# ALTERNATIVES ANALYSIS REPORT

## FORMER BUFFALO CHINA SITE
## 51 HAYES PLACE
## BUFFALO, NEW YORK

## BROWNFIELD CLEANUP SITE NO. C915209

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SEPTEMBER 2010
REF. NO. 037191 (9)

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## 1.0 INTRODUCTION

Conestoga-Rovers & Associates, Inc. (CRA) has prepared this Alternatives Analysis Report (AAR) on behalf of Buffalo China, Inc. (Buffalo China) for the Former Buffalo China Site located in Buffalo, New York (Site). The location of the Site is shown on Figure 1.1.

Buffalo China has entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) to investigate and remediate, as appropriate, potential areas of environmental concern associated with the Site under the Brownfield Cleanup Program (BCP). A Draft Remedial Investigation (RI) Report presenting the findings of the RI was submitted to the NYSDEC and the New York State Department of Health (NYSDOH) on February 26, 2010. The AAR presented hereafter was developed based on the findings of the RI and has been completed in accordance with the NYSDEC Division of Remediation (DER) Draft Brownfield Cleanup Program Guide (BCP Guide) dated May 2004, 6 NYCRR Part 375 Environmental Remediation Programs (Part 375), and NYSDEC the DER Draft Technical Guidance for Site Investigation and Remediation (DER-10). The RI report and AAR were accepted by NYSDEC in August 2010 and finalized in September 2010.

### 1.1 OBJECTIVE

The primary purpose of the AAR is to identify and evaluate the most appropriate remedial alternatives to eliminate or mitigate, through the proper application of scientific and engineering principles, any significant threats to the public health and to the environment presented by contaminants present in Site environmental media.

The ultimate goal of the AAR is to select an appropriate final remedy that will allow continued use of the Site as an active industrial facility. The AAR presents the remedy selection process and the final selected remedy for the Site based on a risk-based, land use approach. The final selected remedy will utilize the generic soil cleanup objectives to remediate the Site under Track 2 of the BCP to conditions suitable for future industrial or commercial redevelopment of the Site.

## 1.2 ORGANIZATION OF THE REPORT

This report presents an analysis of remedial alternatives and is organized as follows:

i) Section 1 – Introduction: An overview of the project is presented in Section 1.

ii) Section 2 – Site Description and History: A description of the Site and a summary of its history are presented in Section 2.

iii) Section 3 - Summary of Remedial Investigation: The results of the RI are summarized in Section 3.

iv) Section 4 - Remedial Action Objectives and Goals: The goals and objectives of the proposed remedy are discussed in Section 4.

v) Section 5 - General Response Actions and Identification of Remedial Technologies: A review and screening of applicable technologies for remediating environmental media exhibiting concentrations of contaminants exceeding relevant standards at the Site are presented in Section 5.

vi) Section 6 – Initial Screening of Remedial Technologies: The initial screening of the remedial technologies potentially applicable at the Site is presented in Section 6.

vii) Section 7 – Detailed Analyses of Retained Remedial Alternatives: The detailed analyses of retained potential remedial alternatives to address the presence of contaminants at concentrations exceeding relevant regulatory criteria in environmental media at the Site is presented in Section 7.

viii) Section 8 – Comparative Analyses of Remedial Alternatives: The comparative analyses of the remedial alternatives for the Site are presented in Section 8.

ix) Section 9 – Recommended Remedial Alternative: A recommendation for the Site remedy and justification of the selection is presented in Section 9.

x) Section 10 – References: A list of the references used in the preparation of this AAR is presented in Section 10.

## 2.0 SITE DESCRIPTION AND HISTORY

The Former Buffalo China Site is located at 51 Hayes Place in Buffalo, Erie County, New York. The Site layout is shown on Figure 2.1. The Site comprises approximately 10 acres and is bounded on the north by the CSX Railroad right-of-way, on the east by a warehouse currently leased by Robinson Home Products and other commercial/industrial facilities, and on the south and west by commercial, industrial, and residential properties. Interstate I-190 is located nearby to the south of the Site, while the former City of Buffalo School 26 and adjacent playground is located a few hundred feet to the southwest. The nearest body of water is the Buffalo River, located approximately ¼ to ½ mile south and east of the Site. The primary access to the Site is through the east side of the Site from Buffalo China Road or through the south side of the Site via the City of Buffalo street named Hayes Place.

The Site includes a manufacturing building, a warehouse, outdoor storage silos, a rail spur, roadways, and parking areas. The manufacturing building is a multi-story structure covering approximately 4 acres. The manufacturing building is connected to a warehouse to the east. The warehouse is currently leased to Robinson Home Products. Another smaller building referred to as the Harrison Street Warehouse is located at the northwest end of the Site and covers an area of approximately 0.5 acres.

### 2.1 SITE HISTORY

The property has been used for the manufacture of china for the past 100 plus years. During that time period, the manufacturing facility expanded to adjacent industrial properties that historically included the Standard Mirror Company and Atlas Wrecking. The Harrison Street Warehouse was once a part of the Standard Mirror Company facility.

### 2.2 CURRENT OPERATIONS

The property is currently owned by Niagara Ceramics. Niagara Ceramics continues to manufacture china dinnerware at the Site. The Harrison Street Warehouse is presently used for storage.

## 3.0 SUMMARY OF REMEDIAL INVESTIGATION

An RI was conducted by CRA on behalf of Buffalo China between July 2007 and July 2009. The results of the RI were reported in the "Remedial Investigation Report" prepared by CRA and dated September 2010.

A summary of the results of the RI and the identified potential exposure pathways for each of the impacted environmental media are presented in the following subsections.

### 3.1 GEOLOGY/HYDROGEOLOGY

#### 3.1.1 SITE GEOLOGY

Fill encountered at the Site ranges in thickness from 0.5 feet to 16 feet, with the thickest fill encountered along the Soil Mound north of the Harrison Street Warehouse. The Soil Mound is approximately 10 feet higher in elevation than the surrounding Site topography. It should be noted that the borings at these locations began at the top of the Soil Mound, resulting in an increased measured thickness for the fill material. The average thickness of the fill considering both on- and off-Site locations, and disregarding the soil mound thickness, is 2.62 feet.

The native soils underlying the fill generally consist of dense clay underlying sand and/or silt; however, the soil stratigraphy is highly variable, and silt and clay generally underlies the fill at the Site. The average clay thickness considering both on- and off-Site locations is 7.34 feet. Bedrock is encountered immediately beneath the clay unit at all investigation locations.

Bedrock cores were collected and logged at 15 bedrock monitoring well locations. These cores indicate a light to dark gray cherty limestone (the Onondaga Limestone). The limestone is massive and moderately fractured or broken at the top of the formation.

#### 3.1.2 SITE HYDROGEOLOGY

Groundwater is first encountered at the site in the low permeability, silty clay. The average depth to groundwater is approximately 6.63 below ground surface (bgs) across the Site based on the most comprehensive round of water level measurements obtained in July 2009.

As depicted on Figures 3.1 and 3.2, groundwater flow direction is generally to the west southwest at a gradient of 0.023 foot per foot in the overburden and 0.024 foot per foot in the bedrock. Bedrock groundwater in the vicinity of the Harrison Street Warehouse has a flow direction to the east. Seasonal variations in groundwater elevations between January 2009 and July 2009 ranged from several tenths of a foot to slightly greater than a foot. From a seasonal perspective, it is anticipated that water levels would rise and fall congruently across the Site.

The hydraulic conductivity of the overburden ranged from approximately 1.48E-05 cm/sec at monitoring well MW-11 to 5.58E-04 cm/sec at monitoring well MW-7. The geometric mean hydraulic conductivity for the overburden wells is calculated to be 1.95E-04 cm/sec. The hydraulic conductivity of the bedrock ranged from approximately 2.24E-04 cm/sec at monitoring well MW-23A to 1.06E-01 cm/sec at monitoring well MW-25A. The geometric mean hydraulic conductivity for the bedrock wells is calculated to be 2.79E-02 cm/sec.

## 3.2 NATURE AND EXTENT OF CONTAMINATION

The investigation and data analysis presented in the RI indicated that current or potential future risks to human health and/or the environment were present if there was direct exposure to:

i) Impacted groundwater.
ii) Impacted subsurface soils.
iii) Exposure to sub-slab soil gas through vapor intrusion into off-Site properties.

The potential impact of soil vapor migration and intrusion to the off-Site properties will be addressed through interim remedial measures (IRMs) upon agreement of the property owner(s) and is therefore not addressed further in this AAR. IRM work plans will be prepared for review and approval by the NYSDEC and NSYDOH.

### 3.2.1 GROUNDWATER

The concentrations of volatile organic compounds (VOCs), in the overburden and bedrock monitoring wells are shown on Figure 3.3, and summarized on Table 3.1. The analytical data have been compared to the NYSDEC standards and guidance values for

Class GA (potable) groundwater and detected concentrations exceeding the standards are highlighted on the tables. Review of the data shows the following:

i) VOCs, primarily trichloroethene (TCE) and its degradation product cis-1,2-dichloroethene (cis-1,2-DCE) are present in Site overburden and bedrock groundwater at concentrations exceeding the relevant standards and guidance values.

ii) VOC-impacted groundwater has migrated off Site.

iii) No semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), or pesticides were detected at concentrations exceeding relevant standards and guidance values in groundwater samples.

iv) Total antimony, iron, lead, manganese, magnesium, sodium, and thallium were detected in concentrations exceeding the relevant standards; however, dissolved concentrations were below relevant standards for those metals except for manganese, magnesium, and sodium.

### 3.2.2 SHALLOW AND SUBSURFACE SOIL

A summary of soil analytical results that exceed the soil cleanup objectives (SCOs) for restricted use in 6 NYCRR Part 375 is presented on Figure 3.4 and summarized on Table 3.2. Shallow and subsurface soil analytical results for on-Site sample locations were compared to industrial use SCOs in order to characterize the Site and determine the need for remediation. A review of the data shows the following:

i) One VOC (TCE) was detected at a concentration exceeding the applicable SCO in one sample collected during a previous investigation completed in 2006.

ii) VOCs were not detected at concentrations exceeding applicable SCOs at on-Site soil samples collected as part of the RI.

iii) Four SVOCs were detected in Site subsurface soils at concentrations exceeding the applicable SCOs.

iv) Arsenic was detected at a concentration exceeding the SCO for restricted industrial use at a depth of 3.5 to 8 feet bgs at one location on Site.

v) Lead was detected at concentrations exceeding the applicable SCO in near surface soils at two locations on Site.

vi) Lead was detected at concentrations exceeding the SCO for industrial use in one subsurface soil sample underneath the building slab of the manufacturing building.

vii) No PCBs, herbicides, or pesticides were detected at concentrations exceeding applicable SCOs.

## 3.3 SUMMARY OF THE NATURE AND EXTENT OF CONTAMINATION AND POTENTIAL EXPOSURE PATHWAYS

The results of the RI indicate that the primary media of concern is groundwater. Overburden and bedrock groundwater are impacted by VOCs. VOCs were found in both on-Site and off-Site wells.

Secondary to the groundwater contamination, limited soil contamination was identified. Four SVOCs and two metals constituents were detected in subsurface and near surface soil samples at concentrations exceeding applicable SCOs during the RI. Additionally TCE was detected at a concentration in a soil sample from one location collected during the 2006 investigation.

The following summarizes the compounds of concern (COCs) and potential exposure pathways identified through the completion of the RI:

i) Groundwater
- COCs – VOCs
- Potential Exposure Pathways – worker or resident incidental ingestion, inhalation of vapors, and/or direct contact

ii) Subsurface Soil
- COCs – VOCs, SVOCs, and metals
- Potential Exposure Pathways - worker or trespasser direct contact, incidental ingestion, and inhalation of vapors

# 4.0 REMEDIAL ACTION OBJECTIVES AND GOALS

## 4.1 POTENTIAL STANDARDS, CRITERIA, AND GUIDELINES

Applicable or relevant and appropriate standards, criteria, and guidelines (SCGs) are used to develop remedial action objectives (RAOs) and to scope and formulate remedial action technologies and alternatives. SCGs are categorized as:

i) Chemical-specific requirements that define acceptable exposure levels and may, therefore, be used in establishing preliminary remediation goals;

ii) Location-specific requirements that may set restrictions on activities without specific locations, such as floodplains or wetlands; and/or

iii) Action-specific requirements which may set controls or restrictions for particular treatment and disposal activities related to the management of hazardous wastes.

Potential SCGs are described in the following subsections.

### 4.1.1 CHEMICAL-SPECIFIC SCGs

Chemical-specific SCGs define health- or risk-based concentration limits in various environmental media for hazardous substances and contaminants. Concentration limits provide protective cleanup levels or may be used as a basis for estimating appropriate cleanup levels for the COCs in the designated media. Chemical-specific SCGs may be used to determine treatment system discharge requirements or disposal restrictions for remedial activities and/or to assess the effectiveness or suitability of a remedial alternative. Chemical-specific SCGs are generally promulgated standards.

Potential chemical-specific SCGs that may apply to groundwater, subsurface soil, surface soil, and air at the Site are described in the subsections that follow.

#### 4.1.1.1 GROUNDWATER

For the purpose of this AAR, Site groundwater will be considered Class GA. Class GA groundwater pertains to fresh groundwater found in the saturated zone of unconsolidated deposits and bedrock. The best usage of Class GA groundwater is a source of potable water supply; however, Site groundwater is not used as a drinking water source. The NYS water quality standards and guidance values for Class GA groundwater are stipulated in:

i) New York Water Classifications and Quality Standards (6 NYCRR Parts 609, and 700-704).

ii) Technical and Operation Guidance Standards (TOGS) 1.1.1, Ambient Water Quality Standards and Guidance Values dated October 22, 1993 (reissued June 1998).

#### 4.1.1.2 SOIL

For the purpose of characterizing the nature and extent of contamination at the Site and the potential exposure scenarios in the RI Report, the chemical-specific SCGs used for soils were the NYSDEC recommended SCOs presented in 6 NYCRR Part 375, Environmental Remediation Programs. The restricted use SCOs for protection of public health – industrial use were used for on-Site soils and residential use SCOs were used for off-Site soils.

As stated in Part 375, the soil component of the remedial program shall achieve the lowest of the three potentially applicable contaminant specific SCOs for all soils above bedrock. NYSDEC has developed SCOs for protection of public health, for protection of groundwater, and for protection of ecological resources. The Fish and Wildlife Resource Impact Assessment (FWIA) completed as part of the RI concluded that there were no impacts to fish and wildlife on or near the Site due to dense urbanization and lack of natural habitats surrounding the Site. Therefore, the SCOs for the protection of ecological resources are not applicable to this Site. The SCOs for the protection of groundwater are more stringent than the protection of public heath SCOs and therefore are applicable to the Site. Table 4.1 and Figure 4.1 present a summary of the soil results that exceed the protection of groundwater criteria. As required by Part 375, the AAR must also consider an alternative to remediate the Site under an unrestricted use scenario. Table 4.2 and Figure 4.2 provide a comparison of the soil analytical results compared to the Part 375 unrestricted use SCOs.

### 4.1.2 ACTION-SPECIFIC SCGs

Action-specific SCGs are determined by the particular remedial activities that are selected for the Site cleanup. Action-specific requirements establish controls or restrictions on the design, implementation, and performance of remedial activities. Following the development of remedial alternatives, action-specific SCGs that specify performance levels, actions, technologies, or specific levels for discharged or residual chemicals provide a means for assessing the feasibility and effectiveness of the remedial activities.

The action-specific SCGs that may be applicable to potential Site remedial technologies are presented in Table 4.3.

### 4.1.3 LOCATION-SPECIFIC SCGs

Potential location-specific SCGs are requirements that set restrictions on activities depending on the physical and environmental characteristics of the Site or its immediate surroundings.

The Site is bounded by industrial, commercial, residential, and undeveloped properties. The FWIA completed during the RI concluded that there are no identified rare, threatened or endangered species, habitats of concern, or freshwater wetlands within a 1/2-mile radius of the Site.

Potential location-specific SCGs that may be applicable to potential Site remedial technologies are the City of Buffalo zoning ordinances and building codes.

## 4.2 REMEDIAL ACTION GOALS AND OBJECTIVES

### 4.2.1 REMEDIAL ACTION GOALS

The primary goals of any remedial action are that:

i) It be protective of human health and the environment.

ii) It maintains protection over time.

iii) It minimizes untreated waste.

The remedy selection process will be performed in a manner consistent with established state and federal guidance.

### 4.2.2 REMEDIAL ACTION OBJECTIVES

RAOs established for the protection of human health and the environment should specify:

i) The contaminants and media of concern.

ii) The exposure routes and receptors.

iii) An acceptable contaminant level or range of levels for each exposure route.

Based on the results of the RI, the remedial actions evaluated for the Site address the presence of VOCs in on-Site and off-Site groundwater, and the presence of VOC, SVOCs, and metals in on-Site shallow and subsurface soils. The following RAOs have been established for Site media:

i) To prevent unacceptable exposure/contact of human receptors to VOCs detected in on-Site and off-Site groundwater, and VOCs, SVOCs, and metals in Site soil.

ii) To address overburden and bedrock groundwater impacts to the extent practicable so that groundwater conditions are consistent with the contemplated use of the Site as a commercial/industrial manufacturing facility.

iii) To prevent or mitigate, to the extent practicable, further degradation of groundwater quality as a result of leaching from contaminated soils.

iv) To prevent or mitigate, to the extent practicable, further migration of impacted groundwater to off-Site areas.

v) To monitor the groundwater to confirm that the selected remedy is protective of human health and the environment.

## 5.0 GENERAL RESPONSE ACTIONS AND IDENTIFICATION OF REMEDIAL TECHNOLOGIES

General response actions are remedial approaches encompassing those actions that will satisfy the RAOs. General response actions may include treatment, containment, excavation, disposal, institutional controls, or a combination of these, if required, to address varied Site environmental problems and to be effective in meeting all of the RAOs. The general response actions and remedial technologies evaluated for each medium of concern at the Site are described in the following subsections and listed in Table 5.1.

### 5.1 GROUNDWATER

#### 5.1.1 NO ACTION

The No Action response is primarily used as a basis for comparison with other alternatives. Under the No Action response, no remedial measures are taken to improve environmental conditions at the Site. This response does not reduce the volume, mobility, or toxicity of the hazardous constituents of the Site media beyond the reductions which are achieved through ongoing natural attenuation mechanisms.

In the case of the Site, the No Action alternative includes the institutional controls already in place. These institutional controls include fencing restricting unauthorized access to the Former Buffalo China property.

In addition, public potable water is available to the Site and the surrounding properties.

#### 5.1.2 INSTITUTIONAL CONTROL

The institutional control response is not intended to reduce the toxicity, mobility, or volume of hazardous site constituents, but to reduce the potential for human and wildlife exposure to those constituents. Institutional controls may include controls to restrict or limit the use of the Site or the contaminated media until such time that it is restored to acceptable quality consistent with the intended land use; implementation of a long-term monitoring program to track contaminant migration and transport; and/or development of protective work procedures to minimize the potential for exposure of workers to Site contaminants during ground intrusive construction activities. At the Site, institutional controls would provide an additional layer of protection over what currently exists, or an assurance that if the industrial activities at the Site were to stop, all controls would remain in place.

### 5.1.3 MONITORED NATURAL ATTENUATION (MNA)

Natural attenuation refers to natural subsurface processes that reduce groundwater contaminant concentrations, including VOCs. Natural attenuation can be sufficiently protective of human health and the environment and can be more cost effective than other remedial alternatives. Biodegradation is the most important natural in-situ destructive mechanism. Non-destructive natural mechanisms include sorption, dispersion, dilution, and volatilization.

MNA includes long-term groundwater monitoring at and downgradient of the Site until VOC concentrations are deemed acceptable relative to applicable standards and intended Site use.

### 5.1.4 IN-SITU GROUNDWATER TREATMENT

The in-situ groundwater treatment technologies identified as potentially applicable at the Site are in-situ chemical oxidation (ISCO), air sparging, enhanced biological degradation, permeable reactive barrier, and in-well air stripping. Each of these technologies is described in detail in the following subsections.

Groundwater monitoring will be included in the Operation and Maintenance Plan (O&M Plan) for any in-situ groundwater treatment alternative.

#### 5.1.4.1 CHEMICAL OXIDATION

ISCO uses an oxidizing agent to convert the target compounds into non-hazardous or less toxic compounds, primarily carbon dioxide, water, and chloride.

Because any chemical oxidant is short-lived in the subsurface, the effectiveness of chemical oxidants as a treatment technology depends greatly on the ability to quickly disperse the oxidant throughout the treatment area. Fenton's Reagent, potassium permanganate ($KMnO_4$), hydrogen peroxide-activated sodium persulfate, and ozone are commonly used oxidants.

#### 5.1.4.2 PERMEABLE REACTIVE BARRIER

A permeable reactive barrier (PRB) consists of a barrier wall installed across the flow path of impacted groundwater. Groundwater passes through the wall and the target compounds are either degraded or retained in a concentrated form by the barrier material. This method of treatment results in either permanent containment of or decreased volume of chemicals in groundwater passing through the wall.

Metals precipitation/biofouling is a cause of concern with a PRB, particularly in the presence of elevated calcium and magnesium concentrations as in the Site groundwater. Metal precipitation within the barrier wall causes gradual loss of permeability and deterioration in the treatment performance. Over extended treatment times, the reactive media loses its treatment capacity and may need to be replaced.

#### 5.1.4.3 IN-SITU ENHANCED BIODEGRADATION

In situ anaerobic enhanced biodegradation (ISEB) is a treatment process whereby chlorinated organic contaminants are sequentially metabolized into less toxic or non-toxic compounds by naturally occurring microorganisms in a process called reductive dechlorination. The microorganisms utilize the compounds as a source of carbon and energy.

Site conditions can be manipulated to enhance in-situ biodegradation processes and speed up degradation rates of site contaminants. In this process, several techniques can be applied to enhance biodegradation, such as:

i) Injection of an organic substrate such as soy-lactate, molasses, whey, sodium or ethyl lactate, to stimulate enhanced biodegradation of certain compounds such as PCE, TCE and highly chlorinated aromatic compounds under anaerobic conditions

ii) Nutrient supplementation with suitable sources of nitrogen and phosphorus to enhance biodegradation of contaminants by the indigenous microbial population

iii) Bioaugmentation by injection of microbial cultures to improve the effectiveness of the microbial population in degrading the compounds of concern

One, or a combination of these techniques, can be applied based on the groundwater conditions. Soy-lactate can be used to enhance chlorinated solvent biodegradation under anaerobic conditions. Typically the groundwater becomes nutrient deficient during enhanced biodegradation, therefore, nutrient supplementation is often necessary. Bioaugmentation is used when the natural microbial population has been shown to be unable to degrade all the contaminants present or where it is considered necessary to augment the natural biodegradation process.

#### 5.1.4.4 AIR SPARGING

Air sparging is accomplished by introduction of air into the groundwater below the level of contamination where it percolates into the groundwater. The air increases the partitioning of dissolved and adsorbed phase VOCs to the vapor phase and into bubbles. The bubbles ideally travel to the top of the water table at a 45° angle, but the actual flow path may vary depending on aquifer heterogeneity, groundwater flow conditions, and sparge pressure. Once the air bubbles reach the vadose zone, the VOCs are removed through a soil vapor extraction (SVE) system. In some cases, direct venting through the vadose zone offers sufficient treatment of the vapors. Following extraction, soil vapors are treated and/or vented to the atmosphere.

The zone of influence of air sparging wells increases with the depth of groundwater table. Using this system in shallow groundwater such as at the Site would likely require installation of wells at narrow spacing.

#### 5.1.4.5 IN-WELL AIR STRIPPING

In-well air stripping combines air sparging with water circulation. This combination of processes results in more efficient stripping of chemicals than through air sparging alone. For in-well air stripping, double-screened wells are constructed with the lower screen installed within the saturated zone and the upper screen installed in the unsaturated zone. During in-well air stripping, pressurized air is injected into a double-screened well below the water table, lifting the water in the well and forcing it out the upper screen. Simultaneously, additional water is drawn into the lower screen. The aeration of the water within the lower well screen increases the partitioning of dissolved and adsorbed phase VOCs to the vapor phase and into bubbles which rise in the well to the water surface where vapors are drawn off and treated and/or discharged by an SVE system. Modifications to the basic in-well stripping process may involve injection of additives (e.g., nutrients) into the stripping well to enhance biodegradation. Air stripping systems operate more efficiently with horizontal conductivities greater that $10^{-3}$ cm/sec.

Groundwater is not extracted in this type of system. Therefore, pumping and treatment costs may be reduced.

Complete definition of the extent of chemical presence in groundwater is required prior to the installation of a circulating well system to prevent expansion of chemical presence in the groundwater regime. In addition, fouling of the circulating system may occur due to precipitation of constituents of the groundwater.

### 5.1.5 CONTAINMENT TECHNOLOGIES

Containment technologies create physical and hydraulic containment of contaminated groundwater. The containment response does not reduce the volume or toxicity of the contaminants in the Site media. The purpose of this response is to reduce contaminant mobility, and in doing so, minimize exposure and reduce potential hazards. Periodic monitoring is necessary following implementation of the containment response to determine its effectiveness and evaluate the need for further action.

Physical barriers for containment of groundwater would consist of subsurface vertical barriers to control groundwater migration. Surface barriers to control surface water infiltration and thus transport of COCs from soils to groundwater are not applicable at the Site, as significant COC presence in vadose zone soil has not been identified. Hydraulic containment of groundwater may be achieved through the operation of collection systems (i.e., extraction wells or collection trenches).

Groundwater monitoring would be included as part of any containment alternative.

### 5.1.6 COLLECTION TECHNOLOGIES

Collection technologies reduce the mass of contaminants present to a greater or lesser degree, dependent on the aggressiveness of the collection effort. Use of collection technologies reduces the mobility and toxicity of Site contaminants by removal and disposition at a secure location. These technologies provide no treatment of contaminated media but may be used in conjunction with an ex-situ disposal and/or treatment option to meet the Site-specific goals and objectives.

The groundwater collection technology identified as potentially applicable to the Site utilizes vertical extraction wells and/or a collection trench.

Groundwater monitoring would be included as part of any collection alternative.

### 5.1.7 EX-SITU TREATMENT TECHNOLOGIES

The purpose of an ex-situ groundwater treatment technology is to reduce the volume, toxicity, and/or mobility of Site contaminants in extracted groundwater. Remedial treatment technologies potentially applicable at the Site are air stripping and carbon treatment.

#### 5.1.7.1 AIR STRIPPING

VOCs are partitioned from extracted groundwater by increasing the surface area of the impacted groundwater exposed to air. Aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration. Water droplets fall from the top of the air stripper, while air is forced countercurrent to the water flow. VOCs partition into the air, which is discharged into the atmosphere. Depending on the concentration of VOCs in the air, it may require treatment prior to discharge.

Air stripping equipment can be subject to fouling when elevated concentrations of metals are present in the incoming stream. Under these conditions, the influent is pretreated with flocculants or sequestering agents to either remove the metals constituents or keep them in the dissolved state.

#### 5.1.7.2 ACTIVATED CARBON

Either extracted groundwater or vapor can be treated by adsorption of VOCs onto activated carbon. Groundwater or vapor is passed through one or more vessels containing activated carbon and VOCs in the influent flow are adsorbed onto the carbon. When the concentration of VOCs in the effluent from the carbon bed(s) exceeds a predetermined level, the carbon is replaced.

When elevated concentrations of metals are present in an influent groundwater stream, carbon beds are subject to fouling due to precipitation. This can result in high operation and maintenance costs.

Carbon treatment may not be appropriate where high concentrations of specific VOCs (e.g., vinyl chloride) with poor adsorptive capabilities are present.

### 5.1.8 DISPOSAL TECHNOLOGIES

Disposal technologies involve off-Site or on-Site disposal of contaminated liquid media or products of treatment processes. Disposal technologies do not usually involve reduction of contaminant volume or toxicity, but are primarily intended to reduce contaminant mobility.

#### 5.1.8.1 OFF-SITE DISPOSAL

Off-Site disposal options include municipal sewer discharge or disposal at a permitted treatment, storage, and disposal facility (TSDF). Off-Site disposal options normally involve transportation of the contaminated media to the TSDF. Pre-treatment may be required as a condition for off-site disposal to a municipal sewer. In addition, volume restrictions may be imposed on discharges to a municipal sewer.

#### 5.1.8.2 ON-SITE DISPOSAL

The on-Site treated water disposal options potentially applicable for Site groundwater are injection back into the groundwater aquifer or permitted discharge to surface water.

##### 5.1.8.2.1 INJECTION

In disposal of treated groundwater through injection, treated groundwater is discharged into injection wells. Injection wells are generally located downgradient of the groundwater extraction system, but may be located upgradient or cross-gradient to improve flow of impacted groundwater toward the extraction system. The injection systems may be either passive (e.g., gravity flow) or active (e.g., pumping).

Hydraulic monitoring is required in conjunction with injection to assure that containment of the groundwater in the area of concern is maintained.

##### 5.1.8.2.2 DISCHARGE TO SURFACE WATER

Disposal of treated groundwater can be made through permitted direct discharge to a storm sewer or surface water body. Monitoring of the treated effluent would be conducted in accordance with permit requirements to ensure that the quality of discharged water is in accordance with applicable standards. Since there is no surface water body on or near the site, the treated water would be discharged to a Site storm sewer.

## 5.2 SOIL

### 5.2.1 NO ACTION

The No Action response is primarily used as a basis for comparison with other alternatives. Under the No Action response, no additional measures are taken to improve environmental conditions at the Site. This response does not reduce the volume, mobility, or toxicity of the hazardous constituents of the Site media.

In the case of the Site, the No Action alternative includes the engineering controls already in place. These engineering controls include fencing restricting unauthorized access to the Former Buffalo China property and the existing manufacturing building floor slab.

### 5.2.2 INSTITUTIONAL AND ENGINEERING CONTROLS

The institutional and engineering control response is not intended to reduce the toxicity, mobility, or volume of hazardous site constituents but to reduce the potential for human and wildlife exposure to those constituents. Options may include initiation of institutional or engineering controls to restrict or limit the use of the Site or the contaminated media, prevent contact with contaminated media, and/or development of protective work procedures to reduce the potential for exposure of workers to Site contaminants during ground intrusive construction activities. The existing engineering controls at the Site consist of perimeter fencing around the Site to prevent unauthorized access, and the manufacturing building floor slab that prevents direct contact with underlying contaminated soil and minimizes the potential migration of contaminants from the underlying soils to groundwater.

### 5.2.3 MONITORED NATURAL ATTENUATION

Natural attenuation refers to natural subsurface processes that reduce VOC and SVOC concentrations. Natural attenuation can be sufficiently protective of human health and the environment and can be more cost effective than other remedial alternatives. Biodegradation is the most important natural in-situ destructive mechanism.

The MNA technology for soil would include groundwater monitoring to confirm that COCs are not impacting groundwater quality or that the rate of migration of contaminants from soil to groundwater is decreasing.

### 5.2.4 CONTAINMENT TECHNOLOGIES

Containment technologies for surface soils consist of physical containment. The containment response does not reduce the volume or toxicity of the contaminants in the Site media. The purpose of this response is to reduce contaminant mobility, and in doing so, minimize exposure and reduce potential hazards at the Site. Periodic monitoring in the way of inspection is necessary to insure that containment is maintained.

The soil containment technology identified as potentially applicable to the Site is the use of an impermeable surface barrier (cap) to prevent exposure to contaminants in Site soils and minimize storm and melt water infiltration.

### 5.2.5 COLLECTION TECHNOLOGIES

Collection technologies reduce the mass of contaminants present to a greater or lesser degree, dependent on the aggressiveness of the collection effort. Use of the collection technologies reduces the mobility and toxicity of Site contaminants by removal and disposition at a secure location. These technologies provide no treatment of contaminated media but may be used in conjunction with a disposal and/or treatment option to meet the Site-specific goals and objectives.

The collection technology identified as potentially applicable to soil at the Site is excavation of impacted soil.

### 5.2.6 TREATMENT TECHNOLOGIES

The purpose of a treatment technology is to reduce the volume, toxicity and/or mobility of Site contaminants. Remedial treatment technologies include physical and chemical, or a combination of those processes (e.g., physical/chemical treatment).

#### 5.2.6.1 IN-SITU TREATMENT TECHNOLOGIES

Soil vapor extraction (SVE) is an in-situ unsaturated (vadose) zone soil remediation technology in which a vacuum is applied to the soil to induce the controlled flow of air and remove volatile and some semivolatile contaminants from the soil. The gas leaving the soil may be treated to recover or destroy the contaminants, depending on local and state air discharge regulations. Vertical extraction vents are typically used at depths of 5 feet or greater and have been successfully applied as deep as 300 feet. Horizontal extraction vents (installed in trenches or horizontal borings) can be used as warranted by contaminant zone geometry, drill rig access, or other site-specific factors.

#### 5.2.6.2 EX-SITU TREATMENT TECHNOLOGIES

The ex-situ treatment technologies identified as potentially applicable to excavated surface soils at the Site are thermal desorption and incineration. Considering the relatively small volume of impacted surface soils at the Site, treatment would most cost effectively be performed off-Site.

##### 5.2.6.2.1 THERMAL DESORPTION

Thermal desorption is a physical treatment method for excavated soils. Thermal desorption does not result in reduction of the volume or toxicity of the Site contaminants. To thermally treat the VOCs and SVOCs in Site surface soils, excavated soil would be heated to high temperature to volatilize water and the COCs. The resultant vapors would then be transported in a carrier gas or by vacuum extraction to a treatment system.

Dewatering of soils may be required to achieve acceptable soil moisture content prior to treatment.

##### 5.2.6.2.2 INCINERATION

Incineration is a potential physical/chemical treatment method for excavated soils. Organic chemical compounds present in excavated soils would be destroyed through volatilization and combustion. Off gases and combustion residuals would require treatment.

### 5.2.7 DISPOSAL TECHNOLOGIES

Disposal technologies involve off-Site or on-Site disposal of contaminated media or products of treatment processes. Disposal technologies do not usually involve reduction of contaminant volume or toxicity, but are primarily intended to reduce contaminant mobility. Off-Site disposal options include disposal at a permitted TSDF. Off-Site disposal options normally involve transportation of the contaminated media to the TSDF.

On-Site soil disposal options include use of excavated, treated soil as excavation backfill. This option is not technically feasible where excavated soil is treated off-Site.

## 6.0 INITIAL SCREENING OF REMEDIAL TECHNOLOGIES

Prior to developing a list of remedial alternatives potentially applicable at the Site for detailed analysis and comparison, all identified available and appropriate technologies are screened. The identified technologies described in Section 5 have been screened utilizing the following criteria:

i) Short- and long-term effectiveness.

ii) Implementability.

iii) Relative cost.

iv) Short-term risk.

The initial screening of remedial technologies and process options is designed to determine their applicability to the Site and eliminate those technologies that technically cannot be reasonably implemented.

The results of the initial screening of the remedial technologies assembled to address the general response actions presented in Section 5 and listed in Table 5.1, are shown in Tables 6.1 through 6.4.

In summary, the technologies listed below are retained for assembly into remedial alternatives and further evaluation.

### 6.1 GROUNDWATER

The following technologies are retained for further evaluation. These technologies may be used individually or in combination.

i) No Action.

ii) Institutional Controls.

iii) Monitored Natural Attenuation.

iv) In-Situ Treatment Utilizing Chemical Oxidation.

v) In-Situ Treatment Utilizing Enhanced Biodegradation.

vi) Hydraulic Containment and Collection through Extraction Wells.

vii) Ex-Situ Treatment Utilizing Air Stripping.

