Feasibility Study
640 Trolley Boulevard Site (8-28-108)
Monroe County, Town of Gates, New York

Prepared for

New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233

Prepared by

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January 2009
Revision: FINAL
EA Project No. 14368.02

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LIST OF ACRONYMS

1,1-DCA	1,1-Dichloroethane
1,1,1-TCA	1,1,1-Trichloroethane
bgs	Below ground surface
CAMP	Community Air Monitoring Program
COPC	Chemicals of Potential Concern
CVOC	Chlorinated Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid
EA	EA Engineering, P.C. and its affiliate EA Science and Technology
ERH	Electrical Resistive Heating
FS	Feasibility Study
GAC	Granular Activated Carbon
HASP	Health and Safety Monitoring Plan
MNA	Monitored Natural Attenuation
NYCRR	New York Code of Rules and Regulations
NYSBC	New York State Barge Canal
NYSDEC	New York State Department of Environmental Conservation
OM&M	Operation, Maintenance, and Monitoring
PCB	Polychlorinated Biphenyl
ppb	Parts per billion
ppm	Parts per million
RAO	Remedial Action Objective
RI	Remedial Investigation
SCG	Standards, Criteria, and Guidance
SVOC	Semivolatile Organic Compound
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. INTRODUCTION AND PROJECT OVERVIEW

The New York State Department of Environmental Conservation (NYSDEC) tasked EA Engineering, P.C. and its affiliate EA Science and Technology (EA), to perform a remedial investigation (RI)/feasibility study (FS) at 640 Trolley Boulevard in the town of Gates, Monroe County, New York (Figures 1-1 and 1-2). The Work Assignment was conducted under the NYSDEC State Superfund Standby Contract (Work Assignment No. D004438-2). The RI/FS Work Assignment consisted of the following three tasks:

- ***Task 1***—Background review and preparation of work plans
- ***Task 2***—Site RI
- ***Task 3***—Preparation of FS.

This FS report has been prepared as part of Task 3, using information obtained during the RI, to support an informed risk management decision determining which remedial alternative is the most appropriate, cost effective, and protective of public health and the environment.

1.1 PURPOSE AND SCOPE

The purpose of this FS report is to identify suitable remedial alternatives that are protective of human health and the environment and achieve site specific remedial action objectives (RAOs). The RAOs are focused on the affected media (or medium) and consider the established standards, criteria, and guidance values (SCGs) used to evaluate the site during the RI.

The FS has been prepared in accordance with the approved RI/FS Work Plan and the following documents:

- DER-10, *Technical Guidance for Site Investigation and Remediation*

- *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act* (United States Environmental Protection Agency [USEPA], 1988)

The FS focused on a limited number of remedial alternatives proven effective at addressing polychlorinated biphenyls (PCBs) and volatile organic compounds (VOCs). The FS establishes RAOs for the site media of interest and identifies potential remedial action technologies to address these objectives. The remedial technologies that were applicable to the affected site media were then used to develop comprehensive remedial action alternatives.

1.2 REPORT ORGANIZATION

The FS report has been organized as follows:

- ***Section 1 Introduction and Project Overview***—This section is an introduction to the FS report and the purpose for preparing the report.

- ***Section 2 Site History and Description—***This section contains a brief summary of the site history and a summary of the physical characteristics of the site.

- ***Section 3 Summary of Remedial Investigation and Exposure Assessment—*** This section discusses the results of the RI and the results of the exposure assessment conducted during the RI.

- ***Section 4 Remedial Goals and Remedial Action Objectives—***In this section, the RAOs are developed based upon an evaluation of the RI results and the results of the human health exposure assessment. Where appropriate, RAOs are based upon the SCGs designed to protect human health and environment.

- ***Section 5 General Response Actions—***This section identifies general response actions specific to media of interest. For each medium addressed, volumes or areas to be remediated are identified and characterized with respect to protectiveness and specific site characteristics (i.e., geologic, chemical).

- ***Section 6 Identification and Screening of Technologies—***In this section, various remedial action technologies are identified and screened to determine which technologies are appropriate for the site's remedial goals. A number of remedial action technologies are eliminated from further consideration as a result of the screening.

- ***Section 7 Development of Preliminary Remedial Action Alternatives***—This section summarizes the selected remedial action technologies into preliminary remedial action alternatives based on the media of interest.

- ***Section 8 Description and Evaluation of Remedial Action Alternatives—***This section of the report combines the preliminary remedial action alternatives into full scale remedial action alternatives for the entire site. Also included is an evaluation of the remedial action alternatives based on the criteria established in DER-10 and USEPA guidance documents.

- ***Section 9 Comparative Analysis of Remedial Action Alternatives*****—**A summary and comparison of the selected remedial action alternative are discussed in this section.

- ***Section 10 References***—A list of references utilized in this report are shown in this section.

2. SITE DESCRIPTION AND HISTORY

The following section provides a brief discussion of the site background for the 640 Trolley Boulevard site. A full site description is provided in the draft RI Report, which was submitted as a separate deliverable.

2.1 SITE LOCATION AND HISTORY

The 640 Trolley Boulevard site is located on the north side of Trolley Boulevard, in the town of Gates, Monroe County, New York. The site is located approximately 4 miles west of the city of Rochester and approximately 54 miles east of Buffalo.

Several commercial businesses have operated at the 640 Trolley Boulevard site since the building was constructed in approximately 1964. The Clarke Witbeck Company operated at the site from the 1960s until 1992; they reportedly distributed abrasives, cutting tools, fasteners, and other products. They declared bankruptcy in 1992. Kenneth Crosby, Inc. reportedly purchased the Clarke Witbeck Company and also reportedly owned other businesses that operated at the site including T.T. Bearing Co., Inc.; Rochester Tool Corp.; and Jasco Tool.

In 1994, while Kenneth Crosby Inc. operated at the site, a spill was reported from a leaky dumpster that contained cutting oils, waste latex, oil based paints, and possible solvents. The spill was contained and later closed. A drywell/disposal pit was discovered in October 2000 while the tenant (AAA Environmental, Inc.) was removing trees in order to expand the parking area.

As a result of the drywell/disposal pit discovery, a Preliminary Site Assessment (PSA) was initiated by the NYSDEC to investigate this drywell area. The PSA field activities were completed in November 2001 and February 2002. The PSA consisted of test pit excavations, monitoring well installation and groundwater sampling, surface water and sediment sampling, and surface soil sampling. The focus of the PSA was the drywell/disposal pit area located at the rear of the subject structure, approximately 10 ft from the northwest corner of the structure (Figure 2-1). The drywell/disposal pit was inspected and determined to contain a brown oily liquid. The drywell was a 4×4 ft disposal pit that was lined with cinder blocks and/or stone. Approximately 20 gallons of the brown oily liquid was removed from the drywell, pumped into drums, and tested. A liquid sample was collected and analyzed for VOCs, semivolatile organic compounds (SVOCs), and a soil/sludge sample was collected for PCBs. Analytical results of the brown oily liquid detected high levels of PCBs, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), and other chlorinated solvents. The presence of elevated concentrations of PCBs and solvents prompted an excavation of soil around the drywell as part of an interim remedial measure. Approximately 19.5 tons of soil was removed from the drywell area and stockpiled on-site. The excavation was then lined with a geo-membrane liner and backfilled with gravel. Chemical analysis of a sample from the stockpile soil classified the soil as hazardous characteristic waste and the soil was removed from the site and disposed off-site at a licensed facility.

The 2002 PSA provided an initial characterization of the sub-surface conditions within the vicinity of the former drywell/disposal pit and the nature of impacted media at the Trolley Boulevard site. However, the extent of impacts to the surface and sub-surface soil, the potential for vapor intrusion exposure pathways into on-site and off-site structures, surface water and sediment delineation, and groundwater impacts had not been fully characterized. During the PSA, soil, groundwater, sediment, and surface water samples were collected for VOCs, SVOCs, PCBs, pesticides, and metals. The PSA predominantly showed that VOCs were present in site groundwater at concentrations above the groundwater standard, and PCBs were present in both surface and subsurface soil at concentrations above the cleanup standards.

2.2 PHYSIOGRAPHY

The 640 Trolley Boulevard site is located within the Erie and Ontario Lowlands region within the Central Lowland physiographic province. This province is characterized by glacial erosion and deposition of the Pleistocene Epoch. The Erie and Ontario Lowlands region is a plains region that is covered by a layer of relatively young glacial drift that has created topography containing moraines, lakes, and lake plains. The elevation at the 640 Trolley Boulevard site is approximately 528 ft above mean sea level. The site is relatively level, but generally slopes northward towards the New York State Barge Canal (NYSBC).

2.3 SITE GEOLOGY

The 640 Trolley Boulevard site is underlain by the Oak Orchard and Penfield Dolostones of the Lockport Group which is Upper Silurian in age. The Lockport Group consists of beds of argillaceous dolomite and minor amounts of dolomitic limestone and shale. This formation is approximately 150-ft thick and underlain by the Rochester shale. Generally, the rocks within this formation dip southward approximately 1-2 degrees.

The Monroe County Soil Survey (United States Department of Agriculture, 1973) shows the site to consist mainly of fill material. The native soil mapped by the United States Department of Agriculture is the moderate to shallow variant of Sun Loam. This soil, which is level to nearly level, is formed in gravelly calcareous glacial till often overlying the Lockport Formation. Where fill is absent, other soils associated with Sun Loam, are the Massena soils. These soils are generally poorly drained and remain ponded for prolonged periods.

Geological information for the 640 Trolley Boulevard site was gathered from the advancement of soil borings and monitoring wells at on-site locations. Using the geologic information from the soil borings installed as part of the RI work, two geologic cross-sections were constructed for 640 Trolley Boulevard. Geologic cross section A-A’ is presented on Figure 2-2 and runs along the approximate centerline of the northern parking lot from MW-10 (northern portion of the 640

Trolley Boulevard garage) to MW-05 (southern edge of the “bermed area”). In addition, geologic cross-section B-B’ is shown on Figure 2-3 and runs perpendicular to geologic cross section A-A’, from west to east across the northern parking lot, from MW-02 to MW-03.

The depth and composition of the overburden unit, fill material, and unconsolidated soil were relatively constant across the site. The thickness of the fill material across the site was approximately 1-2-ft thick in most areas. Fill material was typically dry and consists of medium to coarse-grain sand, trace amounts of silt, some gravel, and other debris. The unconsolidated soil beneath the fill material consists of poorly-graded silty sand with a mixture of gravelly sand. The unconsolidated soil was typically encountered between 2 and 5 ft above the bedrock unit.

Based on the existing monitoring well network and the newly installed bedrock monitoring wells, an interpreted top of bedrock contour map is shown in Figure 2-4. Based on the available data, there appears to be a slight depression in the bedrock surface that trends from north-northwest to south-southeast. The greatest relief in the bedrock topographic surface is from MW-03 south to MW-07 (4.73 ft).

