs [2]
	VB-S-2	VB-S-4	VB-S-5	VB-S-6	VB-S-7	VB-S-8		
Metals								
Antimony	ND [3]	**5.7**	ND [3]	ND [3]	ND [3]	**49**	37	5.4
Barium	22	25.7	20.2	62.7	75.8	80.9	10,000	1,600
Beryllium	0.3	ND [3]	ND [3]	0.3	0.8	1	2,300	63
Cadmium	ND [3]	**14**	ND [3]	ND [3]	ND [3]	**14.6**	77	7.5
Chromium	ND [3]	**99.2**	1.7	3.4	6.8	8.5	120	38
Copper	7.6	**1,330**	24.4	60.5	733	636	2,900	920
Lead	6.3	**722**	8.7	**86.7**	**230**	**310**	230	81
Mercury	0.114	**6.08**	0.11	0.975	0.181	1.38	32	2.1
Nickel	2.6	12.7	3.8	4.6	31.1	60.4	2,700	950
Zinc	9.4	3,240	20.3	150	560	1,260	10,000	10,000
Free Cyanide	0.308	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	9.6	0.94

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Parameter	Sample No.					IDEM RISC Soil IDCLs [1]	IDEM RISC Soil RDCLs [2]
	VB-S-9	VB-S-11	VB-S-12	VB-S-13	VB-S-15		
Depth of Sample (feet bgl)	1-2	1-2	2-4	2-4	0-1		
VOCs							
Methylene chloride	ND [3]	**0.0438**	ND [3]	ND [3]	ND [3]	1.8	0.023
Tetrachloroethene (PCE)	ND [3]	0.0246	ND [3]	**0.15**	ND [3]	0.64	0.058
Trichloroethene (TCE)	ND [3]	ND [3]	ND [3]	0.0066	ND [3]	0.35	0.057
Semi-VOCs							
Phenanthrene	0.65	ND [3]	ND [3]	ND [3]	ND [3]	170	13
Bis (2-ethylhexyl) phthalate	ND [3]	1.52	ND [3]	ND [3]	ND [3]	980	300
Benzo(b)fluoranthene	ND [3]	ND [3]	0.065	ND [3]	ND [3]	15	5
Benzo(k)fluoranthene	ND [3]	ND [3]	0.063	ND [3]	ND [3]	150	50
Pyrene	ND [3]	ND [3]	0.077	ND [3]	ND [3]	2,000	2,000
Di-n-butylphthalate	ND [3]	ND [3]	0.58	ND [3]	ND [3]	760	760
2,6-Dinitrotoluene	ND [3]	ND [3]	**0.55**	ND [3]	ND [3]	0.031	0.0091
N-Nitrosodi-n-propylamine	ND [3]	ND [3]	**0.57**	ND [3]	ND [3]	0.002	0.0006

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Parameter	Sample No.					IDEM RISC Soil IDCLs [1]	IDEM RISC Soil RDCLs [2]
	VB-S-9	VB-S-11	VB-S-12	VB-S-13	VB-S-15		
Metals							
Arsenic	ND [3]	ND [3]	2.2	**4.4**	ND [3]	5.8	3.9
Barium	33.7	23.1	20	24	11	10,000	1,600
Beryllium	ND [3]	ND [3]	0.12	0.094	ND [3]	2,300	63
Chromium	4.0	**71.1**	3.1	4.6	2.1	120	38
Copper	75	20.1	49	25	10	2,900	920
Lead	54.4	19.4	38	35	14	230	81
Mercury	0.264	0.287	0.092	0.066	0.05	32	2.1
Nickel	5.94	6.07	4.9	6.8	4.0	2,700	950
Zinc	154	68	59	67	90	10,000	10,000
Free Cyanide	ND [3]	**1.14**	NAF [6]	NAF [6]	NAF [6]	9.6	0.94

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Parameter	Sample No.					IDEM RISC Soil IDCLs [1]	IDEM RISC Soil RDCLs [2]
	VB-S-17	S-63-A	S-64-A	S-65-A	S-66-A		
Depth of Sample (feet bgl)	2-4	1-2	1-2	1-2	1-2		
VOCs							
Methylene chloride	0.021	ND [3]	ND [3]	ND [3]	ND [3]	1.8	0.023
Tetrachloroethene (PCE)	0.0067	**0.0697**	ND [3]	0.00793	ND [3]	0.64	0.058
Semi-VOCs							
Benzo(b)fluoranthene	ND [3]	0.42	ND [3]	ND [3]	0.87	15	5
Bis(2-ethylhexyl)phthalate	ND [3]	1.74	ND [3]	ND [3]	0.76	980	300
Pyrene	ND [3]	ND [3]	ND [3]	ND [3]	0.8	2000	2000
Metals							
Arsenic	ND [3]	**4.0**	ND [3]	**17**	ND [3]	5.8	3.9
Barium	7.6	109	51	171	264	10,000	1,600
Cadmium	ND [3]	ND [3]	ND [3]	ND [3]	**12**	77	7.5
Chromium	1.2	20	ND [3]	7	16	120	38
Copper	1.3	69	75	89	383	2,900	920
Lead	1.9	**302**	57	**514**	**225**	230	81
Nickel	3.0	18	4	13	12	2,700	950
Zinc	10	262	119	146	756	10,000	10,000

TABLE 1
DETECTED PARAMETERS IN SOIL SAMPLES

Note: Results reported in milligrams per kilogram (mg/kg) or parts per million (ppm).

(1) IDEM RISC Industrial Default Closure Level (IDCL) for soil (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).

(2) IDEM RISC Residential Default Closure Level (RDCL) for soil (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).

(3) ND - Not detected above the laboratory's reporting limit.