## 6.2 SOIL

The following technologies are retained for further evaluation. These technologies may be used individually or in combination.

i) No Further Action.

ii) Institutional and Engineering Controls.

iii) Monitored Natural Attenuation.

iv) Collection through Excavation.

v) Off-Site Disposal of Excavated Soil.

## 7.0 DETAILED ANALYSES OF RETAINED REMEDIAL ALTERNATIVES

Remedial technologies for Site groundwater and soil were evaluated in Section 6 for development into potential remedial alternatives for the Site. These alternatives are subject to a detailed analysis using the nine evaluation criteria outlined in the BCP Guide. The evaluation criteria are as follows:

i) Protection of human health and the environment.
ii) Compliance with SCGs.
iii) Reduction of toxicity, mobility, or volume.
iv) Short-term effectiveness.
v) Long-term effectiveness and permanence.
vi) Implementability.
vii) Cost effectiveness.
viii) Land use.
ix) Community acceptance.

The criterion of community acceptance cannot be evaluated at the alternatives analysis stage because it is based upon public comments regarding the Site remedy. Consequently, no further discussion of this criterion is provided in this AAR.

The remaining eight criteria are divided into two primary groups, namely threshold criteria and balancing criteria.

The threshold criteria include compliance with applicable SCGs and overall protection of human health and the environment. With the exception of the No Action alternative, all remedial alternatives must meet the threshold criteria to be eligible for further consideration.

The remaining six evaluation criteria are considered the balancing criteria. Each of the remedial alternatives is assessed and analyzed on a comparative basis using these evaluation criteria. Ultimately, a selected remedy is proposed that incorporates the alternatives that provides the best solution with respect to the balancing criteria.

The detailed analysis of retained alternatives has been performed in a manner consistent with the applicable regulations. The analyses are described in detail in the following subsections. Backup information for the cost estimates is presented in Appendix A.

## 7.1 GROUNDWATER

The groundwater remedial technologies retained following the initial screening have been assembled into the following alternatives for detailed analysis.

i) Groundwater Alternative 1: No Action.

ii) Groundwater Alternative 2: Monitored Natural Attenuation with Institutional Controls.

iii) Groundwater Alternative 3: In-Situ Enhanced Biodegradation with Institutional Controls.

iv) Groundwater Alternative 4: Chemical Oxidation with Enhanced Biodegradation and Institutional Controls.

v) Groundwater Alternative 5: Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.

Each of the groundwater remedial alternatives is described and evaluated in detail in the following subsections.

### 7.1.1 GROUNDWATER ALTERNATIVE 1: NO ACTION

#### 7.1.1.1 DESCRIPTION

Groundwater Alternative 1 (GW Alternative 1), No Action, provides no active remedial measures to improve environmental conditions at the Site. Natural attenuation and biodegradation would reduce COC concentrations in groundwater over the long term.

The No Action Alternative also includes the institutional controls already in place. These institutional controls include fencing restricting unauthorized access to the property

In addition, groundwater is not used as a potable source since public potable water is available to the Site and the surrounding properties through a municipal system.

No additional remedial actions, institutional controls, or monitoring would be implemented with GW Alternative 1.

#### 7.1.1.2 ASSESSMENT

Protection of Human Health and the Environment: Because no additional remedial measures are implemented with GW Alternative 1, the potential future risk to human health and the environment would not be reduced beyond that which would be achieved through natural degradation processes (biodegradation and natural physical processes).

Compliance with SCGs: GW Alternative 1 would not achieve the chemical-specific SCGs which apply to groundwater through a remedial action. However, the chemical-specific SCGs will be achieved over time through natural attenuation processes. Since no remedial action would be implemented, no action-specific or location-specific SCGs apply to GW Alternative 1.

Reduction of Toxicity, Mobility, or Volume: GW Alternative 1 provides no active reduction of toxicity, mobility, or volume of the COCs. However, over the long term, the volume and toxicity of COCs in groundwater will be reduced at the Site through active natural attenuation and biological degradation processes.

Short-Term Effectiveness: GW Alternative 1 requires no remedial actions. Therefore, although there would be no additional short-term risks posed to the community, the workers, or the environment as a result of the implementation of this alternative, there would be no short term reduction in existing risks.

Long-Term Effectiveness and Permanence: GW Alternative 1 would not result in any remedial actions; therefore, the residual risks would not be reduced beyond that which will be achieved through natural attenuation and biological degradation processes, and existing controls and practices. GW Alternative 1 will achieve the GW RAOs over time and will provide a permanent remedy once groundwater is restored through the natural attenuation processes.

Land Use: Since no actions would be undertaken to address the groundwater conditions at the Site, GW Alternative 1 would not be compatible with the anticipated future land use as it affords no additional protection to human health and the environment.

Implementability: Because there are no remedial actions being undertaken, the implementability criterion is not applicable.

Cost: There are no remedial actions, institutional controls, or monitoring being undertaken in GW Alternative 1; therefore, no costs will be incurred. This is reflected in the cost summary presented in Table 7.1.

### 7.1.2 GROUNDWATER ALTERNATIVE 2: MNA WITH INSTITUTIONAL CONTROL

#### 7.1.2.1 DESCRIPTION

In GW Alternative 2, a long-term groundwater monitoring program would be conducted to evaluate the effectiveness of natural attenuation processes in restoring groundwater quality. The groundwater monitoring program would consist of both hydraulic and water quality monitoring in overburden and bedrock monitoring wells. The purpose of the hydraulic monitoring program would be to confirm that the groundwater flow patterns do not change over time resulting in further off-site impact. Groundwater quality monitoring would be conducted to track the reductions in COC concentrations over time, evaluate the conditions for natural attenuation, and confirm the protectiveness of the remedy. The groundwater monitoring network would consist of 21 wells (including one additional proposed overburden well and two additional proposed bedrock wells). The proposed monitoring wells to be sampled are shown on Figure 7.1. Wells within the contaminant plume would be analyzed for VOCs and monitored natural attenuation parameters to monitor COC concentrations and to evaluate whether the groundwater conditions remain favorable for the natural attenuation process. A monitoring plan would be prepared and submitted to NYSDEC for approval prior to implementation of the remedy. It is assumed for purposes of cost estimating that the MNA program would be conducted over a period of 30 years, with quarterly monitoring for the first 5 years, followed by semiannual monitoring thereafter.

In GW Alternative 2, additional institutional controls beyond those already in place at the Site would be implemented to further restrict direct exposure to contaminated groundwater. Specifically there would be:

i) Additional safe work practices and definitions of levels of personnel protective equipment (PPE) for specific work activities would be developed if necessary and implemented for subsurface maintenance or construction activities conducted within the limits of COC presence in groundwater.

ii) A deed restriction and an environmental easement would be added to the existing deed. The deed restriction would inform the property owners of the Site history and restricted land use on the property. A deed restriction would also require the property owner to notify the NYSDEC before performing construction activities in areas within the limits of COC presence in groundwater. Any future conveyance of the property would be subject to these restrictions. The environmental easement would grant Buffalo China and its representatives access to the property to inspect and maintain institutional and engineering controls and conduct monitoring of the remedy. The restriction or restrictive covenants and easement would be drafted in accordance with applicable and relevant State and municipal legal codes to be enforceable.

#### 7.1.2.2 ASSESSMENT

Overall Protection of Human Health and the Environment: Effective deed restrictions and monitoring would be protective of human health by preventing potential exposure to contaminated groundwater. The potential future risk to the environment using GW Alternative 2 would not be reduced beyond that which will be achieved through natural attenuation and biological degradation.

Compliance with SCGs: GW Alternative 2 would achieve the chemical-specific SCGs which apply to groundwater through natural attenuation processes. Since no remedial action would be implemented, no action-specific SCGs apply to GW Alternative 2. The potentially applicable location-specific SCGs for this Alternative are the City of Buffalo zoning ordinances.

Reduction of Toxicity, Mobility, or Volume: GW Alternative 2 will provide reductions in toxicity and volume of the COCs in groundwater over time. The mobility of the COCs will not be reduced through the implementation of GW Alternative 2.

Short-Term Effectiveness: No additional short-term risk to the community or the environment would be posed as a result of the implementation of GW Alternative 2. Risk to workers conducting the monitoring program would be mitigated through the implementation of safe work practices and proper PPE.

Long-Term Effectiveness and Permanence: The additional institutional controls established for GW Alternative 2 would make this alternative effective in the long term as long as they are enforced until groundwater has been restored to the extent necessary for the intended future land use.

Land Use: GW Alternative 2 would achieve the groundwater RAOs over time if the institutional controls described in Section 7.1.2.1 are imposed and enforced until groundwater has been restored to the extent necessary for the intended future land use.

Implementability: GW Alternative 2 can be readily implemented.

Cost: The estimated 30-year present worth cost for GW Alternative 2, is $822,000. The cost summary is presented in Table 7.2.

### 7.1.3 GROUNDWATER ALTERNATIVE 3: ENHANCED BIODEGRADATION WITH INSTITUTIONAL CONTROL

#### 7.1.3.1 DESCRIPTION

Groundwater Alternative 3 (GW Alternative 3) would consist of in-situ groundwater treatment performed in hotspot areas to accelerate the biodegradation of COCs in groundwater and thus actively reduce risk. In situ enhancement of biodegradation would be conducted through supplementation of nutrient/carbon sources. In addition, institutional controls as described for GW Alternative 2 in Section 7.1.2 would be part of GW Alternative 3.

The use of ISEB at this Site would address VOC contamination in the overburden and bedrock groundwater in the hot spot areas. This technology would be used as a long-term remedy to reduce VOC concentrations through anaerobically enhanced reductive dechlorination. The application of ISEB would involve the injection of a carbon substrate in the form of a soy lactate emulsion. The emulsion would be applied to the saturated zones of the overburden and bedrock through newly installed injection wells in addition to the existing wells within the hotspot area (MW-4, MW-5, MW-5A, MW-12, MW-13A, MW-18, MW-18A, MW-19, MW-19A, and MW-21A). Each application would be accompanied by a nutrient injection. It is expected that soy lactate applications would occur every other year while nutrient applications would be required semi-annually. The use of ISEB to treat high concentrations of chlorinated VOCs typically requires an extended treatment time. The treatment time for this Site is expected to be 8 to 10 years. A bench scale treatability study is necessary to determine optimum soy-lactate doses and the need for bioaugmentation.

The conceptual model for the use of ISEB would involve the installation of 75 permanent injection wells. Sixty-five of the injection wells would be installed to a depth of 10 feet bgs with a 5 foot screened interval extending from 4 to 10 feet bgs to address the overburden. Ten of the injection wells would address both the overburden and bedrock. These wells would be installed to a depth of 12 feet bgs with a 5 foot screened interval extending approximately 2 feet into the bedrock. In addition to the proposed injection well installations, the existing overburden wells (MW-4, MW-5, MW-12, MW-18, and MW-19) within the hotspot area will be used for injection. Due to the presence of clay in the overburden, the injection wells would be installed at 15 foot spacing in the hot spot area. Figure 7.2 presents the proposed locations for the injection wells. Treatment would involve the injection of a soy lactate emulsion at the 75 injection well locations biannually for a total of four events. A nutrient solution comprised of diammonium sulfate, sodium dihydrogen phosphate, and water would be injected into the overburden and bedrock wells on a semi-annual basis.

Groundwater monitoring would be conducted on a semiannual basis during treatment and then annually for 3 years after treatment. The groundwater monitoring network would the same as described in Section 7.1.2 and as shown on Figure 7.1. Plume wells will be sampled for VOCs and natural attenuation parameters to monitor COC concentrations and groundwater conditions. Perimeter wells would be monitored for plume migration.

#### 7.1.3.2 ASSESSMENT

Overall Protection of Human Health and the Environment: GW Alternative 3 would reduce the highest concentrations of COCs in groundwater, thus immediately reducing the potential risk attributable to exposure to Site groundwater and enhancing the conditions under which natural attenuation processes can progress.

Compliance with SCGs: GW Alternative 3 would achieve the chemical-specific SCGs which apply to groundwater. The potentially applicable action-specific SCGs which apply to GW Alternative 3 are those listed in Table 4.3 under the following headings:

i) Container Storage.

This SCG would be satisfied by GW Alternative 3.

The potentially applicable location-specific SCGs for this Alternative are the City of Buffalo zoning ordinances.

Reduction of Toxicity, Mobility, or Volume: GW Alternative 3 will provide reduction of the toxicity and volume of the COCs. The mobility of COCs in groundwater will not be affected by GW Alternative 3.

Short-Term Effectiveness: Short-term hazards to workers during the in-situ treatment or monitoring events would be mitigated through the implementation of safe work practices and proper PPE. Mixing and pumping mechanisms may be present on the ground surface during the treatment process; however, all solutions would be containerized and no additional short-term risks would be posed to the community, the workers, or the environment.

Long-Term Effectiveness and Permanence: GW Alternative 3 will achieve the groundwater RAOs and will be effective in meeting the RAOs for saturated soils.

Land Use: GW Alternative 3 would achieve the groundwater RAOs if the institutional controls described in Section 7.1.2.1 are imposed and enforced until groundwater has been restored to the extent necessary for the intended future land use; however, GW Alternative 3 would not achieve the soil RAOs for unsaturated soils and, therefore, would not be compatible with the intended future land use without implementation of a soil remedy.

Implementability: GW Alternative 3 can be readily implemented.

Cost: The estimated 11-year present worth cost for GW Alternative 3 as described in Section 7.1.3.1 is $934,000. The cost summary is presented in Table 7.3.

### 7.1.4 GROUNDWATER ALTERNATIVE 4: IN-SITU CHEMICAL OXIDATION WITH ENHANCED BIODEGRADATION, AND INSTITUTIONAL CONTROL

#### 7.1.4.1 DESCRIPTION

Groundwater Alternative 4 (GW Alternative 4) would consist of in-situ chemical oxidation (ISCO) followed by enhanced biodegradation, and institutional controls as described in Section 7.1.3.

In-situ chemical oxidation is site specific. Successful treatment is a function of delivery and oxidation demand. A sufficient amount of oxidants needs to be delivered specifically to targeted area for effective oxidation. The treatment performance is dependent on the soil chemistry to a great extent. A critical factor in the evaluation of ISCO treatment is determining the dosages of oxidant that are required to effectively oxidize the contaminants as well as the natural oxidant demand (NOD).

The preferred oxidant for this Site is hydrogen peroxide-activated sodium persulfate. Persulfate, in solution with TCE, reacts to form carbon dioxide, hydrogen and sodium cations, and chloride and sulfate anions, which would be expected to be present as sodium sulfate, and hydrochloric and sulfuric acids:

$$3Na_2S_2O_8 + C_2HCl_3 + 4H_2O \rightarrow 2CO_2 + 9H^+ + 3Cl^- + 6Na^+ + 6\ SO_4^{\ 2-}$$

The reaction begins with an activation stage (shown below) where the presence of a hydrogen peroxide activator produces 4 free radicals in the form of 2 sulfate radicals and 2 hydroxyl radicals. Free radicals are very reactive intermediates that attach to the molecule to be oxidized and contain the energy necessary to cause it to decompose.

$$[S_2O_8^{-2} + H_2O_2 \rightarrow 2SO_4\bullet + 2OH\bullet]$$

Hydrogen peroxide activation of sodium persulfate results in the creation of the sulfate and hydroxyl radicals that serve as electron donors in the decomposition of chlorinated organic compounds. The sequential removal of chlorine atoms from TCE begins with the sulfate or hydroxyl radicals attaching to the trichloroethylene molecule at the double bond between the 2 carbon atoms. This is leads to the initial removal of the hydrogen ion from the TCE molecule followed by the release of a chlorine anion. Once all three chlorine atoms are released as chloride anions the remaining carbons atoms form carbon dioxide and the sulfate anion is released. The chloride and sulfate anions combine with sodium and hydrogen cations to form sulfuric and hydrochloric acids and sodium sulfate.

The oxidant would be applied to the subsurface through newly installed injection wells, in addition to an underground piping gallery. The piping gallery will be installed as part of a soil excavation remedy (likely Soil Alternative 3). Upon completion of excavation of impacted unsaturated soil, a network of perforated PVC pipe will be installed horizontally at the base of the excavation. Vertical riser pipes will be connected to the gallery to allow for introduction of chemical oxidants. The excavation will be backfilled to return the area to existing grades. In addition, two lines of injection wells will be installed west of MW-21A and north of MW-13/13A, MW-6/6A, and MW-20/20A to act as a barrier to contaminant migration in these areas. Injection wells will also be installed upgradient of off-Site wells MW-11 and MW-14/14A. Figure 7.3

presents the proposed layout/locations for the gallery and injection wells. The need for installation of one or more vertical overburden and/or bedrock injection wells in the source area will be determined based on the effectiveness of the horizontal piping gallery.

The treatment would require quarterly oxidant injections over a period of 18 months. Although, chemical oxidation is expected to treat more than 90 percent of the organic contaminants present it is anticipated that ISEB polishing would be required to meet cleanup levels. A period of 6 months after the last oxidant injection would be sufficient to ensure that the oxidant was exhausted and that dissolved oxygen would be reduced to pretreatment levels in the groundwater. It is possible that the bacterial populations may need to be augmented if they have not returned to pretreatment levels during the 6 month period. ISEB would then be initiated by the injection of soy-lactate substrate and nutrients for a 3 to 5 year period. It is expected that soy lactate applications would occur every other year while nutrient applications would be required annually. A bench scale treatability study is necessary to determine optimum oxidant and soy lactate doses and the need for bioaugmentation. Pilot-scale testing is recommended to determine optimum injection point spacing and injection rates.

Groundwater monitoring would be conducted on a semiannual basis during treatment and for two years after treatment. The two years of post-treatment groundwater monitoring is an assumed time for cost estimating purposes. The actual length of time groundwater monitoring will conducted will be based on the monitoring results. The groundwater monitoring network would be the same as described in Section 7.1.2 and is shown on Figure 7.1. Plume wells will be sampled for VOCs and natural attenuation parameters to monitor COC concentrations and groundwater conditions. Perimeter wells would be monitored for plume migration.

#### 7.1.4.2 ASSESSMENT

Overall Protection of Human Health and the Environment: GW Alternative 4 would reduce the highest concentrations of COCs in groundwater, thus immediately reducing the potential risk attributable to exposure to Site groundwater and enhancing the conditions under which natural attenuation processes can progress.

Compliance with SCGs: GW Alternative 4 would achieve the chemical-specific SCGs which apply to groundwater in the shortest timeframe compared to the other alternatives. The potentially applicable action-specific SCGs which apply to GW Alternative 4 are those listed in Table 4.3 under the following headings:

i) Container Storage.

This SCG would be satisfied by GW Alternative 4.

Potentially applicable location-specific SCGs for this Alternative are the City of Buffalo ordinances and building codes.

Reduction of Toxicity, Mobility, or Volume: GW Alternative 4 will provide reduction of the toxicity, volume, and mobility of the COCs in groundwater. The volume of COCs in sub-slab vapor will also be reduced by GW Alternative 4.

Short-Term Effectiveness: Short-term hazards to workers during the in-situ treatment, or monitoring events would be mitigated through the implementation of safe work practices and proper PPE. Mixing and pumping mechanisms may be present on the ground surface during the treatment and construction processes; however, all solutions would be containerized and no additional short-term risks would be posed to the community, the workers, or the environment.

Long-Term Effectiveness and Permanence: The implementation of GW Alternative 4 will achieve the groundwater RAOs. GW Alternative 4 would also reduce VOC concentrations to meet the soil RAOs for soils in the saturated zone.

Land Use: GW Alternative 4 would achieve the groundwater RAOs if the institutional controls described in Section 7.1.2.1 are imposed and enforced until groundwater has been restored to the extent necessary for the intended future land use; however, GW Alternative 4 would not achieve the unsaturated soil RAOs and, therefore, would not be compatible with the intended future land use without implementation of a soil remedy.

Implementability: GW Alternative 4 can be readily implemented.

Cost: For cost purposes, it is assumed that ISCO/ISEB will be conducted over a 7-year period. The estimated 7-year present worth cost for GW Alternative 4 as described in Section 7.1.4.1 is $695,000. The cost summary is presented in Table 7.4.

### 7.1.5 GROUNDWATER ALTERNATIVE 5: CHEMICAL OXIDATION WITH ENHANCED BIODEGRADATION AND INSTITUTIONAL CONTROLS FOR OVERBURDEN, WITH HYDRAULIC CONTAINMENT/COLLECTION AND ON-SITE TREATMENT/DISPOSAL FOR BEDROCK

#### 7.1.5.1 DESCRIPTION

Groundwater Alternative 5 (GW Alternative 5) would consist of a combination of previously defined alternative GW Alternative 4 to address the overburden along with hydraulic containment/collection and on-Site treatment/disposal to address the bedrock.

Hydrogen peroxide-activated sodium persulfate would be applied to the overburden through an underground piping gallery, in addition to newly installed overburden injection wells. The piping gallery will be installed as part of a soil excavation remedy (likely Soil Alternative 3). In addition, two lines of overburden injection wells will be installed north of MW-13/13A, MW-6/6A, and MW-20/20A to act as a barrier to contaminant migration in these areas. Overburden injection wells will also be installed upgradient of off-Site well MW-11. Figure 7.4 presents the proposed layout/locations for the gallery, injection wells, and extraction wells.

As with GW Alternative 4, treatment would require quarterly oxidant injections over a period of 18 months, with a 6-month equilibration period after the last oxidant injection, followed by ISEB for a 3 to 5 year period. It is expected that soy lactate applications would occur every other year while nutrient applications would be required annually. A bench scale treatability study is necessary to determine optimum oxidant and soy lactate doses and the need for bioaugmentation. Pilot-scale testing is recommended to determine optimum injection point spacing and injection rates.

Bedrock groundwater will be addressed by hydraulic containment and groundwater collection, with on-Site treatment of recovered groundwater prior to discharge. An extraction well system would be designed to contain and recover impacted groundwater in the bedrock formations. For cost estimation purposes, it is assumed that six bedrock wells would be installed in the alignment shown on Figure 7.4.

Extracted groundwater would be treated utilizing air stripping. Based on preliminary modeling, treatment of vapors will not be required. Treated water would be discharged directly to the storm sewer in the southwest portion of the Site. This sewer discharges to the City of Buffalo municipal sewer system. A permit would be required for discharge.

Pumping and pilot scale testing will be required prior to design of the extraction and treatment systems.

In GW Alternative 5, a long-term groundwater monitoring program would be conducted to evaluate the continuing effectiveness of the remedial action in restoring groundwater quality. The groundwater monitoring program would consist of both hydraulic and water quality monitoring in overburden and bedrock monitoring wells. The purpose of the hydraulic monitoring program would be to confirm that the groundwater flow patterns do not change over time resulting in unexpected off-Site impact. Groundwater quality monitoring would be conducted to track the reductions in COC concentrations over time and confirm the protectiveness of the remedy. To obtain a conservative cost estimate for use in this FS, it has been assumed that the groundwater monitoring network would consist of approximately 21 wells and that groundwater samples would be analyzed for VOCs. A complete monitoring plan would be prepared and submitted to NYSDEC for approval prior to implementation of the remedy.

Treatment system influent and effluent monitoring would be conducted as necessary to monitor system performance and meet permit requirements. For the purpose of the FS, it is assumed that influent and effluent analyses would be conducted weekly for three months and monthly thereafter.

#### 7.1.5.2 ASSESSMENT

Overall Protection of Human Health and the Environment: GW Alternative 5 would reduce the highest concentrations of COCs in overburden groundwater, thus immediately reducing the potential risk attributable to exposure to this medium. Additional protectiveness is gained through the hydraulic containment, collection, and treatment of contaminated bedrock groundwater, and through the enforcement of additional institutional controls.

Compliance with SCGs: GW Alternative 5 would achieve the chemical-specific SCGs which apply to overburden and bedrock groundwater, although SCGs for overburden groundwater will be met in a shorter timeframe. The potentially applicable action-specific SCGs which apply to GW Alternative 5 are those listed in Table 4.3 under the following headings:

i) Container Storage.

ii) Discharge of Treatment System Effluent.

iii) Land Treatment.

iv) Surface Water Control.
v) Treatment (in a unit).
vi) Closure of Land Treatment Units.
vii) Transporting Hazardous Waste Off Site.
viii) Vapor Emissions.

These SCGs would be satisfied by GW Alternative 5.

Potentially applicable location-specific SCGs for this Alternative are the City of Buffalo ordinances and building codes.

Reduction of Toxicity, Mobility, or Volume: GW Alternative 5 will provide reduction of the toxicity, volume, and mobility of the COCs in groundwater.

Short-Term Effectiveness: Short-term hazards to workers during the extraction well and treatment system installation, in-situ treatment, or monitoring events would be mitigated through the implementation of safe work practices and proper PPE. Mixing and pumping mechanisms may be present on the ground surface during the treatment and construction processes; however, all solutions would be containerized and no additional short-term risks would be posed to the community, the workers, or the environment. The short-term effectiveness of GW Alternative 5 would be almost immediate upon startup of the on-Site treatment system as a result of the near-immediate commencement of reduction of the toxicity, mobility, and volume of COCs in groundwater.

Long-Term Effectiveness and Permanence: The implementation of GW Alternative 5 will achieve the groundwater RAOs. GW Alternative 5 would also reduce VOC concentrations to meet the soil RAOs for soils in the saturated zone.

Land Use: GW Alternative 5 would achieve the groundwater RAOs if the institutional controls described in Section 7.1.2.1 are imposed and enforced until groundwater has been restored to the extent necessary for the intended future land use; however, GW Alternative 5 would not achieve the unsaturated soil RAOs and, therefore, would not be compatible with the intended future land use without implementation of a soil remedy.

Implementability: GW Alternative 5 can be readily implemented.

Cost: For cost purposes, it is assumed that ISCO/ISEB will be conducted over a 7-year period, while containment/collection and treatment of bedrock groundwater will be conducted for 21 years. The estimated present worth cost for GW Alternative 5 as described in Section 7.1.5.1 is $2,393,000. The cost summary is presented in Table 7.5.

## 7.2 SOIL

The remedial technologies to address unsaturated soil retained following the initial screening have been assembled into the following alternatives for detailed analysis:

i) Soil Alternative 1: No Further Action.

ii) Soil Alternative 2: Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) Soil Alternative 3: Excavation with Off-Site Disposal with Institutional and Engineering Controls.

iv) Soil Alternative 4: Unrestricted Use Alternative.

Each of the unsaturated soil remedial alternatives is evaluated in detail in the following subsections.

### 7.2.1 SOIL ALTERNATIVE 1: NO FURTHER ACTION

#### 7.2.1.1 DESCRIPTION

Soil Alternative 1 (SO Alternative 1), No Further Action, provides no active remedial measures to improve environmental conditions at the Site. Natural degradation would reduce COC concentrations in soils over the long term. No further remedial actions, institutional or engineering controls, or monitoring would be conducted.

#### 7.2.1.2 ASSESSMENT

Overall Protection of Human Health and the Environment: Because no additional remedial measures are implemented with SO Alternative 1, the potential future risk to human health and the environment from groundwater contaminants would not be reduced beyond that which would be achieved for organic constituents through natural degradation processes (biodegradation and natural physical processes) and realized as an indirect result of the remedial action implemented to address Site groundwater.

The apparent source of VOCs in soil is historic Site activities at the Harrison Street Warehouse. Since the area is no longer used for manufacturing purposes, sources of continuing discharge have been eliminated; therefore, SO Alternative 1 will be protective of human health and the environment in the future with respect to organic constituents. SO Alternative 1 would not reduce risk associated with metals beyond the protection from direct contact afforded by the existing engineering controls.

Compliance with SCGs: SO Alternative 1 would achieve the chemical-specific SCGs which apply to soil for organic constituents in the long term due to natural degradation processes but would not achieve SCGs for metals. Since no remedial action would be implemented, no action-specific or location-specific SCGs apply to SO Alternative 1.

Reduction of Toxicity, Mobility, or Volume: SO Alternative 1 provides no active reduction of toxicity, mobility, or volume of the COCs; however, over the long term, the volume and toxicity of organic COCs in soil will be reduced by natural degradation processes.

Short-Term Effectiveness: SO Alternative 1 requires no remedial actions. Therefore, there would be no additional short-term risks posed to the community, the workers, or the environment as a result of the implementation of this alternative.

Long-Term Effectiveness and Permanence: Over time, through natural degradation processes, SO Alternative 1 will achieve the RAOs applicable to soil with respect to VOCs and SVOCs but would not meet the RAOs for metals.

Land Use: Since no actions would be undertaken to address the groundwater conditions at the Site it would not be compatible with the anticipated future land use as it affords no additional protection to human health and the environment.

Implementability: Because there are no remedial actions being undertaken, the implementability criterion is not applicable.

Cost: Because there are no remedial actions, institutional controls, or monitoring being undertaken, there are no costs associated with SO Alternative 1. The cost summary is presented in Table 7.6.

### 7.2.2 SOIL ALTERNATIVE 2: MONITORED NATURAL ATTENUATION WITH INSTITUTIONAL AND ENGINEERING CONTROLS

#### 7.2.2.1 DESCRIPTION

In SO Alternative 2, no active remedial measures would be taken to address COCs in soil at the Site. VOC and SVOC COCs would be allowed to degrade naturally over time. Metals do not degrade naturally; however, analytical results for dissolved lead in Site groundwater were non-detect indicating that lead present in on-Site soils has not impacted groundwater quality. A groundwater monitoring program would be conducted to evaluate the effectiveness of natural attenuation processes in protecting groundwater quality. The monitoring would be conducted in conjunction with the selected groundwater remedy. The groundwater monitoring program would consist of both hydraulic and water quality monitoring in overburden and bedrock monitoring wells. The purpose of the hydraulic monitoring program would be to confirm that the groundwater flow patterns do not change over time resulting in off-site impact. Groundwater quality monitoring would be conducted to confirm the protectiveness of the remedy. Groundwater samples would be analyzed for SVOCs and dissolved lead. Only the five overburden plume wells shown on Figure 7.1 would be sampled as part of this remedy. A complete monitoring plan would be prepared and submitted to NYSDEC for approval prior to implementation of the remedy. The monitoring would be conducted in conjunction with the selected groundwater remedy. The time frame for SO Alternative 2 ranges from 7 years in conjunction with GW Alternative 4, to 30 years in conjunction with GW Alternative 2.

In SO Alternative 2, additional Institutional Controls beyond those already in place at the Site would be implemented to further restrict direct exposure to contaminated soil. Specifically these are as follows:

i) Additional safe work practices and definitions of levels of personnel protective equipment (PPE) for specific work activities would be developed if necessary and implemented for subsurface maintenance or construction activities conducted within the limits of COC presence in unsaturated soils.

ii) A deed restriction and an environmental easement would be added to the existing deed. The deed restriction would inform the property owners of the Site history and restricted land use on the property. A deed restriction would also require the property owner to notify the NYSDEC before performing construction activities in areas within the limits of COC presence in soil. Any future conveyance of the property would be subject to these restrictions. The environmental easement would grant Buffalo China and its representatives access to the property to inspect and maintain institutional and engineering controls and conduct monitoring of the remedy. The restriction or restrictive covenants and easement would be drafted in accordance with applicable and relevant State and municipal legal codes to be enforceable.

#### 7.2.2.2 ASSESSMENT

Overall Protection of Human Health and the Environment: Maintaining the existing manufacturing building floor slab, effective deed restrictions, and monitoring would be protective of human health by preventing potential exposure to contaminated soil. The potential future risk to the environment using SO Alternative 2 would not be reduced beyond that which will be achieved through natural attenuation and biological degradation of VOCs.

Compliance with SCGs: SO Alternative 2 would achieve the chemical-specific SCGs for organic constituents that apply to soil through the natural attenuation processes. SCGs would not be achieved for metals. Since no remedial action would be implemented, no action-specific SCGs apply to SO Alternative 2. The potentially applicable location-specific SCGs for this Alternative are the City of Buffalo zoning ordinances.

Reduction of Toxicity, Mobility, or Volume: SO Alternative 2 will provide reductions in toxicity and volume of the organic COCs in soil and groundwater over time. The mobility of the COCs will not be reduced through the implementation of SO Alternative 2.

Short-Term Effectiveness: No additional short-term risk to the community or the environment would be posed as a result of the implementation of SO Alternative 2. Risk to workers conducting the monitoring program would be mitigated through the implementation of safe work practices and proper PPE.

Long-Term Effectiveness and Permanence: The additional institutional controls established for SO Alternative 2 would make this Alternative effective in the long term as long as they are enforced until soil has been restored to the extent necessary for the intended future land use.

Land Use: SO Alternative 2 would achieve the soil RAOs for VOCs and SVOCs. However; SO Alternative 2 would not achieve the soil RAOs for metals and, therefore, would not be compatible with the intended future land use without implementation of an additional soil remedy.

Implementability: SO Alternative 2 can be readily implemented.

Cost: For cost estimation purposes, it has been assumed that SO Alternative 2 would not be performed independently, but rather must be coupled with a groundwater remedy. The costs have been developed to reflect only the increase above the cost of the respective groundwater remedy. The estimated range of cost for SO Alternative 2 is $11,000 to $43,000, depending on the accompanying groundwater remedy that is selected. The cost summaries are presented in Tables 7.7A through 7.7C.

### 7.2.3 SOIL ALTERNATIVE 3: EXCAVATION WITH OFF-SITE DISPOSAL AND INSTITUTIONAL AND ENGINEERING CONTROLS

#### 7.2.3.1 DESCRIPTION

Soil Alternative 3 (SO Alternative 3) includes:

i) Excavation of unsaturated soil containing VOC and metals at concentrations exceeding SCGs.
ii) Off-Site disposal of the excavated soil at a permitted landfill.
iii) Maintenance of existing engineering controls (manufacturing building floor slab) to prevent contact with impacted soil and implementation of institutional controls to restrict exposure to and migration of contaminated subsurface soil.

The estimated areas from which soil would be excavated are shown on Figure 7.5. Area A would be excavated to remove soils in the unsaturated zone with VOC concentrations exceeding the Part 375 protection of groundwater SCOs. The area of impact is approximately 6,100 square feet ($ft^2$). The unsaturated zone extends to approximately 4 feet bgs in Area A. Approximately 900 cubic yards (CY) of soil would be excavated.

Excavations at Areas B through E will be limited to 100 $ft^2$ by 2 feet deep to address these discrete locations with lead above the protection of groundwater SCOs.

Soils will be precharacterized for disposal. Based on the concentrations of VOCs around MW-5 and lead at BH-7 in Area A, it is anticipated that some of these soils would be characterized as hazardous waste. The remaining soils would be characterized as non-hazardous. Excavated soils would be transported to an off-Site, permitted TSDF for treatment (if required) and disposal. Excavated soil likely would be removed from the Site concurrently with the excavation activities.

The excavation would then be backfilled with clean, imported, granular fill and regraded as necessary to promote drainage. The filled areas will be restored to existing conditions.

It is anticipated that excavation and backfilling would be completed in a 2-week period.

#### 7.2.3.2 ASSESSMENT

Overall Protection of Human Health and the Environment: SO Alternative 3 would be protective of human health by preventing potential incidental exposure to contaminated soil. SO Alternative 3 would be protective of the environment by reducing the future potential transport of COCs in soil to off-Site areas as a result of wind dispersion, surface runoff, or other mechanical means. SO Alternative 3 would also eliminate the migration of COCs in soil to underlying groundwater

Compliance with SCGs: SO Alternative 3 would achieve the chemical-specific SCGs that apply to soils.