2.4 HYDROGEOLOGY

Based on previous work completed at the site and the work completed as part of the RI, groundwater was typically encountered below the top of the bedrock at the site. Due to the nature of the geology, there is no groundwater within the overburden unit at the site.

As part of the RI, six additional bedrock monitoring wells were installed to supplement the five existing bedrock monitoring wells with the purpose of examining groundwater quality and providing water level information for evaluating the groundwater flow direction on-site. Groundwater level measurements were taken prior to the initiation of the groundwater sampling events in October 2006, March 2007, and November 2007. All groundwater measurements were taken from the top of the inner polyvinyl chloride casing using an oil/water interface probe. Groundwater was encountered from 8.65 to 15.1 ft below ground surface (bgs) in October 2006, from 7.54 to 13.46 ft bgs in March 2007, and from 9.65 to 12.8 ft bgs in November 2007. On average, the seasonal fluctuation of groundwater table was 0.88 ft between gauging events. The groundwater flow direction based on the groundwater level measurements indicates that groundwater flow is to the south-southeast in the northern portion of the site, but trends southwest in the southern portion of the site. Interpreted groundwater elevation surface maps illustrating the direction of groundwater flow for each gauging event are shown in Figures 2-5, 2-6, and 2-7.

The hydraulic gradient from the MW-04 area to the MW-01 area ranged from 0.015 to 0.017 (or 15-17 ft per thousand ft), based on the groundwater level measurements. Although a hydraulic conductivity test was not performed as part of the RI, assuming a hydraulic conductivity of 5 ft per day and an effective porosity of 0.05, the horizontal groundwater seepage velocity was estimated at 1.6 ft per day.

The water level in the NYSBC was measured from the bridge crossing on Lee Road in conjunction with each gauging event. The water level in the NYSBC was approximately 490 ft above mean sea level. The groundwater elevations recorded at the site ranged from 529.61 to 521.37 ft above mean sea level. Because groundwater flow direction beneath the site was to the south-southeast away from the NYSBC, it appears that there is no hydraulic connectivity between groundwater and the NYSBC (north of the site) surface water. The water level in the NYSBC remained relatively constant during each of the monitoring events and does not appear to be impacting the direction of shallow bedrock groundwater flow on the 640 Trolley Boulevard site.

At the site, local recharge to the shallow groundwater system appears to occur in the area immediately north and west of the rear parking lot. Each of the groundwater contour maps (Figures 2-5, 2-6, and 2-7) show a mounded groundwater surface in the MW-02, MW-04, and MW-05 area with a southward gradient. This local recharge area corresponds to the drainage ditches on the 640 Trolley Boulevard site where surface water runoff typically accumulates.
All of the on-site and off-site bedrock monitoring wells were installed within the shallow bedrock unit. During the bedrock monitoring well installation, numerous non-homogenous fractures were encountered within the shallow bedrock layer. The shallow Dolostone bedrock exhibited horizontal to near horizontal fractures that contained veins of calcite and generally took between 100 and 400 gal of water during monitoring well installations indicating that the partings and fractures are interconnected.

3. SUMMARY OF REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT

The following sections briefly summarize the environmental impacts identified during the RI and the associated qualitative exposure assessment conducted for the 640 Trolley Boulevard site that are addressed by this FS.

During the RI, samples were collected from surface and subsurface soils, sediment, surface water, groundwater, indoor/outdoor air, and sub-slab soil vapor. These media were sampled and analyzed for the primary chemicals of potential concern (COPC) at the site, VOCs, SVOCs, and PCBs. Previous sampling completed during the PSA indicated that pesticides and metals were not site contaminants and, therefore, were not evaluated further during the RI. Of the media sampled, the RI identified three media with concentrations of the COPC exceeding the SCGs applicable for this site. These media of concern were identified as surface and subsurface soil, sediment, and groundwater, which are addressed within this FS.

The vapor intrusion evaluation completed during the RI concluded that there was no evidence that vapor intrusion was occurring on-site (640 Trolley Boulevard) or off-site (630 Trolley Boulevard). In addition, surface water samples collected during the RI indicated that site COPCs have not impacted surface waters within the drainage ditches.

The RI included a human health exposure assessment for the 640 Trolley Boulevard site. A summary of the exposure assessment is discussed further in Section 3.3.

3.1 SURFACE, SUB-SURFACE SOIL, AND SEDIMENT

Soil samples collected at the 640 Trolley Boulevard site during the RI, the previous PSA, and Immediate Investigation Work Assignment revealed that concentrations of PCBs exceeding SCGs exist in the areas immediately north of the 640 Trolley Boulevard building and to the north of the parking lot behind the building. The impacts from PCBs have been identified in the surface soils (0-0.5 ft bgs) and the sub-surface soils (below 1 ft bgs) in these areas at concentrations ranging from 0.142 to 237 parts per million (ppm). Figures 3-1 and 3-2 show the areas where PCBs were detected at concentrations that exceed the SCGs. A summary of the COPCs detected above unrestricted use SCGs is provided in the following table.

CHEMICALS OF POTENTIAL CONCERN, SURFACE SOIL, SUBSURFACE SOIL AND SEDIMENT					
Chemical of Potential Concern	Concentration Range Detected (ppm, µg PCB/kg)[a]	SCG[b] (ppm, µg PCB/kg)[a]	Frequency Exceeding SCG[b]	SCG[c] (ppm)	Frequency Exceeding SCG[c]
SURFACE SOIL					
Aroclor 1254	0.0873 - 59.8	0.1	30/79	1	4/79
SUBSURFACE SOIL					
Aroclor 1254	0.0787 -237	0.1	5/43	1	1/43
SEDIMENT					
Aroclor 1254	0.154 - 99.7	3.863[d]	1/11	NA	NA

[a] ppm is equivalent to milligrams per kilogram, mg/kg, in soil; µg PCB/kg sediment = parts per billion per kilogram (normalized using Total Organic Carbon percentage)
[b] SCG = 6 NYCRR Part 375 - Unrestricted Use Soil Cleanup Objectives, NYSDEC Technical Guidance for Screening Contaminated Sediment
[c] SCG = 6 NYCRR Part 375 – Protection of Public Health Restricted Use Soil Cleanup Objectives – Industrial (NA – not applicable for sediment)
[d] SCG = NYSDEC, Guidance for Screening Contaminated Sediment, 1999. The criteria for organic compounds are calculated based on an average Total Organic Carbon of 3.11%. The lowest value from the available criteria was used.

PCBs were predominantly detected in site soil at concentrations above the SCG in the areas immediately north of the 640 Trolley Boulevard building and to the northwest of the parking lot behind the building. The "bermed area" northwest of the parking lot reported the highest number of samples with PCB concentrations above the SCG.

Results of the sediment sampling indicate that only one of the 11 sediment samples contained measureable PCBs, based upon screening in accordance with the Technical Guidance for Screening Contaminated Sediments. PCB impacts above SCGs were located directly adjacent to the former drywell/disposal pit at sediment location SED-01.

The presence of PCBs exceeding SCGs in surface soil, subsurface soil, and sediment are associated with historical disposal activities that occurred at the former drywell/disposal pit located just north of 640 Trolley Boulevard. The subsequent parking lot expansion and regrading activities at the site mobilized PCBs (via reworking/regarding the soil) to areas further north and in the "bermed area".

3.2 GROUNDWATER

Analytical results from the groundwater sampling program at 640 Trolley Boulevard completed during the RI identified VOCs, SVOCs, and PCBs at concentrations above groundwater SCGs. The compounds detected above groundwater SCGs are summarized in the following table.

CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER			
Chemical of Potential Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
VOLATILE ORGANIC COMPOUNDS			
Acetone	1.01 - 907	50	3/26
Chloroethane	0.35 - 1,160	5	13/26
1,1-Dichloroethane	0.79 - 745	5	16/26
1,2-Dichloroethane	0.23 - 3.4	0.6	5/26
1,1-Dichloroethene	0.12 - 17.4	5	6/26
1,1,1-Trichloroethane	0.28 - 452	5	7/26
SEMIVOLATILE ORGANIC COMPOUNDS			
Benzo(b)flouranthene	1.1	0.002	1/26
Bis(2-Ethylhexyl)phthalate	1.1 - 12	5	1/26
Phenol	7.7 - 75	1	3/26
POLYCHLORINATED BIPHENYLS			
Aroclor 1254	1.47	0.09	1/10

[a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water
[b] SCG = standards, criteria, and guidance values; Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

During the first groundwater sampling event (October 2006), PCBs were detected in groundwater collected from monitoring well MW-04. PCBs were not detected in groundwater at MW-04 during the subsequent groundwater sampling events. Based on the presence of PCBs in only one groundwater sample (MW-04) and since the results were not duplicated during the subsequent sampling events, PCBs are not considered a groundwater COPC.

Three SVOCs, (benzo(b)flouranthene, bis(2-Ethylhexyl)phthalate and phenol) were detected at levels exceeding groundwater SCGs at monitoring well locations MW-04, MW-07, and MW-10 during the sampling events. Benzo(b)flouranthene was only detected above groundwater SCGs at MW-07 and MW-10 locations in October 2006. Bis(2-Ethylhexyl)phthalate was only detected above groundwater SCGs at MW-07 in November 2007. Because the SVOC results for benzo(b)flouranthene and bis(2-Ethylhexyl)phthalate were detected in separate wells and not duplicated during any of the sampling events, these compounds are not considered COPCs for the site. Phenol was detected above the groundwater SCG at MW-04 (former drywell/disposal pit) during all three sampling events, as well as during the PSA. Due to the concentration levels and consistent detection of phenol above the groundwater SCG at MW-04, this compound is considered a COPC for the site.

VOC analytical results from the groundwater monitoring events performed during the RI and the previous PSA reveal that CVOCs were detected above SCGs in 8 of 11 monitoring wells. The highest detections centered at monitoring well MW-04, the former drywell location, and extended to the MW-06, MW-08, and MW-10 areas. The chlorinated compounds 1,1-DCA and chloroethane were the most prevalent chlorinated volatile organic compounds (CVOCs) detected throughout the monitoring well network during the RI. Chloroethane was detected at the highest concentrations in groundwater. Both 1,1-DCA and chloroethane are breakdown compounds of 1,1,1-TCA, which was reported at high levels in both groundwater and soil samples collected near the former drywell/disposal pit during the PSA, as well as the analytical results of the 20 gal of brown oily liquid originally removed from the former drywell/disposal pit.

The reported concentrations of CVOCs in groundwater samples collected from the farthest down gradient wells (MW-01, MW-07, and MW-09) were either below (MW-01) or slightly above (MW-07 and MW-09) the SCGs in March 2007 and November 2007. These data suggest that the dissolved phase groundwater plume is not migrating off-site toward Trolley Boulevard. The data also suggest that residual impacts and sources of CVOCs have been removed or are limited. The overall geometry and areal distribution of the CVOC plume around the location of the former drywell/disposal pit is consistent with groundwater flow at the site.