(4) U.S. EPA Region 9 Preliminary Remedial Goals for Industrial Soils (U.S. EPA Region 9, October 1, 2002).

(5) U.S. EPA Region 9 Preliminary Remedial Goals for Residential Soils (U.S. EPA Region 9, October 1, 2002).

(6) NAF - Not analyzed for in this sample.

Bold - Detected above the IDEM RISC Soil RDCL.

■ - Detected above the IDEM RISC Soil IDCL.

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-1		MW-2		MW-3		MW-4/MW-4-R			
Sample No.	MW-1-A	MW-1-B	MW-2-A	MW-2-B	MW-3-A	MW-3-B	MW-4-A	MW-4R-B		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	Aug 2008		
VOCs										
cis-1,2-Dichloroethene (c-DCE)	0.0082	0.0177	0.009	ND [3]	**0.21**	0.0125	ND [3]	ND [3]	1.0	0.07
trans-1,2-Dichloroethene (t-DCE)	ND [3]	ND [3]	ND [3]	ND [3]	0.0028	ND [3]	ND [3]	ND [3]	2.0	0.1
Tetrachloroethene (PCE)	**0.006**	ND [3]	ND [3]	ND [3]	**0.48**	**0.147**	ND [3]	ND [3]	0.055	0.005
Trichloroethene (TCE)	0.0013	ND [3]	ND [3]	ND [3]	**0.084**	**0.0193**	ND [3]	ND [3]	0.031	0.005
Vinyl chloride	**0.0067**	**0.00805**	ND [3]	ND [3]	**0.026**	**0.0184**	ND [3]	ND [3]	0.004	0.002
Semi-VOCs										
Bis(2-ethylhexyl)phthalate	ND [3]	NAF [4]	ND [3]	ND [3]	**0.019**	NAF [4]	ND [3]	NAF [4]	0.2	0.006
Metals										
Antimony	ND [3]	NAF [4]	ND [3]	NAF [4]	**0.038**	NAF [4]	ND [3]	NAF [4]	0.041	0.006
Barium	0.15	NAF [4]	0.15	NAF [4]	0.073	NAF [4]	0.058	NAF [4]	20	2.0
Cadmium	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	0.0041	NAF [4]	0.051	0.005
Chromium	ND [3]	NAF [4]	0.0057	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	0.31	0.1
Lead	ND [3]	NAF [4]	**0.018**	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	0.042	0.015
Zinc	ND [3]	NAF [4]	0.05	NAF [4]	ND [3]	NAF [4]	0.033	NAF [4]	31	11

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-5		MW-6		MW-7		MW-8/MW-8R			
Sample No.	MW-5-A	MW-5-B	MW-6-A	MW-6-B	MW-7-A	MW-7-B	MW-8-A	MW-8R-B		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	Aug 2008		
VOCs										
cis-1,2-Dichloroethene (c-DCE)	ND [3]	ND [3]	ND [3]	ND [3]	**0.091**	**0.267**	0.0063	**0.201**	1.0	0.07
trans-1,2-Dichloroethene (t-DCE)	ND [3]	ND [3]	ND [3]	ND [3]	0.0022	ND [3]	ND [3]	ND [3]	2.0	0.1
Methyl-t-Butyl Ether	ND [3]	ND [3]	ND [3]	ND [3]	0.0033	ND [3]	ND [3]	ND [3]	0.72	0.04
Tetrachloroethene (PCE)	ND [3]	ND [3]	ND [3]	ND [3]	**0.091**	**0.139**	ND [3]	ND [3]	0.055	0.005
Trichloroethene (TCE)	ND [3]	ND [3]	ND [3]	ND [3]	**0.016**	**0.0484**	ND [3]	ND [3]	0.031	0.005
Vinyl chloride	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	**0.0538**	0.004	0.002
Semi-VOCs										
Anthracene	0.00064	ND [3]	ND [3]	ND [3]	ND [3]	NAF [4]	ND [3]	NAF [4]	31	2.3
Fluorene	0.0035	ND [3]	ND [3]	ND [3]	ND [3]	NAF [4]	ND [3]	NAF [4]	4.1	0.31
TPH-ERO	NAF [4]	**0.19**	NAF [4]	ND [3]	NAF [4]	NAF [4]	NAF [4]	NAF [4]	1.1	0.1
Metals										
Barium	0.052	NAF [4]	0.15	NAF [4]	0.14	NAF [4]	0.18	NAF [4]	20	2.0
Copper	0.049	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	4.1	1.3
Zinc	0.18	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	31	11

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-9		MW-14		MW-15		MW-16			
Sample No.	MW-9-A	MW-9-B	MW-14-A	MW-14-B	MW-15-A	MW-15-B	MW-16-A	MW-16-B		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008		
VOCs										
cis-1,2-Dichloroethene (c-DCE)	ND [3]	ND [3]	0.003	ND [3]	0.022	0.0334	0.0066	0.0278	1.0	0.07
Methyl-t-Butyl Ether	ND [3]	ND [3]	0.037	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.72	0.04
Tetrachloroethene (PCE)	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.0016	ND [3]	0.055	0.005
Vinyl chloride	ND [3]	ND [3]	**0.0048**	ND [3]	**0.024**	**0.0141**	ND [3]	ND [3]	0.004	0.002
Semi-VOCs	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	NAF [4]	-	-
TPH-ERO	NAF [4]	ND [3]	NAF [4]	NAF [4]	NAF [4]	NAF [4]	NAF [4]	NAF [4]	1.1	0.1
Metals										
Arsenic	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	**0.027**	NAF [4]	0.01	0.01
Barium	0.068	NAF [4]	0.32	NAF [4]	0.12	NAF [4]	0.21	NAF [4]	20	2.0
Chromium	ND [3]	NAF [4]	0.016	NAF [4]	ND [3]	NAF [4]	0.027	NAF [4]	0.31	0.1
Copper	ND [3]	NAF [4]	0.011	NAF [4]	ND [3]	NAF [4]	0.11	NAF [4]	4.1	1.3
Lead	ND [3]	NAF [4]	**0.019**	NAF [4]	ND [3]	NAF [4]	**0.086**	NAF [4]	0.042	0.015
Nickel	ND [3]	NAF [4]	0.014	NAF [4]	ND [3]	NAF [4]	0.083	NAF [4]	2.0	0.73
Zinc	ND [3]	NAF [4]	0.097	NAF [4]	0.024	NAF [4]	0.37	NAF [4]	31	11