The potentially applicable action-specific SCGs for this Alternative are those listed in Table 4.3 under the following headings:

i) Capping.
ii) Container Storage.
iii) Excavation.
iv) Surface Water Control.
v) Waste Pile.
vi) Closure with Waste in Place.
vii) Transporting Hazardous Waste Off Site.

These SCGs would be satisfied by SO Alternative 3.

The potentially applicable location-specific SCGs for this Alternative are the City of Buffalo ordinances and building codes.

Reduction of Toxicity, Mobility, or Volume: SO Alternative 3 does not provide a reduction in toxicity or volume of COCs in excavated soil unless treatment is required at the disposal facility. Mobility of COCs in Site soil would be eliminated through the removal and transport of soil from the area.

SO Alternative 3 will assist in achieving the RAOs for VOCs in groundwater.

Short-Term Effectiveness: Soil excavation and backfill can be completed using standard techniques. Short-term hazards to workers would be mitigated through proper work and health and safety procedures. The short-term effectiveness of SO Alternative 3 would be almost immediate upon completion since the potential for direct exposure of human receptors to Site soils would be eliminated immediately. Dust control and community air monitoring programs would be implemented during construction activities to control short-term risks posed to the community by SO Alternative 3.

Long-Term Effectiveness and Permanence: SO Alternative 3 is a permanent solution to prevent exposure to contaminated soils. The enforcement of the institutional controls to be established for SO Alternative 3 would make this Alternative effective to prevent exposure to chemicals in remaining impacted subsurface soils, if present.

Land Use: SO Alternative 3 would achieve the RAOs for soil and would be compatible with the intended future land use.

Cost: The estimated cost for SO Alternative 3 is $240,000, assuming that up to 115 tons of material are classified hazardous and are landfilled without pretreatment. The cost summary is presented in Table 7.8. The cost of SO Alternative 3 is highly dependent upon: i) the ultimate volume of soil excavated; and ii) how much of the excavated soil is a hazardous waste for disposal.

### 7.2.4 UNRESTRICTED USE ALTERNATIVE

#### 7.2.4.1 DESCRIPTION

Per the BCP Guide and Part 375, the AAR must include analysis of an alternative that will achieve a cleanup level for soil that will allow the Site to be used for any purpose without any restrictions on the use of the Site. The soil remedy must achieve the unrestricted use SCOs for all soils above bedrock. The remedy may not include the use of long-term institutional or engineering controls. The Unrestricted Use Alternative includes:

i) Excavation of soil containing VOC, SVOC, and metals concentrations exceeding SCGs.
ii) Off-Site disposal of the excavated soil at a permitted landfill.
iii) Groundwater treatment via in-situ chemical oxidation with enhanced biological degradation.

The estimated area from which surface soil would be excavated is shown on Figure 7.6. Because the soil mound is comprised of fill material, it is anticipated that the entire mound would be removed for off-site disposal. Additional soil sampling and analyses may be required prior to commencement of the excavation activities to further define the horizontal extent of the excavation.

For Area A, it is assumed that soils will be excavated to bedrock which is 10 feet bgs and that all other areas as highlighted on Figure 7.6 would be excavated to an average depth of 4 feet. Excavated soils would be transported to an off-Site, permitted TSDF for treatment (if required) and disposal.

Following completion of the excavation activities, the area of the excavation would be covered with filter fabric to provide a visual separation between the soil and the imported cover. The excavation would then be backfilled with clean, imported, granular fill and regraded as necessary to promote drainage. The filled areas will be restored to existing conditions.

Excavated soil likely would be removed from the Site concurrently with the excavation activities and not stockpiled. It is estimated that soil excavation and Site restoration would be completed in an 8-week period.

#### 7.2.4.2 ASSESSMENT

Overall Protection of Human Health and the Environment: The Unrestricted Use Alternative would be protective of human health by preventing potential incidental exposure to contaminated soil and groundwater. The Unrestricted Use Alternative would be protective of the environment by reducing the future potential transport of COCs in soil to off-Site areas as a result of wind dispersion, surface runoff, or other mechanical means and reducing COC concentrations in groundwater to below the NYS groundwater quality standards.

Compliance with SCGs: The Unrestricted Use Alternative would achieve the unrestricted use chemical-specific SCGs that apply to soils and the groundwater SCGs.

The potentially applicable action-specific SCGs for this Alternative are those listed in Table 4.3 under the following headings:

i) Capping.
ii) Container Storage.
iii) Excavation.
iv) Surface Water Control.
v) Waste Pile.
vi) Transporting Hazardous Waste Off Site.

These SCGs would be satisfied by the Unrestricted Use Alternative.

The potentially applicable location-specific SCGs for this Alternative are the City of Buffalo ordinances and building codes.

Reduction of Toxicity, Mobility, or Volume: The Unrestricted Use Alternative does not provide a reduction in toxicity or volume of COCs in excavated soil unless treatment is required at the disposal facility. Mobility of COCs in Site soil would be reduced through the removal and transport of soil from the area. This Alternative would reduce the toxicity and volume of COCs in groundwater but not the mobility.

Short-Term Effectiveness: Soil excavation and backfill can be completed using standard techniques. Short-term hazards to workers would be mitigated through proper work and health and safety procedures. The short-term effectiveness of the Unrestricted Use Alternative would be almost immediate upon completion since the potential for direct exposure of human receptors to Site soils would be eliminated immediately. Dust control and community air monitoring programs would be implemented during construction activities to control short-term risks posed to the community.

Long-Term Effectiveness and Permanence: The Unrestricted Use Alternative is a permanent solution to prevent exposure to contaminated soils.

Land Use: The Unrestricted Use Alternative would achieve the soil RAOs for soil and groundwater and would be compatible with the intended future land use.

Implementability: Although the Unrestricted Use Alternative would be implementable, construction activities would interfere with Site operations at this active manufacturing facility due to the volume of soils to be excavated and increased truck traffic.

Cost: The cost summary for the Unrestricted Use Alternative is presented in Table 7.9. The cost of the Unrestricted Use Alternative is estimated to be $4,562,000, and could be greater depending on: i) the volume of soil excavated; and ii) the quantity of excavated soil that is a hazardous waste for disposal.

## 8.0 COMPARATIVE ANALYSES OF REMEDIAL ALTERNATIVES

The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each Alternative evaluated in detail in the previous sections. The detailed evaluation assessed each remedial Alternative independently. The comparison of remedial alternatives in this section evaluates the relative performance of each Alternative with respect to the detailed evaluation criteria: overall protection of human health and the environment, compliance with SCGs, short term effectiveness, long-term effectiveness and permanence, reduction of toxicity, mobility, and volume, land use, implementability, and cost.

### 8.1 COMPARATIVE ANALYSIS OF GROUNDWATER REMEDIAL ALTERNATIVES

Table 8.1 presents a ranking of each of the groundwater remedial alternatives included in the detailed analysis presented in Section 7.1. Discussions of the relative advantages and disadvantages of the alternatives are presented in the following subsections.

Each of the groundwater remedial alternatives except the No Action Alternative would be combined with additional institutional controls and overburden and bedrock groundwater monitoring. The costs associated with the institutional controls and monitoring are included in the cost estimates presented in Tables 7.2 through 7.5.

#### 8.1.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The groundwater remedial alternatives are ranked as follows relative to overall protection of human health and the environment:

i) GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control.
ii) GW Alternative 3, Enhanced Biodegradation and Institutional Control.
iii) GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.
iv) GW Alternative 2, Monitored Natural Attenuation and Institutional Control
v) GW Alternative 1, No Action.

GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control, would be the most protective of human health and the environment. In situ chemical oxidation in the areas in which COC concentrations are the highest would immediately reduce chemical presence, consequently also immediately reducing the potential risk to human health and the environment.

GW Alternative 3, Enhanced Biodegradation with Institutional Control, would be protective of human health and the environment by reducing chemical presence, but would require a longer period of time to achieve this state compared with GW Alternative 4.

GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock, is ranked third in protectiveness. GW Alternative 5 will immediately reduce chemical presence in overburden groundwater, while COC presence in bedrock groundwater is primarily contained. COC presence in bedrock groundwater will still be reduced, but over a longer duration.

The monitoring conducted in conjunction with GW Alternative 2, would make this Alternative more protective than GW Alternative 1 (No Action); however, the restoration of groundwater quality would not be accelerated beyond that which would be achieved by the natural attenuation processes.

GW Alternative 1, No Action, provides the least additional protection to human health or the environment.

### 8.1.2 COMPLIANCE WITH SCGS

All the GW Alternatives considered for the Site will achieve compliance with SCGs over time. Each will achieve the chemical-specific SCGs either through natural attenuation or a combination of natural attenuation and another remedial technology. GW Alternative 4 will achieve the chemical-specific SCGs sooner than GW Alternative 3. Groundwater Alternative 5, though less aggressive than GW Alternatives 4 and 3, will achieve chemical-specific SCGs sooner than GW Alternatives 1 and 2. The restoration of groundwater quality through GW Alternatives 1 and 2 would not be accelerated beyond that which would be achieved by natural attenuation processes. All groundwater alternatives will comply with the applicable action- and location-specific SCGs, where such exist.

### 8.1.3 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

All the GW Alternatives considered for the Site will achieve reductions in toxicity and volume over time. The groundwater remedial alternatives are ranked as follows relative to reduction of toxicity, mobility, and volume:

i) GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.
ii) GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control.
iv) GW Alternative 3, Enhanced Biodegradation and Institutional Control.
v) GW Alternative 2, Monitored Natural Attenuation and Institutional Control.
vi) GW Alternative 1, No Action.

GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock, is ranked first in reduction of toxicity, mobility, and volume. The toxicity and volume of COCs in groundwater will be reduced by GW Alternative 5. GW Alternative 5 will also reduce the mobility of COCs in groundwater by providing a barrier to additional off-Site migration.

GW Alternatives 3, Enhanced Biodegradation with MNA and Institutional Control, and 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control, ranked the same in reduction of toxicity, mobility, and volume. These alternatives will achieve reductions in toxicity and volume of COCs in groundwater albeit over different timeframes. However, the mobility of impacted groundwater would not be reduced.

GW Alternatives 1 and 2, No Action and MNA with Institutional Control are ranked third and second in reduction of toxicity, mobility, and volume, respectively. The reductions in toxicity and volume of COCs in groundwater will be the same in both remedial alternatives.

### 8.1.4 SHORT-TERM EFFECTIVENESS

The groundwater remedial alternatives are ranked as follows relative to short-term effectiveness:

i) GW Alternative 1, No Action.

ii) GW Alternative 2, MNA with Institutional Control.

iii) GW Alternative 3, Enhanced Biodegradation with MNA and Institutional Control.

iv) GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control, and GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.

No risk to the community, workers, or the environment would be presented by the implementation of GW Alternative 1, No Action. Therefore, GW Alternative 1 is ranked first in short-term effectiveness.

GW Alternative 2, MNA with Institutional Control, is ranked second in short-term effectiveness because a low risk to workers conducting monitoring activities would be present; however, this risk can be mitigated through proper work procedures.

The differences in short-term effectiveness associated with GW Alternatives 3, 4, and 5 are associated with the risks posed by well installation, maintenance and monitoring activities, treatment plant construction, and the potential for spills or leaks of treatment solution. All these risks can be minimized through the implementation of proper work procedures and operating plans. Risks to workers installing monitoring wells and conducting monitoring activities are the same in GW Alternatives 3 and 4. However, there is additional risk and, as a result, less effectiveness in GW Alternatives 4 and 5 due to the storage and handling of the in-situ treatment chemicals.

### 8.1.5 LONG-TERM EFFECTIVENESS AND PERMANENCE

The groundwater remedial alternatives are ranked as follows relative to long-term effectiveness and permanence:

i) GW Alternative 3, Enhanced Biodegradation and Institutional Control and GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control.

ii) GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.

iii) GW Alternative 2, MNA with Institutional Control.

iv) GW Alternative 1, No Action.

No significant continuing sources of VOCs to groundwater remain at the Site. Therefore, since the Site's natural attenuation processes are effective for the destruction of COCs in groundwater, all remedial alternatives evaluated will provide long-term effectiveness and permanence.

GW Alternatives 3, Enhanced Biodegradation with MNA and Institutional Control, and 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control, ranked equally in long-term protectiveness and permanence because they will reduce chemical concentrations through treatment (in-situ biodegradation and chemical oxidation) thus accelerating the restoration of groundwater quality, although GW Alternative 4 will achieve a final solution in the shortest period of time. The enforcement of the institutional controls will protect residents and workers until such time as the restoration of groundwater quality to the extent appropriate for the intended future land use is complete.

GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock, is ranked third in protectiveness and permanence. More uncertainty as to long-term effectiveness is associated with GW Alternative 5 as it is difficult to establish and maintain hydraulic control.

GW Alternative 2, MNA with Institutional Control, provides greater long-term effectiveness than GW Alternative 1, No Action, through the monitoring of groundwater and enforcement of institutional controls for protection of residents and workers while restoration of groundwater quality is underway.

The long-term effectiveness and permanence of GW Alternative 1, No Action, is the lowest of the remedial alternatives evaluated. While natural attenuation processes will effectively and permanently restore groundwater quality over the long term, there would not be protection provided by the institutional controls which are part of the other remedies.

### 8.1.6 IMPLEMENTABILITY

The groundwater remedial alternatives are ranked as follows relative to implementability:

i) GW Alternative 1, No Action.

ii) GW Alternative 2, MNA with Institutional Control.

iii) GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control.

iv) GW Alternative 3, Enhanced Biodegradation with MNA and Institutional Control.

v) GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.

GW Alternative 1, No Action, would be the most implementable since there would be no work involved and thus no access to off-Site properties required, interference with ongoing facility operations, and imposition or enforcement of institutional controls.

The ability to impose and enforce institutional controls is a major factor in the implementability of the other remedial alternatives. The other important factor is the long-term access to off-Site properties for treatment and monitoring and maintenance.

GW Alternative 2, Monitored Natural Attenuation with Institutional Control, ranked second with respect to implementability. While long-term access to off-Site properties would be required, it would be for monitoring of existing wells and maintenance. No further intrusive activities would be necessary.

GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control, and GW Alternative 3, Enhanced Biodegradation with Institutional Control, would require access to the off-Site properties for additional well installations and treatment as well as long-term monitoring. GW Alternative 4 ranked third while GW Alternative 3 ranked fourth due to the longer treatment time.

GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock, ranked fifth due to the need for construction of the groundwater treatment system and longer treatment time associated with this remedy.

### 8.1.7 LAND USE

The groundwater remedial alternatives are ranked as follows relative to compatibility with land use:

i) GW Alternative 3, Enhanced Biodegradation and Institutional Control and GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control.

ii) GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock.

iii) GW Alternative 2, MNA with Institutional Control and GW Alternative 1, No Action.

All the GW Alternatives considered for the Site are compatible with the future land use as groundwater is not used as a source of potable water and COCs will be reduced by natural attenuation over time. GW Alternative 3, Enhanced Biodegradation and Institutional Controls, and GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Controls, ranked equally because the reduction of COCs would be accelerated by treatment, reducing potential risks associated with direct contact with the groundwater. GW Alternative 5, Chemical Oxidation with Enhanced Biodegradation and Institutional Controls for Overburden, with Hydraulic Containment/Collection and On-Site Treatment/Disposal for Bedrock, ranked third. Although the groundwater COCs would be reduced, this reduction would take longer than with GW Alternatives 3 or 4. The restoration of groundwater quality through GW Alternatives 1 and 2 would not be accelerated beyond that which would be achieved by natural attenuation processes and there would be no reduction of risks.

### 8.1.8 COST

The cost associated with the implementation of the groundwater remedial alternatives is lowest for GW Alternative 1, No Action ($0). The costs of GW Alternatives 2 through 5 are $822,000, $934,000, $695,000, and $2,393,000, respectively.

## 8.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SOIL

Table 8.2 presents a ranking of each of the surface soil remedial alternatives included in the detailed analysis presented in Section 7.2. Discussions of the relative advantages and disadvantages of the alternatives are presented in the following subsections.

### 8.2.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The soil remedial alternatives are ranked as follows relative to overall protection of human health and the environment:

i) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls and SO Alternative 4, Unrestricted Use Alternative.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) SO Alternative 1, No Further Action.

SO Alternatives 3, Excavation and Disposal with Institutional and Engineering Controls, and 4, Unrestricted Use Alternative, provide the highest overall protection of human health and the environment. Excavation of soils with disposal in accordance with applicable regulations will eliminate potential impacts on human health through removal and potential impacts to the environment through transport to other media or to off-Site areas. The alternatives are equally weighted since the current and expected future use of the Site is for industrial purposes and both alternatives would provide sufficient protection.

SO Alternative 2, Monitored Attenuation with Institutional and Engineering Controls, is protective although the impacted soils will remain in place. Although lead will not degrade overtime, the concentrations of organic COCs are only slightly above the chemical-specific SCGs and are expected to degrade. SO Alternative 2 would be protective, as any future impacts to groundwater would be identified through monitoring. The institutional controls will mitigate worker exposure through safe work practices.

SO Alternative 1, No Further Action, provides no protection to human health or the environment.

### 8.2.2 COMPLIANCE WITH SCGs

The soil remedial alternatives are ranked as follows relative to compliance with SCGs:

i) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls and SO Alternative 4, Unrestricted Use Alternative.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls and SO Alternative 1, No Further Action.

SO Alternative 4, Unrestricted Use Alternative, will comply with chemical-specific SCGs by removing impacted surface and subsurface soils to bedrock. SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, will comply with the chemical-specific SCGs for soil by removing the shallow subsurface and surface soils from the Site. VOCs identified in deeper soils would degrade over time or be addressed by groundwater treatment.

Neither SO Alternative 1, No Further Action, nor SO Alternative 2, Monitored Natural Attenuation and Institutional and Engineering Controls, will comply with the chemical-specific SCGs in the short-term.

All soil alternatives will comply with the applicable action- and location-specific SCGs, where such exist.

### 8.2.3 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME

The soil remedial alternatives are ranked as follows regarding reduction of toxicity, mobility, and volume:

i) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, and SO Alternative 4, Unrestricted Use Alternative.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) SO Alternative 1, No Further Action.

Both SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, and SO Alternative 4, Unrestricted Use Alternative, will reduce the mobility and volume of COCs in soils by removal from the Site, in addition to SO Alternative 3 restricting mobility of contaminants under the manufacturing facility by maintaining the existing building floor slab. Toxicity will be reduced through proper disposal at a TSDF.

SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls, will not result in a reduction in the toxicity or volume of COCs but would reduce the mobility by preventing migration of COCs in soil under the manufacturing building and tracking impacts to groundwater from soil COCs.

SO Alternative 1, No Further Action, will not actively reduce the toxicity, mobility, or volume of the COCs in soil.

### 8.2.4 SHORT-TERM EFFECTIVENESS

The soil remedial alternatives are ranked as follows regarding short-term effectiveness:

i) SO Alternative 1, No Further Action.
ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.
iii) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls.
iv) SO Alternative 4, Unrestricted Use Alternative.

No risk to the community, workers, or the environment would be presented by the implementation of SO Alternative 1, No Further Action.

A low risk to community, workers, or the environment would be presented by SO Alternative 2; however, these risks can be mitigated through proper work procedures.

The greatest risk to the community, workers, or the environment would be presented by the implementation of SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, or SO Alternative 4, Unrestricted Use Alternative. SO Alternative 4 ranked lower than SO Alternative 3 due to the volume of soil and time it would take to complete the work. Risks can be minimized through the implementation of proper work procedures and community monitoring plans.

### 8.2.5 LONG-TERM EFFECTIVENESS AND PERMANENCE

The soil remedial alternatives are ranked as follows relative to long-term effectiveness and permanence:

i) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, and SO 4, Unrestricted Use Alternative.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) SO Alternative 1, No Further Action.

SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, and SO Alternative 4, Unrestricted Use Alternative, both provide long-term effectiveness and permanence through removal of the impacted surface soil from the Site.

SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls, can provide long-term effectiveness by preventing incidental contact with impacted soil; however, SO Alternative 2 does not provide a permanent remedy.

No long-term effectiveness or permanence is provided by SO Alternative 1, No Further Action.

### 8.2.6 IMPLEMENTABILITY

The soil remedial alternatives are ranked as follows for implementability:

i) SO Alternative 1, No Further Action.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls.

iv) SO Alternative 4, Unrestricted Use Alternative.

SO Alternative 1 would be the most implementable since there would be no work involved.

SO Alternative 2 includes monitoring at existing on-Site wells. This alternative would require sampling of the existing wells. Additionally, the manufacturing building floor slab would need to remain in place and be maintained.

SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls, and SO Alternative 4, Unrestricted Use Alternative, would be more difficult to implement, with SO Alternative 4 being the most difficult to implement due to the greater volume of soils to be excavated.

### 8.2.7 LAND USE

The soil remedial alternatives are ranked as follows relative to compatibility with future land use:

i) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls.

iii) SO 4 Unrestricted Use Alternative.

iv) SO Alternative 1, No Further Action.

SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls is compatible with future land use as it would reduce the volume, toxicity, and volume of COCs in soils.

SO Alternative 2, Monitored Attenuation with Institutional and Engineering Controls, is compatible although the impacted soils will remain in place. The institutional controls will mitigate worker exposure through safe work practices.

SO Alternative 4 is excessive with regard to future land use as the Site would meet Unrestricted Use Criteria. The future intended use of the Site is to remain industrial and/or commercial land. The Site is an active manufacturing facility in an urban area surrounded by a mix of industrial, commercial, and residential activities.

SO Alternative 1, No Further Action, is not compatible with future land use.

#### 8.2.8 COST

The cost associated with the implementation of the soil remedial alternatives is lowest for SO Alternative 1, No Further Action ($0). The cost of SO Alternative 2 ranges from $11,000 to $43,000, while the cost of SO Alternative 3 is $240,000. The cost for the Unrestricted Use Alternative is $4,562,000. There is a high degree of uncertainty associated with the cost of SO Alternative 3 and the Unrestricted Use Alternative. These uncertainties include the ultimate extent of the excavations, the unknown characterization of the excavated materials for disposal, and the handling of excavated soils and water should excavation have to be conducted during wet periods. There will be no additional benefit realized with the additional costs associated with SO Alternative 4, Unrestricted Use Alternative. The Site is an active manufacturing facility in an urban area surrounded by a mix of industrial, commercial, and residential activities. There is no real possibility that this Site would be redeveloped at any time in the future as anything other that industrial or commercial property.

## 9.0 RECOMMENDED REMEDIAL ALTERNATIVE

Table 9.1 provides a summary of the remedial alternatives and associated costs. The remedial Alternative recommended for the Site is a combination of remedial alternatives for groundwater and soil. The recommended remedial Alternative is:

i) GW Alternative 4, In-Situ Chemical Oxidation with Enhanced Biodegradation and Institutional Control - $695,000.

ii) SO Alternative 2, Monitored Natural Attenuation with Institutional and Engineering Controls - $11,000.

iii) SO Alternative 3, Excavation and Disposal with Institutional and Engineering Controls - $240,000.

This combination of remedial alternatives will achieve the RAOs for each of the environmental media as discussed previously in this AAR.

The total estimated cost of the recommended remedial Alternative is $946,000.

## 10.0 REFERENCES


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Conestoga-Rovers & Associates, Inc., Supplemental Site Investigation Report and Qualitative Human Health Exposure Assessment, Niagara Ceramics 51 Hayes Place, Buffalo, New York, June 2006.

Conestoga-Rovers & Associates, Inc., Fish and Wildlife Impact Assessment for the Former Buffalo China Site, April, 2008.

6 NYCRR Part 375 Environmental Remediation Programs, Effective December 14, 2006.

New York State Department of Environmental Conservation Division of Environmental Remediation Draft Technical Guidance for Site Investigation and Remediation, December 2002.

New York State Department of Environmental Conservation Division of Environmental Remediation Draft Brownfield Cleanup Guide, May 2004.

6 NYCRR Part 701, "Classifications-Surface Waters and Groundwaters"

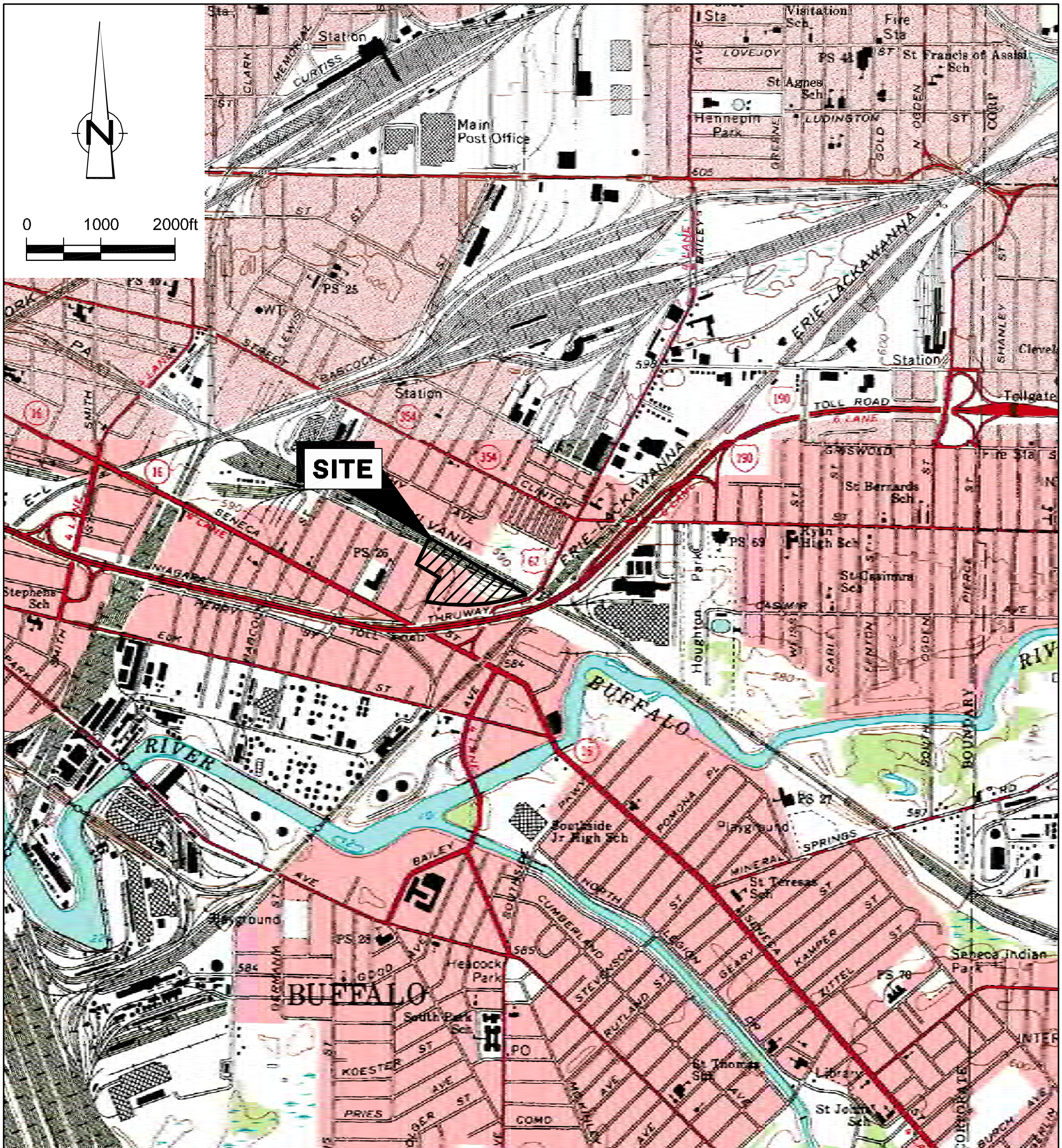
Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, Reissued June 1998 [TOGS 1.1.1]

Federal Remediation Technologies Roundtable, "Remediation Technologies Screening Matrix and Reference Guide," Version 4.0

CRA. 2008. Fish and Wildlife Impact Assessment for the Former Buffalo China Site. April, 2008

USEPA, 2008. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics. EPA-600-R-02-016. Office of Research and Development. Washington, DC 20460

FIGURES




REFERENCE:

UNITED STATES GEOLOGIC SURVEY BUFFALO NE, BUFFALO SE QUADRANGLE, NY
TOPOGRAPHIC, 7.5 MINUTES SERIES 1965
SCALE: 1:24,000

figure 1.1

SITE LOCATION MAP
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU012 MAR 15/2010

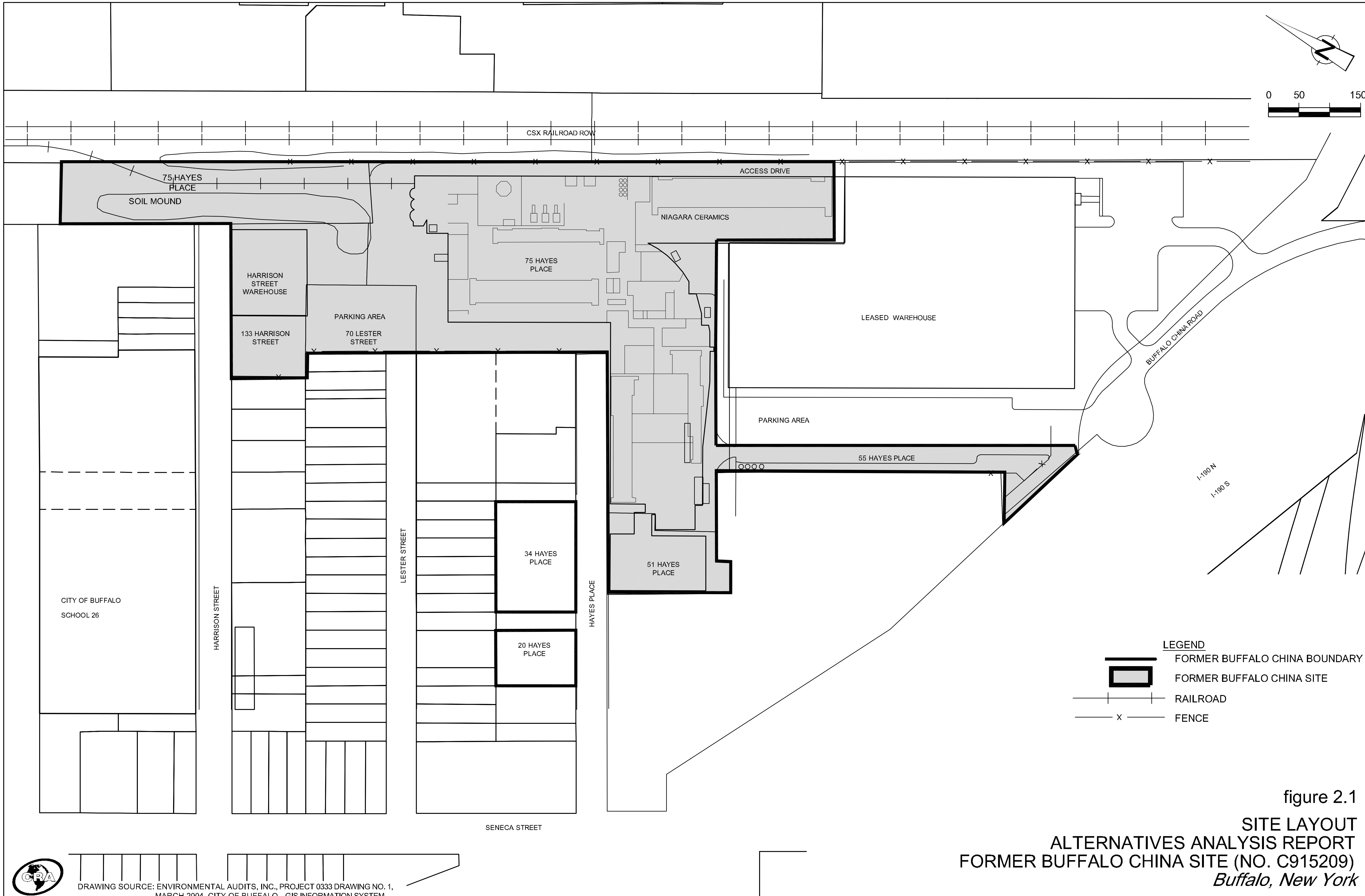



figure 2.1

SITE LAYOUT
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU013 MAR 15/2010

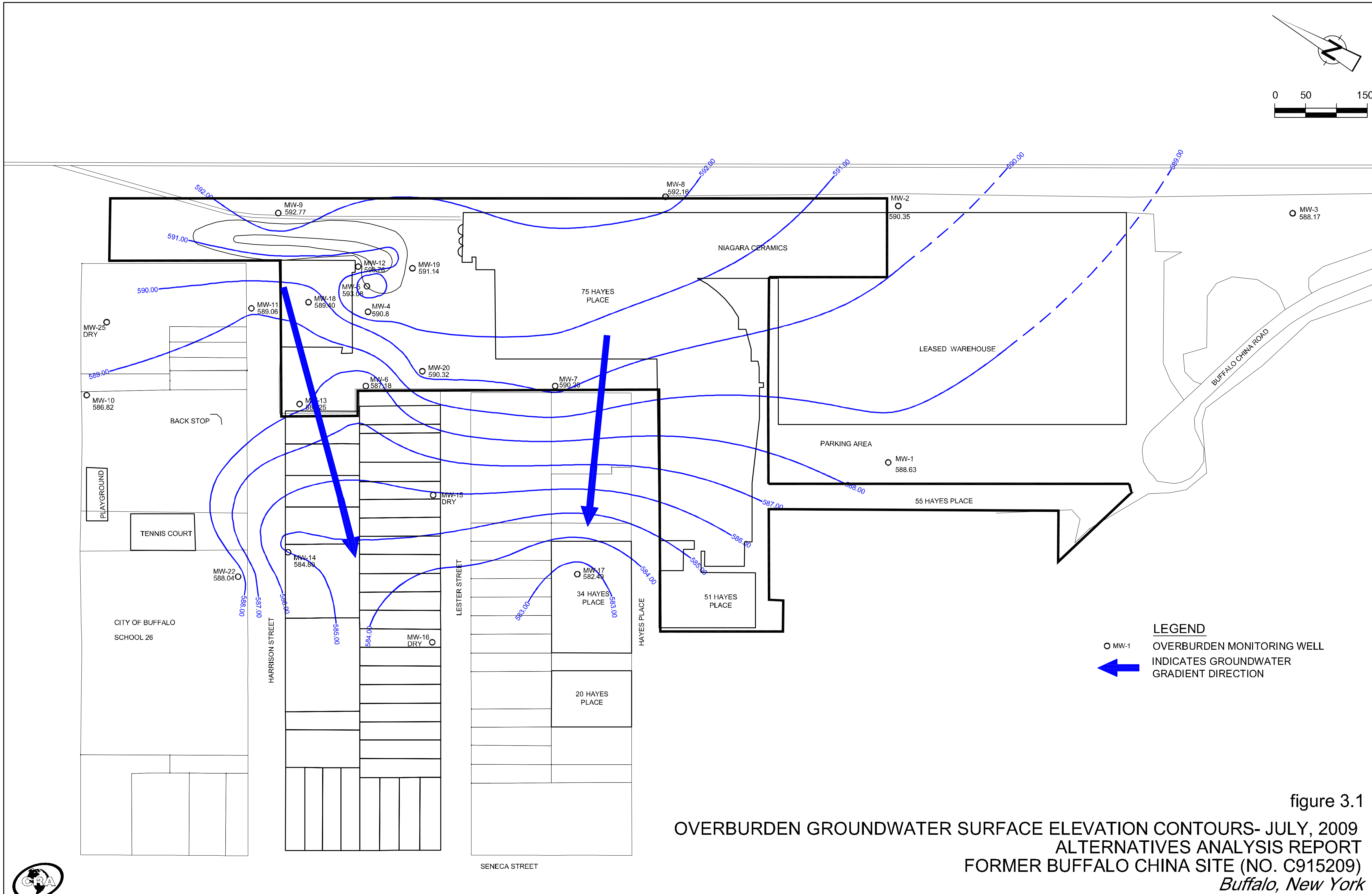



figure 3.1

OVERBURDEN GROUNDWATER SURFACE ELEVATION CONTOURS- JULY, 2009
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU004 MAR 15/2010