Concentrations of CVOCs decrease by two orders of magnitude from MW-04, former source area drywell/disposal pit, and the outlying monitoring wells (MW-01, MW-03, MW-07, and MW-09) to the east and southeast. Groundwater characteristics and chemical analyses show that the CVOCs are attenuating naturally within the shallow bedrock groundwater.

Acetone was only detected above SCGs at MW-04 which is located adjacent to the former source area drywell/disposal pit.

Figures 3-3 and 3-4 show the distribution of VOCs and SVOCs. Figures 3-5, 3-6, and 3-7 illustrate the estimated isopleths for 1,1-DCA.

3.3 EXPOSURE ASSESSMENT

EA completed a qualitative exposure assessment during the RI to identify potential current and future off-site human receptors and their associated exposure pathways, and provided a qualitative assessment of the potential significance of exposure pathways.

Several classes of chemicals were detected in the environmental media at the 640 Trolley Boulevard site. The COPCs identified for the site (listed in the previous tables) were selected following the practice established by the USEPA in the Risk Assessment Guidance for Superfund Volume I, Part A (USEPA, 1989).

The human exposure assessment provides qualitative descriptions of potential exposure to site-related COPCs for human populations who may reasonably be expected to contact site media under present or future conditions. The qualitative assessment was comprised of two components:

- Description of exposure setting and identification of potentially exposed populations

- Identification of exposure pathways.

A complete exposure pathway is one that met the following criteria (NYSDEC, 2002; USEPA, 1989):

- A source of COPC must be present

- Release and transport mechanisms and media must be available to move the chemicals from the source medium to an exposure medium

- An opportunity must exist for receptors to contact the affected media

- A receptor population and a means for chemical uptake (e.g., ingestion and inhalation) must exist.

Under current and future site use conditions, the potentially exposed populations (i.e., potential receptors) are those that might come into contact with the COPCs.

Based on the above criteria, EA concluded that there are distinct human populations both on-site and in the vicinity of the site that could potentially be exposed to site-related COPCs. Current on-site populations which may be exposed include trespassers and on-site workers. Current off-site populations which may be exposed include commercial/industrial workers, and adult and child visitors to commercial/industrial establishments. Under future site use conditions, potential populations at risk of exposure include construction and utility workers, commercial/industrial workers, adult and child visitors to future on-site commercial/industrial establishments, and adult and child residents.

The RI and qualitative human exposure assessment indicated that there are actual and potential pathways through which populations on-site and off-site could be exposed to potentially hazardous materials related to former disposal activities at the 640 Trolley Boulevard site. Exposure to on-site COPCs will be limited through engineering and administrative controls; no additional on-site data collection is necessary. The engineering and administrative controls will be addressed in the development of the site Remedial Action Plan.

4. REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

This section presents the remedial goals and RAOs established for the media of interest at the 640 Trolley Boulevard site. Remedial goals are common to all inactive hazardous waste sites on the registry and are derived from the 6 New York Code of Rules and Regulations (NYCRR) Part 375 and NYSDEC guidance. The remedial goals express the intent of remedial actions to restore the site to conditions prior to hazardous waste disposal within certain limitations. The remedial goals for the 640 Trolley Boulevard site are:

- Restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law.

- Elimination or mitigation of significant threats to the public health and the environment caused by site-related operations and improper disposal of hazardous waste through the proper application of scientific and engineering principles.

These remedial goals provide a framework under which RAOs are defined for site media that have been impacted by historical operations and/or disposal activities at the site.

Guidance on developing RAOs is provided in NYSDEC Technical and Administrative Guidance Memorandum 4030 (NYSDEC, 1990) and examples of RAOs are also covered in DER-10 (NYSDEC, 2002). The RAOs are media-specific targets that are expected to be protective of human health and environment. RAOs defined for the protection of human health typically reflect the concentration of a COPC and the potential exposure route. Protection of human health may be reached by limiting potential exposure (e.g., use restrictions, site controls), as well as reducing concentrations. RAOs that provide protection for environmental receptors are typically intended to restore or preserve resources. Environmental RAOs are set based on the media of interest and a specific concentration level.

Environmental media that are being evaluated for remedial alternatives are identified based on nature and extent of contamination, and applicable or relevant and appropriate SCGs. The 640 Trolley Boulevard site media of concern identified during the RI are surface and subsurface soil, groundwater, and sediment localized north of the former drywell/disposal pit. As recognized in 6 NYCRR Part 375, SCGs are provided in guidance by the NYSDEC. The most recent and applicable NYSDEC guidance containing SCGs is the draft DER-10 (NYSDEC, 2002).

4.1 IDENTIFICATION OF SCGs

SCGs include promulgated standards and non-promulgated guidance, which govern activities that may affect the environment. The standards and criteria are clean-up standards, standards of control and other substantive requirements, and criteria or limitations that are officially promulgated under federal or state law. Although guidance standards do not represent a legal requirement, guidance standards are considered based on professional judgment where applicable to site-specific conditions (NYSDEC, 2002).

The NYSDEC Environmental Remediation Programs guidance (6 NYCRR Part 375) requires that site remedies "*conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, unless good cause exists why conformity should be dispensed with* [6 NYCRR Part 75, 375-1.8(f)(2)]". The table below presents the potential SCGs, which may govern remedial actions at the 640 Trolley Boulevard site. This table identifies the requirement and a description of the SCG and how it is applicable to the remedial evaluation.

SCGS FOR THE 640 TROLLEY BOULEVARD SITE REMEDY	
Requirement	Rationale
FEDERAL	
Clean Water Act **National Pollution Discharge Elimination System 40 CFR Part 122** The National Pollution Discharge Elimination System establishes permitting requirements, technology-based limitations and standards, control of toxic pollutants, and monitoring of effluents to assure discharge permit conditions and limits are not exceeded.	Applicable if groundwater will be extracted from ground and discharged.
Safe Drinking Water Act (National Primary and Secondary Drinking Water Regulations) (42 U.S.C. 300f, 40 CFR Part 141, 40 CFR Part 143) The Safe Drinking Water Act provides a national framework to ensure the quality and safety of drinking water. The primary standards establish maximum contaminant levels and maximum contaminant level goals for chemical constituents in drinking water. Secondary standards pertain primarily to the aesthetic qualities of drinking water.	The removal action is being conducted to reduce chemical concentrations in soil and groundwater, with a goal of meeting cleanup levels at the property boundary.
Clean Air Act, as Amended (42 U.S.C. 7401) The Clean Air Act is a comprehensive law which is designed to regulate any activities that affect air quality, and provides the national framework for controlling air pollution. The National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50) set standards for ambient pollutants which are regulated within a region. The National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61) establishes numerical standards for hazardous air pollutants.	The Clean Air Act is required if any remediation alternatives produce air emissions.
Resource Conservation and Recovery Act Provides the governing regulations for owners and operators of hazardous waste treatment, storage, and disposal facilities; and for the generators and transporters of hazardous waste.	All waste generated during the removal action will be characterized and handled per Resource Conservation and Recovery Act regulations, as implemented by WAC 173-303.
Occupational Safety and Health Act (29 CFR 1910) Establishes the worker health and safety requirements for operations at hazardous waste sites.	Site activities will be conducted under appropriate Occupational Safety and Health Act standards.
Rules for Transport of Hazardous Waste (49 CFR 107, 171) The U.S. Department of Transportation establishes requirements for packaging, handling, and manifesting hazardous waste.	Any hazardous waste generated during site activities will be characterized as needed to determine packaging, handling, and transport requirements.

SCGS FOR THE 640 TROLLEY BOULEVARD SITE REMEDY	
Requirement	Rationale
STATE	
New York State Department of Environmental Conservation Environmental Remediation Programs. 6 NYCRR Part 375 This program applies to the development and implementation of remedial programs for environmental restoration sites.	Site cleanup will be conducted in accordance with 6 NYCRR Part 375
Solid Waste Management Facilities. 6 NYCRR Part 360 Provides standards and regulations for permitting and operating solid waste management facilities	These regulations will be followed for off-site generation, treatment, and disposal of hazardous waste (if generated during the removal action).
Waste Transporter Permits. NYCRR Part 364 Provides standards and regulations for waste transporters	
Land Disposal Restrictions. 6 NYCRR Part 376	
Hazardous Waste Management System. 6 NYCRR Part 370, 371, 372, 373, 375 Provides standards and regulations for the state hazardous waste management system, identification and listing of hazardous wastes, and provides standards, regulations, and guidelines for the manifest system, as well as additional standards for generators, transporters, and facilities.	
New York State Department of Transportation Rules for Hazardous Materials Transport. 49 CFR, Parts 107, 171.1-500. Addresses requirements for labeling, manifesting, handling, and transport of hazardous materials; applicable if off-site treatment or disposal of wastes is required	
Water Quality Regulations for Surface Waters and Groundwater. 6 NYCRR Part 700-705 Provides standards, regulations, and guidelines for the protection of waters within the state	Water discharged from the site will comply with this guidance.
Air Quality Standards. 6 NYCRR Part 257 Air quality standards are designed to provide protection from the adverse health effects of air contamination; and they are intended further to protect and conserve the natural resources and environment.	All substantive requirements of the State air pollution control regulations will be followed during implementation of the remedial action.
STATE GUIDANCE	
Technical and Administrative Guidance Memorandum HWR-90-4030 Selection of Remedial Actions at Inactive Hazardous Waste Sites	Guidance is applicable to developing the remedial action objectives. May relate to selection of remedial action.
NYSDEC TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values	Guidance would be applicable for development of groundwater RAOs and indirectly relate to developing RAOs for site soil and sediment. Guidance would be applicable for remedial action alternatives that involve work associated with site groundwater.
NYSDEC Technical Guidance for Screening of Contaminated Sediment Sediment screening guidance document	Guidance relates to development of remedial action objectives for sediment. Methodology presented in this guidance would apply to the development of ecologically risk based sediment RAOs. Guidance would be applicable for developing alternative RAOs for evaluating remedial action alternatives that involve work associated with Site sediment.
NYSDEC *Draft* DER-10 Technical Guidance for Site Investigation and Remediation	Draft guidance relates to development of remedial action objectives. Relates to all site remedial action activities.

SCGS FOR THE 640 TROLLEY BOULEVARD SITE REMEDY	
Requirement	Rationale
LOCAL	
Land development standards, storm water and surface water regulations, and clearing and grading requirements	Local permits are required depending on the selected remedial action.
Building permits and building codes	Local permits are required depending on the selected remedial action.

4.2 MEDIA OF INTEREST AND SPECIFIC REQUIREMENTS

The following 640 Trolley Boulevard site media were identified during the RI and evaluated below as potential media of interest requiring RAOs: surface and subsurface soil, sediment, and groundwater. A summary of the RI results for these media was presented in Section 3. A brief summary of the media specific exposure assessment is provided following their relevant subsections.