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-17		MW-24		MW-26		MW-27			
Sample No.	MW-17-A	MW-17-B	MW-24-A	MW-24-B	MW-26-A	MW-26-B	MW-27-A	MW-27-B		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008		
VOCs										
1,1-Dichloroethene	0.0014	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	5.1	0.007
cis-1,2-Dichloroethene (c-DCE)	**0.21**	**0.0957**	0.033	ND [3]	ND [3]	0.0507	**0.21**	0.0658	1.0	0.07
trans-1,2-Dichloroethene (t-DCE)	0.0034	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.0062	ND [3]	2.0	0.1
Tetrachloroethene (PCE)	**2.2**	**1.2**	**0.013**	ND [3]	ND [3]	**0.0197**	**0.61**	**0.203**	0.055	0.005
Trichloroethene (TCE)	**0.13**	**0.139**	**0.01**	ND [3]	ND [3]	**0.00815**	**0.067**	**0.0112**	0.031	0.005
Vinyl chloride	**0.0058**	**0.00299**	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	0.004	0.002
Semi-VOCs										
Bis(2-ethylhexyl)phthalate	**0.019**	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	0.2	0.006
Metals										
Barium	0.12	NAF [4]	0.067	NAF [4]	0.2	NAF [4]	0.057	NAF [4]	20	2.0
Chromium	ND [3]	NAF [4]	ND [3]	NAF [4]	ND [3]	NAF [4]	0.0067	NAF [4]	0.31	0.1

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-28		MW-29		MW-30		MW-53	MW-54		
Sample No.	MW-28-A	MW-28-B	MW-29-A	MW-29-B	MW-30-A	MW-30-B	MW-53	MW-54		
Date Sampled	Sept 2005	June 2008	Sept 2005	June 2008	Sept 2005	June 2008	Aug 2008	Aug 2008		
VOCs										
cis-1,2-Dichloroethene (c-DCE)	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	**0.186**	1.0	0.07
Methyl-t-Butyl Ether	ND [3]	ND [3]	0.014	**0.0651**	ND [3]	ND [3]	0.0167	ND [3]	0.72	0.04
Tetrachloroethene (PCE)	ND [3]	ND [3]	**0.032**	**0.0165**	ND [3]	ND [3]	ND [3]	**0.444**	0.055	0.005
Trichloroethene (TCE)	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	**0.013**	**0.191**	0.031	0.005

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.						IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-55	MW-56	MW-57	MW-58	MW-59	MW-60		
Sample No.	MW-55	MW-56	MW-57	MW-58	MW-59	MW-60		
Date Sampled	Aug 2008	Aug 2008	Aug 2008	Aug 2008	Aug 2008	Aug 2008		
VOCs								
sec-Butylbenzene	0.0136	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	NCR [5]	NCR [5]
cis-1,2-Dichloroethene (c-DCE)	0.0637	0.0392	ND [3]	**0.123**	ND [3]	ND [3]	1.0	0.07
Tetrachloroethene (PCE)	**0.0147**	**0.645**	**0.0988**	**1.91**	**0.0133**	**0.361**	0.055	0.005
Trichloroethene (TCE)	ND [3]	**0.0571**	ND [3]	**0.16**	ND [3]	**0.0126**	0.031	0.005
Naphthalene	**0.0549**	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	2.0	0.0083
n-Propylbenzene	0.0106	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	4.1	0.31
1,2,4-Trimethylbenzene	**0.0627**	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	5.1	0.016
1,3,5-Trimethylbenzene	**0.0212**	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	5.1	0.016
Vinyl chloride	ND [3]	ND [3]	ND [3]	**0.00546**	ND [3]	ND [3]	0.004	0.002
Xylenes (Total)	0.0105	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	20	10

TABLE 2
DETECTED PARAMETERS IN UPPER AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.					IDEM RISC Groundwater IDCLs (1)	IDEM RISC Groundwater RDCLs (2)
	MW-61	MW-62	MW-76	MW-77	MW-78		
Sample No.	MW-61	MW-62	MW-76	MW-77	MW-78		
Date Sampled	Aug 2008	Aug 2008	Oct 2008	Oct 2008	Oct 2008		
VOCs							
cis-1,2-Dichloroethene (c-DCE)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	1.0	0.07
Methyl-t-Butyl Ether	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	0.72	0.04
Tetrachloroethene (PCE)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	0.055	0.005
Trichloroethene (TCE)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	0.031	0.005

Note: Results reported in milligrams per liter (mg/l) or parts per million (ppm).
(1) IDEM RISC Industrial Default Closure Level (IDCL) for groundwater (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).
(2) IDEM RISC Residential Default Closure Level (RDCL) for groundwater (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).
(3) ND - Not detected above the laboratory's reporting limit.
(4) NAF - Not analyzed for in this sample.
(5) NCR - No concentration reported.
Bold - Detected above the IDEM RISC Groundwater RDCL.
■ Detected above the IDEM RISC Groundwater IDCL.