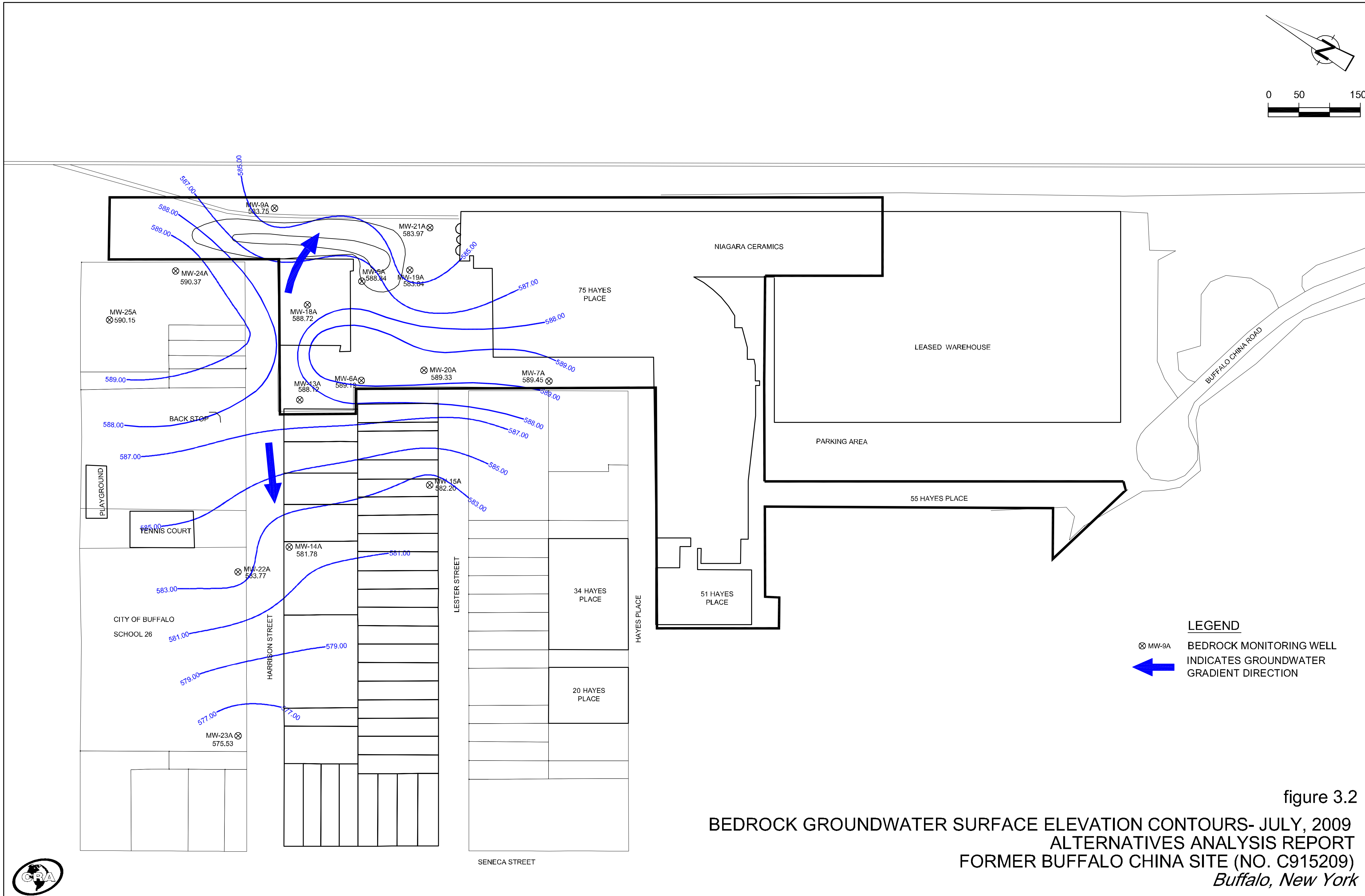
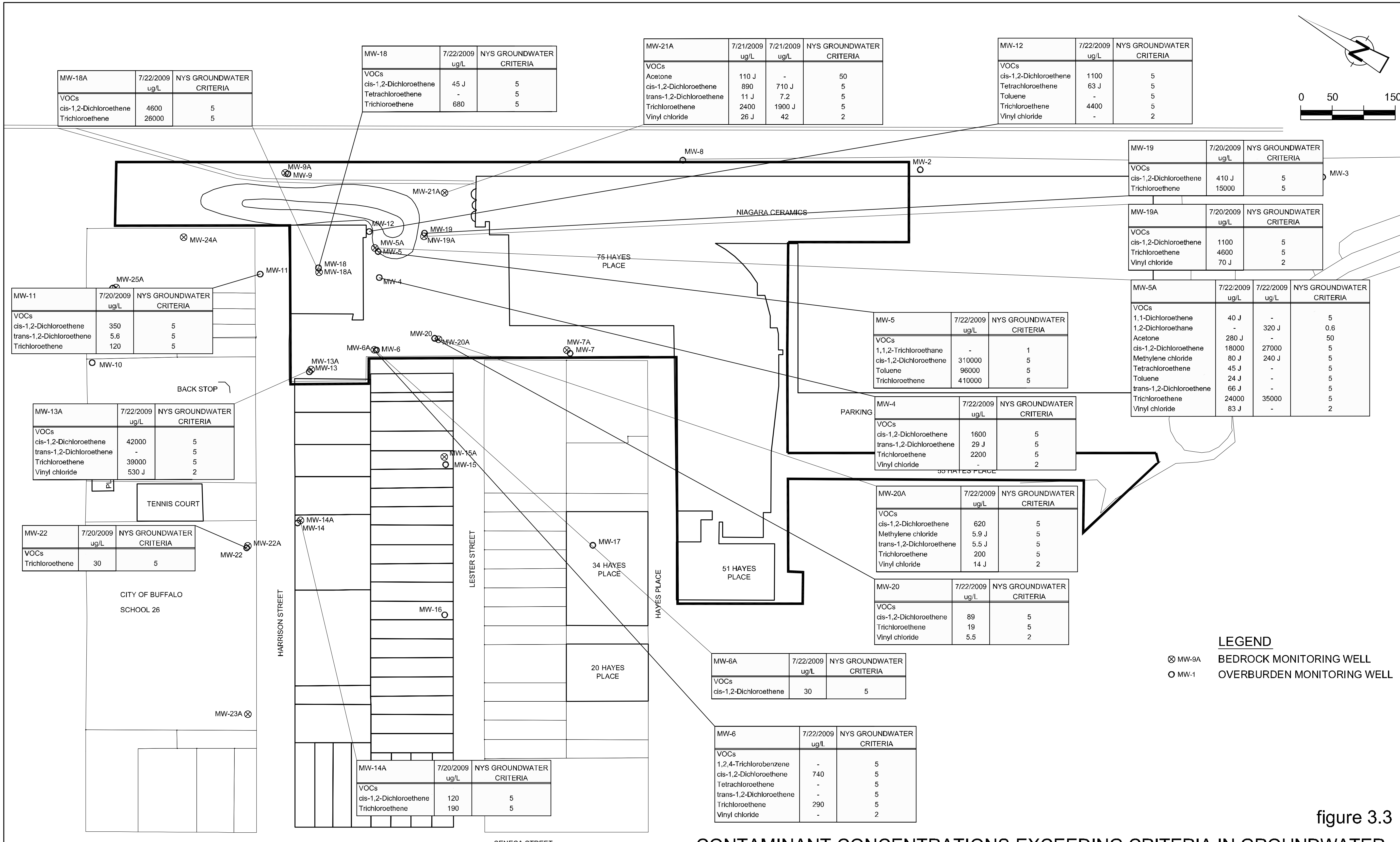



figure 3.2

BEDROCK GROUNDWATER SURFACE ELEVATION CONTOURS- JULY, 2009
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU005 MAR 15/2010




| MW-18A | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 4600 | 5 |
| Trichloroethene | 26000 | 5 |

| MW-18 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 45 J | 5 |
| Tetrachloroethene | - | 5 |
| Trichloroethene | 680 | 5 |

| MW-21A | 7/21/2009 ug/L | 7/21/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|---|
| VOCs | | | |
| Acetone | 110 J | - | 50 |
| cis-1,2-Dichloroethene | 890 | 710 J | 5 |
| trans-1,2-Dichloroethene | 11 J | 7.2 | 5 |
| Trichloroethene | 2400 | 1900 J | 5 |
| Vinyl chloride | 26 J | 42 | 2 |

| MW-12 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 1100 | 5 |
| Tetrachloroethene | 63 J | 5 |
| Toluene | - | 5 |
| Trichloroethene | 4400 | 5 |
| Vinyl chloride | - | 2 |

| MW-19 | 7/20/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 410 J | 5 |
| Trichloroethene | 15000 | 5 |

| MW-19A | 7/20/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 1100 | 5 |
| Trichloroethene | 4600 | 5 |
| Vinyl chloride | 70 J | 2 |

| MW-11 | 7/20/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 350 | 5 |
| trans-1,2-Dichloroethene | 5.6 | 5 |
| Trichloroethene | 120 | 5 |

| MW-5A | 7/22/2009 ug/L | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|---|
| VOCs | | | |
| 1,1-Dichloroethene | 40 J | - | 5 |
| 1,2-Dichloroethane | - | 320 J | 0.6 |
| Acetone | 280 J | - | 50 |
| cis-1,2-Dichloroethene | 18000 | 27000 | 5 |
| Methylene chloride | 80 J | 240 J | 5 |
| Tetrachloroethene | 45 J | - | 5 |
| Toluene | 24 J | - | 5 |
| trans-1,2-Dichloroethene | 66 J | - | 5 |
| Trichloroethene | 24000 | 35000 | 5 |
| Vinyl chloride | 83 J | - | 2 |

| MW-5 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| 1,1,2-Trichloroethane | - | 1 |
| cis-1,2-Dichloroethene | 310000 | 5 |
| Toluene | 96000 | 5 |
| Trichloroethene | 410000 | 5 |

| MW-13A | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 42000 | 5 |
| trans-1,2-Dichloroethene | - | 5 |
| Trichloroethene | 39000 | 5 |
| Vinyl chloride | 530 J | 2 |

| MW-4 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 1600 | 5 |
| trans-1,2-Dichloroethene | 29 J | 5 |
| Trichloroethene | 2200 | 5 |
| Vinyl chloride | - | 2 |

| MW-20A | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 620 | 5 |
| Methylene chloride | 5.9 J | 5 |
| trans-1,2-Dichloroethene | 5.5 J | 5 |
| Trichloroethene | 200 | 5 |
| Vinyl chloride | 14 J | 2 |

| MW-22 | 7/20/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| Trichloroethene | 30 | 5 |

| MW-20 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 89 | 5 |
| Trichloroethene | 19 | 5 |
| Vinyl chloride | 5.5 | 2 |

| MW-6A | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 30 | 5 |

| MW-6 | 7/22/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| 1,2,4-Trichlorobenzene | - | 5 |
| cis-1,2-Dichloroethene | 740 | 5 |
| Tetrachloroethene | - | 5 |
| trans-1,2-Dichloroethene | - | 5 |
| Trichloroethene | 290 | 5 |
| Vinyl chloride | - | 2 |

| MW-14A | 7/20/2009 ug/L | NYS GROUNDWATER CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 120 | 5 |
| Trichloroethene | 190 | 5 |

figure 3.3

# CONTAMINANT CONCENTRATIONS EXCEEDING CRITERIA IN GROUNDWATER

ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

GROUNDWATER CRITERIA USED FOR EVALUATION OF ANALYTICAL RESULTS - NYSDEC TOGS 1.1.1 AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES AND GROUNDWATER EFFLUENT LIMITATIONS JUNE 1998, JANUARY 1999 ERRATA SHEET, APRIL 2000 ADDENDUM, JUNE 2004 ADDENDUM.

37191-00(009)GN-BU007 MAR 26/2010

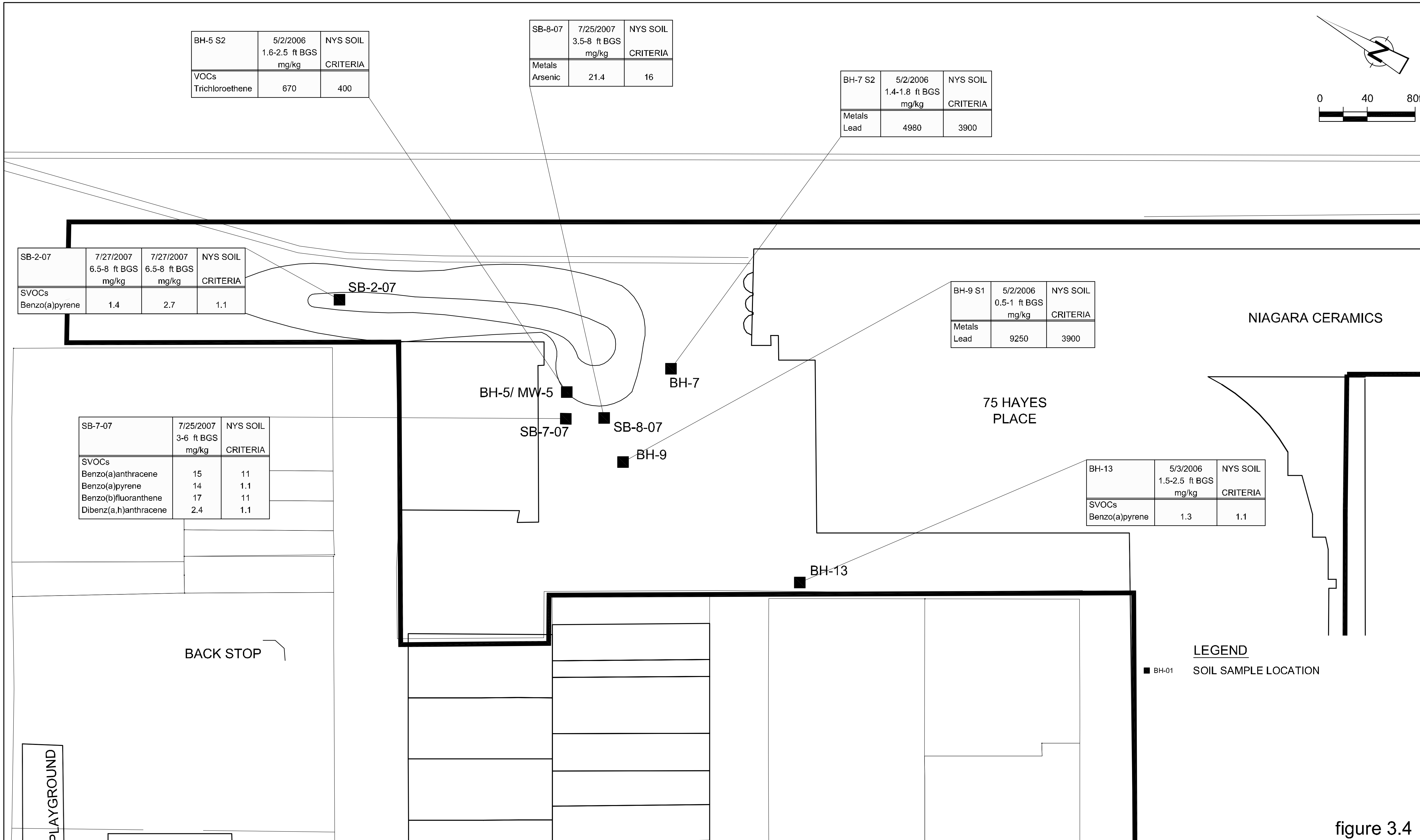


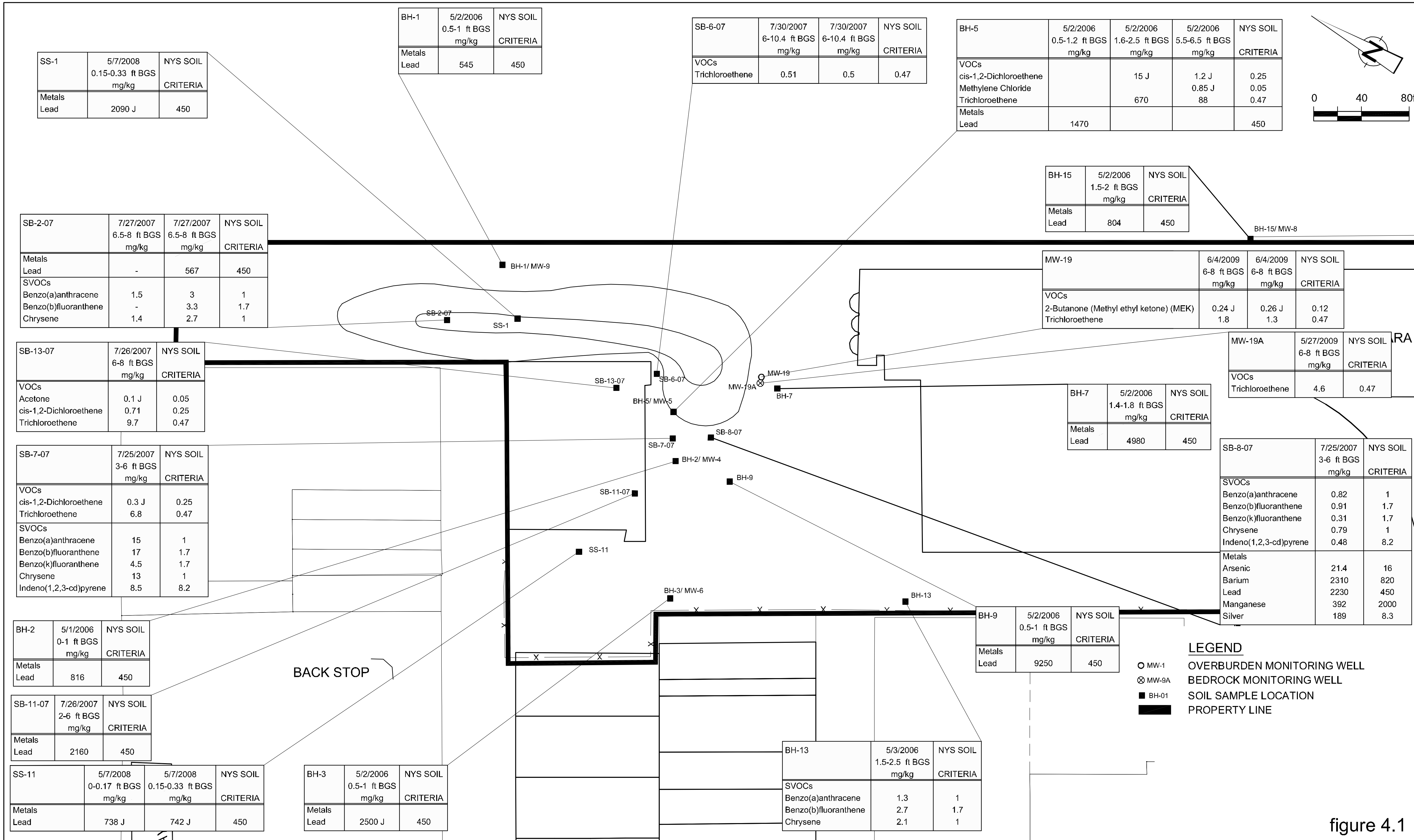

figure 3.4

CONTAMINANT CONCENTRATIONS EXCEEDING INDUSTRIAL USE CRITERIA IN SOIL
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

SOIL CRITERIA USED FOR EVALUATION OF ANALYTICAL RESULTS - 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES - PROTECTION OF PUBLIC HEALTH. INDUSTRIAL CRITERIA USED FOR ON-SITE LOCATIONS. RESIDENTIAL CRITERIA USED FOR OFF-SITE LOCATIONS.

CRA

37191-00(009)GN-BU026 MAR 15/2010




| SS-1 | 5/7/2008 0.15-0.33 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 2090 J | 450 |

| BH-1 | 5/2/2006 0.5-1 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 545 | 450 |

| SB-6-07 | 7/30/2007 6-10.4 ft BGS mg/kg | 7/30/2007 6-10.4 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|---|
| VOCs | | | |
| Trichloroethene | 0.51 | 0.5 | 0.47 |

| BH-5 | 5/2/2006 0.5-1.2 ft BGS mg/kg | 5/2/2006 1.6-2.5 ft BGS mg/kg | 5/2/2006 5.5-6.5 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|---|---|
| VOCs | | | | |
| cis-1,2-Dichloroethene | | 15 J | 1.2 J | 0.25 |
| Methylene Chloride | | | 0.85 J | 0.05 |
| Trichloroethene | | 670 | 88 | 0.47 |
| Metals | | | | |
| Lead | 1470 | | | 450 |

| BH-15 | 5/2/2006 1.5-2 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 804 | 450 |

| SB-2-07 | 7/27/2007 6.5-8 ft BGS mg/kg | 7/27/2007 6.5-8 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|---|
| Metals | | | |
| Lead | - | 567 | 450 |
| SVOCs | | | |
| Benzo(a)anthracene | 1.5 | 3 | 1 |
| Benzo(b)fluoranthene | - | 3.3 | 1.7 |
| Chrysene | 1.4 | 2.7 | 1 |

| MW-19 | 6/4/2009 6-8 ft BGS mg/kg | 6/4/2009 6-8 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|---|
| VOCs | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | 0.24 J | 0.26 J | 0.12 |
| Trichloroethene | 1.8 | 1.3 | 0.47 |

| SB-13-07 | 7/26/2007 6-8 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| VOCs | | |
| Acetone | 0.1 J | 0.05 |
| cis-1,2-Dichloroethene | 0.71 | 0.25 |
| Trichloroethene | 9.7 | 0.47 |

| MW-19A | 5/27/2009 6-8 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| VOCs | | |
| Trichloroethene | 4.6 | 0.47 |

| BH-7 | 5/2/2006 1.4-1.8 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 4980 | 450 |

| SB-7-07 | 7/25/2007 3-6 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| VOCs | | |
| cis-1,2-Dichloroethene | 0.3 J | 0.25 |
| Trichloroethene | 6.8 | 0.47 |
| SVOCs | | |
| Benzo(a)anthracene | 15 | 1 |
| Benzo(b)fluoranthene | 17 | 1.7 |
| Benzo(k)fluoranthene | 4.5 | 1.7 |
| Chrysene | 13 | 1 |
| Indeno(1,2,3-cd)pyrene | 8.5 | 8.2 |

| SB-8-07 | 7/25/2007 3-6 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| SVOCs | | |
| Benzo(a)anthracene | 0.82 | 1 |
| Benzo(b)fluoranthene | 0.91 | 1.7 |
| Benzo(k)fluoranthene | 0.31 | 1.7 |
| Chrysene | 0.79 | 1 |
| Indeno(1,2,3-cd)pyrene | 0.48 | 8.2 |
| Metals | | |
| Arsenic | 21.4 | 16 |
| Barium | 2310 | 820 |
| Lead | 2230 | 450 |
| Manganese | 392 | 2000 |
| Silver | 189 | 8.3 |

| BH-2 | 5/1/2006 0-1 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 816 | 450 |

| BH-9 | 5/2/2006 0.5-1 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 9250 | 450 |

| SB-11-07 | 7/26/2007 2-6 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 2160 | 450 |

| SS-11 | 5/7/2008 0-0.17 ft BGS mg/kg | 5/7/2008 0.15-0.33 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|---|
| Metals | | | |
| Lead | 738 J | 742 J | 450 |

| BH-3 | 5/2/2006 0.5-1 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| Metals | | |
| Lead | 2500 J | 450 |

| BH-13 | 5/3/2006 1.5-2.5 ft BGS mg/kg | NYS SOIL CRITERIA |
|---|---|---|
| SVOCs | | |
| Benzo(a)anthracene | 1.3 | 1 |
| Benzo(b)fluoranthene | 2.7 | 1.7 |
| Chrysene | 2.1 | 1 |

figure 4.1

CONTAMINANT CONCENTRATIONS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA IN SOIL
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

SOIL CRITERIA USED FOR EVALUATION OF ANALYTICAL RESULTS - 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR PROTECTION OF GROUNDWATER.

37191-00(009)GN-BU024 MAR 24/2010

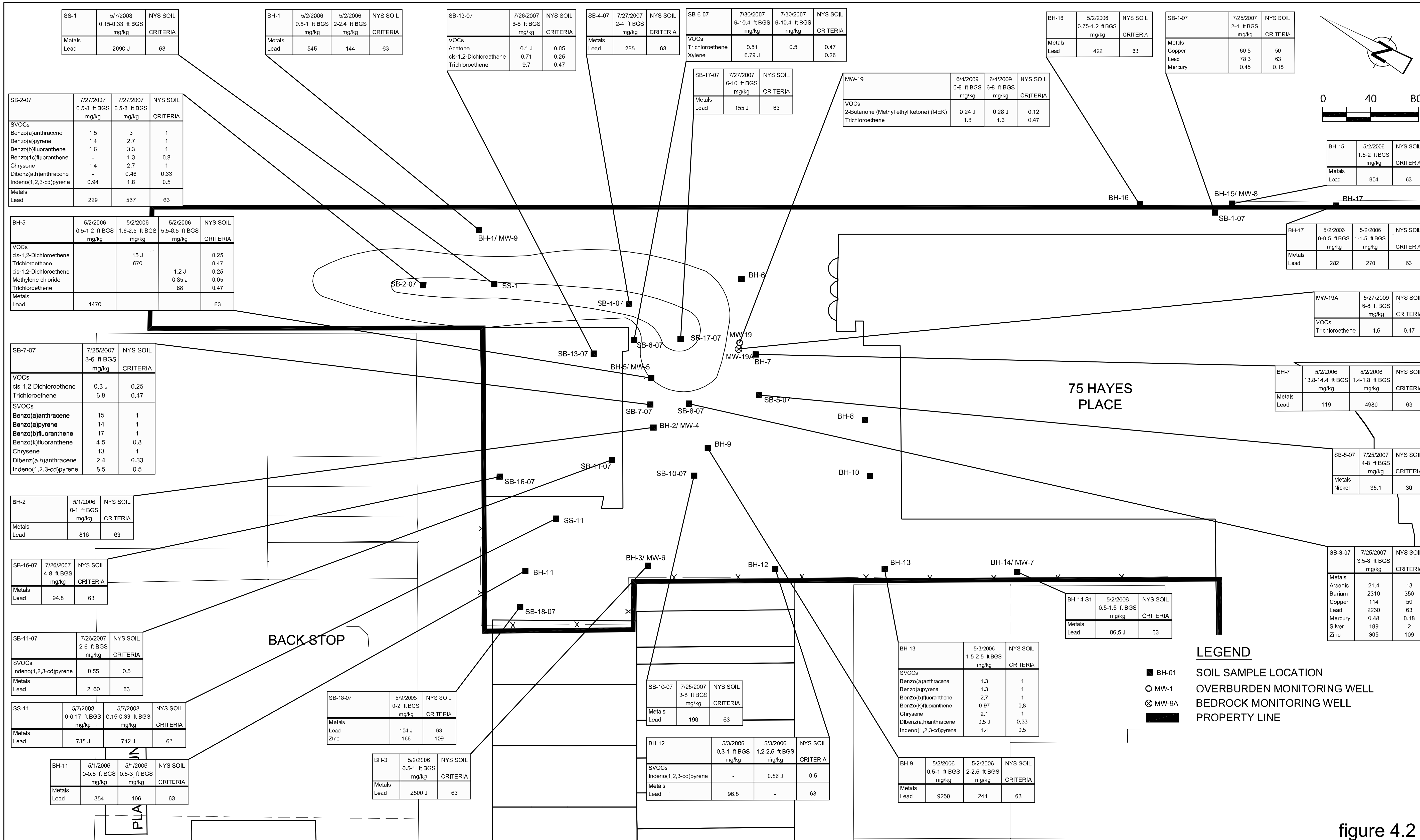


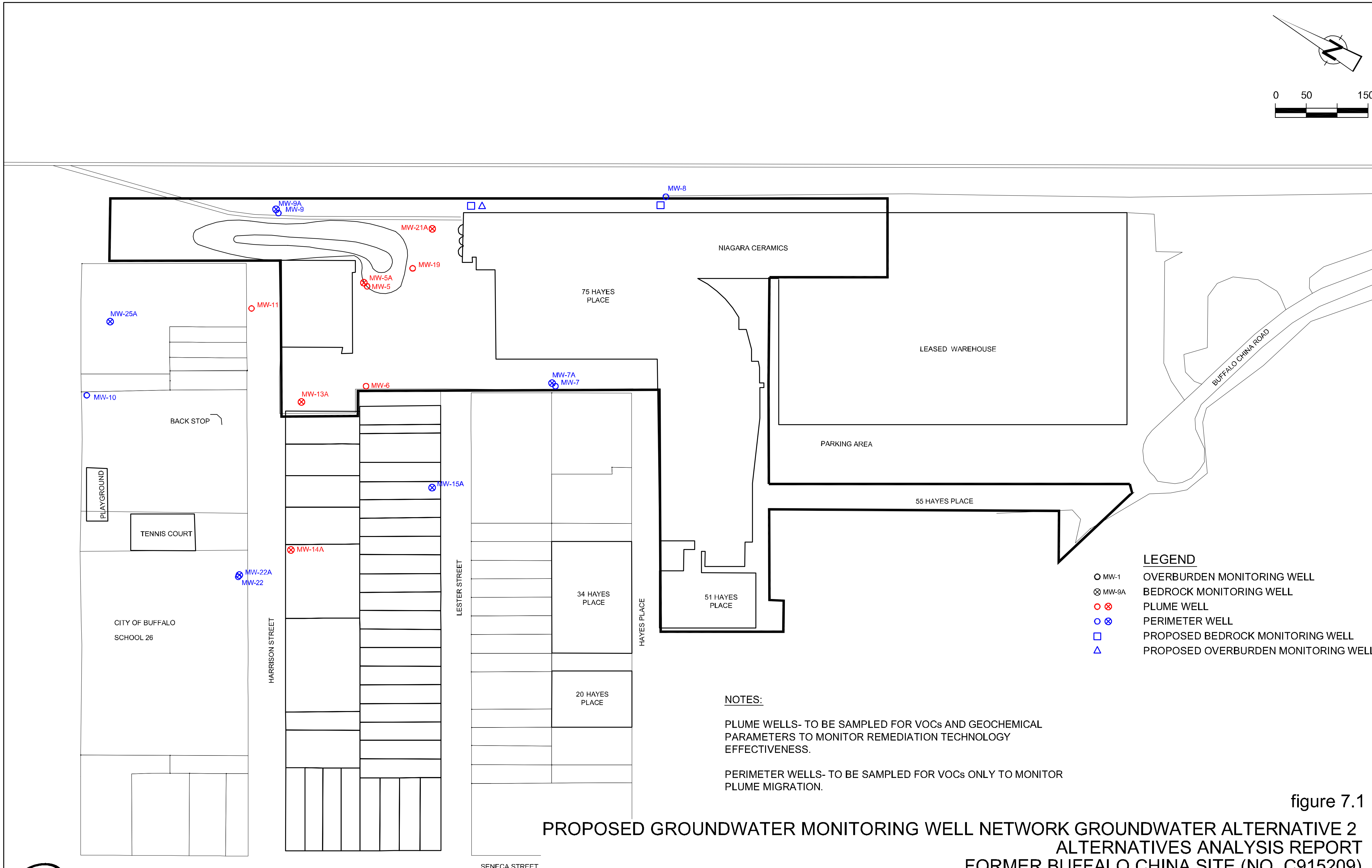

figure 4.2

CONTAMINANT CONCENTRATIONS EXCEEDING UNRESTRICTED USE CRITERIA IN SOIL
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

SOIL CRITERIA USED FOR EVALUATION OF ANALYTICAL RESULTS - 6 NYCRR PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES.

CRA

37191-00(009)GN-BU002 MAR 24/2010




LEGEND

MW-1 OVERBURDEN MONITORING WELL

MW-9A BEDROCK MONITORING WELL

PLUME WELL

PERIMETER WELL

PROPOSED BEDROCK MONITORING WELL

PROPOSED OVERBURDEN MONITORING WELL

NOTES:

PLUME WELLS- TO BE SAMPLED FOR VOCs AND GEOCHEMICAL PARAMETERS TO MONITOR REMEDIATION TECHNOLOGY EFFECTIVENESS.