4.2.1 Surface and Subsurface Soil

Historical operations and disposal activities at the 640 Trolley Boulevard site have impacted surface and subsurface soil with PCBs. The remedial requirements for the 640 Trolley Boulevard site surface and subsurface soil have been determined using the SCGs, the results of the exposure assessment, and with approval from the NYSDEC.

Chemical specific SCGs that apply to the site were derived from 6 NYCRR Part 375 and are shown in the table below. SCGs used to evaluate the media during the RI were based on 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives for unrestricted use. Due to the location of the 640 Trolley Boulevard site and its zoning determination (light industrial); EA has included the SCG from 6 NYCRR Part 375 Restricted Use Soil Cleanup Objectives for industrial use for informational documentation in the table below.

SURFACE AND SUBSURFACE CLEANUP STANDARDS			
Chemical of Potential Concern	Concentration Range Detected (ppm)[a]	SCG[b] **(ppm)**	SCG[c] **(ppm)**
POLYCHLORINATED BIPHENYLS			
Aroclor 1254	0.0787 - 273	0.1	25
[a] ppm is equivalent to milligrams per kilogram in soil; [b] SCG = 6 NYCRR Part 375 - Unrestricted Use Soil Cleanup Objectives [c] SCG = 6 NYCRR Part 375 – Protection of Public Health Restricted Use Soil Cleanup Objectives - Industrial			

As discussed in the RI, potential exposure pathways exist for human populations to come in contact with both surface and subsurface soil at the site.

The RAOs for surface and subsurface soil based on the SCGs outlined in the above table, the qualitative exposure assessment, and draft NYSDEC guidance regarding the development of RAOs in DER-10 (NYSDEC, 2002), the following RAOs have been established for the 640 Trolley Boulevard site:

- Prevent ingestion, dermal contact, and/or inhalation with soil that exceeds applicable SCGs.
- Prevent uncontrolled migration of contaminants to off-site locations.

4.2.2 Sediment

PCBs were detected above the NYSDEC Technical Guidance for Screening Contaminated Sediments at one sediment location at the 640 Trolley Boulevard site. The PCB Arcolor 1254 was detected in sediment sample SED-01 at a concentration of 99,700 parts per billion (ppb). The sediment results, when normalized based on the average total organic carbon (TOC) concentration results from the sediment sample locations, indicate that the levels of PCB contaminants at the SED-01 location present an appreciable risk to piscivorous wildlife from consuming fish or other aquatic life from the water body over the contaminated sediments, as well as an appreciable risk to human health. The PCB impacts were only appreciable in one location directly adjacent to the former drywell/disposal pit at sediment location SED-01.

SEDIMENT CLEANUP STANDARDS		
Chemical of Potential Concern	Concentration Range Detected (µg PCB/kg)[a]	SCG[b] (µg PCB/kg)
POLYCHLORINATED BIPHENYLS		
Aroclor 1254	0.154 - 99.7	3.863[b]

[a] µg PCB/kg sediment = parts per billion per kilogram (normalized using TOC percentage)
[b] SCG = NYSDEC, Guidance for Screening Contaminated Sediment, 1999. The criteria for organic compounds are calculated based on an average TOC of 3.11%. The lowest value from the available criteria was used.

As discussed in the RI, potential exposure pathways exist for human populations to come in contact with surface water and sediment at the site. Because the discharge trenches are seasonally influenced and RI field activities were not noted as discharging to the NYSBC system, the potential for an exposure route to off-site populations was considered minimal. In addition, no aquatic life was observed in the discharge trenches.

Based on the remedial requirements discussed above, the following RAOs have been established for sediment located within the discharge trenches around and to the north of the former drywell/disposal pit.

- Prevent releases of chemicals from sediment that would result in surface water concentrations of COPCs in excess of ambient water quality criteria Class A waters.

- Prevent the migration of COPCs to down gradient locations of the drainage trenches and potentially the NYSBC.

4.2.3 Groundwater

During the RI, groundwater results showed that acetone, CVOCs, and phenol (a SVOC) were present in the dissolved phase plume for site groundwater. An evaluation of historical groundwater analytical data, RI analytical data, and groundwater quality parameters (specifically oxidation reduction potential and dissolved oxygen values) suggest that anaerobic biodegradation of CVOCs is occurring. Based on the low concentrations of site contaminants detected in the down gradient monitoring wells and cross gradient well MW-03, the groundwater data suggest that the dissolved plume is not continuing to expand. Concentrations of CVOCs decrease by two orders of magnitude from MW-04, former source area (drywell/disposal pit area), to the outlying monitoring wells to the east and southeast.

The COPCs identified in the groundwater at this site and the relevant cleanup standards, based on the NYSDEC Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, are shown in the table below.

GROUNDWATER CLEANUP STANDARDS		
Chemical of Potential Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)
VOLATILE ORGANIC COMPOUNDS		
Acetone	1.01 - 907	50
Chloroethane	0.35 - 1,160	5
1,1-Dichloroethane	0.79 - 745	5
1,2-Dichloroethane	0.23 - 3.4	0.6
1,1-Dichloroethene	0.12 - 17.4	5
1,1,1-Trichloroethane	0.28 - 452	5
SEMIVOLATILE ORGANIC COMPOUNDS		
Phenol	7.7 - 75	1
[a] ppb is equivalent to micrograms per liter, ug/L, in water; [b] SCG = Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations		

As stated in the RI and briefly discussed above, the groundwater sampling results strongly suggest that anaerobic biodegradation of the CVOCs in the groundwater is occurring. Groundwater is not currently used for drinking water or any purposes at the 640 Trolley Boulevard site or anywhere within the vicinity of the site. The 640 Trolley Boulevard building and adjacent buildings are connected to a public water supply system. However, while there is presently no use of groundwater at the site, until groundwater meets SCGs, groundwater is considered to be a potential exposure pathway.

A potential for exposure via volatilization from groundwater to the overlying indoor or outdoor air was assessed during the RI through a vapor intrusion evaluation. The results of the vapor intrusion evaluation concluded that no vapor intrusion impacts are occurring at the site.

The following RAOs have been established for the 640 Trolley Boulevard site groundwater.

- Prevent the migration of COPCs in groundwater off-site.
- Reduce the concentration levels of COPCs in groundwater to below SCGs.

5. GENERAL RESPONSE ACTIONS

This section presents the general response actions identified for media of interest at the 640 Trolley Boulevard site. General response actions describe those actions that can potentially achieve the RAOs established in Section 4. These actions are intended to: (1) mitigate potential exposure, (2) control migration, and/or (3) remediate COPCs identified in Section 4.2. The media of interest identified in the RI and throughout this FS are surface and subsurface soil, sediment, and groundwater.

Pursuant to DER-10 Section 4.2, where presumptive remedies are available to address the contamination identified, they should be strongly considered. If presumptive remedies are applicable, pursuant to USEPA or DER guidance, the remedy selection process may skip the identification of general response actions, with the exception of estimating volumes/areas of contaminated media.

In accordance with DER-10, EA identified three presumptive remedies for contaminated surface and subsurface soil, and sediment. The three presumptive remedies documented in DER-15 (NYSDEC, 2007) Section 6, "*Presumptive/Proven Remedial Technologies for PCBs and Pesticides Contamination*", were selected and screened. Further discussion and evaluation of the presumptive remedies screened is covered in Section 6.

The following general response actions were identified for contaminated groundwater at the 640 Trolley Boulevard site.

- No Further Action
- Institutional/Administrative Controls
- Monitored Natural Attenuation
- Extraction with *Ex situ* Treatment
- *In situ* Treatment.

For each medium addressed, the volume or area is identified and characterized with respect to protectiveness, and identifies any chemical and geologic characterizations that would influence a remedial action alternative. Each general response action is evaluated in the following sections.

5.1 NO FURTHER ACTION

A no-action alternative provides a basis for comparison with other remedial action alternatives. All ongoing activities would cease under a no-action response. Natural degradation, dispersion, adsorption, dilution, and volatilization are the processes that would occur and would continue to occur regardless of intervention.

5.2 INSTITUTIONAL/ADMINISTRATIVE CONTROLS

Institutional and administrative controls can be used as a form of protectiveness to human and ecological receptors. Implementation of institutional and administrative controls can act to restrict access; therefore, mitigating potential exposure to contaminated media. These controls typically include posting signs at the site, installation of fencing to restrict unauthorized access, deed restrictions, and regulated future use of the site. Administrative measures can limit human activities or access, restricting the use of potentially contaminated media.

Currently there are no institutional or administrative controls in place for the 640 Trolley Boulevard site.

5.3 MONITORED NATURAL ATTENUATION

Monitored natural attenuation (MNA) has long been recognized as an alternative for contaminant reduction and has been proven effective for certain COPCs. Degradation, a major component of natural attenuation, is a significant factor in observed decreases of chlorinated solvents and many other contaminants. Degradation can take place by either biotic (e.g., subsurface microbes) or abiotic (e.g., hydrolysis) mechanisms.

Under a MNA general response action, risk reduction would occur through natural degradation, decay, and volatilization. MNA is potentially applicable to the CVOCs in groundwater. The MNA response action would include the collection and review of monitoring data to determine that the natural decline of contaminant concentrations are continuing to occur. The analytical data and water quality parameters collected during the RI, when evaluated and reviewed with historical data, strongly indicates that dechlorination processes are occurring at the site.

MNA would be implemented in conjunction with a site-specific monitoring plan for up gradient, interior plume, and down gradient monitoring wells. There must be no threat of an active on-site source and human health must be protected. In addition, a site-specific contingency plan would need to be developed to detail site-specific issues. A contingency remedial action plan would also need to be implemented were the conditions outlined in a contingency plan are not being met (e.g., contaminant concentrations did not continue to decline to below SCGs).

The fundamental elements in establishing MNA as an appropriate remedy include: groundwater contamination is not currently posing an unacceptable human health risk, source removal or control is planned or completed, and historic documentation of static or retreating plume contours has been established. Natural attenuation can be verified by the identification of parent or breakdown products, a static plume or reducing plume, the presence of geochemical indicator compounds, and water quality parameters, specifically oxidation reduction potential and dissolved oxygen levels.

This FS has retained MNA as a remedial action alternative where historic data indicates degradation is occurring specifically for 1,1,1-TCA in site groundwater. Multiple 1,1,1-TCA breakdown products have been detected in groundwater and historical monitoring has shown a reduction in 1,1,1-TCA concentrations.

5.4 EXTRACTION WITH *EX SITU* TREATMENT

Groundwater extraction consists of pumping from either wells or trenches. *Ex situ* treatment methods separate, destroy, or convert contaminants in extracted groundwater and soil vapor. Soil vapor is as a typical by-product from a groundwater treatment system. Potential *ex situ* groundwater treatment methods include sorption to aqueous phase granular activated carbon (GAC), air sparging/air stripping, oxidation, ion exchange, chemical/biological treatment, bioremediation, and zero valance iron filings treatment. Potential *ex situ* vapor treatments include vapor-phase GAC, thermal or catalytic oxidation, and resin sorption.