TABLE 3
DETECTED PARAMETERS IN MIDDLE OF AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.							IDEM RISC Groundwater IDCLs [1]	IDEM RISC Groundwater RDCLs [2]
	MW-18		MW-19		MW-20				
Sample No.	MW-18-A	MW-18-B	MW-19-A	MW-19-B	MW-20-A	MW-20-B	MW-20-C		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2008		
VOCs									
cis-1,2-Dichloroethene (c-DCE)	ND [3]	ND [3]	ND [3]	ND [3]	0.0072	ND [3]	NAF [4]	1.0	0.07
Semi-VOCs	ND [3]	NAF [4]	ND [3]	ND [3]	ND [3]	NAF [4]	NAF [4]	-	-
Metals									
Antimony	ND [3]	NAF [4]	**0.041**	NAF [4]	ND [3]	NAF [4]	ND [3]	0.041	0.006
Arsenic	ND [3]	NAF [4]	ND [3]	NAF [4]	**0.04**	NAF [4]	ND [3]	0.01	0.01
Barium	0.16	NAF [4]	0.12	NAF [4]	0.14	NAF [4]	0.1	20	2.0
Chromium	ND [3]	NAF [4]	ND [3]	NAF [4]	0.0089	NAF [4]	ND [3]	0.31	0.1
Copper	ND [3]	NAF [4]	ND [3]	NAF [4]	0.025	NAF [4]	ND [3]	4.1	1.3
Lead	ND [3]	NAF [4]	ND [3]	NAF [4]	**0.054**	NAF [4]	ND [3]	0.042	0.015
Nickel	ND [3]	NAF [4]	ND [3]	NAF [4]	0.023	NAF [4]	ND [3]	2.0	0.73
Zinc	ND [3]	NAF [4]	ND [3]	NAF [4]	0.14	NAF [4]	ND [3]	31	11

TABLE 3
DETECTED PARAMETERS IN MIDDLE OF AQUIFER GROUNDWATER MONITORING WELL SAMPLES

Parameter	Well No.								IDEM RISC Groundwater IDCLs (1)	IDEM RISC Groundwater RDCLs (2)
	MW-21		MW-22		MW-23		MW-25			
Sample No.	MW-21-A	MW-21-B	MW-22-A	MW-22-B	MW-23-A	MW-23-B	MW-25-A	MW-25-B		
Date Sampled	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008	Aug 2005	June 2008		
VOCs										
1,1-Dichloroethene	ND (3)	ND (3)	0.0012	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	5.1	0.007
cis-1,2-Dichloroethene (c-DCE)	ND (3)	ND (3)	**0.33**	**1.1**	ND (3)	ND (3)	ND (3)	ND (3)	1.0	0.07
trans-1,2-Dichloroethene (t-DCE)	ND (3)	ND (3)	0.0031	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	2.0	0.1
Tetrachloroethene (PCE)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	0.0017	ND (3)	0.055	0.005
Semi-VOCs	ND (3)	ND (3)	ND (3)	NAF (4)	ND (3)	NAF (4)	ND (3)	NAF (4)	-	-
Metals										
Barium	0.14	NAF (4)	0.12	NAF (4)	0.12	NAF (4)	0.18	NAF (4)	20	2.0
Zinc	0.045	NAF (4)	ND (3)	NAF (4)	ND (3)	NAF (4)	ND (3)	NAF (4)	31	11

Note: Results reported in milligrams per liter (mg/l) or parts per million (ppm).
(1) IDEM RISC Industrial Default Closure Level (IDCL) for groundwater (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).
(2) IDEM RISC Residential Default Closure Level (RDCL) for groundwater (IDEM-RISC Technical Resource Guidance Document, January 31, 2006 Update Table).
(3) ND - Not detected above the laboratory's reporting limit.
(4) NAF - Not analyzed for in this sample.
Bold - Detected above the IDEM RISC Groundwater RDCL.
■ Detected above the IDEM RISC Groundwater IDCL.