PERIMETER WELLS- TO BE SAMPLED FOR VOCs ONLY TO MONITOR PLUME MIGRATION.

figure 7.1

PROPOSED GROUNDWATER MONITORING WELL NETWORK GROUNDWATER ALTERNATIVE 2
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU020 MAR 15/2010

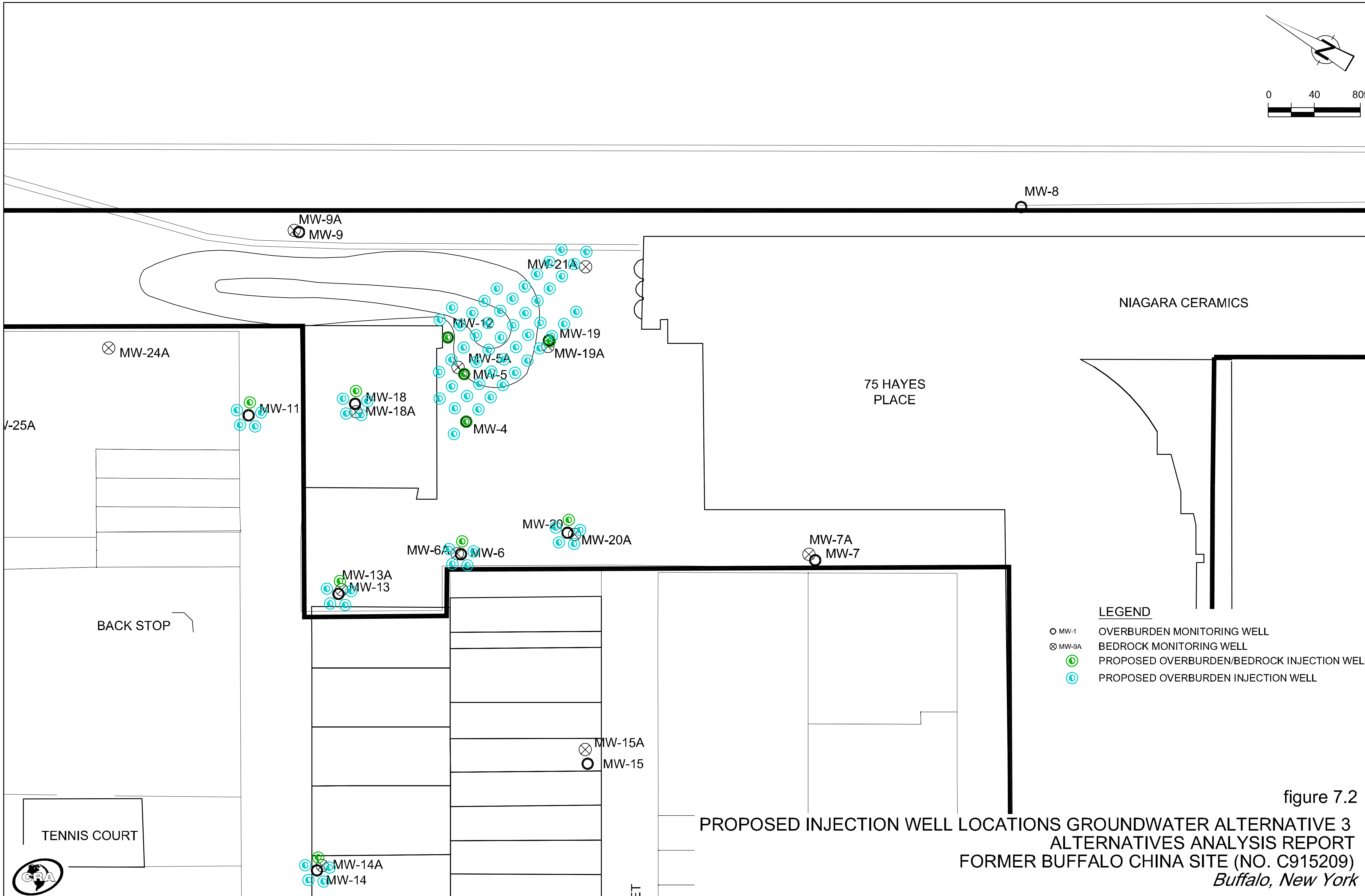



figure 7.2

PROPOSED INJECTION WELL LOCATIONS GROUNDWATER ALTERNATIVE 3
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU023 MAR 26/2010

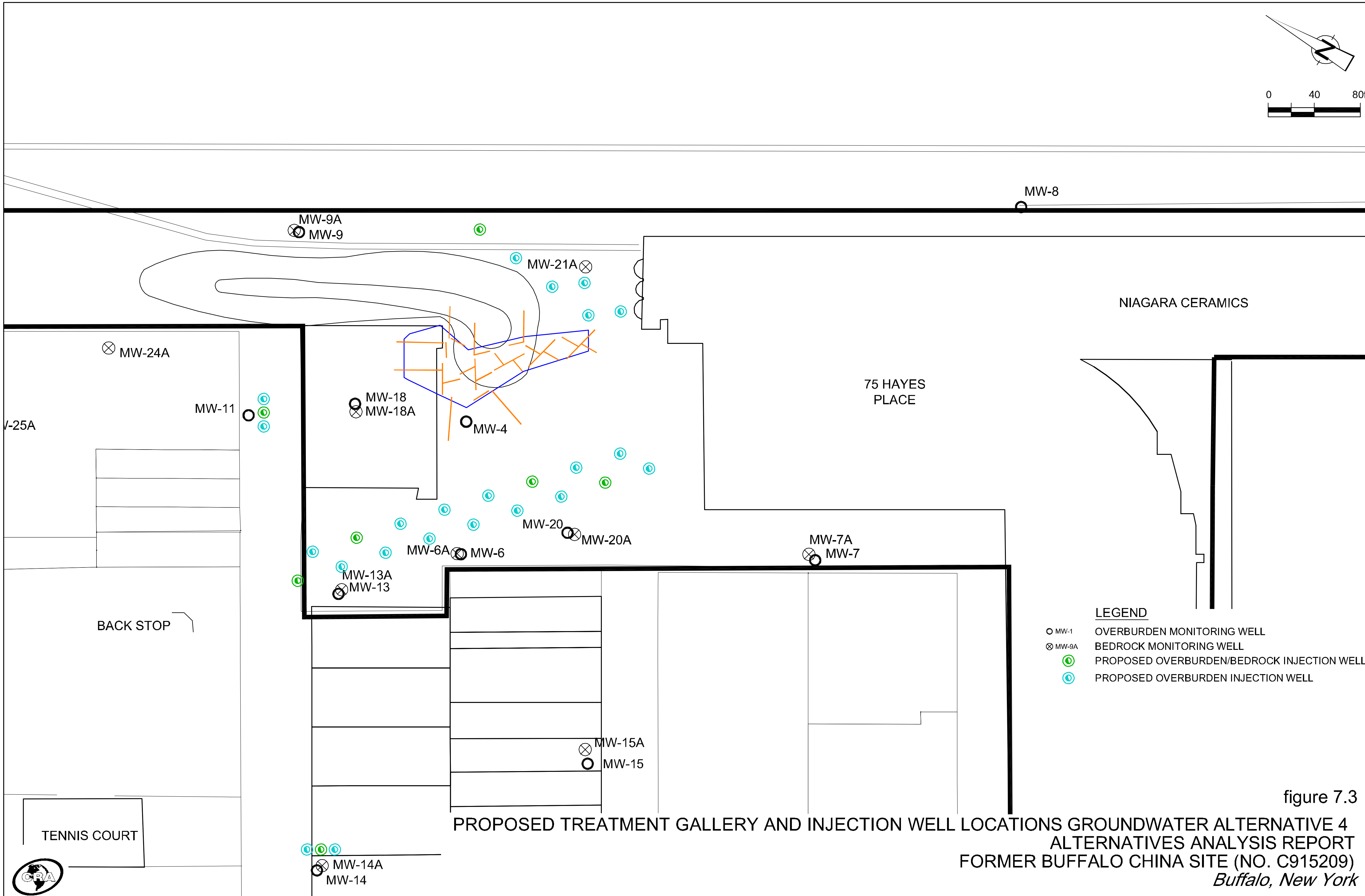



figure 7.3

PROPOSED TREATMENT GALLERY AND INJECTION WELL LOCATIONS GROUNDWATER ALTERNATIVE 4
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU035 MAR 26/2010

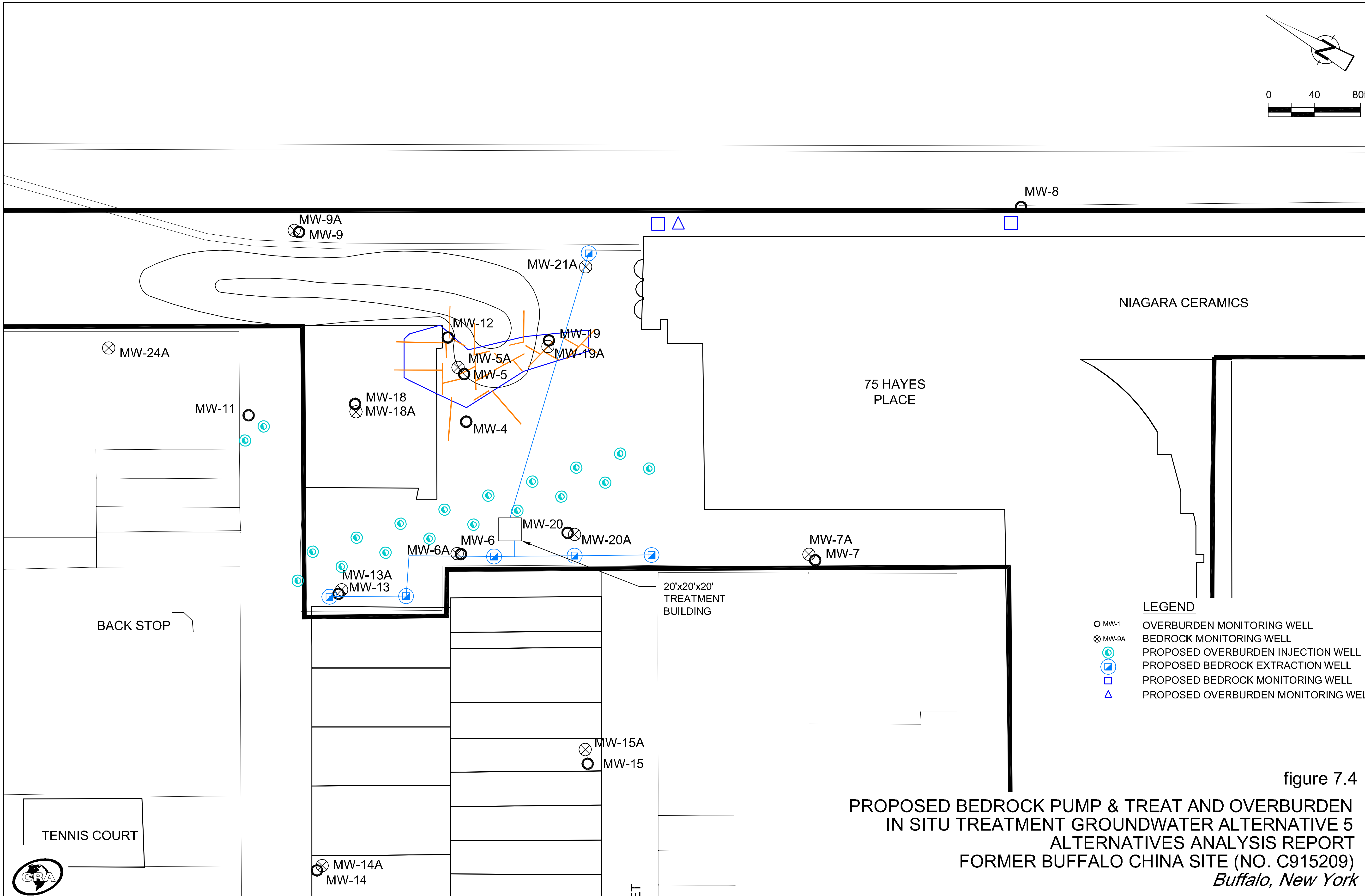



figure 7.4

PROPOSED BEDROCK PUMP & TREAT AND OVERBURDEN IN SITU TREATMENT GROUNDWATER ALTERNATIVE 5
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU036 APR 01/2010

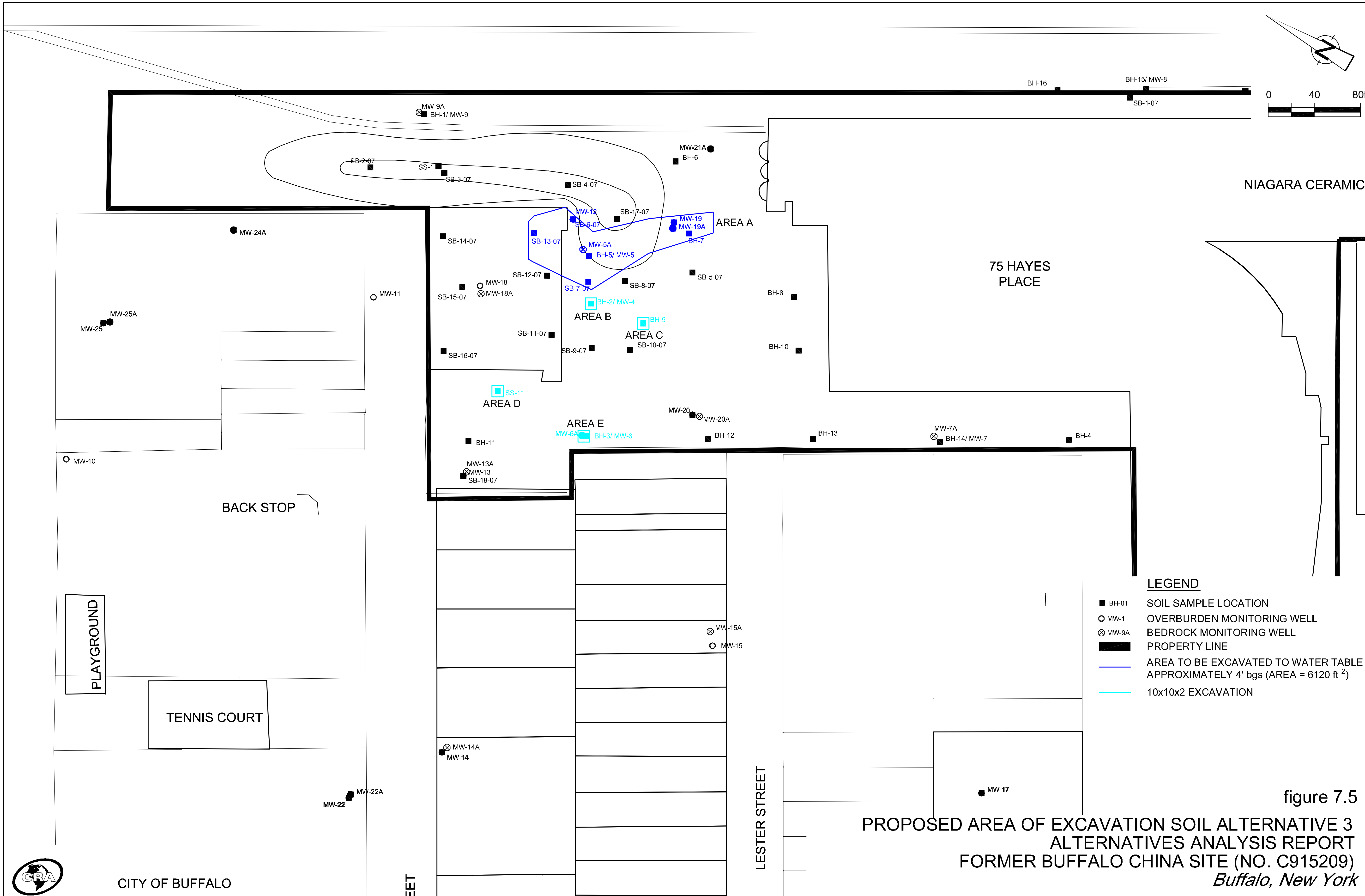



figure 7.5

PROPOSED AREA OF EXCAVATION SOIL ALTERNATIVE 3
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU033 MAR 16/2010

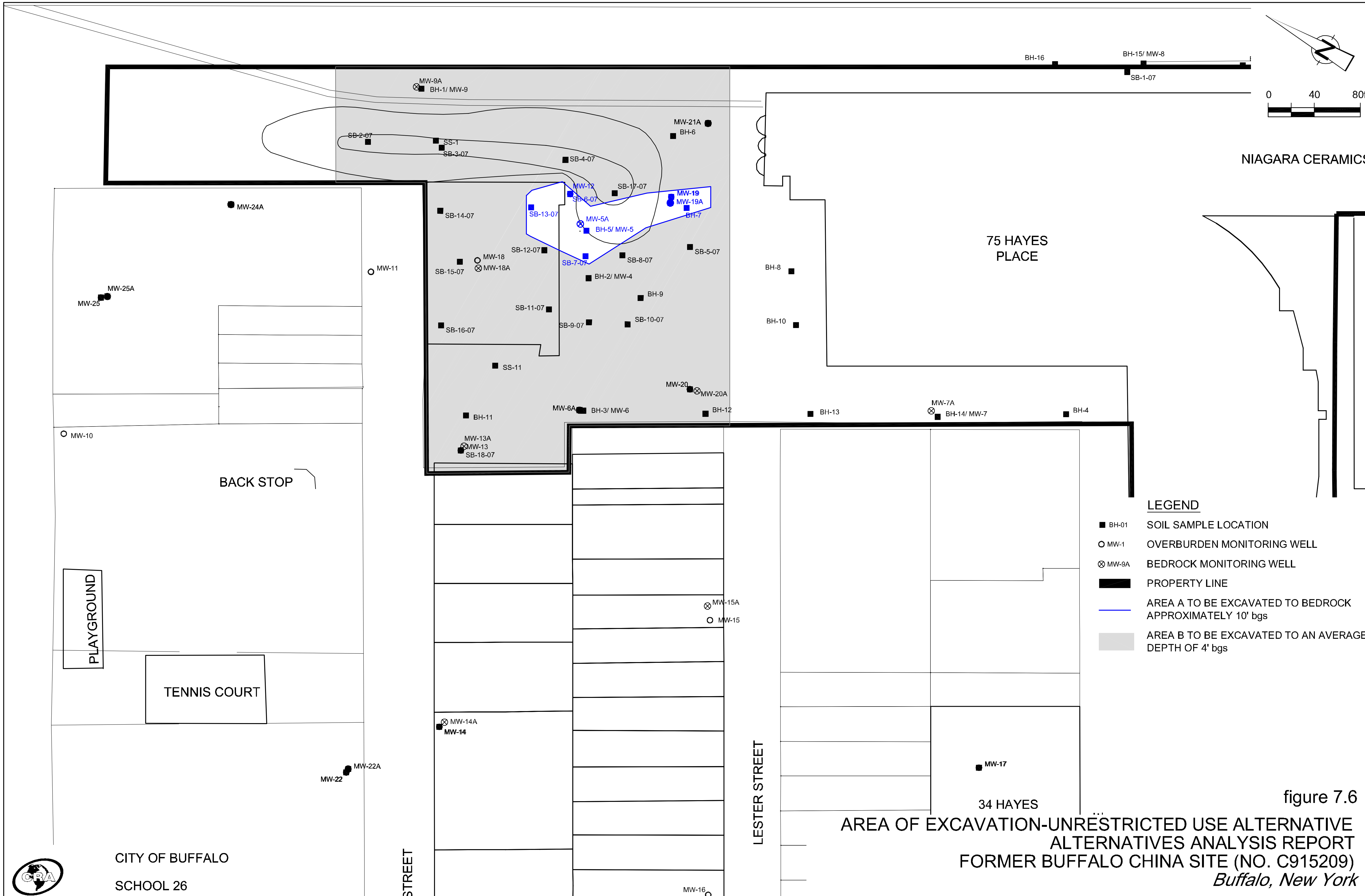



figure 7.6

AREA OF EXCAVATION-UNRESTRICTED USE ALTERNATIVE
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
*Buffalo, New York*

37191-00(009)GN-BU034 MAR 16/2010

TABLES

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | | *MW-4* | *MW-5* | *MW-5A* | *MW-5A* | *MW-6* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | | *WG-37191-072209-037* | *WG-37191-072209-040* | *WG-37191-072209-038* | *WG-37191-072209-039* | *WG-37191-072209-035* |
| *Sample Date:* | | | | *7/22/2009* | *7/22/2009* | *7/22/2009* | *7/22/2009* | *7/22/2009* |
| | | | | | | | *Duplicate* | |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 120 U | 20000 U | **40 J** | 1000 U | 50 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 120 U | 20000 U | 120 U | **320 J** | 50 U |
| Acetone | µg/L | NC | 50 | 500 U | 80000 U | **280 J** | 4000 U | 200 U |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | **1600** | **310000** | **18000** | **27000** | **740** |
| Methylene chloride | µg/L | 5 | NC | 120 U | 20000 U | **80 J** | **240 J** | 50 U |
| Tetrachloroethene | µg/L | 5 | NC | 120 U | 20000 U | **45 J** | 1000 U | 50 U |
| Toluene | µg/L | 5 | NC | 120 U | **96000** | **24 J** | 1000 U | 50 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | **29 J** | 20000 U | **66 J** | 1000 U | 50 U |
| Trichloroethene | µg/L | 5 | NC | **2200** | **410000** | **24000** | **35000** | **290** |
| Vinyl chloride | µg/L | 2 | NC | 120 U | 20000 U | **83 J** | 1000 U | 50 U |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

NC - No criteria.

µg/L - Micrograms per liter.

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | | *MW-6A* | *MW-7* | *MW-7A* | *MW-8* | *MW-9* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | | *WG-37191-072209-033* | *WG-37191-072209-030* | *WG-37191-072209-029* | *WG-37191-072109-018* | *WG-37191-072109-015* |
| *Sample Date:* | | | | *7/22/2009* | *7/22/2009* | *7/22/2009* | *7/21/2009* | *7/21/2009* |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Acetone | µg/L | NC | 50 | 22 J | 20 U | 20 U | 20 UJ | 20 UJ |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | **30** | 5.0 U | 0.90 J | 5.0 U | 5.0 U |
| Methylene chloride | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Tetrachloroethene | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Toluene | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Trichloroethene | µg/L | 5 | NC | 12 U | 5.0 U | 5.0 U | 1.1 J | 5.0 U |
| Vinyl chloride | µg/L | 2 | NC | 12 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

NC - No criteria.

µg/L - Micrograms per liter.

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | | *MW-9A* | *MW-10* | *MW-11* | *MW-12* | *MW-13A* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | | *WG-37191-072109-014* | *WG-37191-072009-011* | *WG-37191-072009-006* | *WG-37191-072209-036* | *WG-37191-072209-034* |
| *Sample Date:* | | | | *7/21/2009* | *7/20/2009* | *7/20/2009* | *7/22/2009* | *7/22/2009* |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | 1.5 J | 120 U | 1200 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 5.0 U | 5.0 U | 5.0 U | 120 U | 1200 U |
| Acetone | µg/L | NC | 50 | 20 UJ | 20 UJ | 12 J | 500 U | 5000 U |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | **350** | **1100** | **42000** |
| Methylene chloride | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 120 U | 1200 U |
| Tetrachloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | **63 J** | 1200 U |
| Toluene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 120 U | 1200 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | **5.6** | 120 U | 1200 U |
| Trichloroethene | µg/L | 5 | NC | 5.0 U | 0.86 J | **120** | **4400** | **39000** |
| Vinyl chloride | µg/L | 2 | NC | 5.0 U | 5.0 U | 5.0 U | 120 U | **530 J** |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

NC - No criteria.

µg/L - Micrograms per liter.

**TABLE 3.1**

**SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Location ID:* | | | | *MW-14A* | *MW-15A* | *MW-17* | *MW-18* | *MW-18A* |
| *Sample Name:* | | | | *WG-37191-072009-005* | *WG-37191-072009-012* | *WG-37191-072009-013* | *WG-37191-072209-042* | *WG-37191-072209-041* |
| *Sample Date:* | | | | *7/20/2009* | *7/20/2009* | *7/20/2009* | *7/22/2009* | *7/22/2009* |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 50 U | 1500 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 5.0 U | 5.0 U | 5.0 U | 50 U | 1500 U |
| Acetone | µg/L | NC | 50 | 20 UJ | 20 UJ | 11 J | 200 U | 6000 U |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | **120** | 1.1 J | 5.0 U | **45 J** | **4600** |
| Methylene chloride | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 50 U | 1500 U |
| Tetrachloroethene | µg/L | 5 | NC | 2.2 J | 5.0 U | 5.0 U | 50 U | 1500 U |
| Toluene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 50 U | 1500 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | 0.88 J | 5.0 U | 5.0 U | 50 U | 1500 U |
| Trichloroethene | µg/L | 5 | NC | **190** | 4.5 J | 5.0 U | **680** | **26000** |
| Vinyl chloride | µg/L | 2 | NC | 5.0 U | 5.0 U | 5.0 U | 50 U | 1500 U |

**1.0 -** Exceeds criteria.
U - Not present at the associated value.
J - Estimated concentration.
NC - No criteria.
µg/L - Micrograms per liter.

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | | *MW-19* | *MW-19A* | *MW-20* | *MW-20A* | *MW-21A* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | | *WG-37191-072009-002* | *WG-37191-072009-001* | *WG-37191-072209-032* | *WG-37191-072209-031* | *WG-37191-072109-016* |
| *Sample Date:* | | | | *7/20/2009* | *7/20/2009* | *7/22/2009* | *7/22/2009* | *7/21/2009* |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 500 U | 200 U | 1.3 J | 25 U | 50 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 500 U | 200 U | 5.0 U | 25 U | 50 U |
| Acetone | µg/L | NC | 50 | 2000 UJ | 800 UJ | 20 U | 100 U | **110 J** |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | **410 J** | **1100** | **89** | **620** | **890** |
| Methylene chloride | µg/L | 5 | NC | 500 U | 200 U | 5.0 U | **5.9 J** | 50 U |
| Tetrachloroethene | µg/L | 5 | NC | 500 U | 200 U | 5.0 U | 25 U | 50 U |
| Toluene | µg/L | 5 | NC | 500 U | 200 U | 5.0 U | 25 U | 50 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | 500 U | 200 U | 3.0 J | **5.5 J** | **11 J** |
| Trichloroethene | µg/L | 5 | NC | **15000** | **4600** | **19** | **200** | **2400** |
| Vinyl chloride | µg/L | 2 | NC | 500 U | **70 J** | **5.5** | **14 J** | **26 J** |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
NC - No criteria.
µg/L - Micrograms per liter.

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | | *MW-21A* | *MW-22* | *MW-22A* | *MW-23A* | *MW-23A* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | | *WG-37191-072109-017* | *WG-37191-072009-004* | *WG-37191-072009-003* | *WG-37191-072009-007* | *WG-37191-072009-008* |
| *Sample Date:* | | | | *7/21/2009* | *7/20/2009* | *7/20/2009* | *7/20/2009* | *7/20/2009* |
| | | | | *Duplicate* | | | | *Duplicate* |
| | | *New York State Water Quality* | | | | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 2.5 J | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 5.0 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Acetone | µg/L | NC | 50 | 20 UJ | 20 UJ | 11 J | 20 UJ | 20 UJ |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | **710 J** | 1.5 J | 5.0 U | 0.99 J | 5.0 U |
| Methylene chloride | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Tetrachloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Toluene | µg/L | 5 | NC | 5.0 U | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | **7.2** | 5.0 U | 5.0 U | 5.0 U | 5.0 U |
| Trichloroethene | µg/L | 5 | NC | **1900 J** | **30** | 5.0 U | 1.6 J | 5.0 U |
| Vinyl chloride | µg/L | 2 | NC | **42** | 5.0 U | 5.0 U | 5.0 U | 5.0 U |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
NC - No criteria.
µg/L - Micrograms per liter.

# TABLE 3.1

## SUMMARY OF GROUNDWATER ANALYTICAL RESULTS EXCEEDING CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | |
|---|---|---|---|---|---|
| *Location ID:* | | | | *MW-24A* | *MW-25A* |
| *Sample Name:* | | | | *WG-37191-072009-010* | *WG-37191-072009-009* |
| *Sample Date:* | | | | *7/20/2009* | *7/20/2009* |
| | | *New York State Water Quality* | | | |
| *Parameters* | *Units* | *Standards* | *Guidance Values* | | |
| *Volatile Organic Compounds* | | | | | |
| 1,1-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U |
| 1,2-Dichloroethane | µg/L | 0.6 | NC | 5.0 U | 5.0 U |
| Acetone | µg/L | NC | 50 | 20 UJ | 11 J |
| cis-1,2-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U |
| Methylene chloride | µg/L | 5 | NC | 5.0 U | 5.0 U |
| Tetrachloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U |
| Toluene | µg/L | 5 | NC | 5.0 U | 5.0 U |
| trans-1,2-Dichloroethene | µg/L | 5 | NC | 5.0 U | 5.0 U |
| Trichloroethene | µg/L | 5 | NC | 5.0 U | 1.1 J |
| Vinyl chloride | µg/L | 2 | NC | 5.0 U | 5.0 U |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
NC - No criteria.
µg/L - Micrograms per liter.

# TABLE 3.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING INDUSTRIAL USE CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *BH-5 S2* | *BH-7 S2* | *BH-9 S1* | *BH-13 S2* | *MW-17* |
| *Sample Name:* | | | *S-37191-050206-PK-021* | *S-37191-050206-PK-014* | *S-37191-050206-PK-018* | *S-37191-050306-PK-036* | *SB-37191-050908-JP-002* |
| *Sample Date:* | | | *5/2/2006* | *5/2/2006* | *5/2/2006* | *5/3/2006* | *5/9/2008* |
| *Depth:* | | | *1.6-2.5 ft BGS* | *1.4-1.8 ft BGS* | *0.5-1 ft BGS* | *1.5-2.5 ft BGS* | *0-2 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(b): Restricted Use Soil Cleanup Objectives - Industrial* | | | | | |
| *Volatile Organic Compounds* | | | | | | | |
| Trichloroethene | mg/kg | 400 | **670** | -- | -- | 0.0014 J | 0.0058 U |
| *Semivolatile Organic Compounds* | | | | | | | |
| Benzo(a)anthracene | mg/kg | 11 | 0.26 J | -- | -- | 1.3 | 3.7 |
| Benzo(a)pyrene | mg/kg | 1.1 | 0.11 J | -- | -- | **1.3** | **2.8** |
| Benzo(b)fluoranthene | mg/kg | 11 | 0.24 J | -- | -- | 2.7 | 5 |
| Dibenz(a,h)anthracene | mg/kg | 1.1 | 0.38 U | -- | -- | 0.5 J | 0.66 |
| *Metals* | | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | -- | 5.2 |
| Lead | mg/kg | 3900 | 16.7 | **4980** | **9250** | 53.2 | 87.3 J |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 3.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING INDUSTRIAL USE CRITERA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | *SB-2-07* | *SB-2-07* | *SB-7-07* | *SB-8-07* |
|---|---|---|---|---|---|---|
| *Sample Name:* | | | *SO-37191-072707-RN-SB-2* | *SO-37191-072707-RN-SB-20* | *SO-37191-072507-RN-SB-7* | *SO-37191-072507-RN-SB-8* |
| *Sample Date:* | | | *7/27/2007* | *7/27/2007* | *7/25/2007* | *7/25/2007* |
| *Depth:* | | | *6.5-8 ft BGS* | *6.5-8 ft BGS* | *3-6 ft BGS* | *3.5-8 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | | *Duplicate* | | |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(b): Restricted Use Soil Cleanup Objectives - Industrial* | | | | |
| ***Volatile Organic Compounds*** | | | | | | |
| Trichloroethene | mg/kg | 400 | 0.0019 J | 0.0067 U | 6.8 | 0.058 |
| ***Semivolatile Organic Compounds*** | | | | | | |
| Benzo(a)anthracene | mg/kg | 11 | 1.5 | 3 | **15** | 0.82 |
| Benzo(a)pyrene | mg/kg | 1.1 | **1.4** | **2.7** | **14** | 0.69 |
| Benzo(b)fluoranthene | mg/kg | 11 | 1.6 | 3.3 | **17** | 0.91 |
| Dibenz(a,h)anthracene | mg/kg | 1.1 | 0.23 | 0.46 | **2.4** | 0.14 |
| ***Metals*** | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | **21.4** |
| Lead | mg/kg | 3900 | 229 | 567 | 46.0 | 2230 |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.1

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | *BH-1 S1* | *BH-2 S1* | *BH-3 S1* | *BH-5 S1* | *BH-5 S2* |
|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | *S-37191-050206-PK-023* | *S-37191-050106-JRR-001* | *S-37191-050206-PK-027* | *S-37191-050206-PK-020* | *S-37191-050206-PK-021* |
| *Sample Date:* | | | *5/2/2006* | *5/1/2006* | *5/2/2006* | *5/2/2006* | *5/2/2006* |
| *Depth:* | | | *0.5-1 ft BGS* | *0-1 ft BGS* | *0.5-1 ft BGS* | *0.5-1.2 ft BGS* | *1.6-2.5 ft BGS* |
| *On/Off - Site* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| ***Parameters*** | ***Units*** | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | | | |
| ***Volatile Organic Compounds*** | | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | -- | -- | -- | -- | 29 U |
| Acetone | mg/kg | 0.05 | -- | -- | -- | -- | 120 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | -- | -- | -- | -- | **15 J** |
| Methylene chloride | mg/kg | 0.05 | -- | -- | -- | -- | 29 U |
| Tetrachloroethene | mg/kg | 1.3 | -- | -- | -- | -- | 29 U |
| Trichloroethene | mg/kg | 0.47 | -- | -- | -- | -- | **670** |
| ***Semivolatile Organic Compounds*** | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | -- | -- | -- | 0.26 J |
| Benzo(b)fluoranthene | mg/kg | 1.7 | -- | -- | -- | -- | 0.24 J |
| Benzo(k)fluoranthene | mg/kg | 1.7 | -- | -- | -- | -- | 0.38 U |
| Chrysene | mg/kg | 1 | -- | -- | -- | -- | 0.38 U |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | -- | -- | -- | -- | 0.091 J |
| ***Metals*** | | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | -- | -- |
| Barium | mg/kg | 820 | -- | -- | -- | -- | -- |
| Lead | mg/kg | 450 | **545** | **816** | **2500 J** | **1470** | 16.7 |
| Manganese | mg/kg | 2000 | -- | -- | -- | -- | -- |
| Silver | mg/kg | 8.3 | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

**TABLE 4.1**

**SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ***Location ID:*** | | | ***BH-5 S3*** | ***BH-7 S2*** | ***BH-9 S1*** | ***BH-13 S2*** | ***BH-15 S1*** |
| ***Sample Name:*** | | | ***S-37191-050206-PK-022*** | ***S-37191-050206-PK-014*** | ***S-37191-050206-PK-018*** | ***S-37191-050306-PK-036*** | ***S-37191-050206-PK-007*** |
| ***Sample Date:*** | | | ***5/2/2006*** | ***5/2/2006*** | ***5/2/2006*** | ***5/3/2006*** | ***5/2/2006*** |
| ***Depth:*** | | | ***5.5-6.5 ft BGS*** | ***1.4-1.8 ft BGS*** | ***0.5-1 ft BGS*** | ***1.5-2.5 ft BGS*** | ***1.5-2 ft BGS*** |
| ***On/Off - Site*** | | | ***On-Site*** | ***On-Site*** | ***On-Site*** | ***On-Site*** | ***On-Site*** |
| ***Parameters*** | ***Units*** | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | | | |
| ***Volatile Organic Compounds*** | | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | 2.9 U | -- | -- | R | -- |
| Acetone | mg/kg | 0.05 | 11 U | -- | -- | R | -- |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | **1.2 J** | -- | -- | 0.0066 U | -- |
| Methylene chloride | mg/kg | 0.05 | **0.85 J** | -- | -- | 0.0066 U | -- |
| Tetrachloroethene | mg/kg | 1.3 | 1.3 J | -- | -- | 0.0066 U | -- |
| Trichloroethene | mg/kg | 0.47 | **88** | -- | -- | 0.0014 J | -- |
| ***Semivolatile Organic Compounds*** | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.38 U | -- | -- | **1.3** | -- |
| Benzo(b)fluoranthene | mg/kg | 1.7 | 0.065 J | -- | -- | **2.7** | -- |
| Benzo(k)fluoranthene | mg/kg | 1.7 | 0.028 J | -- | -- | 0.97 | -- |
| Chrysene | mg/kg | 1 | 0.38 U | -- | -- | **2.1** | -- |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | 0.03 J | -- | -- | 1.4 | -- |
| ***Metals*** | | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | -- | -- |
| Barium | mg/kg | 820 | -- | -- | -- | -- | -- |
| Lead | mg/kg | 450 | -- | **4980** | **9250** | 53.2 | **804** |
| Manganese | mg/kg | 2000 | -- | -- | -- | -- | -- |
| Silver | mg/kg | 8.3 | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