If the *ex situ* treatment train produces a phase changed contaminant such as sorption into GAC, the resulting contaminated media would need to be properly disposed of at a licensed facility or further treated.

Disposal of treated groundwater could include discharge to surface water, public sewer systems, on-site surface discharge, site storm drains, reinjection, on-site reuse, and air misting. Treated vapor would be discharged to the atmosphere.

5.5 *IN SITU* TREATMENT

In situ treatment methods destroy, convert, or degrade contaminants in groundwater to less toxic compounds. Potential *in situ* treatment methods would be air sparging, reactive barriers, *in situ* chemical reduction, *in situ* thermal treatment, and enhanced bioremediation of organic contaminants.

In situ treatment typically requires multiple conduits into the known groundwater plume for the injection of chemical/biological reducers, thermal heating rods, or air sparging wells. *In situ* technologies also require pilot testing to ensure that the remedial objectives can be achieved. Typically, a post remediation monitoring plan would be required to document that COPC concentrations were below SCGs post treatment.

6. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section screens a variety of remedial technologies that could potentially be used individually or in combination to achieve the RAOs for the media of interest at the 640 Trolley Boulevard site. Remedial technologies that fully meet the screening criteria are then organized into preliminary remedial action alternatives and subject to evaluation in Section 7. The preliminary remedial action alternatives that are considered appropriate for the site are then presented as full remedial action alternatives in Section 8.

6.1 TECHNOLOGY SCREENING ANALYSIS

The remedial technologies evaluated for the media of interest are general engineering approaches that would rely on *ex situ*, *in situ*, excavation and removal, MNA, and easement types of responses that could meet one or more of the RAOs. The technologies evaluated were identified through a review of NYSDEC information, USEPA guidelines, relevant literature, site-specific conditions, and EA's experience in developing feasibility studies and remedial action plans for similar types of environmental conditions.

The screening assessed the technology types applicable to the site-specific media and contaminants, as well as with the following five categories:

- Compliance with RAO
- Effectiveness
- Implementability
- Reduction of toxicity, mobility, and volume
- Cost.

6.1.1 Summary of Remedial Technologies – Soil and Sediment

Guidance in DER-10 Technical Guidance for Site Investigation and Remediation, Section 4.0 (Remedy Selection), specifically subsection 4.2 (Development and Evaluation of Alternatives), recommends where presumptive remedies are available to address the contamination identified, that the presumptive remedy be strongly considered, but not exclusionary to other innovative technologies. If the presumptive remedies are applicable, pursuant to current USEPA and DER guidance, the remedy selection process can continue to the assembly of technologies into operable units and/or site-wide alternatives. The following table identifies the three presumptive remedies selected for screening for soil and sediment remedial alternatives.

PRESUMPTIVE REMEDIES FOR ON-SITE SOIL AND SEDIMENT					
Presumptive Remedy	Compliance with RAO	Effectiveness	Implementability	Reduction of toxicity, mobility, and volume	Average Cost
Thermal Desorption	Yes	Effective at treating up to 3 ft bgs, low to non-detect concentrations achievable	Proven technology has been successfully implemented in New York	Phase change (solid/liquid to vapor), potential for carbon waste stream depending on toxicity of material	$80 - $300/ton highly variable
Incineration	Yes	Documented up to 99.99 percent removal efficiencies	Proven technology numerous successful implementations	Volatilizes the contaminant utilizing combustion, potential for dioxins and furans to be formed	$350 - $900/ton
Excavation and Off-site Disposal	Yes	Complete on-site removal	Most common remedial action for PCBs	No reduction in toxicity with off-site disposal, mobility, and volume will be removed from on-site to managed disposal or treatment facility depending on toxicity levels	$150 - $450/ton dependent on TCSA

6.1.2 Summary of Remedial Technologies – Groundwater

Five technologies were screened as remedial alternatives for site groundwater and are presented in the following table.

REMEDIAL TECHNOLOGIES SCREENED FOR GROUNDWATER					
Presumptive Remedy	**Compliance with RAO**	**Effectiveness**	**Implementability**	**Reduction of toxicity, mobility, and volume**	**Average Cost**
Ex Situ Groundwater Pump and Treat	Yes	Uncertainty on effectiveness, can operate until RAOs are achieved, long-term O&M	Established technology, longer installation process with pilot study	Phase change from liquid to vapor, GAC waste stream and disposal	Average capital investment and operation and maintenance costs
Monitored Natural Attenuation	Potential for long term compliance	Dependent on COPCs and initial contaminant source removal efficiency as well as attenuation capacity of the hydrogeologic system	Easily implemented, well documented approaches	Reduction of primary compounds, stall can occur at later dechlorination stages due to geochemical deficiencies	No capital investment, long-term monitoring costs and potential for additional treatment if stall occurs
In Situ Chemical Reduction	Yes	Effectively treats COPCs based on bench scale or pilot treatment study, effective in the short-term usually RAOs are achieved within 12 month period	Established treatment process, intensive and intrusive installation, short duration of treatment application	Destruction of COPCs by dechlorination processes	Average capital investment, reduced long-term monitoring and no long-term O&M costs
In Situ Thermal Treatment	Yes	Effectively treats COPCs, RAOs are achieved in shorter time frame	Technology has been demonstrated, limited case studies in bedrock application	Phase change from liquid to vapor, off-gas treatment could include GAC or oxidizer	High capital investment, reduced long-term monitoring and no long-term O&M costs
In Situ Enhanced Bioremediation	Yes	Proven to provide anaerobic conditions in subsurface environment, limited effectiveness in low permeability lithology	Technology has been widely implemented, intensive and intrusive installation	Provides anaerobic environment for biodegradation of VOCs, typically initial COPC spikes occur prior to degradation process	Average capital investment, long-term monitoring, can require repetitive applications

6.2 COMMON ACTIONS

Common actions involve technologies or actions that would be included in applicable remedial action alternatives that will be evaluated in detail in Section 8. These common actions are, generally, presumptive remedies or controls necessary to document the status of a site as an inactive hazardous waste site. The common action identified for the 640 Trolley Boulevard site is the institution of an environmental easement for the property.

An environmental easement would be implemented to control future site uses, depending on the selected remedial action alternative. The environmental easement could potentially include a Site Management Plan specifying any operations, maintenance, and monitoring (OM&M) requirements for the remediation implemented at the site (e.g., maintenance of engineering controls, annual certification that the controls and environmental easement requirements are in place and are effective, and groundwater monitoring plans). An environmental easement would require any owners of the property to convey to Grantee (the State) real property rights and interests that would run the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this controlled property at a level that has been determined to be safe for specific use while ensuring the performance of OM&M requirements. The easement would also ensure potential restriction of future uses of the land that are inconsistent with the above-stated purpose.

7. DEVELOPMENT OF PRELIMINARY REMEDIAL ACTION ALTERNATIVES

In this section, the remedial technologies retained through the technology screening and evaluation identified in Section 6 are further described and defined based on media of interest at the site.

The following sections describe the remedial alternatives evaluated for surface and subsurface soil and sediment, and the alternatives described for site groundwater.

7.1 SOIL AND SEDIMENT

7.1.1 Alternative 1: No Action

The no-action alternative is evaluated as a procedural requirement and as a basis for comparison. It requires deed restrictions and the implementation of institutional controls, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

7.1.2 Alternative 2: *In Situ* Thermal Desorption

In situ thermal desorption is an enhanced treatment technology that uses a conductive heating blanket to directly transfer heat to environmental media. Use of the heating blanket is effective at treating soils up to 3 ft bgs. The aim is to heat soils to average temperatures of 1,000°F. As the soils are heated, adsorbed and liquid-phase contaminants begin to vaporize. A significant portion of organic contaminants either oxidize (if sufficient air is present) or pyrolize once design temperatures have been reached. Desorbed contaminants are recovered through a network of collection points installed within the blanket heating system.

The collected vapor is then treated either by thermal oxidation, which breaks down the organic vapors to carbon dioxide and water (primarily), or by direct condensation of the vapors to a liquid phase. This liquid product is then separated into aqueous and non-aqueous phases. Non-aqueous phase liquid is disposed of at a licensed disposal facility while the aqueous phase undergoes further on-site treatment using activated carbon adsorption units, then released into the atmosphere.

Thermal blanket technology is limited to the treatment of soils less than or equal to 3 ft bgs. Subsurface soil requiring remediation at the 640 Trolley Boulevard site occurs as great as 6ft bgs; therefore, this technology will not address the contamination at those depths. Additionally, large energy requirements and high energy costs also limit the applicability of this technology. This technology will not be carried through to the development of the remedial action alternatives evaluation.

7.1.3 Alternative 3: Soil Excavation and Incineration with On-Site Backfill

This alternative is aimed at removing contaminated soil exceeding the SCGs. Excavation is a common remedy used to remove contaminated soil from a source area. This approach can be effective and relatively inexpensive if the contaminants are located at a shallow depth, above the water table, and there are no major obstructions on the site. Excavated soils would be treated using an on-site incineration process.

Incineration of contaminated soils can be a very effective means of destroying organic wastes. Efficiencies in excess of 99 percent can be achieved by maintaining temperatures above 2,000°F and residence times greater than 2 seconds. The high costs associated with the mobilization and fueling of on-site incineration processes makes this application viable only in situations when the haul distances to approved impacted material disposal destinations affecting the cost of off-site disposal to be very high, which is not the case for this location. This presumptive remedial technology will not be carried through to the development of the remedial action alternatives evaluation.

7.1.4 Alternative 4: Excavation and Off-site Disposal

This alternative is aimed at removing the contaminated soil exceeding the SCGs. Excavation is a common remedy used to remove contaminated soil from a source area. This approach can be effective and relatively inexpensive if the contaminants are located at a shallow depth, above the water table, and there are no major obstructions on the site. Although excavation is possible below the water table, it can be substantially more expensive because it is necessary to either dewater the excavation (if possible) or to provide water management for the saturated soils.

Excavated soil can either be transported off-site for treatment or disposal, or treated on-site. Off-site treatment and/or disposal can be expensive depending on the location of the site relative to treatment or disposal facilities, the volume of soil involved, the nature of contamination, and the availability of different treatment or disposal options in the area. In addition, generally the same volume of soil hauled off-site for disposal or treatment must be hauled back to the site as backfill for the excavation.

The costs associated with off-site disposal as compared to on-site incineration are less by 50-70 percent. Based on this initial cost comparison as well as the relative ease of implementation, this alternative will be the presumptive remedy for impacted surface and subsurface soil and sediment.

This remedy is one of the presumptive remedies selected for PCB contaminated soil defined in the NYSDEC Program Policy DER-15: “Presumptive/Proven Remedial Technologies”. Soil removal and disposal can be performed at the site with minimal remedial design elements.