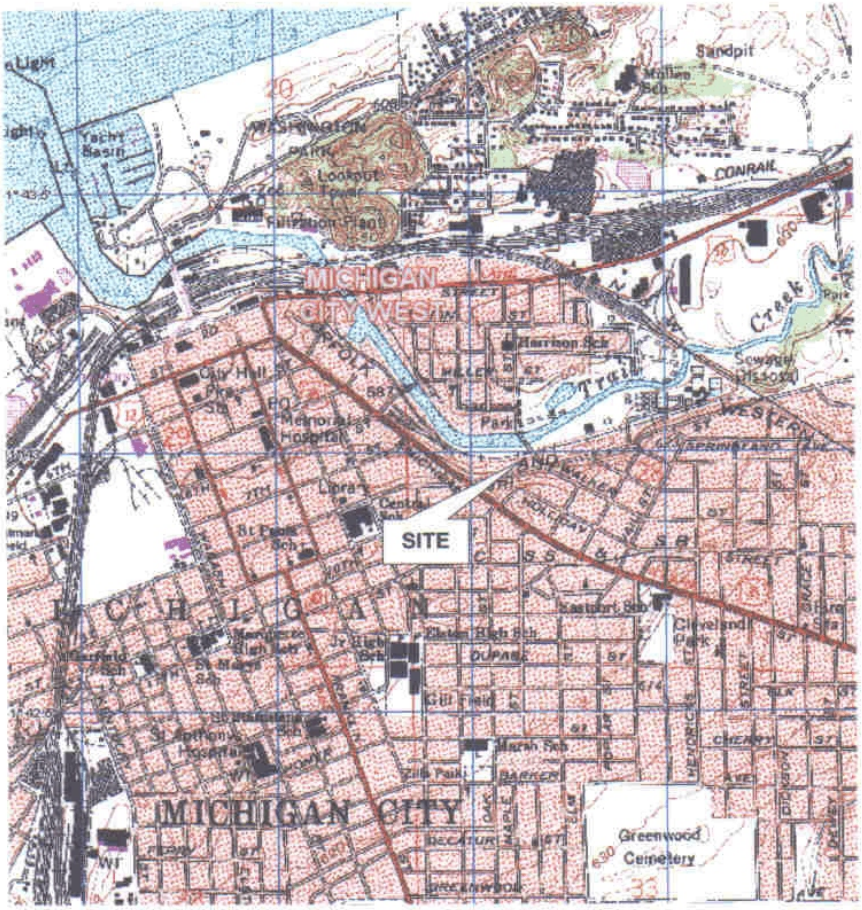
TABLE 4
EVALUATION OF POTENTIAL SOIL REMEDIAL ALTERNATIVES

Criteria	No Action	Off-Site Landfilling	Ex-Situ Soil Washing	Ex-Situ Solidification/ Stabilization	In-Situ Solidification/ Stabilization
Technical feasibility	Low	High	High	High	High
Protectiveness of human health and the environment	Low	High	High	High	High
Cost	Low	Medium	High	Medium/High	Medium
Treatability/pilot testing	No	No	Yes	Yes	Yes
Ability to achieve the proposed cleanup criteria	Low	High	Medium/High	Medium/High	Medium/High
Implementation time frame	Short	Short	Medium	Medium	Medium
Community acceptance	Low	Medium/High	High	High	High
Advantages	Low cost	Short time frame; medium cost; unrestricted future end use of site	Liability eliminated; treated soils used as backfill	Liability potentially eliminated; treated soils used as backfill	Liability potentially eliminated; soils treated in-place; medium cost
Disadvantages	Liability still exists; impacted soils remain on-site	Liability (minimal) exists at landfill; need for imported backfill	High cost; formulation of single suitable washing solution for contaminants is difficult; disposal of rinse water required	High cost; unknown long term reliability of stabilization process; may hinder/limit future end use of site and future groundwater remedial alternative; significant increase in volume of treated material; organics are difficult to immobilize	Unknown long term reliability of stabilization process; may hinder/limit future end use of site and future groundwater remedial alternative; significant increase in volume of treated material; organics are difficult to immobilize

TABLE 5
ESTIMATED COSTS FOR POTENTIAL SOIL REMEDIAL ALTERNATIVES

DESCRIPTION	ESTIMATED COSTS				
	No Action	Off-Site Landfilling	Ex-Situ Soil Washing	Ex-Situ Solidification/ Stabilization	In-Situ Solidification/ Stabilization
Community Involvement	NA (1)	$10,000	$10,000	$10,000	$10,000
Treatability Study	NA (1)	NA (1)	$50,000	$30,000	$30,000
Preparation of Work Plans	NA (1)	$14,000	$17,000	$17,000	$17,000
Site Remedial Activities	NA (1)	$587,000	$1,050,000	$710,000	$610,000
Confirmatory Sampling	NA (1)	$13,000	$22,000	$22,000	$22,000
Preparation of Corrective Action Completion Report	NA (1)	$10,000	$10,000	$10,000	$10,000
Contingency (5%)	NA (1)	$31,000	$58,000	$40,000	$35,000
Total Estimated Cost	NA (1)	$665,000	$1,217,000	$839,000	$734,000

Notes: (1) Not applicable.



SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET
REFERENCE LEVEL 576.8 FEET; INTERNATIONAL GREAT LAKES DATUM

FIGURE 1

MICHIGAN CITY WEST, IN,
QUADRANGLE 1980
7.5 MINUTE SERIES (TOPOGRAPHIC)

ENVIRONMENTAL INCORPORATED

SITE LOCATION MAP
FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360

DRAWN:	MLP	DATE:	12/03/08	S.O.#:	MCRC0807
CHECKED:	TBS	SCALE:	AS SHOWN	DWG.#:	MCRC-1

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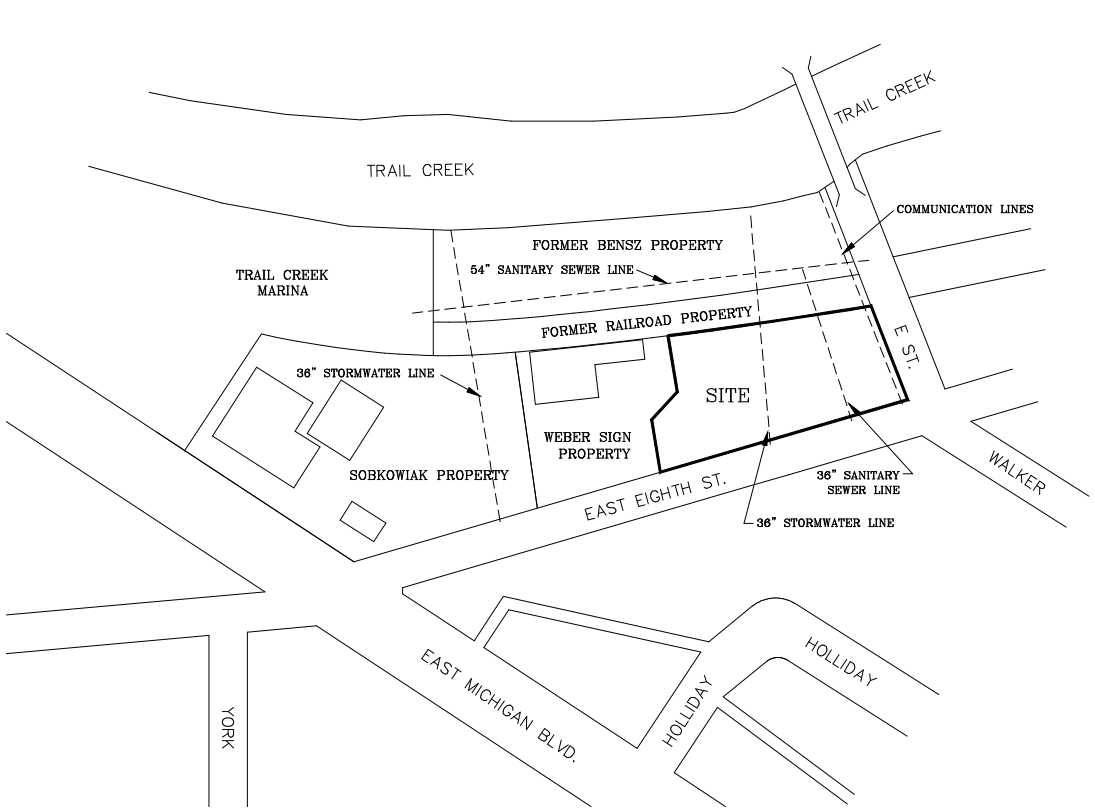