**TABLE 4.1**

**SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | | | | |
|---|---|---|---|---|---|---|
| ***Location ID:*** | | | ***MW-19*** | ***MW-19*** | ***MW-19A*** | ***SB-11-07*** |
| ***Sample Name:*** | | | ***SO-37191-060409-JJW-008*** | ***SO-37191-060409-JJW-009*** | ***SO-37191-052709-JJW-002*** | ***SO-37191-072607-RN-SB-11*** |
| ***Sample Date:*** | | | ***6/4/2009*** | ***6/4/2009*** | ***5/27/2009*** | ***7/26/2007*** |
| ***Depth:*** | | | ***6-8 ft BGS*** | ***6-8 ft BGS*** | ***6-8 ft BGS*** | ***2-6 ft BGS*** |
| ***On/Off - Site*** | | | ***On-Site*** | ***On-Site*** ***Duplicate*** | ***On-Site*** | ***On-Site*** |
| ***Parameters*** | ***Units*** | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | | |
| ***Volatile Organic Compounds*** | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | **0.24 J** | **0.26 J** | 0.29 U | 0.0067 U |
| Acetone | mg/kg | 0.05 | 1.1 UJ | 1.1 UJ | 1.2 UJ | 0.027 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | 0.28 U | 0.28 U | 0.29 U | 0.035 |
| Methylene chloride | mg/kg | 0.05 | 0.28 U | 0.28 U | 0.29 U | 0.0067 U |
| Tetrachloroethene | mg/kg | 1.3 | 0.046 J | 0.053 J | 0.078 J | 0.037 |
| Trichloroethene | mg/kg | 0.47 | **1.8** | **1.3** | **4.6** | 0.21 |
| ***Semivolatile Organic Compounds*** | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | -- | -- | 0.78 |
| Benzo(b)fluoranthene | mg/kg | 1.7 | -- | -- | -- | 0.93 |
| Benzo(k)fluoranthene | mg/kg | 1.7 | -- | -- | -- | 0.3 |
| Chrysene | mg/kg | 1 | -- | -- | -- | 0.7 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | -- | -- | -- | 0.55 |
| ***Metals*** | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | -- |
| Barium | mg/kg | 820 | -- | -- | -- | -- |
| Lead | mg/kg | 450 | -- | -- | -- | **2160** |
| Manganese | mg/kg | 2000 | -- | -- | -- | -- |
| Silver | mg/kg | 8.3 | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.1

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | *SB-13-07* | *SB-2-07* | *SB-2-07* | *SB-6-07* |
|---|---|---|---|---|---|---|
| *Sample Name:* | | | *SO-37191-072607-RN-SB-13* | *SO-37191-072707-RN-SB-2* | *SO-37191-072707-RN-SB-20* | *SO-37191-073007-CB-SB6* |
| *Sample Date:* | | | *7/26/2007* | *7/27/2007* | *7/27/2007* | *7/30/2007* |
| *Depth:* | | | *6-8 ft BGS* | *6.5-8 ft BGS* | *6.5-8 ft BGS* | *6-10.4 ft BGS* |
| *On/Off - Site* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | | | *Duplicate* | |
| *Parameters* | *Units* | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | | |
| ***Volatile Organic Compounds*** | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | 0.31 U | 0.0062 U | 0.0067 U | 0.12 J |
| Acetone | mg/kg | 0.05 | **0.1 J** | 0.025 UJ | 0.023 J | 1.1 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | **0.71** | 0.0014 J | 0.0067 U | 0.091 J |
| Methylene chloride | mg/kg | 0.05 | 0.31 U | 0.0062 U | 0.0067 U | 0.38 U |
| Tetrachloroethene | mg/kg | 1.3 | 0.13 J | 0.0062 U | 0.0067 U | 0.18 J |
| Trichloroethene | mg/kg | 0.47 | **9.7** | 0.0019 J | 0.0067 U | **0.51** |
| ***Semivolatile Organic Compounds*** | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.082 U | **1.5** | **3** | 0.2 |
| Benzo(b)fluoranthene | mg/kg | 1.7 | 0.082 U | 1.6 | **3.3** | 0.2 |
| Benzo(k)fluoranthene | mg/kg | 1.7 | 0.082 U | 0.73 | 1.3 | 0.085 |
| Chrysene | mg/kg | 1 | 0.082 U | **1.4** | **2.7** | 0.19 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | 0.082 U | 0.94 | 1.8 | 0.079 |
| ***Metals*** | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | -- | -- |
| Barium | mg/kg | 820 | -- | -- | -- | -- |
| Lead | mg/kg | 450 | 7.3 | 229 | **567** | 6.2 |
| Manganese | mg/kg | 2000 | -- | -- | -- | -- |
| Silver | mg/kg | 8.3 | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.1

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | |
|---|---|---|---|---|---|---|
| *Location ID:* | | | *SB-6-07* | *SB-7-07* | *SB-8-07* | *S Harrison St WH (SS-11)* |
| *Sample Name:* | | | *SO-37191-073007-CB-SB19* | *SO-37191-072507-RN-SB-7* | *SO-37191-072507-RN-SB-8* | *SS-37191-050708-CMB-022* |
| *Sample Date:* | | | *7/30/2007* | *7/25/2007* | *7/25/2007* | *5/7/2008* |
| *Depth:* | | | *6-10.4 ft BGS* | *3-6 ft BGS* | *3.5-8 ft BGS* | *0 - 2 inches bgs* |
| *On/Off - Site* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | *Duplicate* | | | |
| *Parameters* | *Units* | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | | |
| *Volatile Organic Compounds* | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | 0.28 U | 0.4 U | 0.0061 U | - |
| Acetone | mg/kg | 0.05 | 1.1 U | 1.6 UJ | 0.025 UJ | - |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | 0.066 J | **0.3 J** | 0.0028 J | - |
| Methylene chloride | mg/kg | 0.05 | 0.28 U | 0.4 U | 0.0061 U | - |
| Tetrachloroethene | mg/kg | 1.3 | 0.086 J | 0.4 U | 0.0061 U | - |
| Trichloroethene | mg/kg | 0.47 | **0.5** | **6.8** | 0.058 | - |
| *Semivolatile Organic Compounds* | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.37 | **15** | 0.82 | - |
| Benzo(b)fluoranthene | mg/kg | 1.7 | 0.48 | **17** | 0.91 | - |
| Benzo(k)fluoranthene | mg/kg | 1.7 | 0.074 U | **4.5** | 0.31 | - |
| Chrysene | mg/kg | 1 | 0.33 | **13** | 0.79 | - |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | 0.12 | **8.5** | 0.48 | - |
| *Metals* | | | | | | |
| Arsenic | mg/kg | 16 | -- | -- | **21.4** | **-** |
| Barium | mg/kg | 820 | -- | -- | **2310** | **-** |
| Lead | mg/kg | 450 | 5.1 | 46.0 | **2230** | **738 J** |
| Manganese | mg/kg | 2000 | -- | -- | 392 | - |
| Silver | mg/kg | 8.3 | -- | -- | **189** | **-** |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.1

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING PROTECTION OF GROUNDWATER CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | |
|---|---|---|---|---|---|
| *Location ID:* | | | *S Harrison St WH (SS-11)* | *Soil Mound (SS-1)* | *Soil Mound (SS-1)* |
| *Sample Name:* | | | *SS-37191-050708-CMB-023* | *SS-37191-050708-CMB-018* | *SS-37191-050708-CMB-019* |
| *Sample Date:* | | | *5/7/2008* | *5/7/2008* | *5/7/2008* |
| *Depth:* | | | *2 - 4 inches bgs* | *0 - 2 inches bgs* | *2 - 4 inches bgs* |
| *On/Off - Site* | | | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives - Protection of Groundwater* | | | |
| *Volatile Organic Compounds* | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | mg/kg | 0.12 | - | - | - |
| Acetone | mg/kg | 0.05 | - | - | - |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | - | - | - |
| Methylene chloride | mg/kg | 0.05 | - | - | - |
| Tetrachloroethene | mg/kg | 1.3 | - | - | - |
| Trichloroethene | mg/kg | 0.47 | - | - | - |
| *Semivolatile Organic Compounds* | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | - | - | - |
| Benzo(b)fluoranthene | mg/kg | 1.7 | - | - | - |
| Benzo(k)fluoranthene | mg/kg | 1.7 | - | - | - |
| Chrysene | mg/kg | 1 | - | - | - |
| Indeno(1,2,3-cd)pyrene | mg/kg | 8.2 | - | - | - |
| *Metals* | | | | | |
| Arsenic | mg/kg | 16 | - | - | - |
| Barium | mg/kg | 820 | - | - | - |
| Lead | mg/kg | 450 | **742 J** | 30.8 | **2090 J** |
| Manganese | mg/kg | 2000 | - | - | - |
| Silver | mg/kg | 8.3 | - | - | - |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *BH-1 S1* | *BH-1 S2* | *BH-2 S1* | *BH-3 S1* | *BH-5 S1* | *BH-5 S2* |
| *Sample Name:* | | | *S-37191-050206-PK-023* | *S-37191-050206-PK-024* | *S-37191-050106-JRR-001* | *S-37191-050206-PK-027* | *S-37191-050206-PK-020* | *S-37191-050206-PK-021* |
| *Sample Date:* | | | *5/2/2006* | *5/2/2006* | *5/1/2006* | *5/2/2006* | *5/2/2006* | *5/2/2006* |
| *Depth:* | | | *0.5-1 ft BGS* | *2-2.4 ft BGS* | *0-1 ft BGS* | *0.5-1 ft BGS* | *0.5-1.2 ft BGS* | *1.6-2.5 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | -- | -- | -- | -- | -- | 29 U |
| Acetone | mg/kg | 0.05 | -- | -- | -- | -- | -- | 120 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | -- | -- | -- | -- | -- | **15 J** |
| Methylene chloride | mg/kg | 0.05 | -- | -- | -- | -- | -- | 29 U |
| Tetrachloroethene | mg/kg | 1.3 | -- | -- | -- | -- | -- | 29 U |
| Trichloroethene | mg/kg | 0.47 | -- | -- | -- | -- | -- | **670** |
| Xylene (total) | mg/kg | 0.26 | -- | -- | -- | -- | -- | 87 U |
| *Semivolatile Organic Compounds* | | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | -- | -- | -- | -- | 0.26 J |
| Benzo(a)pyrene | mg/kg | 1 | -- | -- | -- | -- | -- | 0.11 J |
| Benzo(b)fluoranthene | mg/kg | 1 | -- | -- | -- | -- | -- | 0.24 J |
| Benzo(k)fluoranthene | mg/kg | 0.8 | -- | -- | -- | -- | -- | 0.38 U |
| Chrysene | mg/kg | 1 | -- | -- | -- | -- | -- | 0.38 U |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | -- | -- | -- | -- | -- | 0.38 U |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | -- | -- | -- | -- | -- | 0.091 J |
| *Metals* | | | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | -- | -- | -- |
| Barium | mg/kg | 350 | -- | -- | -- | -- | -- | -- |
| Copper | mg/kg | 50 | -- | -- | -- | -- | -- | -- |
| Lead | mg/kg | 63 | **545** | **144** | **816** | **2500 J** | **1470** | 16.7 |
| Manganese | mg/kg | 1600 | -- | -- | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | -- | -- | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | -- | -- | -- | -- | -- | -- |
| Silver | mg/kg | 2 | -- | -- | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | -- | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *BH-5 S3* | *BH-7 S2* | *BH-9 S1* | *BH-9 S2* | *BH-11 S1* | *BH-11 S2* |
| *Sample Name:* | | | *S-37191-050206-PK-022* | *S-37191-050206-PK-014* | *S-37191-050206-PK-018* | *S-37191-050206-PK-019* | *S-37191-050106-JRR-003* | *S-37191-050106-JRR-004* |
| *Sample Date:* | | | *5/2/2006* | *5/2/2006* | *5/2/2006* | *5/2/2006* | *5/1/2006* | *5/1/2006* |
| *Depth:* | | | *5.5-6.5 ft BGS* | *1.4-1.8 ft BGS* | *0.5-1 ft BGS* | *2-2.5 ft BGS* | *0-0.5 ft BGS* | *0.5-3 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | 2.9 U | -- | -- | -- | -- | -- |
| Acetone | mg/kg | 0.05 | 11 U | -- | -- | -- | -- | -- |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | **1.2 J** | -- | -- | -- | -- | -- |
| Methylene chloride | mg/kg | 0.05 | **0.85 J** | -- | -- | -- | -- | -- |
| Tetrachloroethene | mg/kg | 1.3 | 1.3 J | -- | -- | -- | -- | -- |
| Trichloroethene | mg/kg | 0.47 | **88** | -- | -- | -- | -- | -- |
| Xylene (total) | mg/kg | 0.26 | 8.6 U | -- | -- | -- | -- | -- |
| *Semivolatile Organic Compounds* | | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.38 U | -- | -- | -- | -- | -- |
| Benzo(a)pyrene | mg/kg | 1 | 0.04 J | -- | -- | -- | -- | -- |
| Benzo(b)fluoranthene | mg/kg | 1 | 0.065 J | -- | -- | -- | -- | -- |
| Benzo(k)fluoranthene | mg/kg | 0.8 | 0.028 J | -- | -- | -- | -- | -- |
| Chrysene | mg/kg | 1 | 0.38 U | -- | -- | -- | -- | -- |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | 0.38 U | -- | -- | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | 0.03 J | -- | -- | -- | -- | -- |
| *Metals* | | | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | -- | -- | -- |
| Barium | mg/kg | 350 | -- | -- | -- | -- | -- | -- |
| Copper | mg/kg | 50 | -- | -- | -- | -- | -- | -- |
| Lead | mg/kg | 63 | -- | **4980** | **9250** | **241** | **354** | **106** |
| Manganese | mg/kg | 1600 | -- | -- | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | -- | -- | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | -- | -- | -- | -- | -- | -- |
| Silver | mg/kg | 2 | -- | -- | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | -- | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | *BH-12 S1* | *BH-12 S2* | *BH-13 S2* | *BH-14 S1* | *BH-15 S1* | *BH-16 S1* |
|---|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | *S-37191-050306-PK-032* | *S-37191-050306-PK-033* | *S-37191-050306-PK-036* | *S-37191-050206-PK-030* | *S-37191-050206-PK-007* | *S-37191-050206-PK-009* |
| *Sample Date:* | | | *5/3/2006* | *5/3/2006* | *5/3/2006* | *5/2/2006* | *5/2/2006* | *5/2/2006* |
| *Depth:* | | | *0.3-1 ft BGS* | *1.2-2.5 ft BGS* | *1.5-2.5 ft BGS* | *0.5-1.5 ft BGS* | *1.5-2 ft BGS* | *0.75-1.2 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | | |
| *Volatile Organic Compounds* | | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | -- | R | R | -- | -- | -- |
| Acetone | mg/kg | 0.05 | -- | R | R | -- | -- | -- |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | -- | 0.0061 U | 0.0066 U | -- | -- | -- |
| Methylene chloride | mg/kg | 0.05 | -- | 0.0061 U | 0.0066 U | -- | -- | -- |
| Tetrachloroethene | mg/kg | 1.3 | -- | 0.0061 U | 0.0066 U | -- | -- | -- |
| Trichloroethene | mg/kg | 0.47 | -- | 0.0061 U | 0.0014 J | -- | -- | -- |
| Xylene (total) | mg/kg | 0.26 | -- | 0.018 U | 0.02 U | -- | -- | -- |
| *Semivolatile Organic Compounds* | | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | 0.7 J | **1.3** | -- | -- | -- |
| Benzo(a)pyrene | mg/kg | 1 | -- | 0.68 J | **1.3** | -- | -- | -- |
| Benzo(b)fluoranthene | mg/kg | 1 | -- | 0.85 | **2.7** | -- | -- | -- |
| Benzo(k)fluoranthene | mg/kg | 0.8 | -- | 0.34 J | **0.97** | -- | -- | -- |
| Chrysene | mg/kg | 1 | -- | 0.78 | **2.1** | -- | -- | -- |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | -- | 0.13 J | **0.5 J** | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | -- | **0.56 J** | **1.4** | -- | -- | -- |
| *Metals* | | | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | -- | -- | -- |
| Barium | mg/kg | 350 | -- | -- | -- | -- | -- | -- |
| Copper | mg/kg | 50 | -- | -- | -- | -- | -- | -- |
| Lead | mg/kg | 63 | **96.8** | 54.9 | 53.2 | **86.5 J** | **804** | **422** |
| Manganese | mg/kg | 1600 | -- | -- | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | -- | -- | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | -- | -- | -- | -- | -- | -- |
| Silver | mg/kg | 2 | -- | -- | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | -- | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| *Location ID:* | | | *BH-17 S1* | *BH-17 S2* | *MW-19* | *MW-19* | *MW-19A* |
|---|---|---|---|---|---|---|---|
| *Sample Name:* | | | *S-37191-050206-PK-005* | *S-37191-050206-PK-006* | *SO-37191-060409-JJW-008* | *SO-37191-060409-JJW-009* | *SO-37191-052709-JJW-002* |
| *Sample Date:* | | | *5/2/2006* | *5/2/2006* | *6/4/2009* | *6/4/2009* | *5/27/2009* |
| *Depth:* | | | *0-0.5 ft BGS* | *1-1.5 ft BGS* | *6-8 ft BGS* | *6-8 ft BGS* | *6-8 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | | | | *Duplicate* | |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | |
| *Volatile Organic Compounds* | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | -- | -- | **0.24 J** | **0.26 J** | 0.29 U |
| Acetone | mg/kg | 0.05 | -- | -- | 1.1 UJ | 1.1 UJ | 1.2 UJ |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | -- | -- | 0.28 U | 0.28 U | 0.29 U |
| Methylene chloride | mg/kg | 0.05 | -- | -- | 0.28 U | 0.28 U | 0.29 U |
| Tetrachloroethene | mg/kg | 1.3 | -- | -- | 0.046 J | 0.053 J | 0.078 J |
| Trichloroethene | mg/kg | 0.47 | -- | -- | **1.8** | **1.3** | **4.6** |
| Xylene (total) | mg/kg | 0.26 | -- | -- | 0.83 U | 0.83 U | 0.88 U |
| *Semivolatile Organic Compounds* | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | -- | -- | -- | -- |
| Benzo(a)pyrene | mg/kg | 1 | -- | -- | -- | -- | -- |
| Benzo(b)fluoranthene | mg/kg | 1 | -- | -- | -- | -- | -- |
| Benzo(k)fluoranthene | mg/kg | 0.8 | -- | -- | -- | -- | -- |
| Chrysene | mg/kg | 1 | -- | -- | -- | -- | -- |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | -- | -- | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | -- | -- | -- | -- | -- |
| *Metals* | | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | -- | -- |
| Barium | mg/kg | 350 | -- | -- | -- | -- | -- |
| Copper | mg/kg | 50 | -- | -- | -- | -- | -- |
| Lead | mg/kg | 63 | **282** | **270** | -- | -- | -- |
| Manganese | mg/kg | 1600 | -- | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | -- | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | -- | -- | -- | -- | -- |
| Silver | mg/kg | 2 | -- | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *S Harrison St WH (SS-11)* | *S Harrison St WH (SS-11)* | *Soil Mound (SS-1)* | *Soil Mound (SS-1)* | *SB-10-07* |
| *Sample Name:* | | | *SS-37191-050708-CMB-022* | *SS-37191-050708-CMB-023* | *SS-37191-050708-CMB-018* | *SS-37191-050708-CMB-019* | *SO-37191-072507-RN-SB-10* |
| *Sample Date:* | | | *5/7/2008* | *5/7/2008* | *5/7/2008* | *5/7/2008* | *7/25/2007* |
| *Depth:* | | | *0-0.17 ft BGS* | *0.15-0.33 ft BGS* | *0 - 2 inches bgs* | *2 - 4 inches bgs* | *3-8 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | |
| ***Volatile Organic Compounds*** | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | -- | -- | -- | -- | 0.0059 U |
| Acetone | mg/kg | 0.05 | -- | -- | -- | -- | 0.012 J |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | -- | -- | -- | -- | 0.0059 U |
| Methylene chloride | mg/kg | 0.05 | -- | -- | -- | -- | 0.0059 U |
| Tetrachloroethene | mg/kg | 1.3 | -- | -- | -- | -- | 0.0059 U |
| Trichloroethene | mg/kg | 0.47 | -- | -- | -- | -- | 0.0017 J |
| Xylene (total) | mg/kg | 0.26 | -- | -- | -- | -- | 0.018 U |
| ***Semivolatile Organic Compounds*** | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | -- | -- | -- | -- | 0.09 |
| Benzo(a)pyrene | mg/kg | 1 | -- | -- | -- | -- | 0.085 |
| Benzo(b)fluoranthene | mg/kg | 1 | -- | -- | -- | -- | 0.11 |
| Benzo(k)fluoranthene | mg/kg | 0.8 | -- | -- | -- | -- | 0.045 J |
| Chrysene | mg/kg | 1 | -- | -- | -- | -- | 0.087 |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | -- | -- | -- | -- | 0.079 U |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | -- | -- | -- | -- | 0.076 J |
| ***Metals*** | | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | -- | -- |
| Barium | mg/kg | 350 | -- | -- | -- | -- | -- |
| Copper | mg/kg | 50 | -- | -- | -- | -- | -- |
| Lead | mg/kg | 63 | **738 J** | **742 J** | 30.8 | **2090 J** | **196** |
| Manganese | mg/kg | 1600 | -- | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | -- | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | -- | -- | -- | -- | -- |
| Silver | mg/kg | 2 | -- | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | -- | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *SB-1-07* | *SB-11-07* | *SB-13-07* | *SB-16-07* | *SB-17-07* |
| *Sample Name:* | | | *SO-37191-072507-RN-SB-1* | *SO-37191-072607-RN-SB-11* | *SO-37191-072607-RN-SB-13* | *SO-37191-072607-RN-SB-16* | *SO-37191-072707-RN-SB-17* |
| *Sample Date:* | | | *7/25/2007* | *7/26/2007* | *7/26/2007* | *7/26/2007* | *7/27/2007* |
| *Depth:* | | | *2-4 ft BGS* | *2-6 ft BGS* | *6-8 ft BGS* | *4-8 ft BGS* | *6-10 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | |
| ***Volatile Organic Compounds*** | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | 0.0069 U | 0.0067 U | 0.31 U | 0.0067 U | 0.0072 U |
| Acetone | mg/kg | 0.05 | 0.028 U | 0.027 U | **0.1 J** | 0.027 UJ | 0.029 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | 0.0069 U | 0.035 | **0.71** | 0.0067 U | 0.19 |
| Methylene chloride | mg/kg | 0.05 | 0.0069 U | 0.0067 U | 0.31 U | 0.0067 U | 0.0072 U |
| Tetrachloroethene | mg/kg | 1.3 | 0.0069 U | 0.037 | 0.13 J | 0.0025 J | 0.0072 U |
| Trichloroethene | mg/kg | 0.47 | 0.0069 U | 0.21 | **9.7** | 0.008 | 0.14 J |
| Xylene (total) | mg/kg | 0.26 | 0.021 U | 0.02 U | 0.92 U | 0.02 U | 0.022 U |
| ***Semivolatile Organic Compounds*** | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.061 J | 0.78 | 0.082 U | 0.09 U | 0.084 J |
| Benzo(a)pyrene | mg/kg | 1 | 0.047 J | 0.78 | 0.082 U | 0.09 U | 0.089 J |
| Benzo(b)fluoranthene | mg/kg | 1 | 0.044 J | 0.93 | 0.082 U | 0.09 U | 0.1 |
| Benzo(k)fluoranthene | mg/kg | 0.8 | 0.022 J | 0.3 | 0.082 U | 0.09 U | 0.028 J |
| Chrysene | mg/kg | 1 | 0.1 | 0.7 | 0.082 U | 0.09 U | 0.089 J |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | 0.093 U | 0.09 | 0.082 U | 0.09 U | 0.097 U |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | 0.055 J | **0.55** | 0.082 U | 0.09 U | 0.042 J |
| ***Metals*** | | | | | | | |
| Arsenic | mg/kg | 13 | 11.4 | -- | -- | -- | -- |
| Barium | mg/kg | 350 | 103 | -- | -- | -- | -- |
| Copper | mg/kg | 50 | **60.8** | -- | -- | -- | -- |
| Lead | mg/kg | 63 | **78.3** | **2160** | 7.3 | **94.8** | **155 J** |
| Manganese | mg/kg | 1600 | 712 | -- | -- | -- | -- |
| Mercury | mg/kg | 0.18 | **0.45** | -- | -- | -- | -- |
| Nickel | mg/kg | 30 | 16.0 | -- | -- | -- | -- |
| Silver | mg/kg | 2 | 0.69 U | -- | -- | -- | -- |
| Zinc | mg/kg | 109 | 107 | -- | -- | -- | -- |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Location ID:* | | | *SB-18-08* | *SB-2-07* | *SB-2-07* | *SB-4-07* | *SB-5-07* |
| *Sample Name:* | | | *SB-37191-050908-JP-001* | *SO-37191-072707-RN-SB-2* | *SO-37191-072707-RN-SB-20* | *SO-37191-072707-RN-SB-4* | *SO-37191-072507-RN-SB-05* |
| *Sample Date:* | | | *5/9/2008* | *7/27/2007* | *7/27/2007* | *7/27/2007* | *7/25/2007* |
| *Depth:* | | | *0-2 ft BGS* | *6.5-8 ft BGS* | *6.5-8 ft BGS* | *2-4 ft BGS* | *4-8 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | | | *Duplicate* | | |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | | |
| ***Volatile Organic Compounds*** | | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | 0.0061 U | 0.0062 U | 0.0067 U | 0.0062 U | 0.006 U |
| Acetone | mg/kg | 0.05 | 0.024 UJ | 0.025 UJ | 0.023 J | 0.025 U | 0.024 U |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | 0.0061 U | 0.0014 J | 0.0067 U | 0.0062 U | 0.012 |
| Methylene chloride | mg/kg | 0.05 | 0.011 | 0.0062 U | 0.0067 U | 0.0062 U | 0.006 U |
| Tetrachloroethene | mg/kg | 1.3 | 0.0061 U | 0.0062 U | 0.0067 U | 0.0062 U | 0.006 U |
| Trichloroethene | mg/kg | 0.47 | 0.0061 U | 0.0019 J | 0.0067 U | 0.0062 U | 0.083 |
| Xylene (total) | mg/kg | 0.26 | 0.018 U | 0.019 U | 0.02 U | 0.019 U | 0.018 U |
| ***Semivolatile Organic Compounds*** | | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.23 | **1.5** | **3** | 0.66 | 0.081 U |
| Benzo(a)pyrene | mg/kg | 1 | 0.21 | **1.4** | **2.7** | 0.66 | 0.081 U |
| Benzo(b)fluoranthene | mg/kg | 1 | 0.35 | **1.6** | **3.3** | 0.81 | 0.081 U |
| Benzo(k)fluoranthene | mg/kg | 0.8 | 0.16 U | 0.73 | **1.3** | 0.28 | 0.081 U |
| Chrysene | mg/kg | 1 | 0.21 | **1.4** | **2.7** | 0.65 | 0.081 U |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | 0.16 U | 0.23 | **0.46** | 0.12 | 0.081 U |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | 0.13 J | **0.94** | **1.8** | 0.45 | 0.081 U |
| ***Metals*** | | | | | | | |
| Arsenic | mg/kg | 13 | 5.9 | -- | -- | -- | 9.7 |
| Barium | mg/kg | 350 | 161 | -- | -- | -- | 132 |
| Copper | mg/kg | 50 | 18.8 | -- | -- | -- | 31.2 |
| Lead | mg/kg | 63 | **104 J** | **229** | **567** | **285** | 14.5 |
| Manganese | mg/kg | 1600 | 795 J | -- | -- | -- | 602 |
| Mercury | mg/kg | 0.18 | 0.18 | -- | -- | -- | 0.022 J |
| Nickel | mg/kg | 30 | 8.4 | -- | -- | -- | **35.1** |
| Silver | mg/kg | 2 | 0.26 J | -- | -- | -- | 0.60 U |
| Zinc | mg/kg | 109 | **166** | -- | -- | -- | 80.4 |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.

J - Estimated concentration.

mg/kg - Milligrams per kilogram.

# TABLE 4.2

## SUMMARY OF SOIL ANALYTICAL RESULTS EXCEEDING UNRESTRICTED USE CRITERIA
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | | | | |
|---|---|---|---|---|---|---|
| *Location ID:* | | | *SB-6-07* | *SB-6-07* | *SB-7-07* | *SB-8-07* |
| *Sample Name:* | | | *SO-37191-073007-CB-SB6* | *SO-37191-073007-CB-SB19* | *SO-37191-072507-RN-SB-7* | *SO-37191-072507-RN-SB-8* |
| *Sample Date:* | | | *7/30/2007* | *7/30/2007* | *7/25/2007* | *7/25/2007* |
| *Depth:* | | | *6-10.4 ft BGS* | *6-10.4 ft BGS* | *3-6 ft BGS* | *3.5-8 ft BGS* |
| *On/Off - Site:* | | | *On-Site* | *On-Site* | *On-Site* | *On-Site* |
| | | | | *Duplicate* | | |
| *Parameters* | *Units* | *6 NYCRR Part 375-6.8(a): Unrestricted Use Soil Cleanup Objectives* | | | | |
| *Volatile Organic Compounds* | | | | | | |
| 2-Butanone (Methyl ethyl ketone) (MEK) | mg/kg | 0.12 | 0.12 J | 0.28 U | 0.4 U | 0.0061 U |
| Acetone | mg/kg | 0.05 | 1.1 U | 1.1 U | 1.6 UJ | 0.025 UJ |
| cis-1,2-Dichloroethene | mg/kg | 0.25 | 0.091 J | 0.066 J | **0.3 J** | 0.0028 J |
| Methylene chloride | mg/kg | 0.05 | 0.38 U | 0.28 U | 0.4 U | 0.0061 U |
| Tetrachloroethene | mg/kg | 1.3 | 0.18 J | 0.086 J | 0.4 U | 0.0061 U |
| Trichloroethene | mg/kg | 0.47 | **0.51** | **0.5** | **6.8** | 0.058 |
| Xylene (total) | mg/kg | 0.26 | **0.79 J** | 0.84 U | 1.2 U | 0.018 U |
| *Semivolatile Organic Compounds* | | | | | | |
| Benzo(a)anthracene | mg/kg | 1 | 0.2 | 0.37 | **15** | 0.82 |
| Benzo(a)pyrene | mg/kg | 1 | 0.15 | 0.28 | **14** | 0.69 |
| Benzo(b)fluoranthene | mg/kg | 1 | 0.2 | 0.48 | **17** | 0.91 |
| Benzo(k)fluoranthene | mg/kg | 0.8 | 0.085 | 0.074 U | **4.5** | 0.31 |
| Chrysene | mg/kg | 1 | 0.19 | 0.33 | **13** | 0.79 |
| Dibenz(a,h)anthracene | mg/kg | 0.33 | 0.075 U | 0.074 U | **2.4** | 0.14 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.5 | 0.079 | 0.12 | **8.5** | 0.48 |
| *Metals* | | | | | | |
| Arsenic | mg/kg | 13 | -- | -- | -- | **21.4** |
| Barium | mg/kg | 350 | -- | -- | -- | **2310** |
| Copper | mg/kg | 50 | -- | -- | -- | **114** |
| Lead | mg/kg | 63 | 6.2 | 5.1 | 46.0 | **2230** |
| Manganese | mg/kg | 1600 | -- | -- | -- | 392 |
| Mercury | mg/kg | 0.18 | -- | -- | -- | **0.48** |
| Nickel | mg/kg | 30 | -- | -- | -- | 13.8 |
| Silver | mg/kg | 2 | -- | -- | -- | **189** |
| Zinc | mg/kg | 109 | -- | -- | -- | **305** |

**1.0 -** Exceeds criteria.

U - Not present at the associated value.
J - Estimated concentration.
mg/kg - Milligrams per kilogram.