This remedy is aimed at removing the contaminated soil exceeding the unrestricted SCGs of 0.1

mg/kg for Aroclor 1254. This area is depicted in Figure 7-1. The estimated volume of surface and sub-surface soils exceeding the unrestricted SCG is estimated to be approximately 1,100 cubic yards based on removal and disposal to a maximum depth of 6 ft bgs in the subsurface locations, with the majority of soil being removed from the surface to 1 ft bgs. Removal and disposal of this soil would be completed in accordance with NYSDEC DER-10 Section 5.4 Remedial Action Performance Compliance.

This alternative would be implemented at the site as follows:

- A pre-design soil investigation would be conducted to refine the extent of contaminated soil to be removed and to characterize the soil for waste disposal.

- The soil would be removed from the areas shown in Figure 7-1 from surface and subsurface soil, to the depths indicated. Excavation will be performed to bedrock in the impacted subsurface soil areas, which is not expected to exceed 6 feet bgs. Groundwater is not expected to be encountered at these depths.

- Clean fill would be placed in the excavated areas and confirmation samples will be collected to confirm soil left in place (if any) does not exceed the soil cleanup levels.

- Contaminated soil would be stockpiled on-site, upon completion of excavation activities, composite soil samples will be collected and analyzed for waste characterization parameters at the rate required by the off-site disposal facility.

- Contaminated soil would then be hauled to an off-site treatment and/or disposal facility based on waste characterization sampling results.

- The site would be returned to grade, compacted, and covered in gravel.

7.2 GROUNDWATER

7.2.1 Alternative 1: No Action

The no-action alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

7.2.2 Alternative 2: Monitored Natural Attenuation

As previously discussed, biodegradation of CVOCs in site groundwater is currently occurring. Natural attenuation pertains to the reduction of contaminant concentrations through naturally occurring physical, chemical, and biological processes. The primary remediation mechanisms for COPC attenuation include dispersion, diffusion, volatilization, and intrinsic biodegradation. Biological attenuation processes (i.e., intrinsic bioremediation) depend upon site-specific conditions (i.e., the presence of appropriate micro-organisms, oxygen content, temperature, pH, nutrient availability, as well as the COPC phase [i.e., dissolved, absorbed]) with respect to the types of COPCs at the site. Chlorinated compounds (e.g., TCE, DCE, and 1,1,1-TCA) can be attenuated biologically under anaerobic conditions. Natural attenuation typically requires extensive monitoring to ensure that the predicted natural processes are occurring. Further, natural attenuation remedies may take longer than engineered remedies to correct a problem. Scientific data, site characterization data, and predictive modeling are necessary to demonstrate that natural processes are sufficient to reduce risk and provide protectiveness under the timeframe required. Under the use of monitored natural attenuation, there should be a readily available contingent remedy for the site in the event that natural attenuation processes do not reduce the risk within the required timeframe.

Under this remedial action alternative, quarterly groundwater monitoring would be conducted for 2 years and annually for years 3 through 30 in existing groundwater monitoring wells. Groundwater samples would be collected for analysis of VOCs. In addition, MNA water quality parameters would be collected quarterly for the first 2 years and annually for year 3 through 30 of monitoring. Continued degradation of the CVOCs would be monitored.

MNA is not effective for remediation of high concentrations of primary contaminants. This alternative will be carried through the remedial action alternative evaluation.

7.2.3 Alternative 3: *In Situ* Chemical Reduction

For saturated soil, bedrock, and groundwater treatment, *in situ* treatment using a reducing agent is discussed in this alternative. A variety of chemical reductants and application techniques are commercially available that can be used at sites contaminated with CVOCs. Chemical reduction of contaminants occurs when oxygen, hydrogen, or electrons are exchanged between a reductant and the contaminant. This results in the breakdown of a chlorinated hydrocarbon (i.e., 1,1,1-TCA) into non-hazardous byproducts. Creation of a reductive environment in groundwater can be achieved using reduced metal colloids (e.g., zero valent iron) or liquid reductants.

Generally, treatment involves injecting or mixing (through wells, excavation, or direct-push technologies) solutions capable of promoting chemical reduction of the COPCs.

In contrast to other remedial technologies, contaminant reduction can be seen relatively quickly (e.g., weeks or months) (USEPA, 2004).

This alternative would be implemented as follows:

- A pilot study would be conducted to evaluate site characteristics, to determine product effectiveness, and to support remedial design.

- Following remedial design, a chemical reductant would be added at depths of 30 ft bgs through bore holes.

- Additional down gradient monitoring wells would be installed if necessary and monitored quarterly until SCGs are achieved. If necessary, a second application of product will be applied.

- Under this remedial action alternative, quarterly groundwater monitoring would be conducted for 2 years and annually for years 3 through 30 in existing groundwater monitoring wells. Groundwater samples would be collected for analysis of VOCs.

A preliminary design layout for this alternative is presented in Figure 7-2. Alternative 3, for groundwater, is being carried through to the development of remedial action alternatives.

7.2.4 Alternative 4: Groundwater Pump and Treat

Pump and treat systems have been used for years for groundwater remediation systems. In general, a pump and treat system consists of a series of extraction wells screened in the contaminated groundwater. Pumps in the wells extract the contaminated groundwater and pump it to a central location for treatment. The treated groundwater can then be discharged to a sewer system, re-infiltrated into the groundwater, or discharged to surface water (requiring a National Pollutant Discharge Elimination System permit).

This alternative would be implemented as follows:

- A pilot study would be conducted to evaluate site characteristics and to support remedial design.

- Following remedial design, a series of wells will be installed and plumbed to a central treatment structure. Groundwater treatment will consist of air stripping and disposal to the Publicly Owned Treatment Works. Off-gas is treated using GAC.

- Down gradient monitoring wells would be monitored until SCGs are achieved.

- Under this remedial action alternative, quarterly groundwater monitoring would be conducted for 2 years and annually for years 3 through 30 in existing groundwater monitoring wells. Groundwater samples would be collected for analysis of VOCs.

A preliminary design layout for this alternative is presented in Figure 7-3. Alternative 4, for groundwater, is being carried through to the development of remedial action alternatives.

7.2.5 Alternative 5: *In Situ* Thermal Treatment

Electrical resistive heating (ERH) uses heating and steam stripping for subsurface remediation. The technology has been demonstrated as an effective method for the removal of VOCs and SVOCs from both the unsaturated and saturated zones regardless of soil permeability or heterogeneity (USEPA, 1999). ERH uses sets of conventional utility transformers to direct three-phase electricity from a municipal power line into the subsurface treatment region through electrodes installed using standard drilling or pile driving techniques. These electrodes are in electrical contact and cause heating of the subsurface. Increasing subsurface temperatures to the boiling point of water, ERH speeds the removal of contaminants by two primary mechanisms: increased volatilization and steam stripping. As subsurface temperatures begin to climb, contaminant vapor pressure and the corresponding rate of contaminant extraction increases by a factor of about 30. Through preferential heating, ERH creates steam which acts as a carrier gas, sweeping contaminants to vapor or multi-phase extraction wells screened in known fracture zones.

This alternative would be implemented as follows:

- An evaluation of site characteristics would be completed to support remedial design.
- Following remedial design and evaluation of power requirements, the electrodes/vapor recovery points would be installed to a depth of approximately 30 ft bgs. Groundwater treatment will consist of thermal heating and a vapor recovery system. Off-gas is treated using GAC.
- Down gradient monitoring wells would be monitored quarterly until SCGs are achieved.
- Under this remedial action alternative, quarterly groundwater monitoring would be conducted for 2 years and annually for years 3 through 30 in existing groundwater monitoring wells. Groundwater samples would be collected for analysis of VOCs.

A preliminary design layout for this alternative is presented in Figure 7-4. Alternative 5, for groundwater, is being carried through to the development of remedial action alternatives.

7.2.6 Alternative 6: Enhanced Biological Remediation

In situ bioremediation is a treatment process that uses naturally occurring microorganisms to break down contaminants into less toxic or nontoxic substances (USEPA, 1996).
Numerous bioremediation technologies are commercially available to enhance microbial growth

and population size by creating optimal environmental conditions. *In situ* bioremediation systems treat the contaminated soil or groundwater in the location in which it was found.
Generally, treatment involves injecting or mixing (through wells, excavation, or direct-push technologies) solutions containing oxygen, nutrients and/or microorganisms into groundwater to enhance and accelerate the natural bioremediation process.

The advantages of enhanced bioremediation include the possibility to completely destroy the contaminant, leaving only harmless metabolic byproducts, it is almost always faster than baseline pump and treat, it is usually less expensive than other remediation options, it can treat both dissolved and sorbed contaminants, and it is not limited to a fixed area, which is typical of chemical flushing or heating technologies because it can move with the contaminant plume.

The disadvantages of enhanced bioremediation include: complete COPC destruction is not always achieved which leaves the risk of residual toxic media, some COPCs are resistant to biodegradation, some COPCs (or their co-contaminants) are toxic to the micro-organisms, changes in groundwater redox conditions or substrate supply can reduce the down gradient effectiveness of natural bioattenuation processes, and proliferation of the micro-organism may clog fractured bedding plains in the bedrock subsurface.

While bioremediation projects have had successful implementation, it is difficult to predict the long-term impacts of treatment, specifically on plume longevity or life-cycle costs. It is also difficult to predict the impacts of longer enhanced bioremediation treatment durations. Treatment for several years may produce greater decreases in mass and flux, even in difficult hydrogeologic environments while remaining cost-competitive.

In situ bioremediation is not a “one size fits all” technology, but can be a successful approach to reducing environmental risks and costs of managing dense non-aqueous phase liquid (DNAPL) sites when applied correctly. The ability of *in situ* bioremediation to meet remediation goals at a specific DNAPL site depends on the functional remediation objectives, the hydrogeologic setting, and the source characteristics. When considering the use of *in situ* bioremediation, it should be recognized that effectiveness is site-specific and largely dependent on the site geology and the distribution of dissolved-phase COPCs in the subsurface. Also, implementation of *in situ* bioremediation requires sufficient dechlorinating activity by either indigenous or bioaugmented microorganisms and may require the addition of an electron donor as biostimulation. Finally, adverse impacts of *in situ* bioremediation on secondary water quality objectives must be carefully balanced against the benefits accruing from the removal of the target contaminants. This technology will be carried through the alternative evaluation.

This alternative would be implemented as follows:

- An evaluation of site characteristics would be completed to support remedial design.

- Following remedial design, a solution will be added to depths of 30 ft bgs through existing monitoring wells.

- Additional down gradient monitoring wells would be installed if necessary and monitored quarterly until SCGs are achieved. If necessary, subsequent applications of solution would be applied at an additional cost.

- Under this remedial action alternative, quarterly groundwater monitoring would be conducted for 2 years and annually for years 3 through 30 in existing groundwater monitoring wells. Groundwater samples would be collected for analysis of VOCs.