FIGURE 2

ENVIRONMENTAL INCORPORATED

SITE PLAN
FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360

DRAWN: JSL	DATE: 12/16/08	SO #: MCRC0807
CHECKED: TBS	SCALE: AS SHOWN	DWG #: 426

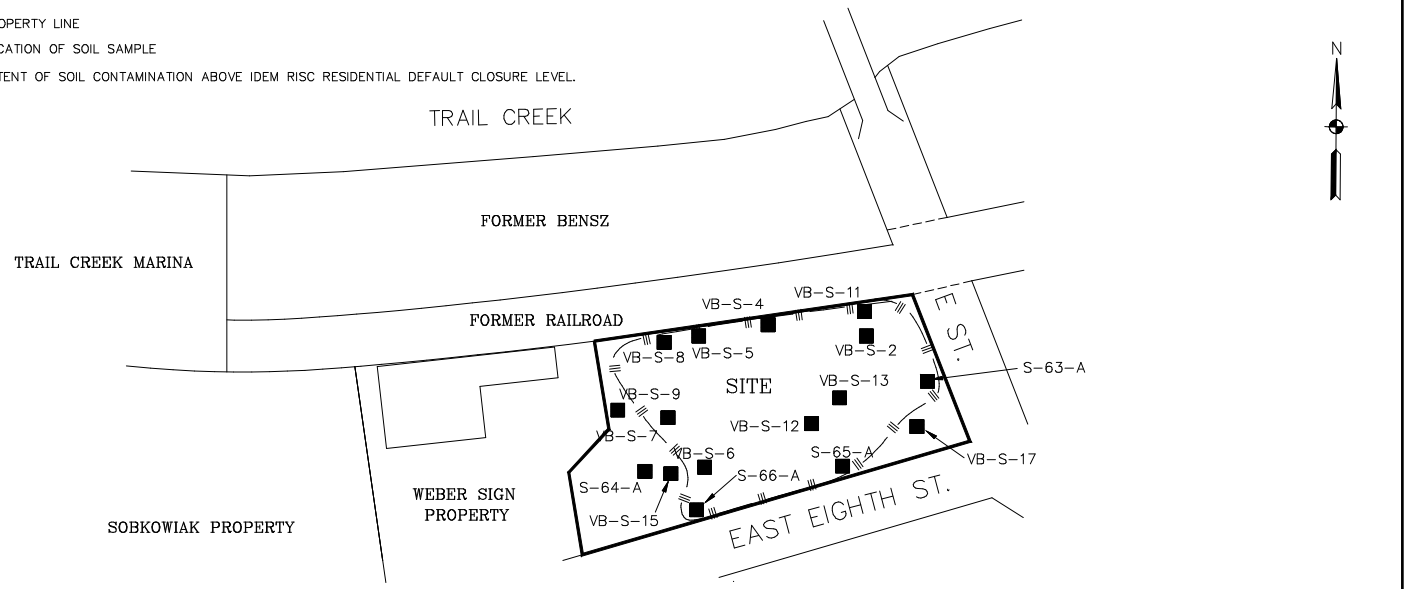
2502 INVERNESS DRIVE, VALPARAISO, INDIANA 46383 Phone: 219-462-7576 Fax: 219-462-8659

LEGEND:

— APPROXIMATE PROPERTY LINE

S-64-A ■ – APPROXIMATE LOCATION OF SOIL SAMPLE

—— ||| —— – APPROXIMATE EXTENT OF SOIL CONTAMINATION ABOVE IDEM RISC RESIDENTIAL DEFAULT CLOSURE LEVEL.



Parameter	Sample No.																
	VB-S-2	VB-S-4	VB-S-5	VB-S-6	VB-S-7	VB-S-8	VB-S-9	VB-S-11	VB-S-12	VB-S-13	VB-S-15	VB-S-17	S-63-A	S-64-A	S-65-A	S-66-A	IDEM RISC RDCL'S
Methylene chloride	**0.0298**	**0.0513**	**0.117**	**0.109**	**0.131**	ND	ND	**0.0438**	ND	ND	ND	0.021	ND	ND	ND	ND	0.023
Tetrachloroethene	**0.0934**	ND	ND	ND	ND	ND	ND	0.0246	ND	**0.15**	ND	0.0067	**0.0697**	ND	0.00793	ND	0.058
2,6 Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	**0.55**	ND	ND	ND	ND	ND	ND	ND	0.0091
n-nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	**0.57**	ND	ND	ND	ND	ND	ND	ND	0.0006
Naphthalene	ND	ND	ND	ND	ND	**12.7**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	2.2	**4.4**	ND	ND	**4.0**	ND	**17**	ND	3.9
Antimony	ND	**5.7**	ND	ND	ND	**49**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.4
Cadmium	ND	**14**	ND	ND	ND	**14.6**	ND	ND	ND	ND	ND	ND	ND	ND	ND	**12**	7.5
Chromium	ND	**99.2**	1.7	3.4	6.8	8.5	4.0	**71.1**	3.1	4.6	2.1	1.2	20	ND	7	16	38
Copper	7.6	**1330**	24.4	60.5	733	636	75	20.1	49	25	10	1.3	69	75	89	383	920
Lead	6.3	**722**	8.7	**86.7**	**230**	**310**	54.4	19.4	38	35	14	1.9	**302**	57	**514**	**225**	81
Mercury	0.114	**6.08**	0.11	0.975	0.181	1.38	0.264	0.287	0.092	0.066	0.05	ND	ND	ND	ND	ND	2.1