**TABLE 4.3**

**POTENTIAL ACTION-SPECIFIC STANDARDS, CRITERIA, AND GUIDELINES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Federal SCGs* | | | *New York State SCGs* | | |
|---|---|---|---|---|---|---|
| *Activity* | *Title* | *Subtitle* | *Citation* | *Title* | *Subtitle* | *Citation* |
| Capping | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Closure and post-closure care<br>Post-closure care and use of property | 40 CFR 264.310<br>40 CFR 264.117(c) | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| | | | | Final status standards for owners and operators of hazardous waste treatment, storage and disposal facilities | -- | 6 NYCRR Subpart 373-2 |
| Container Storage | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Condition of containers<br>Compatibility of waste with containers<br>Management of containers<br>Inspections<br>Containment | 40 CFR 264.171<br>40 CFR 264.172<br>40 CFR 264.173<br>40 CFR 264.174<br>40 CFR 264.175 | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| Construction of New Landfill on Site | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Design and operating requirements<br>Operation and maintenance<br>Closure and post-closure care<br>Groundwater protection | 40 CFR 264.301<br>40 CFR 264.303-304<br>40 CFR 264.310<br>40 CFR 264.91-100 | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| Discharge of Treatment System Effluent | Administered permit programs: The national pollutant discharge elimination system | Establishing limitations, standards and other permit conditions | 40 CFR 122.44 and State regulations approved under 40 CFR 131 | Implementation of NPDES program in New York State<br>Technical and Operations Guidance Series<br>Blending policy for use of sources of drinking water | --<br>--<br>-- | 6 NYCRR Part 750-757<br>--<br>NYSDOH PWS 68 |
| | Criteria and standards for the national pollutant discharge elimination program | Best management practices<br>Discharge to waters of the U.S. | 40 CFR 125.100<br>40 CFR 125.104 | Drinking water supplies<br>Use and protection of waters | --<br>-- | Part 5 of State Sanitary Code<br>6 NYCRR Part 608 |
| | Guidelines establishing test procedures for the analysis of pollutants | Identification of test procedures and alternate test procedures | 40 CFR 136.1-4 | | | |
| | Effluent guidelines and standards | Organic chemicals plastics and synthetic fibers | 40 CFR Part 414 | | | |
| Excavation | Land disposal restrictions (also see Closure) | Treatment standards | 40 CFR 268 (Subpart D) | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 376 |
| Incineration Off Site | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Waste analysis | 40 CFR 264.341 | | | |
| Land Treatment | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Treatment program<br>Design and operating requirements<br>Unsaturated zone monitoring<br>Special requirements for ignitable or reactive waste | 40 CFR 264.271<br>40 CFR 264.273<br>40 CFR 264.278<br>40 CFR 264.281 | Hazardous waste treatment, storage and disposal facility permitting requirements<br>New York air pollution control regulations | --<br>General provisions<br>Permits and certificates<br>General prohibitions<br>General process emission sources<br>Incinerators | 6 NYCRR Subpart 373-1<br>6 NYCRR Part 200<br>6 NYCRR Part 201<br>6 NYCRR Part 211<br>6 NYCRR Part 212<br>6 NYCRR Part 219 |
| Placement of Waste in Land Disposal Unit | Land disposal restrictions | Treatment standards | 40 CFR 268 (Subpart D) | Hazardous waste treatment, storage and disposal facility permitting requirements | --<br>Basis for Listing Hazardous Waste | 6 NYCRR Subpart 373-1<br>6 NYCRR Appendix 22 |

**TABLE 4.3**

**POTENTIAL ACTION-SPECIFIC STANDARDS, CRITERIA, AND GUIDELINES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Federal SCGs* | | | *New York State SCGs* | | |
|---|---|---|---|---|---|---|
| *Activity* | *Title* | *Subtitle* | *Citation* | *Title* | *Subtitle* | *Citation* |
| Surface Water Control | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Design and operating requirements for waste piles | 40 CFR 264.251(c),(d) | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1<br>6 NYCRR Part 701 and Part 703 |
| | | Design and operating requirements for land treatment | 40 CFR 264.273(c),(d) | | | |
| | | Design and operating requirements for landfills | 40 CFR 264.301(c),(d) | | | |
| Treatment (in a unit) | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Design and operating requirements for waste piles | 40 CFR 264.251 | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| | | Design and operating requirements for thermal treatment units | 40 CFR 265.373 | Interim status standards for owners and operators of hazardous waste facilities | -- | 6 NYCRR Subpart 373-3 |
| | | Design and operating requirements for miscellaneous treatment units | 40 CFR 264.601 | New York air pollution control regulations | General provisions<br>Permits and certificates<br>General prohibitions<br>General process emission sources | 6 NYCRR Part 200<br>6 NYCRR Part 201<br>6 NYCRR Part 211<br>6 NYCRR Part 212 |
| Treatment (when waste will be land disposed) | Land disposal restrictions | Identification of waste | 40 CFR 268.10-12 | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| | | Treatment Standards Waste | 40 CFR 268 (Subpart D) | | | |
| | | Specific prohibitions - Solvent wastes | 40 CFR 268.30<br>RCRA Sections 3004 (d) (3), (e) (3)<br>42 USC 6924 (d) (3), (e) (3) | Interim status standards for owners and operators of hazardous waste facilities | -- | 6 NYCRR Subpart 373-3 |
| Waste Pile | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Design and operating requirements | 40 CFR 264.251 | New York air pollution control regulations | General provisions<br>Permits and certificates<br>General prohibitions<br>General process emission sources | 6 NYCRR Part 200<br>6 NYCRR Part 201<br>6 NYCRR Part 211<br>6 NYCRR Part 212 |
| | | | | Hazardous waste treatment, storage and disposal facility permitting requirements | -- | 6 NYCRR Subpart 373-1 |
| | | | | Interim status standards for owners and operators of hazardous waste facilities | -- | 6 NYCRR Subpart 373-3 |
| Closure with Waste in Place | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Closure and post-closure care | 40 CFR 264.258 | | | |
| | | Post-closure care and groundwater monitoring | 40 CFR 264.310 | | | |
| Closure of Land Treatment Units | Standards for owners and operators of hazardous waste treatment, storage and disposal facilities | Closure of land treatment units | 40 CFR 264.280 | Final status standards for owners and operators of hazardous waste facilities | -- | 6 NYCRR Subpart 373-2 |
| Transporting Hazardous Waste Off Site | Standards applicable to transporters of hazardous waste | -- | 40 CFR 263 | Waste transport permits | -- | 5 NYCRR Part 364 |
| | | | | Hazardous waste manifest system and related standards for generators, transporters and facilities | -- | 6 NYCRR Part 372 |
| Vapor Emissions | Air emissions standards for process vents | -- | 40 CFR 264 (Subpart AA) | NY air pollution control regulations | General provisions<br>Permits and certificates | 6NYCRR Part 200<br>6NYCRR Part 201 |

**TABLE 5.1**

**POTENTIAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *Medium* | *General Response Action* | *Remedial Technology* | *Process Options* | *Description* |
|---|---|---|---|---|
| Groundwater | No Action | None | Not Applicable | No action. Natural processes are allowed to reduce chemical concentrations to acceptable levels. |
| | Institutional Control | None | Deed Restrictions | Restrict groundwater usage on Site and in the immediate vicinity of the Site., initiate long-term monitoring, and/or develop and enforce safe work practices. |
| | Monitored Natural Attenuation | Natural Attenuation | None | Monitor the natural degradation and attenuation of COCs in groundwater through sampling and analysis to document the reduction of contaminants over time. |
| | In Situ Groundwater Treatment | Physical/Chemical Treatment | Chemical Oxidation | Oxidation agent(s) are injected into the saturated zone to break down chemicals. |
| | | | Permeable Reactive Barrier | A permeable barrier of reactive substrate is constructed across the groundwater flow path to degrade or retain chemicals present. |
| | | Physical Treatment | Air Sparging | Installation of an air injection system to air-strip volatiles from the groundwater. |
| | | | In-Well Stripping | In-well air sparging combined with stripping and water circulation to enhance volatilization of chemicals. |
| | | Biological Treatment | Enhanced Biological Degradation | Nutrients are injected into groundwater to stimulate biological degradation by indigenous (native) bacteria. If the indigenous microbial population is inactive or inadequate, can supplement with microbes specifically designed for the treatment. Oxygen or oxygen consuming materials may be added to create aerobic or anaerobic conditions. |
| | Physical Containment | Barrier Walls | Slurry Wall/Sheet Piling | Construction of a barrier wall downgradient or around the area of concern to restrict off-Site groundwater migration and limit upgradient groundwater flow to the Site. |
| | | Surface Barrier | Capping | A permanent surface barrier is placed over the area (in whole or in part) containing contaminated media thus eliminating surface water infiltration. |

**TABLE 5.1**

**POTENTIAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *Medium* | *General Response Action* | *Remedial Technology* | *Process Options* | *Description* |
|---|---|---|---|---|
| Groundwater (Cont'd) | Hydraulic Containment | Groundwater Extraction | Groundwater Extraction Well Network | Installation and operation of groundwater extraction wells to provide a hydraulic barrier to groundwater migration through the establishment and maintenance of an inward hydraulic gradient. |
| | | | Collection Trenches | Installation of downgradient groundwater collection drains/trenches to achieve a hydraulic barrier that will restrict migration of groundwater off Site. |
| | Collection | Groundwater Extraction | Groundwater Extraction Well Network | Installation and operation of groundwater extraction well(s) to remove groundwater containing COCs from the source area. |
| | | | Collection Trenches | Installation and operation of collection trenches to remove groundwater containing COCs from the source area. |
| | Ex Situ Treatment | On-site Physical Treatment | Air Stripping | Remove contaminants to vapor phase. Subsequent disposal of treated water. Vapor treatment may be required. |
| | | | Activated Carbon | Adsorption of contaminants onto activated carbon. Subsequent disposal of treated water and used carbon. |
| | Disposal | Off-site Disposal | Off-site Disposal | Transportation of extracted groundwater to a permitted treatment, storage, and disposal facility. Groundwater may or may not be pretreated. |
| | | On-site Disposal | Injection | Extracted, treated groundwater is injected back into the aquifer through on-site points. May also be used to provide hydraulic containment. |
| | | | Discharge to POTW | Discharge of extracted, treated groundwater to a municipal treatment works. |
| Soil | No Action | None | Not Applicable | No action. Natural processes are allowed to reduce chemical concentrations to acceptable levels. |
| | Institutional Control | None | Physical and Deed Restrictions | Restrict exposure to impacted surface soil and/or develop and enforce special procedures for worker protection. |

**TABLE 5.1**

**POTENTIAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *Medium* | *General Response Action* | *Remedial Technology* | *Process Options* | *Description* |
|---|---|---|---|---|
| Soil (Cont'd) | Containment | Physical Treatment | Capping | A permanent surface barrier is placed over the area containing contaminated soil thus preventing or minimizing physical contact. |
| | Collection | Excavation | Excavation | Excavate contaminated soil for on-site treatment or off-site disposal. Backfill excavation with treated soil or clean, imported granular fill. |
| | In Situ Treatment | Physical Treatment | Soil Vapor Extraction | A vacuum is applied to the soil beneath or surrounding the building through soil vapor extraction wells and soil vapors are removed. |
| | Ex Situ Treatment | Physical Treatment | Thermal Desorption | Excavated soil is heated to volatilize chemicals. Treated soils may be used as excavation backfill or transported off-site for disposal. |
| | | | Incineration | Excavated soil is processed at high temperature to volatilize and combust organic contaminants. Treated soils may be used as excavation backfill or transported off-site for disposal. |
| | Disposal | On-site Disposal | Backfilling | Treated excavated soil is returned to the original excavation as backfill. |
| | | Off-site Disposal | Off-site Disposal | Treated or untreated excavated soil is transported to a permitted treatment, storage, and disposal facility. |

**TABLE 6.1**

**SCREENING OF IDENTIFIED REMEDIAL TECHNOLOGIES FOR GROUNDWATER**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *General Response Action* | *Description* | *Effectiveness* | *Implementability* |
|---|---|---|---|
| *NO ACTION* | No measures are taken to improve Site environmental conditions with respect to groundwater. All contaminants remain on Site. Environmental risks and potential exposure pathways are not addressed by any remedial activities. | - Not effective in meeting all RAOs.<br>- No additional risk during implementation. | - Readily implemented. |
| *INSTITUTIONAL CONTROL* | | | |
| Deed Restrictions | Implementation of institutional controls, such as deed restrictions, to reduce potential exposure to Site related chemicals, restrict installation of on-Site water supply wells, and restrict future use of on-Site groundwater. Specific health & safety procedures may be developed and enforced for worker protection. | - Effectiveness is dependant on future enforcement of restrictions and procedures.<br>- No reduction of volume, toxicity, or mobility of COCs.<br>- Effective in reducing potential for human exposure to COCs. | - Readily implemented. |
| *MONITORED NATURAL ATTENUATION* | | | |
| Natural Attenuation | COCs are allowed to naturally attenuate. | - Reduction in volume and toxicity of COCs will be achieved over time. | - Readily implemented.<br>- Groundwater monitoring will be required to track restoration of groundwater. |
| *IN SITU TREATMENT* | | | |
| Chemical Oxidation | Delivery of oxidizing agent to impacted groundwater to destroy COCs or convert them into less toxic or harmless compounds. May be used in conjunction with other technologies or in situ treatment methods. | - Reduction in volume and toxicity of COCs will be achieved.<br>- Effective in reducing potential for human exposure to COCs. | - Oxidizing agent commercially available and easy to handle.<br>- Low permeability soil can impede distribution of oxidant.<br>- Site-specific treatability study would be necessary.<br>- Off-gassing of oxygen with some oxidants poses safety concerns. |
| Permeable Reactive Barrier | Construction of permeable wall across the groundwater flow pathways. Wall is filled with zero-valent iron to treat COCs in groundwater migrating through it. | - Effectiveness is dependant upon the life of the barrier. Fouling may occur and replacement may be required.<br>- Effective in reducing potential for human exposure to COCs on off-site properties.<br>- Reduction in volume, toxicity, and mobility of COCs will be achieved over time. | - Implementable with moderate concern regarding need for future replacement.<br>- Access to off-site properties required for construction and maintenance. |
| Air Sparging | Pressurized aeration of groundwater to vaporize VOCs and transport into the vadose zone. | - Reduction in volume and toxicity of COCs in groundwater will be achieved.<br>- Potential for transport of COCs through soil vapor migration may be increased. | - Implementable with concern regarding transport of COCs in soil vapor.<br>- May need to be combined with SVE.<br>- Does not address COCs in bedrock. |
| In Well Stripping | Air is injected into double-screened wells installed to the bottom of the contaminated interval lifting the water in the well and forcing it out through the upper screen. VOCs are transferred from the dissolved to the vapor phase and subsequently extracted and treated. | - Reduction in volume, toxicity, and mobility of COCs will be achieved.<br>- Effective in reducing potential for human exposure to COCs if migration of soil vapors is controlled. | - Implementable with concern regarding transport of COCs in soil vapor.<br>- Moderate concern regarding maintenance of well screens. |

**TABLE 6.1**

**SCREENING OF IDENTIFIED REMEDIAL TECHNOLOGIES FOR GROUNDWATER**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *General Response Action* | *Description* | *Effectiveness* | *Implementability* |
|---|---|---|---|
| ***IN SITU TREATMENT (Cont'd)*** | | | |
| In Well Stripping (Cont'd) | | - Not recommended for areas containing NAPL or high concentrations of COCs.<br>- Potential for fouling of well screens with metals precipitates and bacteria may limit effectiveness. | |
| Enhanced Biodegradation | Delivery of nutrients to stimulate biological degradation by indigenous (native) bacteria. May be used in hotspots to accelerate natural attenuation. | - Reduction in volume and toxicity of COCs will be achieved.<br>- Effective in reducing potential for human exposure to COCs. | - Implementable with moderate concern regarding effectiveness in bedrock.<br>- Technically feasible.<br>- Nutrients commercially available and easy to handle.<br>- Site-specific treatability study would be necessary. |
| ***CONTAINMENT AND COLLECTION*** | | | |
| *Physical Containment* | | | |
| Vertical Barrier | Slurry or sheet pile barrier walls are constructed around the downgradient perimeter of the COC plume to prevent further off-Site migration. | - No reduction of volume or toxicity of COCs.<br>- Effective in reducing off-site potential for human exposure to COCs.<br>- Hydraulic control upgradient of barrier may be required to prevent groundwater flow around the ends of the wall(s).<br>- Off-site migration in bedrock has already occurred. | - Implementable with concern regarding hydraulic control.<br>- Access to off-site properties during construction may be required. |
| *Hydraulic Containment and/or Source Removal* | | | |
| Extraction Wells | Installation and operation of groundwater extraction wells at the source of contamination and/or downgradient to induce an inward gradient. | - May be effective for collection of groundwater and provision of hydraulic containment.<br>- Reduces mobility of contaminants.<br>- No reduction of volume or toxicity of COCs without treatment.<br>- Potential for fouling of well screens with metals precipitates and bacteria may limit effectiveness. | - Implementable in overburden and bedrock.<br>- Technically feasible.<br>- Requires routine inspection and maintenance.<br>- Required unobstructed access to wells may cause interference with Site use.<br>- Long term access to off-site properties would be required.<br>- Moderate concern regarding maintenance of well screens.<br>- Significant construction would be required for extraction piping network from off-site wells leading to treatment system. |
| Collection Trenches | Installation of downgradient groundwater collection drains/trenches to achieve a hydraulic barrier restricting migration of groundwater off Site. | - Effective and proven for collection of groundwater from shallow aquifers with a lower confining layer.<br>- Reduces mobility of contaminants.<br>- No reduction of volume or toxicity of COCs without treatment.<br>- Off-site migration in bedrock has already occurred. | - Not readily implementable in bedrock.<br>- Requires routine inspection and maintenance.<br>- Would cause disruption of area use.<br>- Long term access to off-site properties would be required.<br>- Significant construction would be required for extraction piping network from off-site wells leading to treatment system. |

**TABLE 6.1**

**SCREENING OF IDENTIFIED REMEDIAL TECHNOLOGIES FOR GROUNDWATER**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *General Response Action* | *Description* | *Effectiveness* | *Implementability* |
|---|---|---|---|
| ***EX SITU TREATMENT*** | | | |
| Air Stripping | Contaminants (VOCs) are removed from the water using an air purging system. Product vapor may need treatment prior to discharge. | - Effective in reducing VOC concentrations. | - Readily implemented.<br>- Technically feasible.<br>- Used in conjunction with a collection technology.<br>- Requires routine maintenance.<br>- May require vapor treatment.<br>- Air permitting may be required. |
| Activated Carbon | Water is passed through activated carbon and VOCs are removed by being adsorbed to the carbon. | - Generally effective in reducing VOC concentrations. | - Used in conjunction with a collection technology.<br>- Not technically feasible due to potential high concentrations of metals and VOCs in influent stream. |
| ***DISPOSAL*** | | | |
| Discharge to POTW | Discharge of pre-treated or untreated groundwater directly into municipal sewer for subsequent treatment at POTW. | - Eliminates potential for human exposure to Site chemicals in groundwater.<br>- Reduces volume, toxicity, and mobility of Site contaminants. | - Used in conjunction with a collection technology.<br>- Implementable with concern regarding permitting.<br>- Pre-treatment prior to discharge may be required.<br>- Technically feasible. |
| Discharge to surface water | Permitted discharge of treated groundwater directly to surface water. | - Eliminates potential for human exposure to Site chemicals in groundwater.<br>- Reduces volume, toxicity, and mobility of Site contaminants. | - Used in conjunction with a collection technology.<br>- Implementable with concern regarding permitting.<br>- Pre-treatment prior to discharge may be required.<br>- Technically feasible. |

Notes:
COCs Compounds of Concern.
POTW Publicly Owned Treatment Works.
RAOs Remedial Action Objectives.
VOC Volatile Organic Compound

**TABLE 6.2**

**SCREENING OF IDENTIFIED REMEDIAL TECHNOLOGIES FOR SOIL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *General Response Action* | *Description* | *Effectiveness* | *Implementability* |
|---|---|---|---|
| ***NO FURTHER ACTION*** | No additional measures are taken to improve Site environmental conditions with respect to soil. All contaminants remain on Site. Environmental risks and potential exposure pathways are not directly addressed by any activities. | - Not effective in meeting all RAOs.<br>- No reduction of volume, toxicity, or mobility of Site contaminants.<br>- No additional risk during implementation. | - Readily implemented. |
| ***INSTITUTIONAL CONTROLS*** | | | |
| Physical and Deed Restrictions | Implementation of institutional controls, such as deed restrictions, safe work practices, or physical barriers such as fencing to reduce potential exposure to Site related chemicals in surface soil. | - Effectiveness is dependant on future enforcement of restrictions.<br>- No reduction of volume, toxicity, or mobility of COCs.<br>- Effective in reducing potential for human exposure to COCs. | - Readily implemented. |
| ***PHYSICAL CONTAINMENT*** | | | |
| Capping | Areas of Site containing soil exhibiting chemical concentrations exceeding potential soil cleanup goals are regraded if necessary to promote drainage and covered with compacted, clean, granular fill. | - Effective in reducing the potential for human exposure to Site chemicals in the soil.<br>- Does not reduce the volume, toxicity, or mobility of COCs. | - Readily implemented.<br>- Technically feasible, although the sporadic nature of impacted areas would make Site-wide capping impractical.<br>- Requires routine inspection and maintenance. |
| ***COLLECTION*** | | | |
| Excavation | Removal of impacted soil. | - Effectively reduces the volume, toxicity, and mobility of contaminants. | - Implementable.<br>- Scope of work highly dependent upon results of confirmatory sample analyses. |
| ***IN SITU TREATMENT*** | | | |
| Soil Vapor Extraction | Installation and operation of soil vapor extraction wells within area of VOC impacts to volatilize COCs. Soil vapor may need to be collected and treated. | - Reduces volume and mobility of Site VOCs in soil. | - Implementable with concern.<br>- Not effecetive in areas with shallow water table and tight soils such as at the Site. |
| ***EX SITU TREATMENT*** | | | |
| Thermal Desorption | Excavated soil is treated on-Site utilizing high temperature thermal desorption. Treated soil is used as backfill or transported off-Site for disposal. | - Does not reduce the volume, toxicity, or mobility of COCs without vapor treatment. | - Not technically feasible for on-Site use. |
| Incineration | Chemical presence in excavated soil is treated through volatilization and combustion. Treated soil is used as backfill or transported off-Site for disposal. | - Effectively reduces the volume, toxicity, and mobility of contaminants. | - Not technically feasible for on-Site use. |

**TABLE 6.2**

**SCREENING OF IDENTIFIED REMEDIAL TECHNOLOGIES FOR SOIL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| *General Response Action* | *Description* | *Effectiveness* | *Implementability* |
|---|---|---|---|
| ***DISPOSAL*** | | | |
| Off-Site Treatment & Disposal | Transport soil to a permitted waste treatment, storage, and disposal facility. | - Eliminates potential for exposure to chemicals in the surface soil.<br>- Reduces volume, toxicity, or mobility of Site contaminants. | - Readily implemented.<br>- Technically feasible.<br>- Disposal as a hazardous waste may be required. |

Notes:
COCs Compounds of Concern.
RAOs Remedial Action Objectives.

**TABLE 6.3**

**SUMMARY OF DEVELOPMENT AND SCREENING OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | | *In Situ Treatment* | | | | |
|---|---|---|---|---|---|---|---|---|
| | *No Action* | *Institutional Control* | *Monitored Natural Attenuation* | *Chemical Oxidation* | *Permeable Reactive Barrier* | *Air Sparging* | *In-Well Stripping* | *Enhanced Biodegradation* |
| ***Effectiveness*** | | | | | | | | |
| • Further reduces toxicity, mobility, and volume of COCs | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| • Further minimizes residual risk and affords additional long-term protection | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ***Implementability*** | Readily implemented | Readily implemented | Readily implemented | Moderate concern | Difficult to implement | Difficult to implement | Moderate concern | Implementable |
| ***Relative Cost*** | | | | | | | | |
| • Capital | None | Low | None | Moderate | High | Moderate | Moderate | Moderate |
| • O&M (30 years) | None | Low | Moderate | Moderate | Low to Moderate | Moderate | Moderate | Moderate |
| ***Recommendation*** | Required for detailed analysis | Retained for detailed analysis | Retained for detailed analysis | Retained for detailed analysis | Eliminated from further consideration | Eliminated from further consideration | Eliminated from further consideration | Retained for detailed analysis |

**TABLE 6.3**

**SUMMARY OF DEVELOPMENT AND SCREENING OF REMEDIAL TECHNOLOGIES FOR GROUNDWATER**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Physical Containment* | *Hydraulic Containment & Collection* | | *Treatment of Collected Groundwater* | | *Disposal* | |
|---|---|---|---|---|---|---|---|
| | ***Barrier Wall*** | ***Extraction Wells*** | ***Collection Trenches*** | ***Air Stripping*** | ***Activated Carbon*** | ***Discharge to Sewer*** | ***Discharge to Surface Water*** |
| ***Effectiveness*** | | | | | | | |
| • Further reduces toxicity, mobility, and volume of COCs | No | Yes | Yes | Yes | Yes | No | No |
| • Further minimizes residual risk and affords additional long-term protection | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ***Implementability*** | Difficult to implement | Difficult to implement | Difficult to implement | Difficult to implement | Difficult to implement | Readily implemented | Readily implemented |
| ***Relative Cost*** | | | | | | | |
| • Capital | High | Moderate | High | Moderate | Moderate | Low | Low |
| • O&M (30 years) | Low | High | High | Moderate | High | Low | Low |
| ***Recommendation*** | Eliminated from further consideration | Retained for detailed analysis | Eliminated from further consideration | Retained for detailed analysis | Eliminated from further consideration | Eliminated from further consideration | Eliminated from further consideration |

## TABLE 6.4

## SUMMARY OF DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES FOR SOIL
## ALTERNATIVES ANALYSIS REPORT
## FORMER BUFFALO CHINA SITE (NO. C915209)
## BUFFALO, NEW YORK

| | | | *Physical Containment* | *Collection* | *In Situ Treatment* | *Ex Situ* |
|---|---|---|---|---|---|---|
| | *No Further Action* | *Institutional Controls* | *Capping* | *Excavation* | *Soil Vapor Extraction* | *Thermal Destruction* |
| ***Effectiveness*** | | | | | | |
| • Further reduces toxicity, mobility, and volume of COCs | No | No | No | Yes | Yes | No |
| • Further minimizes residual risk and affords additional long-term protection | No | Yes | Yes | Yes | Yes | Yes |
| ***Implementability*** | Readily implemented | Readily implemented | Implementable | Implementable | Implementable with Concern | Not Implementable |
| ***Relative Cost*** | | | | | | |
| • Capital | None | Low | Moderate | High | Moderate | High |
| • O&M (30 years) | None | Low | Moderate | Low | None | None |
| ***Land Use*** | Not Compatible | Compatable | Compatable | Compatable | Compatable | Not Compatable |
| ***Recommendation*** | Required for detailed analysis | Retained for detailed analysis | Eliminated from further consideration | Retained for detailed analysis | Eliminated from further consideration | Eliminated from further consideration |

**TABLE 6.4**

**SUMMARY OF DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES FOR SOIL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Treatment* | *Disposal* |
|---|---|---|
| | ***Incineration*** | ***Off-Site*** |
| ***Effectiveness*** | | |
| • Further reduces toxicity, mobility, and volume of COCs | Yes | Yes |
| • Further minimizes residual risk and affords additional long-term protection | Yes | Yes |
| ***Implementability*** | Not Implementable | Readily implemented |
| ***Relative Cost*** | | |
| • Capital | High | Moderate |
| • O&M (30 years) | None | None |
| ***Land Use*** | Not Compatable | Compatable |
| ***Recommendation*** | Eliminated from further consideration | Retained for detailed analysis |

**TABLE 7.1**

**COST ANALYSIS SUMMARY**
**GROUNDWATER ALTERNATIVE 1 - NO ACTION**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Item* | *Estimated Cost* |
|---|---|---|
| A. | Remedial Actions, Institutional Control, Monitoring (no action for any of these) | $0 |
| | **TOTAL ESTIMATED COST - GW ALTERNATIVE 1:** | $0 |

**TABLE 7.2**

**COST ANALYSIS SUMMARY**
**GROUNDWATER ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION AND INSTITUTIONAL CONTROL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $10,000 |
| | | | *Sub-Total, Administrative Cost:* | $10,000 |
| B. | | Direct Capital Cost | | |
| | i) | Monitoring Well Installation and Development | | $13,000 |
| | ii) | Waste Disposal | | $5,000 |
| C. | | Indirect Capital Cost | | $5,000 |
| | | | *Sub-Total, Capital Cost:* | $23,000 |
| D. | | Contingency | | $4,000 |
| | | | ***Total Capital Cost - GW Alternative 2:*** | $37,000 |

| | | | *Estimated Annual Cost* | *Present Worth* [(1)] |
|---|---|---|---|---|
| E. | | Annual Operation & Maintenance | | |
| | i) | Years 1 through 5 (Quarterly Monitoring) | $72,200 | $304,000 |
| | ii) | Years 6 through 30 (Semi-annual Monitoring) | $37,600 | $481,000 |
| | | | *Sub-Total, Operation & Maintenance:* | $785,000 |
| | | | **TOTAL ESTIMATED COST - GW ALTERNATIVE 2:** | $822,000 |

Notes:
(1) Present worth calculated using a 6% interest rate.
Estimates are rounded to the nearest $1,000.

**TABLE 7.3**

**COST ANALYSIS SUMMARY**
**GROUNDWATER ALTERNATIVE 3 - IN SITU ENHANCED BIOLOGICAL DEGRADATION**
**WITH INSTITUTIONAL CONTROL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $10,000 |
| | | | *Sub-Total, Administrative Cost:* | $10,000 |
| B. | | Pre-Design Treatability/Pilot Study | | $50,000 |
| | | | *Sub-Total, Pre-Design:* | $50,000 |
| C. | | Direct Capital Cost | | |
| | i) | Well Installation | | $59,000 |
| | ii) | Waste Disposal | | $5,000 |
| D. | | Indirect Capital Cost | | $45,000 |
| | | | *Sub-Total, Capital Cost:* | $109,000 |
| E. | | Contingency | | $13,000 |
| | | | ***Total Capital Cost - GW Alternative 3:*** | $182,000 |

| | | | *Estimated Annual Cost* | *Present Worth* [(1)] |
|---|---|---|---|---|
| F. | | Annual Operation & Maintenance | | |
| | i) | Biannual Substrate Application | $76,575 | $265,000 |
| | ii) | Semiannual Nutrient Application | $32,200 | $200,000 |
| | iii) | Years 1 through 8 (Semiannual Monitoring) | $37,600 | $233,000 |
| | iv) | Years 9 through 11 (Annual Monitoring) | $20,300 | $54,000 |
| | | | *Sub-Total, Operation & Maintenance:* | $752,000 |
| | | | **TOTAL ESTIMATED COST - GW ALTERNATIVE 3:** | $934,000 |

Notes:
(1) Present worth calculated using a 6% interest rate.
Estimates are rounded to the nearest $1,000.

**TABLE 7.4**

**COST ANALYSIS SUMMARY**
**GROUNDWATER ALTERNATIVE 4 - IN SITU CHEMICAL OXIDATION WITH ENHANCED BIOLOGICAL DEGRADATION AND INSTITUTIONAL CONTROL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | ***Item*** | | ***Estimated Cost*** |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $10,000 |
| | | | *Sub-Total, Administrative Cost:* | $10,000 |
| B. | | Pre-Design Pilot Study | | $50,000 |
| | | | *Sub-Total, Pre-Design:* | $50,000 |
| C. | | Direct Capital Cost | | |
| | i) | Well Installation | | $34,000 |
| | ii) | Waste Disposal | | $5,000 |
| D. | | Indirect Capital Cost | | $41,000 |
| | | | *Sub-Total, Capital Cost:* | $80,000 |
| E. | | Contingency | | $8,000 |
| | | | ***Total Capital Cost - GW Alternative 4:*** | $148,000 |

| | | | ***Estimated Annual Cost*** | ***Present Worth*** [(1)] |
|---|---|---|---|---|
| F. | | Annual Operation & Maintenance | | |
| | i) | Quarterly Oxidant Application | $180,848 | $181,000 |
| | ii) | Biannual Substrate Application | $61,575 | $113,000 |
| | iii) | Semiannual Nutrient Application | $16,200 | $43,000 |
| | iv) | Years 1 through 7 (Semiannual Monitoring) | $37,600 | $210,000 |
| | | | *Sub-Total, Operation & Maintenance:* | $547,000 |
| | | | **TOTAL ESTIMATED COST - GW ALTERNATIVE 4:** | $695,000 |

Notes:
(1) Present worth calculated using a 6% interest rate.
Estimates are rounded to the nearest $1,000.

**TABLE 7.5**

**COST ANALYSIS SUMMARY**
**GROUNDWATER ALTERNATIVE 5 - BEDROCK HYDRAULIC CONTAINMENT/COLLECTION WITH ON-SITE TREATMENT AND DISPOSAL AND INSITU OVERBURDEN TREATMENT**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $10,000 |
| | | | *Sub-Total, Administrative Cost:* | $10,000 |
| B. | | Pre-Design Pumping/Pilot Tests | | $50,000 |
| | | | *Sub-Total, Pre-Design:* | $50,000 |
| C. | | Direct Capital Cost | | |
| | i) | Insurance/Mobilization/Demobilization | | $10,000 |
| | ii) | Insatll injection wells | | $24,000 |
| | iii) | Installation of Well System (incl. pumps) | | $31,000 |
| | iv) | Groundwater Treatment System | | $51,000 |
| | v) | Instrumentation | | $25,000 |
| | vi) | Treatment Bldg & Mechanical/Electrical (includes piping) | | $226,000 |
| | vii) | Monitoring Well Installation & Development | | $6,000 |
| | viii) | Waste Disposal | | $10,000 |
| D. | | Indirect Capital Cost | | $157,000 |
| | | | *Sub-Total, Capital Cost:* | $540,000 |
| E. | | Contingency | | $77,000 |
| | | | ***Total Capital Cost - GW Alternative 5:*** | $677,000 |

| | | | *Estimated Annual Cost* | *Present Worth* (1) |
|---|---|---|---|---|
| F. | | Annual Operation & Maintenance** | | |
| | | *Years 1 through 21* | | |
| | i) | Bedrock Pump and Treat (Years 1 through 21) | $96,600 | $1,136,000 |
| | | *Years 1 through 7* | | |
| | ii) | Quarterly Oxidant Application | $128,744 | $129,000 |
| | iii) | Biannual Substrate Application | $41,110 | $75,000 |
| | iv) | Semiannual Nutrient Application | $11,280 | $30,000 |
| | | | *Sub-Total, Operation & Maintenance:* | $1,370,000 |
| G. | | Annual Monitoring | | |
| | i) | Years 1 through 21 (Semiannual Monitoring) | $29,400 | $346,000 |
| | | | *Sub-Total, Monitoring:* | $346,000 |
| | | | **TOTAL ESTIMATED COST - GW ALTERNATIVE 5:** | $2,393,000 |

Notes:
(1) Present worth calculated using a 6% interest rate. Estimates are rounded to the nearest $1,000.
** Costs are based on 7 years to complete insitu treatment of overburden and 21 years to pump and treat bedrock.

**TABLE 7.6**

**COST ANALYSIS SUMMARY**
**SOIL ALTERNATIVE 1 - NO ACTION**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Item* | *Estimated Cost* |
|---|---|---|
| A. | Remedial Actions, Institutional Control, Monitoring (no action for any of these) | $0 |
| | **TOTAL ESTIMATED COST - SO ALTERNATIVE 1:** | $0 |

**TABLE 7.7A**

**COST ANALYSIS SUMMARY**
**SOIL ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION**
**WITH INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $0 |
| | | | *Sub-Total, Administrative Cost:* | $0 |
| B. | | Direct Capital Cost | | |
| | i) | Not Applicable - Wells are already in place | | $0 |
| C. | | Indirect Capital Cost | | $0 |
| | | | *Sub-Total, Capital Cost:* | $0 |
| D. | | Contingency | | $0 |
| | | | ***Total Capital Cost - SO Alternative 2:*** | $0 |

| | | | *Estimated Annual Cost* | *Present Worth* [1] |
|---|---|---|---|---|
| E. | | Annual Operation & Maintenance | | |
| | i) | Years 1 through 5 (Quarterly Monitoring) | $4,000 | $17,000 |
| | ii) | Years 6 through 30 (Semiannual Monitoring) | $2,000 | $26,000 |
| | | | | $43,000 |
| | | **RANGE TOTAL ESTIMATED COST - SO ALTERNATIVE 2:** | | $43,000 |

Notes:

Table 7.6A assumes that SO Alternative 2 is coupled with GW Alternative 2

(1) Present worth calculated using a 6% interest rate.

Estimates are rounded to the nearest $1,000.

**TABLE 7.7B**

**COST ANALYSIS SUMMARY**
**SOIL ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION**
**WITH INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $0 |
| | | | *Sub-Total, Administrative Cost:* | $0 |
| B. | | Direct Capital Cost | | |
| | i) | Not Applicable - Wells are already in place | | $0 |
| C. | | Indirect Capital Cost | | $0 |
| | | | *Sub-Total, Capital Cost:* | $0 |
| D. | | Contingency | | $0 |
| | | | ***Total Capital Cost - SO Alternative 2:*** | $0 |

| | | | *Estimated Annual Cost* | *Present Worth* [(1)] |
|---|---|---|---|---|
| E. | | Annual Operation & Maintenance | | |
| | i) | Years 1 through 8 (Quarterly Monitoring) | $2,000 | $12,000 |
| | ii) | Years 9 through 11 (Semiannual Monitoring) | $1,000 | $3,000 |
| | | | | $15,000 |
| | | | **RANGE TOTAL ESTIMATED COST - SO ALTERNATIVE 2:** | $15,000 |

Notes:

Table 7.6B assumes that SO Alternative 2 is coupled with GW Alternative 3

(1) Present worth calculated using a 6% interest rate.

Estimates are rounded to the nearest $1,000.

**TABLE 7.7C**

**COST ANALYSIS SUMMARY**
**SOIL ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION**
**WITH INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $0 |
| | | | *Sub-Total, Administrative Cost:* | $0 |
| B. | | Direct Capital Cost | | |
| | i) | Not Applicable - Wells are already in place | | $0 |
| C. | | Indirect Capital Cost | | $0 |
| | | | *Sub-Total, Capital Cost:* | $0 |
| D. | | Contingency | | $0 |
| | | | ***Total Capital Cost - SO Alternative 2:*** | $0 |

| | | | *Estimated Annual Cost* | *Present Worth* [(1)] |
|---|---|---|---|---|
| E. | | Annual Operation & Maintenance | | |
| | i) | Years 1 through 8 (Semiannual Monitoring) | $2,000 | $11,000 |
| | | | | $11,000 |
| | | **RANGE TOTAL ESTIMATED COST - SO ALTERNATIVE 2:** | | $11,000 |

Notes:

Table 7.6C assumes that SO Alternative 2 is coupled with GW Alternatives 4 or 5.

(1) Present worth calculated using a 6% interest rate.

Estimates are rounded to the nearest $1,000.