Alternative 6, for groundwater, is being carried through to the development of remedial action alternatives.

8. EVALUATION OF SELECTED REMEDIAL ACTION ALTERNATIVES

The criteria to which potential remedial alternatives for the 640 Trolley Boulevard site are compared are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York. The detailed analysis of the remedial alternatives includes evaluation of the following factors:

- Compliance with SCGs
- Overall protection of human health and the environment
- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Implementability
- Cost-effectiveness
- Community acceptance.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

Compliance with SCGs. Compliance with SCGs addresses whether a remedy would meet environmental laws, regulations, and other standards and criteria. The SCGs for the 640 Trolley Boulevard site were presented in Section 4.

Protection of Human Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies. Six of the criteria will be given a score from 1 to 5, with 5 being the highest score possible. The criteria against which each alternative will be scored are:

Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives. Evaluation of the short-term effectiveness for an alternative includes consideration of the risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks. Impacts from remedial action implementation include vehicle traffic, temporary relocation of residences/buildings, temporary closure of public facilities, odor, open excavations; and noise, dust, and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is typically related to safety and general construction activity.

Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations above cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. A "permanent cleanup action" achieves cleanup standards without further action at the site, such as long-term monitoring, operation and maintenance, or institutional controls.

Reduction of Toxicity, Mobility, or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site. The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of the waste treatment process, and the characteristics and quantity of treatment residuals generated are evaluated for each alternative.

Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth. Ability to be implemented includes consideration of whether the alternative is technically possible, the availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other.

Cost-Effectiveness. Capital costs and annual OM&M costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision. Costs for each remedial alternative were developed as part of the FS process. Cost estimates were prepared for each alternative using USEPA's *Guide to Developing and Documenting Cost Estimates during the Feasibility Study* and are accurate to -30 percent to +50 percent. Net present value of the project costs were estimated using an inflation rate of 3 percent and a discount rate of 10 percent. The cost estimates were calculated using the most common products and application methods available for a remedial alternative.

There are numerous competing companies and alternative application methods that may be used in the remedial design that could be more cost effective, though the cost estimates provided in this FS allow a relative comparison of each alternative.

Community Acceptance. This final criterion is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received, and is, therefore, not considered in this FS.

In the following sections, each alternative is screened against the threshold criteria. Alternatives passing the threshold are then evaluated against the remaining criterion.

8.1 ALTERNATIVE 1: NO ACTION

8.1.1 Compliance with SCGs

Compliance with SCGs is met when the alternative will meet environmental laws, regulations, and other standards and criteria. Under the no-action alternative, COPCs will remain in on-site soil, sediment, and groundwater at concentrations exceeding the SCGs, thus this alternative does not pass this criterion.

8.1.2 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment can be interpreted as the ability of the technology to meet the long-term RAOs, without creating significant short-term negative health effects. Alternative 1 would not be protective of human health and the environment. Overall, this alternative would not meet the NYSDEC remedial goals for the 640 Trolley Boulevard site.

8.1.3 Short-Term Effectiveness

There are no short-term effects associated with this alternative since there are no actions included under this alternative.

8.1.4 Long-Term Effectiveness and Permanence

While this alternative provides no long-term effectiveness for on-site soil and sediment, natural attenuation would continue to occur based on the site data collected to date. However, under the no-action alternative monitoring of the natural attenuation processes would not be implemented and, therefore, would not allow for long-term effectiveness to be evaluated.

8.1.5 Reduction of Toxicity, Mobility, or Volume

Through the dechlorination process of CVOCs that is currently occurring in groundwater, this alternative would result in the decrease of toxicity, mobility, and volume of these chemicals in groundwater. This method does not provide any means for confirmation that natural attenuation will continue to occur and, therefore, verify that overall CVOC concentrations are being reduced. There would be no reduction of toxicity, mobility, and volume of PCBs for on-site soil and sediment under the no-action alternative.

8.1.6 Implementability

As there are no specific actions related to this alternative, it would be readily implementable.

8.1.7 Cost

Preliminary cost estimates for Alternative 1 are presented below.

Alternative 1: No Action

Present Worth: .... *{$201,599}*
Capital Cost: .... *{$93,797}*
Annual Costs:
(Years 1-2): .... *{$37,695}*
(Years 3-30): .... *{$70,170}*

8.2 ALTERNATIVE 2: EXCAVATION/DISPOSAL AND *IN SITU* CHEMICAL REDUCTION

8.2.1 Compliance with SCGs

An alternative is in compliance with SCGs when the alternative reduces COPCs to meet environmental laws, regulations, and other standards and criteria. Under Alternative 2, soil/sediment excavation and the injection of chemical reducing agents, site specific SCGs would be achieved.

8.2.2 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for soil, sediment, and groundwater. The excavation of contaminated soil and sediment along with environmental easement requirements would prevent direct contact with contaminated on-site soil. The CVOCs in groundwater would degrade upon contact with selected chemical reducing agents expediting the dechlorination process, which then can be confirmed through groundwater monitoring.

8.2.3 Short-Term Effectiveness

It has been conservatively estimated that the time to complete the excavation and the off-site transport of the soil/sediment would be approximately one month. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP). Excavation stability potentially poses safety concerns. However, prior soil removal and shallow depth of expected excavations, as well as safe excavation depths would be defined in the remedial design. The potential for increased risk to the community and on-site workers due to particulate emissions (dust) during soil/sediment excavation would be controlled, if necessary, by implementing dust control measures.

Other potential short-term risks to the community would also be posed under the excavation/disposal portion of the alternative from the transportation of excavated soil to off-site landfill disposal facilities. Potential exposure to spilled material to the community and environment along the transportation routes, as well as truck related injuries and increased truck emissions could pose potential concerns.

In situ chemical reduction does require initial installation activities that are disruptive, as numerous wells will be drilled to allow application of the chemical reductant. However, once the reductant is applied, no additional operation and maintenance is needed.

8.2.4 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term and would be considered a permanent remedial action. This alternative provides for soil excavation, removal, and disposal and the injection of chemical reducing agents into the dissolved phase groundwater plume.

8.2.5 Reduction of Toxicity, Mobility, or Volume

Through the injection of chemical reducing agents, the dechlorination process of CVOCs that is currently occurring in groundwater would be expedited and contaminants would be destroyed. In combination with soil/sediment excavation, this alternative would result in the decrease of toxicity, mobility, and volume of COPCs at the 640 Trolley Boulevard site.

8.2.6 Implementability

The main components of the alternative could be completed within a 6-month period of NYSDEC approval of the remedial design for this remedial action. Performance based requirements may be necessary for the chemical reduction portion of the alternative. Groundwater monitoring would continue beyond this timeframe. Potential technical challenges are based on the type of reduction treatment that is implemented (e.g., zero valance iron reactive barrier or injection of liquid reductants). Uncertainties include the duration of treatment and its effect on performance based requirements. All activities associated with this alternative are readily implementable.

8.2.7 Cost Effectiveness

Preliminary cost estimates for Alternative 2 are presented below.

Alternative 2: Excavation/Disposal and *In Situ* Chemical Reduction

Present Worth: .... *{$1,074,102}*
Capital Cost: .... *{$966,300}*
Annual Costs:
(Years 1-2): .... *{$37,695}*
(Years 3-30): .... *{$70,107}*

8.3 ALTERNATIVE 3: EXCAVATION/DISPOSAL AND *EX SITU* GROUNDWATER PUMP AND TREAT

8.3.1 Compliance with SCGs

Compliance with SCGs is met when the alternative meets environmental laws, regulations, and other standards and criteria. Under Alternative 3, soil/sediment excavation and the *ex situ* groundwater pump and treat, site specific SCGs would be achieved.

8.3.2 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for soil, sediment, and groundwater. The excavation of contaminated soil and sediment along with environmental easement requirements would prevent direct contact with contaminated on-site soil. The COPCs in groundwater would be removed from groundwater via air stripping and off-gas treatment.

8.3.3 Short-Term Effectiveness

It has been conservatively estimated that the time to complete the excavation and trucking off-site of the soil/sediment would be approximately one month. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns. However, prior soil removal and shallow depth of expected excavations, as well as safe excavation depths would be defined in the remedial design. The potential for increased risk to the community and on-site workers due to particulate emissions (dust) during soil/sediment excavation would be controlled, if necessary, by implementing dust control measures.

Other potential short-term risks to the community would also be posed under the excavation/disposal portion of the alternative from the transportation of excavated soil to off-site landfill disposal facilities. Potential exposure to spilled material to the community and environment along the transportation routes, as well as truck related injuries and increased truck emissions, could pose potential concerns.

Installation of the groundwater pump and treat system has limited short-term impacts to the surrounding area during implementation. Construction is expected to take 3 to 4 weeks.

Remedial activities could take up to 15 years to reach SCGs. This has more risk during construction as many different types of heavy equipment will be used and utility connections are required.

8.3.4 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term and would be considered a permanent remedial action. This alternative provides for soil excavation, removal, and disposal and the treatment of groundwater through *ex situ* air stripping.

8.3.5 Reduction of Toxicity, Mobility, or Volume

Air stripping will transfer VOCs from water to air. If used, carbon will require off-site disposal. The contaminants are removed from groundwater, but not destroyed through the *ex situ* groundwater pump and treat alternative. In combination with soil/sediment excavation, this alternative would result in the decrease of toxicity, mobility, and volume of COPCs at the 640 Trolley Boulevard site.

8.3.6 Implementability

The main components of this alternative would be completed within a 6-month period of NYSDEC approval of the remedial design for this remedial action. Technical challenges include determining and maintaining pumping rates to maintain hydraulic control and maximizing treatment of groundwater. Uncertainties include duration of system operation and associated costs. All activities associated with this alternative are readily implementable.

8.3.7 Cost Effectiveness

Preliminary cost estimates for Alternative 3 are presented below.

Alternative 3: Excavation/Disposal and Groundwater Pump and Treat

Present Worth: .... *{$2,569,003}*
Capital Cost: .... *{$652,080}*
Annual Costs:
(Years 1-2): .... *{$214,309}*
(Years 3-30): .... *{$1,702,615}*

8.4 ALTERNATIVE 4: EXCAVATION/DISPOSAL AND MONITORED NATURAL ATTENUATION

8.4.1 Compliance with SCGs

Compliance with SCGs is met when the alternative meets environmental laws, regulations, and other standards and criteria. Soil/sediment excavation at the site would meet SCGs for soil and sediment. MNA will meet the SCGs for groundwater, although certainty and timeframe that the SCGs will be achieved is unknown.

8.4.2 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for soil, sediment, and groundwater. The excavation of contaminated soil and sediment along with environmental easement requirements would prevent direct contact with contaminated on-site soil. A MNA program would be implemented to evaluate and confirm that the reduction of COPC concentrations in groundwater is continuing to occur.