Notes:
Results reported in milligrams per kilogram (ppm)
ND – Not detected above the laboratory's reporting limits.
Bold – Detected above the IDEM's RISC RDCL.

0 25 50 75 100 125 150

APPROXIMATE SCALE IN FEET

FIGURE 3

ENVIRONMENTAL INCORPORATED

APPROXIMATE EXTENT OF SOIL CONTAMINATION
FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360

DRAWN: JSL	DATE: 12/16/08	SO #: MCRC0807	
CHECKED: TBS	SCALE: AS SHOWN	DWG #: 427	

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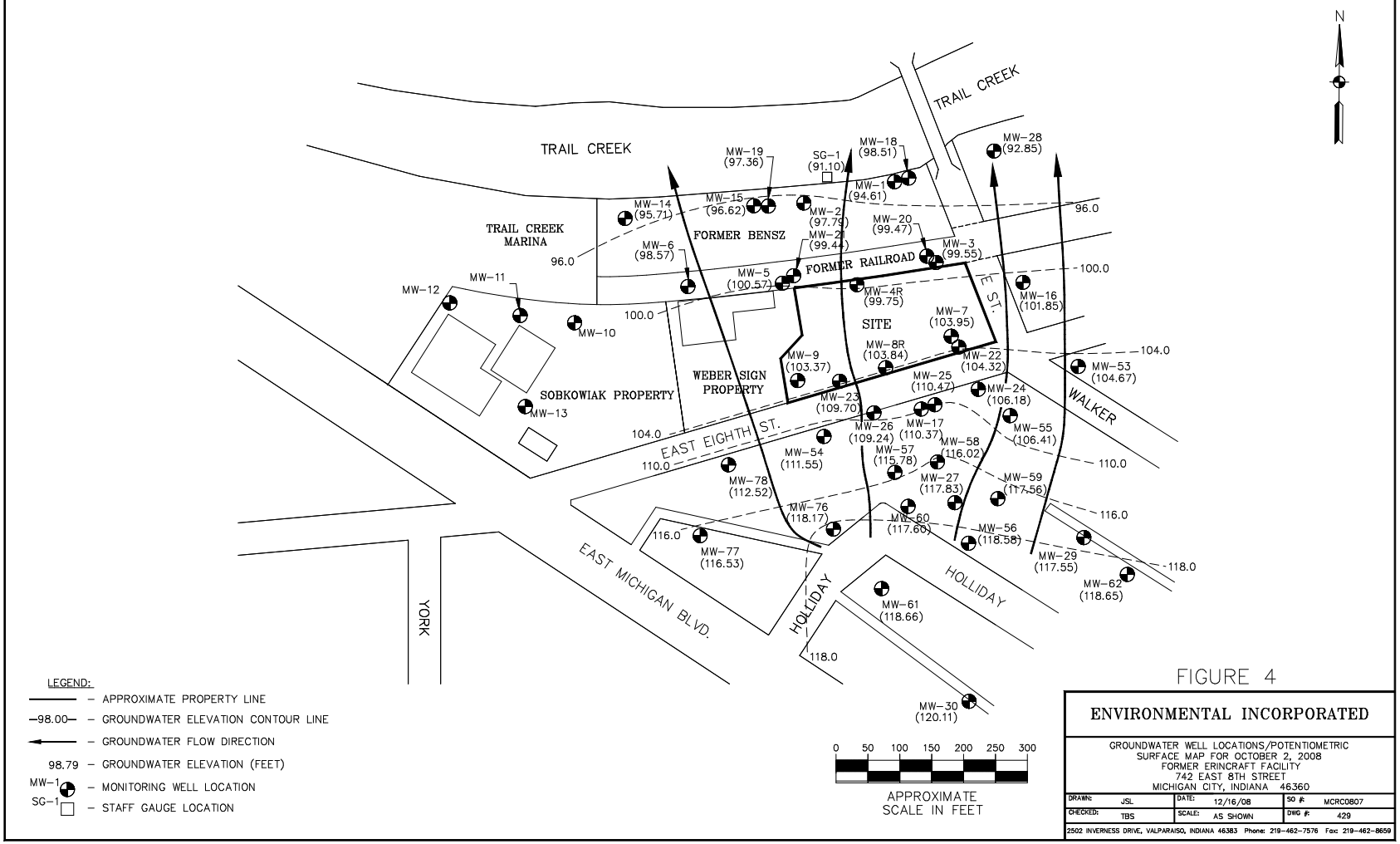

FIGURE 4

ENVIRONMENTAL INCORPORATED

GROUNDWATER WELL LOCATIONS/POTENTIOMETRIC SURFACE MAP FOR OCTOBER 2, 2008
FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360