## TABLE 7.8

### COST ANALYSIS SUMMARY
### SOIL ALTERNATIVE 3 - SOIL EXCAVATION AND DISPOSAL
### WITH INSITUTIONAL AND ENGINEERING CONTROLS
### ALTERNATIVES ANALYSIS REPORT
### FORMER BUFFALO CHINA SITE (NO. C915209)
### BUFFALO, NEW YORK

| | | *Item* | | *Estimated Cost* |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $10,000 |
| | | | *Sub-Total, Administrative Cost:* | $10,000 |
| B. | | Direct Capital Cost | | |
| | i) | Insurance/Mobilization/Demobilization | | $5,000 |
| | ii) | Precharacterization Analysis | | $8,000 |
| | iii) | Excavation & Restoration | | $62,000 |
| | iv) | Transportation and Disposal | | $69,000 |
| | v) | Reintall Monitoring Wells | | $8,000 |
| | vi) | Survey | | $5,000 |
| C. | | Indirect Capital Cost | | $39,000 |
| | | | *Sub-Total, Capital Cost:* | $196,000 |
| E. | | Contingency | | $31,000 |
| | | | ***Total Capital Cost - SO Alternative 3:*** | $237,000 |

| | | *Estimated Annual Cost* | *Present Worth* [(1)] |
|---|---|---|---|
| | Annual Operation & Maintenance | | |
| F. | Years 1 through 8 | $500 | $3,000 |
| | | *Sub-Total, Operation & Maintenance:* | $3,000 |
| | | **TOTAL ESTIMATED COST - SO ALTERNATIVE 3:** | $240,000 |

Notes:
(1) Present worth calculated using a 6% interest rate.
Estimates are rounded to the nearest $1000.

**TABLE 7.9**

**COST ANALYSIS SUMMARY**
**UNRESTRICTED USE ALTERNATIVE**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

**SOIL COMPONENET**

| | | *Item* | | ***Estimated Cost*** |
|---|---|---|---|---|
| A. | | Administrative Cost | | |
| | i) | Institutional Control | | $0 |
| | | | *Sub-Total, Administrative Cost:* | $0 |
| B. | | Direct Capital Cost | | |
| | i) | Insurance/Mobilization/Demobilization | | $10,000 |
| | ii) | Excavation & Restoration | | $1,092,000 |
| | iii) | Transportation and Disposal | | $2,426,000 |
| | iv) | Reintall Monitoring Wells | | $17,000 |
| | v) | Survey | | $5,000 |
| C. | | Indirect Capital Cost | | $562,000 |
| | | | *Sub-Total, Capital Cost:* | $4,112,000 |
| E. | | Contingency | | $450,000 |
| | | | ***Total Capital Cost - Unrestricted Use:*** | $4,562,000 |
| | | | **TOTAL ESTIMATED COST - UNRESTRICTED USE:** | $4,562,000 |

Notes:

Estimates are rounded to the nearest $1000.

**TABLE 8.1**

**COMPARATIVE RANKING OF GROUNDWATER REMEDIAL ALTERNATIVES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Groundwater Alternative* | | | | |
|---|---|---|---|---|---|
| | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** |
| | ***No Action*** | ***MNA with Institutional Control*** | ***Enhanced Bidegradation and Institutional Control*** | ***In Situ Chemical Oxidation (ISCO) with Enhanced Biodegradation and Institutional Control*** | ***ISCO with Enhanced Biodegradation and Institutional Control for Overburden, with Hydraulic Containment/ Collection and On-Site Treatment and Disposal for Bedrock*** |
| Overall Protection of Human Health | 5 | 4 | 2 | 1 | 3 |
| Compliance with SCGs | 1 | 1 | 1 | 1 | 1 |
| Reduction of Toxicity, Mobility, and Volume | 5 | 4 | 2* | 2* | 1 |
| Short-Term Effectiveness | 1 | 2 | 3 | 4* | 4* |
| Long-Term Effectiveness and Permanence | 5 | 4 | 1* | 1* | 3 |
| Implementability | 1 | 2 | 4 | 3 | 5 |
| Land Use | 4* | 4* | 1* | 1* | 3 |
| Net Present Worth Cost** | $0 | $822,000 | $934,000 | $695,000 | $2,393,000 |

Note:
* Alternatives of same ranking are equally effective.
** Present worth calculated using a 6 percent interest rate.

**TABLE 8.2**

**COMPARATIVE RANKING OF SOIL REMEDIAL ALTERNATIVES**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Soil Alternative* | | | |
|---|---|---|---|---|
| | *1* *No Action* | *2* *MNA with Institutional Control* | *3* *Excavation and Disposal* | *4* *Unrestricted Use Criteria* |
| Overall Protection of Human Health | 3 | 2 | 1* | 1* |
| Compliance with SCGs | 2* | 2* | 1* | 1* |
| Reduction of Toxicity, Mobility, and Volume | 2* | 2* | 1* | 1* |
| Short-Term Effectiveness | 1 | 2 | 3 | 4 |
| Long-Term Effectiveness and Permanence | 3 | 2 | 1* | 1* |
| Implementability | 1 | 2 | 3 | 4 |
| Land Use | 4 | 2 | 1 | 3 |
| Net Present Worth Cost** | $0 | $11,000 - $43,000 | $240,000 | $4,562,000 |

Notes:
* Alternatives of same ranking are equally effective.
** Present worth calculated using a 6 percent interest rate.

**TABLE 9.1**

**SUMMARY OF REMEDIAL ALTERNATIVES AND COSTS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | *Groundwater Alternative* | | | | | *Soil Alternative* | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***1*** | ***2*** | ***3*** | ***4*** |
| | ***No Action*** | ***MNA with Institutional Control*** | ***Enhanced Bidegradation and Institutional Control*** | ***In Situ Chemical Oxidation (ISCO) with Enhanced Biodegradation and Institutional Control*** | ***ISCO with Enhanced Biodegradation and Institutional Control for Overburden, with Hydraulic Containment/ Collection and On-Site Treatment and Disposal for Bedrock*** | ***No Action*** | ***MNA with Institutional Control*** | ***Excavation and Disposal*** | ***Unrestricted Use Criteria*** |
| Net Present Worth Cost** | $0 | $822,000 | $934,000 | $695,000 | $2,393,000 | $0 | $11,000 - $43,000 | $240,000 | $4,562,000 |

Notes:
** Present worth calculated using a 6 percent interest rate.

# APPENDIX A

# COST ESTIMATE DETAIL

**TABLE A.1**

**ESTIMATED COSTS - GROUNDWATER ALTERNATIVE 2**
**MONITORED NATURAL ATTENUATION & INSTITUTIONAL CONTROL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | | |
| 1 | | Administrative Cost to Implement Deed Restrictions | 1 | L.S. | $ 10,000 | $ 10,000 |
| | | | | *Sub-Total, Administrative Cost:* | | $ 10,000 |
| ***Direct Capital Costs*** | | | | | | |
| 1 | | Install monitoring wells | | | | |
| | a. | Insurance, Mobilization/Demobilization | 1 | L.S. | $ 5,000 | $ 5,000 |
| | b. | Overburden | 1 | EACH | $ 600 | $ 600 |
| | c. | Bedrock | 2 | EACH | $ 1,500 | $ 3,000 |
| | d. | Curb Boxes/Bollards | 3 | Each | $ 150 | $ 450 |
| 2 | | Well Development/Redevelopment | 40 | Hour | $ 100 | $ 4,000 |
| 3 | | Waste Disposal | 1 | LS | $ 5,000 | $ 5,000 |
| | | | | *Sub-Total, Direct Capital Cost:* | | $ 18,050 |
| ***Indirect Capital Costs*** | | | | | | |
| 1 | | Design, Engineering, & Oversight (assume 25% of capital cost) | | | | $ 4,513 |
| 2 | | Contingency Allowance (assume 20% of capital cost) | | | | $ 3,610 |
| | | | | *Sub-Total, Indirect Capital Costs:* | | $ 8,123 |
| | | | | ***Total Capital Cost - MNA & Institutional Control:*** | | $ 36,173 |
| ***Annual Monitoring*** | | | | | | |
| | | *Years 1 through 5* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 4 | Each | $ 6,000 | $ 24,000 |
| 2 | | Waste Disposal | 4 | Each | $ 2,800 | $ 11,200 |
| 3 | | Sample Analyses | 4 | Each | $ 5,500 | $ 22,000 |
| 4 | | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 |
| 5 | | Reporting | 4 | Each | $ 3,000 | $ 12,000 |
| | | | | *Total, Annual O&M Years 1 through 5:* | | $ 72,200 |
| | | *Years 6 through 30* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 2 | Each | $ 6,000 | $ 12,000 |
| 2 | | Waste Disposal | 2 | Each | $ 2,800 | $ 5,600 |
| 3 | | Sample Analyses | 2 | Each | $ 5,500 | $ 11,000 |
| 4 | | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 |
| 5 | | Reporting | 2 | Each | $ 3,000 | $ 6,000 |
| | | | | *Total, Annual O&M Years 6 through 30:* | | $ 37,600 |

Notes:
Costs are in total present value.

**TABLE A.2**

**ESTIMATED COSTS - GROUNDWATER ALTERNATIVE 3**
**ENHANCED BIOLOGICAL DEGRADATION WITH INSTITUTIONAL CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | |
| 1 | Administrative Cost to Implement Deed Restrictions | 1 | L.S. | $ 10,000 | $ 10,000 |
| | | | | *Sub-Total, Administrative Cost:* | $ 10,000 |
| ***Pre-Design Cost*** | | | | | |
| 1 | Treatability/Pilot study | 1 | L.S. | $ 50,000 | $ 50,000 |
| | | | | *Sub-Total, Pre-Design Cost:* | $ 50,000 |
| ***Direct Capital Costs*** | | | | | |
| 1 | In situ treatment | | | | |
| a. | Mobilization/Demobilization | 1 | L.S. | $ 5,000 | $ 5,000 |
| b. | Install overburden injection wells | 65 | EACH | $ 600 | $ 39,000 |
| c. | Install bedrock injection wells | 10 | EACH | $ 1,500 | $ 15,000 |
| 2 | Waste Disposal | 1 | LS | $ 5,000 | $ 5,000 |
| | | | | *Sub-Total, Direct Capital Cost:* | $ 64,000 |
| ***Indirect Capital Costs*** | | | | | |
| 1 | Oversight of field activities | 35 | Manday | $ 1,000 | $ 35,000 |
| 2 | Engineering (assume 15% of capital cost) | | | | $ 9,600 |
| 3 | Contingency Allowance (assume 20% of capital cost) | | | | $ 12,800 |
| | | | | *Sub-Total, Indirect Capital Costs:* | $ 57,400 |
| | | | | ***Total Capital Cost - Enhanced Bio and Institutional Control:*** | $ 181,000 |
| ***Enhanced Bio - Years 1,3,5,7*** | | | | | |
| 1 | Substrate | 1 | LS | $ 46,575 | $ 46,575 |
| 2 | Application of substrate [1] | 1 | Event | $ 30,000 | $ 30,000 |
| ***Enhanced Bio - Years 1 through 8*** | | | | | |
| 1 | Nutrients | 2 | Event | $ 100 | $ 200 |
| 2 | Application of nutrients [2] | 2 | Event | $ 16,000 | $ 32,000 |
| ***Monitoring During Treatment*** | | | | | |
| | *Years 1 through 8* | | | | |
| 1 | Hydraulic Monitoring & Sampling | 2 | Each | $ 6,000 | $ 12,000 |
| 2 | Waste Disposal | 2 | Each | $ 2,800 | $ 5,600 |
| 3 | Sample Analyses | 2 | Each | $ 5,500 | $ 11,000 |
| 4 | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 |
| 5 | Reporting | 2 | Each | $ 3,000 | $ 6,000 |
| | | | | *Total, Annual O&M Years 1 through 8:* | $ 37,600 |
| | *Years 9 through 11* | | | | |
| 1 | Hydraulic Monitoring & Sampling | 1 | Each | $ 6,000 | $ 6,000 |
| 2 | Waste Disposal | 1 | Each | $ 2,800 | $ 2,800 |
| 3 | Sample Analyses | 1 | Each | $ 5,500 | $ 5,500 |
| 4 | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 |
| 5 | Reporting | 1 | Each | $ 3,000 | $ 3,000 |
| | | | | *Total, Annual O&M Years 9 through 11:* | $ 20,300 |

Notes:

Costs are in total present value.

(1) Assumes 325 gallons of substrate per well at a maximum pumping capacity of 0.5 gpm.

(2) Assumes 180 gallons of nutrient solution per well at a maximum pumping capacity of 0.5 gpm.

**TABLE A.3**
**GROUNDWATER ALTERNATIVE 4 - IN SITU CHEMICAL OXIDATION WITH ENHANCED BIOLOGICAL DEGRADATION AND INSTITUTIONAL CONTROL**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | |
| 1 | Administrative Cost to Implement Deed Restrictions | 1 | L.S. | $ 10,000 | $ 10,000 |
| | | | | *Sub-Total, Administrative Cost:* | $ 10,000 |
| ***Pre-Design Cost*** | | | | | |
| 1 | Treatability/Pilot study | 1 | L.S. | $ 50,000 | $ 50,000 |
| | | | | *Sub-Total, Pre-Design Cost:* | $ 50,000 |
| ***Direct Capital Costs*** | | | | | |
| 1 | In situ treatment | | | | |
| a. | Mobilization/Demobilization | 1 | L.S. | $ 5,000 | $ 5,000 |
| b. | Install overburden injection wells | 22 | Each | $ 600 | $ 13,200 |
| c. | Install bedrock injection wells | 7 | Each | $ 1,500 | $ 10,500 |
| d. | Install piping gallery | 350 | LF | $ 15 | $ 5,250 |
| 2 | Waste Disposal | 1 | LS | $ 5,000 | $ 5,000 |
| | | | | *Sub-Total, Direct Capital Cost:* | $ 38,950 |
| ***Indirect Capital Costs*** | | | | | |
| 1 | Oversight of field activities | 35 | Manday | $ 1,000 | $ 35,000 |
| 2 | Engineering & Design (assume 15% of capital cost) | | | | $ 5,843 |
| 3 | Contingency Allowance (assume 20% of capital cost) | | | | $ 7,790 |
| | | | | *Sub-Total, Indirect Capital Costs:* | $ 48,633 |
| | | | | ***Total Capital Cost - ISCO and ISEB with Institutional Control:*** | $ 148,000 |
| ***ISCO (18 months)*** | | | | | |
| 1 | Oxidant | 1 | LS | $ 75,113 | $ 75,113 |
| 2 | Catalyst | 1 | LS | $ 21,735 | $ 21,735 |
| 3 | Application of Oxidant | 6 | Event | $ 14,000 | $ 84,000 |
| ***Enhanced Bio Years 3 through 7*** | | | | | |
| 1 | Substrate | 1 | LS | $ 46,575 | $ 46,575 |
| 2 | Application of substrate | 1 | Event | $ 15,000 | $ 15,000 |
| 3 | Nutrients | 2 | Event | $ 100 | $ 200 |
| 4 | Application of nutients | 2 | Event | $ 8,000 | $ 16,000 |
| ***Monitoring During Treatment*** | | | | | |
| | *Years 1 through 7* | | | | |
| 1 | Hydraulic Monitoring & Sampling | 2 | Each | $ 6,000 | $ 12,000 |
| 2 | Waste Disposal | 2 | Each | $ 2,800 | $ 5,600 |
| 3 | Sample Analyses | 2 | Each | $ 5,500 | $ 11,000 |
| 4 | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 |
| 5 | Reporting | 2 | Each | $ 3,000 | $ 6,000 |
| | | | | *Total, Annual O&M Years 1 through 7:* | $ 37,600 |

Notes:

Costs are in total present value.

(1) Assumes 140 gallons of oxidant/catalyst per well at a maximum pumping capacity of 0.5 gpm.

(2) Assumes 325 gallons of substrate per well at a maximum pumping capacity of 0.5 gpm.

(3) Assumes 180 gallons of nutrient solution per well at a maximum pumping capacity of 0.5 gpm.

**TABLE A.4**

**ESTIMATED COSTS - GROUNDWATER ALTERNATIVE 5**
**BEDROCK HYDRAULIC CONTAINMENT/COLLECTION WITH**
**ON-SITE TREATMENT AND DISPOSAL AND INSITU OVERBURDEN TREATMENT**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (C915209)**
**BUFFALO, NEW YORK**

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | |
| 1 | Administrative Cost to Implement Deed Restrictions | 1 | L.S. | $ 10,000 | $ 10,000 |
| | | | *Sub-Total, Administrative Cost:* | | $ 10,000 |
| ***Pre-Design Cost*** | | | | | |
| 1 | Pumping/Pilot Tests | 1 | L.S. | $ 50,000 | $ 50,000 |
| | | | *Sub-Total, Pre-Design Cost:* | | $ 50,000 |
| ***Direct Capital Costs*** | | | | | |
| 1 | Insurance, Mobilization/ Demobilization | 1 | L.S. | $ 10,000 | $ 10,000 |
| 2 | Install Injection wells | | | | |
| a. | Overburden | 19 | Each | $ 600 | $ 11,400 |
| b. | Curb Boxes/Bollards | 19 | Each | $ 150 | $ 2,850 |
| c. | Well Development | 40 | Hour | $ 100 | $ 4,000 |
| d. | Install piping gallery | 350 | LF | $ 15 | $ 5,250 |
| 3 | Installation of Bedrock Extraction Wells | | | | |
| a. | Drilling and Development | 6 | Each | $ 2,200 | $ 13,200 |
| b. | Above-Ground Completion | 6 | Each | $ 1,500 | $ 9,000 |
| c. | Pumps | 6 | Each | $ 1,500 | $ 9,000 |
| 4 | Groundwater Treatment System | | | | |
| a. | Air Stripper | 1 | L.S. | $ 25,000 | $ 25,000 |
| b. | Tanks | 1 | L.S. | $ 10,000 | $ 10,000 |
| c. | Pumps | 1 | L.S. | $ 10,000 | $ 10,000 |
| d. | Bag Filter Housings | 2 | Each | $ 3,000 | $ 6,000 |
| 5 | Mechanical | | | | |
| a. | Trenching & Piping | 600 | L.F. | $ 60 | $ 36,000 |
| b. | Treatment systems | 1 | L.S. | $ 75,000 | $ 75,000 |
| 6 | Treatment Building | 1 | L.S. | $ 40,000 | $ 40,000 |
| 7 | Electrical | 1 | L.S. | $ 75,000 | $ 75,000 |
| 8 | Instrumentation | 1 | L.S. | $ 25,000 | $ 25,000 |
| 9 | Install new monitoring wells (2 bedrock 1 overburden) | | | | |
| a. | Overburden | 1 | EACH | $ 600 | $ 600 |
| b. | Bedrock | 2 | EACH | $ 1,500 | $ 3,000 |
| c. | Curb Boxes/Bollards | 3 | Each | $ 150 | $ 450 |
| 10 | Well Development | 24 | Hour | $ 100 | $ 2,400 |
| 11 | Waste Disposal | 1 | LS | $ 10,000 | $ 10,000 |
| | | | *Sub-Total, Direct Capital Cost:* | | $ 383,150 |

**TABLE A.4**

**ESTIMATED COSTS - GROUNDWATER ALTERNATIVE 5**
**BEDROCK HYDRAULIC CONTAINMENT/COLLECTION WITH**
**ON-SITE TREATMENT AND DISPOSAL AND INSITU OVERBURDEN TREATMENT**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (C915209)**
**BUFFALO, NEW YORK**

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* | |
|---|---|---|---|---|---|---|
| ***Indirect Capital Costs*** | | | | | | |
| 1 | Oversight of construction, well installation, & well development | 60 | Day | $ 1,000 | $ 60,000 | |
| 2 | Extraction & treatment system startup | 1 | LS | $ 20,000 | $ 20,000 | |
| 3 | Engineering | | | | | |
| | (assume 20% of capital cost) | | | | $ 76,630 | |
| 4 | Contingency Allowance | | | | | |
| | (assume 20% of capital cost) | | | | $ 76,630 | |
| | | | | *Sub-Total, Indirect Capital Costs:* | $ 233,260 | |
| | | | | ***Total Capital Cost - Hydraulic Containment/Collection:*** | $ 676,410 | |
| ***Annual Operation & Maintenance*** | | | | | | |
| *Bedrock Pump and Treat (Years 1 through 21)* | | | | | | |
| 1 | Extraction Well Maintenance | 6 | Each | $ 500 | $ 3,000 | |
| 2 | Treatment System | | | | | |
| a. | Operator | 416 | Hour | $ 100 | $ 41,600 | * |
| b. | Utilities and Chemicals | 1 | L.S. | $ 35,000 | $ 35,000 | |
| c. | Treatment monitoring, repairs, materials & supplies | 1 | L.S. | $ 15,000 | $ 15,000 | |
| 3 | Waste Disposal | 1 | L.S. | $ 2,000 | $ 2,000 | |
| ***ISCO (18 months)*** | | | | | | |
| 1 | Oxidant | 1 | LS | $ 50,144 | $ 50,144 | |
| 2 | Catalyst | 1 | LS | $ 12,600 | $ 12,600 | |
| 3 | Application of Oxidant | 6 | Event | $ 11,000 | $ 66,000 | |
| ***Enhanced Bio Years 3 through 7*** | | | | | | |
| 1 | Substrate | 1 | LS | $ 31,110 | $ 31,110 | |
| 2 | Application of substrate | 1 | Event | $ 10,000 | $ 10,000 | |
| 3 | Nutrients | 2 | Event | $ 140 | $ 280 | |
| 4 | Application of nutients | 2 | Event | $ 5,500 | $ 11,000 | |
| ***Annual Monitoring ***** | | | | | | |
| | *Years 1 through 21* | | | | | |
| 1 | Hydraulic Monitoring & Sampling | 2 | Each | $ 4,700 | $ 9,400 | |
| 2 | Sample Analyses | 2 | Each | $ 5,500 | $ 11,000 | |
| 3 | Monitoring Well Maintenance & Repair | 1 | L.S. | $ 3,000 | $ 3,000 | |
| 4 | Reporting | 2 | L.S. | $ 3,000 | $ 6,000 | |
| | | | | *Total, Annual Monitoring Years 1 through 21:* | $ 29,400 | |

Notes:
Costs are in total present value.
* Assumes 1 day per week 52 weeks per year

TABLE A.5A

ESTIMATED COSTS - SOIL ALTERNATIVE 2
MONITORED NATURAL ATTENUATION & INSTITUTIONAL AND ENGINEERING CONTROLS
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
BUFFALO, NEW YORK

| | | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|---|
| *Administrative Cost* | | | | | | |
| 1 | | Administrative Cost to Implement Deed Restrictions | 0 | L.S. | $ 10,000 | $ - |
| | | | | | *Sub-Total, Administrative Cost:* | $ - |
| *Direct Capital Costs* | | | | | | |
| 1 | | Install monitoring wells | | | | |
| | a. | Insurance, Mobilization/Demobilization | 0 | L.S. | $ 5,000 | $ - |
| | b. | Overburden | 0 | V.F. | $ 45 | $ - |
| | c. | Bedrock | | | | |
| | i) | overburden casing | 0 | V.F. | $ 60 | $ - |
| | ii) | bedrock coring | 0 | V.F. | $ 60 | $ - |
| | d. | Curb Boxes/Bollards | 0 | Each | $ 150 | $ - |
| 2 | | Well Development/Redevelopment | 0 | Hour | $ 100 | $ - |
| 3 | | Waste Disposal | 0 | LS | $ 5,000 | $ - |
| | | | | | *Sub-Total, Direct Capital Cost:* | $ - |
| *Indirect Capital Costs* | | | | | | |
| 1 | | Engineering (assume 15% of capital cost) | | | | $ - |
| 2 | | Contingency Allowance (assume 20% of capital cost) | | | | $ - |
| | | | | | *Sub-Total, Indirect Capital Costs:* | $ - |
| | | | | | ***Total Capital Cost - MNA & Institutional Control:*** | $ - |
| *Quarterly Monitoring* | | | | | | |
| | | *Years 1 through 5* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 0 | Each | $ 6,000 | $ - |
| 2 | | Waste Disposal | 0 | Each | $ 2,800 | $ - |
| 3 | | Sample Analyses | 4 | Each | $ 1,000 | $ 4,000 |
| 4 | | Monitoring Well Maintenance & Repair | 0 | L.S. | $ 3,000 | $ - |
| 5 | | Reporting | 0 | Each | $ 3,000 | $ - |
| | | | | | *Total, Annual O&M Years 1 through 5:* | $ 4,000 |
| *Semiannual Monitoring* | | | | | | |
| | | *Years 6 through 30* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 0 | Each | $ 6,000 | $ - |
| 2 | | Waste Disposal | 0 | Each | $ 2,800 | $ - |
| 3 | | Sample Analyses | 2 | Each | $ 1,000 | $ 2,000 |
| 4 | | Monitoring Well Maintenance & Repair | 0 | L.S. | $ 3,000 | $ - |
| 5 | | Reporting | 0 | Each | $ 3,000 | $ - |
| | | | | | *Total, Annual O&M Years 6 through 30:* | $ 2,000 |

Notes:
Costs are in total present value.

**TABLE A.5B**

**ESTIMATED COSTS - SOIL ALTERNATIVE 2**
**MONITORED NATURAL ATTENUATION & INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | Estimated Quantity | Unit | Unit Cost | Total |
|---|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | | |
| 1 | | Administrative Cost to Implement Deed Restrictions | 0 | L.S. | $ 10,000 | $ - |
| | | | | | *Sub-Total, Administrative Cost:* | $ - |
| ***Direct Capital Costs*** | | | | | | |
| 1 | | Install monitoring wells | | | | |
| | a. | Insurance, Mobilization/Demobilization | 0 | L.S. | $ 5,000 | $ - |
| | b. | Overburden | 0 | V.F. | $ 45 | $ - |
| | c. | Bedrock | | | | |
| | i) | overburden casing | 0 | V.F. | $ 60 | $ - |
| | ii) | bedrock coring | 0 | V.F. | $ 60 | $ - |
| | d. | Curb Boxes/Bollards | 0 | Each | $ 150 | $ - |
| 2 | | Well Development/Redevelopment | 0 | Hour | $ 100 | $ - |
| 3 | | Waste Disposal | 0 | LS | $ 5,000 | $ - |
| | | | | | *Sub-Total, Direct Capital Cost:* | $ - |
| ***Indirect Capital Costs*** | | | | | | |
| 1 | | Engineering (assume 15% of capital cost) | | | | $ - |
| 2 | | Contingency Allowance (assume 20% of capital cost) | | | | $ - |
| | | | | | *Sub-Total, Indirect Capital Costs:* | $ - |
| | | | | | ***Total Capital Cost - MNA & Institutional Control:*** | $ - |
| ***Semiannual Monitoring*** | | | | | | |
| | | *Years 1 through 8* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 0 | Each | $ 6,000 | $ - |
| 2 | | Waste Disposal | 0 | Each | $ 2,800 | $ - |
| 3 | | Sample Analyses | 2 | Each | $ 1,000 | $ 2,000 |
| 4 | | Monitoring Well Maintenance & Repair | 0 | L.S. | $ 3,000 | $ - |
| 5 | | Reporting | 0 | Each | $ 3,000 | $ - |
| | | | | | *Total, Annual O&M Years 1 through 8:* | $ 2,000 |
| ***Annual Monitoring*** | | | | | | |
| | | *Years 9 through 11* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 0 | Each | $ 6,000 | $ - |
| 2 | | Waste Disposal | 0 | Each | $ 2,800 | $ - |
| 3 | | Sample Analyses | 1 | Each | $ 1,000 | $ 1,000 |
| 4 | | Monitoring Well Maintenance & Repair | 0 | L.S. | $ 3,000 | $ - |
| 5 | | Reporting | 0 | Each | $ 3,000 | $ - |
| | | | | | *Total, Annual O&M Years 9 through 11:* | $ 1,000 |

Notes:
Costs are in total present value.

**TABLE A.5C**

**ESTIMATED COSTS - SOIL ALTERNATIVE 2**
**MONITORED NATURAL ATTENUATION & INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | | |
| 1 | | Administrative Cost to Implement Deed Restrictions | 0 | L.S. | $ 10,000 | $ - |
| | | | | | *Sub-Total, Administrative Cost:* | $ - |
| ***Direct Capital Costs*** | | | | | | |
| 1 | | Install monitoring wells | | | | |
| | a. | Insurance, Mobilization/Demobilization | 0 | L.S. | $ 5,000 | $ - |
| | b. | Overburden | 0 | V.F. | $ 45 | $ - |
| | c. | Bedrock | | | | |
| | i) | overburden casing | 0 | V.F. | $ 60 | $ - |
| | ii) | bedrock coring | 0 | V.F. | $ 60 | $ - |
| | d. | Curb Boxes/Bollards | 0 | Each | $ 150 | $ - |
| 2 | | Well Development/Redevelopment | 0 | Hour | $ 100 | $ - |
| 3 | | Waste Disposal | 0 | LS | $ 5,000 | $ - |
| | | | | | *Sub-Total, Direct Capital Cost:* | $ - |
| ***Indirect Capital Costs*** | | | | | | |
| 1 | | Engineering (assume 15% of capital cost) | | | | $ - |
| 2 | | Contingency Allowance (assume 20% of capital cost) | | | | $ - |
| | | | | | *Sub-Total, Indirect Capital Costs:* | $ - |
| | | | | | ***Total Capital Cost - MNA & Institutional Control:*** | $ - |
| ***Semiannual Monitoring*** | | | | | | |
| | | *Years 1 through 8* | | | | |
| 1 | | Hydraulic Monitoring & Sampling | 0 | Each | $ 6,000 | $ - |
| 2 | | Waste Disposal | 0 | Each | $ 2,800 | $ - |
| 3 | | Sample Analyses | 2 | Each | $ 1,000 | $ 2,000 |
| 4 | | Monitoring Well Maintenance & Repair | 0 | L.S. | $ 3,000 | $ - |
| 5 | | Reporting | 0 | Each | $ 3,000 | $ - |
| | | | | | *Total, Annual O&M Years 1 through 8:* | $ 2,000 |

Notes:
Costs are in total present value.

**TABLE A.6**

**ESTIMATED COSTS - SOIL ALTERNATIVE 3**
**EXCAVATION & DISPOSAL WITH INSTITUTIONAL AND ENGINEERING CONTROLS**
**ALTERNATIVES ANALYSIS REPORT**
**FORMER BUFFALO CHINA SITE (NO. C915209)**
**BUFFALO, NEW YORK**

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | |
| 1 | Administrative Cost to Implement Deed Restrictions | 1 | L.S. | $ 10,000 | $ 10,000 |
| | | | *Sub-Total, Administrative Cost:* | | $ 10,000 |
| ***Direct Capital Costs*** | | | | | |
| | *Excavate & Restore (930 c.y.)* | | | | |
| 1 | Insurance, Mobilization/Demobilization | 1 | L.S. | $ 5,000 | $ 5,000 |
| 2 | Precharacterization Analyses | 5 | EACH | $ 1,500 | $ 7,500 |
| 3 | Excavate & load soil | 930 | c.y. | $ 30 | $ 27,900 |
| 4 | Supply & place imported backfill | 1116 | c.y. | $ 25 | $ 27,900 |
| 5 | Supply & place topsoil (6-inch thickness) | 120 | c.y. | $ 35 | $ 4,200 |
| 6 | Seed & vegetate | 1 | L.S. | $ 1,500 | $ 1,500 |
| 7 | Reinstall overburden wells | 5 | EACH | $ 600 | $ 3,000 |
| 8 | Reinstall bedrock wells | 3 | EACH | $ 1,500 | $ 4,500 |
| 9 | Survey | 1 | L.S. | $ 5,000 | $ 5,000 |
| | | | | | $ 86,500 |
| | *Transportation & Disposal (930 c.y. total)* | | | | |
| 1 | Transportation and disposal as Hazardous | 115 | ton | $ 155 | $ 17,825 |
| 2 | Transportation and disposal as Non-hazardous | 1280 | ton | $ 40 | $ 51,200 |
| | | | | | $ 69,025 |
| | | | *Sub-Total, Direct Capital Cost:* | | $ 155,525 |
| ***Indirect Capital Costs*** | | | | | |
| 1 | Design, Engineering, & Oversight (assume 25% of capital cost) | | | | $ 38,881 |
| 2 | Contingency Allowance (assume 20% of capital cost) | | | | $ 31,105 |
| | | | *Sub-Total, Indirect Capital Costs:* | | $ 69,986 |
| | | | ***Total Capital Cost - Excavation & Disposal*** | | $ 235,511 |
| *Annual Operation & Maintenance* | | | | | |
| 1 | Annual Inspection | 1 | Each | $ 500 | $ 500 |
| | | | ***Total Annual Operation & Maintenance*** | | $ 500 |

Notes:
Costs are in total present value.
Assume Area A is 160 feet x 45 feet, excavated to 4 foot bgs.
Assume Area s B through E are 10 feet x 10 feet, excavated to 2 feet bgs.
Assume weight 1.5 tons per cubic yard of soil.

TABLE A.7

ESTIMATED COSTS - UNRESTRICTED USE ALTERNATIVE
ALTERNATIVES ANALYSIS REPORT
FORMER BUFFALO CHINA SITE (NO. C915209)
BUFFALO, NEW YORK

| | | *Estimated Quantity* | *Unit* | *Unit Cost* | *Total* |
|---|---|---|---|---|---|
| ***Administrative Cost*** | | | | | |
| 1 | Administrative Cost to Implement Deed Restrictions | 0 | L.S. | $ 10,000 | $ - |
| | | | *Sub-Total, Administrative Cost:* | | $ - |
| ***Direct Capital Costs*** | | | | | |
| | *Excavate & Restore (38,240 c.y.)* | | | | |
| 1 | Insurance, Mobilization/Eemobilization | 1 | L.S. | $ 10,000 | $ 10,000 |
| 2 | Excavate & load soil | 38240 | c.y. | $ 5 | $ 191,200 |
| 5 | Supply & place imported backfill | 33495 | c.y. | $ 25 | $ 837,375 |
| 6 | Supply & place topsoil (6 in x 95,000 SF)) | 1759 | c.y. | $ 35 | $ 61,574 |
| 7 | Seed & vegetate | 1 | L.S. | $ 2,000 | $ 2,000 |
| 8 | Reinsatall overburden wells | 9 | L.S. | $ 1,000 | $ 9,000 |
| 8 | Reinsatall bedrock wells | 7 | L.S. | $ 1,200 | $ 8,400 |
| 8 | Survey | 1 | L.S. | $ 5,000 | $ 5,000 |
| | | | | | $ 1,124,549 |
| | *Transportation & Disposal (38,240 c.y. total)* | | | | |
| 1 | Transportation and disposal as Hazardous | 1147.2 | ton | $ 155 | $ 177,816 |
| 2 | Transportation and disposal as Non-hazardous | 56212.8 | ton | $ 40 | $ 2,248,512 |
| | | | | | $ 2,426,328 |
| ***Indirect Capital Costs*** | | | | | |
| 1 | Design, Engineering, & Oversight (assume 25% of capital cost) | | | | $ 562,128 |
| 2 | Contingency Allowance (assume 20% of capital cost) | | | | $ 449,702 |
| | | | *Sub-Total, Indirect Capital Costs:* | | $ 1,011,830 |
| | | | ***Total Capital Cost - Excavation & Disposal*** | | $ 4,562,707 |