DRAWN: JSL	DATE: 12/16/08	SO #: MCRC0807	
CHECKED: TBS	SCALE: AS SHOWN	DWG #: 429	

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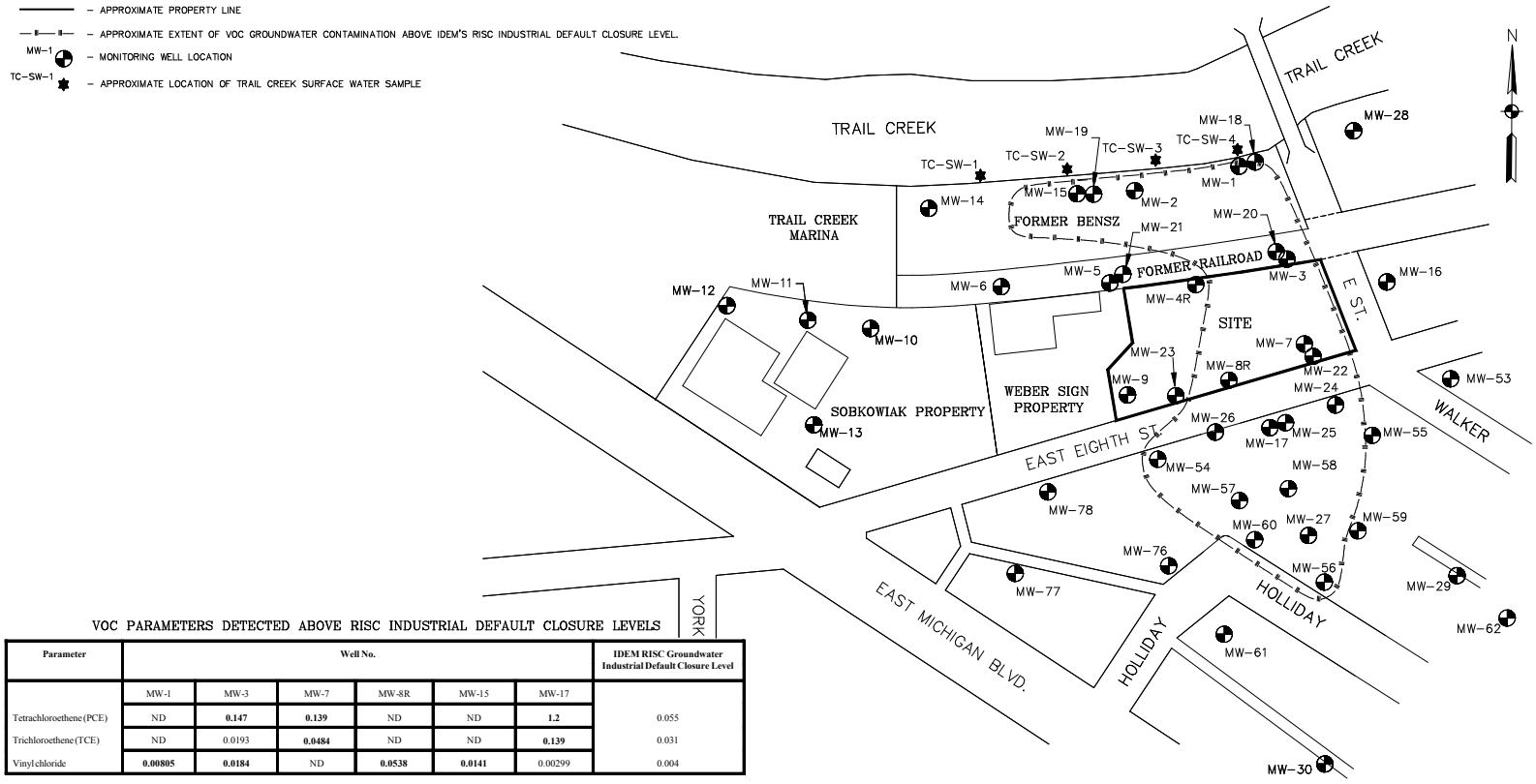

VOC PARAMETERS DETECTED ABOVE RISC INDUSTRIAL DEFAULT CLOSURE LEVELS

Parameter	Well No.						IDEM RISC Groundwater Industrial Default Closure Level
	MW-1	MW-3	MW-7	MW-8R	MW-15	MW-17	
Tetrachloroethene (PCE)	ND	**0.147**	**0.139**	ND	ND	**1.2**	0.055
Trichloroethene (TCE)	ND	0.0193	**0.0484**	ND	ND	**0.139**	0.031
Vinyl chloride	**0.00805**	**0.0184**	ND	**0.0538**	**0.0141**	0.00299	0.004

Parameter	Well No.						IDEM RISC Groundwater Industrial Default Closure Level
	MW-27	MW-54	MW-56	MW-57	MW-58	MW-60	
Tetrachloroethene (PCE)	**0.203**	**0.444**	**0.645**	**0.0988**	**1.91**	**0.361**	0.055
Trichloroethene (TCE)	0.0112	**0.191**	**0.0571**	ND	**0.16**	0.0126	0.031
Vinyl chloride	ND	ND	ND	ND	**0.00546**	ND	0.004

Note: Results reported in milligrams per liter (mg/l) or parts per million (ppm).
ND - Not detected above the laboratory's reporting limit.
Bold - Detected above the IDEM RISC Groundwater Industrial Default Closure Level.

FIGURE 5

ENVIRONMENTAL INCORPORATED

APPROXIMATE EXTENT OF VOC UPPER AQUIFER GROUNDWATER CONTAMINATION
FORMER ERINCRAFT FACILITY
742 EAST 8TH STREET
MICHIGAN CITY, INDIANA 46360

DRAWN:	JSL	DATE:	12/16/08	SO #:	MCRC0807
CHECKED:	TBS	SCALE:	AS SHOWN	DWG #:	428

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