8.4.3 Short-Term Effectiveness

It has been conservatively estimated that the time to complete the excavation and trucking off-site of the soil/sediment would be approximately one month. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns. However, prior soil removal and shallow depth of expected excavations, as well as safe excavation depths would be defined in the RD. The potential for increased risk to the community and on-site workers due to particulate emissions (dust) during soil/sediment excavation would be controlled, if necessary, by implementing dust control measures.

Other potential short-term risks to the community would also be posed under the excavation/disposal portion of the alternative from the transportation of excavated soil to off-site landfill disposal facilities. Potential exposure to spilled material to the community and environment along the transportation routes, as well as truck related injuries and increased truck emissions, could pose potential concerns.

There are minimal short-term impacts associated with MNA.

8.4.4 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term and would be considered a permanent remedial action. This alternative provides for soil excavation, removal, and disposal and the monitoring of natural attenuation processes in groundwater.

8.4.5 Reduction of Toxicity, Mobility, or Volume

Through the dechlorination process of CVOCs that is currently occurring in groundwater, this alternative would result in the decrease of toxicity, mobility, and volume of these chemicals in groundwater. This alternative implements a monitoring program to verify that natural attenuation will continue to occur; therefore, confirming that overall CVOC concentrations are reducing.

8.4.6 Implementability

The excavation/disposal component of this alternative could be completed within a 1 month period of NYSDEC approval of the RD for this remedial action. The MNA component has been widely used and easily implemented. There are limited technical challenges associated with Alternative 4, the existing monitoring well network will be used for monitoring MNA parameters and contaminant concentrations; the alternative does not include *ex-situ* or *in-situ* treatment technologies. All activities associated with this alternative are readily implementable.

8.4.7 Cost Effectiveness

Preliminary cost estimates for Alternative 4 are presented below.

Alternative 4: Excavation/Disposal and Monitored Natural Attenuation

Present Worth: .... *{$616,564}*
Capital Cost: .... *{$438,200}*
Annual Costs:
(Years 1-2): .... *{$69,650}*
(Years 3-30): .... *{$108,714}*

8.5 ALTERNATIVE 5: EXCAVATION/DISPOSAL AND *IN SITU* THERMAL TREATMENT

8.5.1 Compliance with SCGs

Compliance with SCGs is met when the alternative meets environmental laws, regulations, and other standards and criteria. Under the Alternative 5, soil/sediment excavation and in situ thermal treatment, site specific SCGs would be achieved.

8.5.2 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for soil, sediment, and groundwater. The excavation of contaminated soil and sediment along with environmental easement requirements would prevent direct contact with contaminated on-site soil. Treatment of groundwater to SCGs would occur during *in situ* thermal treatment.

8.5.3 Short-Term Effectiveness

It has been conservatively estimated that the time to complete the excavation and trucking off-site of the soil/sediment would be approximately 1 month. During this time, potential impacts to remedial contractors during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns. However, prior soil removal and shallow depth of expected excavations, as well as safe excavation depths, would be defined in the remedial design. The potential for increased risk to the community and on-site workers due to particulate emissions (dust) during soil/sediment excavation would be controlled, if necessary, by implementing dust control measures.

Other potential short-term risks to the community would also be posed under the excavation/disposal portion of the alternative from the transportation of excavated soil to off-site landfill disposal facilities. Potential exposure to spilled material to the community and environment along the transportation routes, as well as truck related injuries and increased truck emissions, could pose potential concerns.

In situ thermal treatment does require initial installation activities that are disruptive, as numerous points/borings will be drilled to allow for the installation of the thermal conductive heating rods. In addition, a large power source would be required for this alternative. The installation of utility poles, transformers, and electrical drops would also effect short-term operations at the site. However, once thermal treatment has been completed no additional operation and maintenance is needed.

8.5.4 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term and would be considered a permanent remedial action. This alternative provides for soil excavation, removal, and disposal and the treatment of groundwater via *in situ* thermal treatment.

8.5.5 Reduction of Toxicity, Mobility, or Volume

In situ thermal treatment removes COPCs from groundwater via steam stripping. If used, vapor-phase carbon will require off-site disposal. The contaminants are removed from groundwater, but not destroyed through *in situ* thermal treatment alternative. In combination with soil/sediment excavation/disposal, this alternative would result in the decrease of toxicity, mobility, and volume of COPCs at the 640 Trolley Boulevard site.

8.5.6 Implementability

The main components of the alternative could be completed within a 6 month period of NYSDEC approval of the RD for this remedial action. Technical challenges include the fact that the implementation of *in situ* thermal treatment has limited case studies in bedrock and may need a preliminary pilot study. Other technical challenges include installation of electrode rods, use of multiple transformers, migration of vapors via steam, and installation of multi-phase extraction wells in bedrock fractures to capture migrating contaminants. Uncertainties include the effective implementation in bedrock. Groundwater monitoring would continue beyond this timeframe. All activities associated with this alternative are readily implementable.

8.5.7 Cost Effectiveness

Preliminary cost estimates for Alternative 5 are presented below.

Alternative 5: Excavation/Disposal and *In Situ* Thermal Treatment

Present Worth: .... *{$2,122,682}*
Capital Cost: .... *{2,014,880}*
Annual Costs:
(Years 1-2): .... *{$37,696}*
(Years 3-30): .... *{$70,107}*

8.6 ALTERNATIVE 6: EXACAVTION/DISPOSAL AND *IN SITU* ENHANCED BIOREMEDIATION

8.6.1 Compliance with SCGs

Compliance with SCGs is met when the alternative meets environmental laws, regulations, and other standards and criteria. Soil/sediment excavation and the site would meet SCGs. Enhanced bioremediation will meet the SCGs for groundwater.

8.6.2 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for soil, sediment, and groundwater. The excavation of contaminated soil and sediment along with environmental easement requirements would prevent direct contact with contaminated on-site soil.

8.6.3 Short-Term Effectiveness

It has been conservatively estimated that the time to complete the excavation and trucking off-site of the soil/sediment would be approximately 1 month. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns. However, prior soil removal and shallow depth of expected excavations, as well as safe excavation depths, would be defined in the remedial design. The potential for increased risk to the community and on-site workers due to particulate emissions (dust) during soil/sediment excavation would be controlled, if necessary, by implementing dust control measures.

Other potential short-term risks to the community would also be posed under the excavation/disposal portion of the alternative from the transportation of excavated soil to off-site landfill disposal facilities. Potential exposure to spilled material to the community and environment along the transportation routes, as well as truck related injuries and increased truck emissions, could pose potential concerns.

Enhanced bioremediation short-term impacts would be minimal. A pilot study or bench scale study may be required to define the appropriate solution mixtures that will be most beneficial for groundwater at the site. The solutions could be injected into groundwater utilizing the existing monitoring well network.

8.6.4 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term and would be considered a permanent remedial action. This alternative provides for soil/sediment excavation, removal, and disposal; and the injection/mixing of solutions containing microorganisms and nutrients to enhance the natural biodegradation of CVOCs in groundwater.

8.6.5 Reduction of Toxicity, Mobility, or Volume

Through the injection of microorganisms and nutrient enhanced solutions the natural biodegradation processes would be increased; therefore, reducing the overall toxicity, mobility, and volume of CVOCs concentrations in groundwater. In conjunction with soil/sediment excavation, this alternative would result in the decrease of toxicity, mobility, and volume of COPCs at the 640 Trolley Boulevard site.

8.6.6 Implementability

The main components of the alternative could be completed within a 6-month period of NYSDEC approval of the RD for this remedial action. Groundwater monitoring would continue beyond this timeframe. Technological challenges include destruction of nutrient solutions or microorganisms to effectively treat groundwater and meet SCGs. Injection points will need to be placed to maximize distribution of solutions in bedrock and overburden. If notable reduction of COPCs is not achieved, additional injections of a carbon source and nutrients may be required to sustain or expand the population of microorganisms. Uncertainties include incomplete COPC destruction either due limited biodegradation of contaminants or associated bi-products and/or the toxicity of the contaminant to microorganisms. Microorganism populations can also be effected by changes in groundwater chemistry. All activities associated with this alternative are readily implementable.

8.6.7 Cost Effectiveness

Preliminary cost estimates for Alternative 6 are presented below.

Alternative 6: Excavation/Disposal and Enhanced Bioremediation

Present Worth: .... *{$1,705,558}*
Capital Cost: .... *{$1,597,756}*
Annual Costs:
(Years 1-2): .... *{$37,695}*
(Years 3-30): .... *{$70,107}*

9. COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

9.1 COMPLIANCE WITH SCGS

PCB and CVOC concentrations in on-site soil will be reduced during the excavation and off-site disposal of approximately 850 cubic yards of impacted soil. This alternative is included in Alternatives 2 through 6 as a method to remove PCBs and CVOC source material, and achieve unrestricted property use SCGs. CVOC concentrations in groundwater would be expected to decrease over time as the natural attenuation process continues to occur; Alternatives 2, 4, and 6 either allow this process to continue or actively degrade the COPCs in groundwater. The timeframe and certainty of compliance with SCGs is unknown for Alternative 4; Alternative 2 typically can meet SCGs within a 12-month period, although future groundwater monitoring is required as concentrations of COPCs have potential to rebound. Alternative 6 has longer uncertainties for timeframe to meet SCGs and has potential for degradation processes to stall. Alternatives 3 and 5 provide active treatment to eliminate COPCs in groundwater. Alternative 3 includes groundwater pump and treat which has been a method that has been employed at numerous sites and will meet site-specific SCGs. Alternative 5, *in-situ* thermal treatment of groundwater will meet site-specific SCGs through phase change and capture of COPCs in granular activated carbon vessels, this alternative has limited application studies in bedrock formations. Alternative 1 does not comply with SCGs.

9.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Since Alternative 1 employs no action, contaminated soil will remain in place and provide no protection for current or potential future exposure. Alternatives 2, 3, 4, 5, and 6 provide more protection of human health and the environment although each to a different degree. Alternatives 2 through 6 incorporate excavation and disposal of contaminated soil/sediment at the 640 Trolley Boulevard site; therefore, eliminating the potential soil/sediment exposures. There are no current human or environmental receptors for impacted groundwater. Alternatives 2 and 6 employ active treatment through the injection of chemical or biological solutions into the groundwater. Alternative 4 implements a MNA plan to document and confirm that natural attenuation would continue to occur in groundwater. Alternatives 3 and 5 utilize an active approach with treatment systems designed to remove contaminants from the groundwater, but also include additional disposal cost of treatment train waste streams (e.g., spent carbon). Each of these alternatives is protective of human health and the environment.

The difference between the alternatives revolves around two factors, the potential exposure to impacted soil and groundwater during the implementation, and the time required to meet site-specific SCGs. Alternative 2 (chemical reduction) and Alternative 6 (enhanced bioremediation) require the injection of chemical and biological solutions to treat groundwater. The effective distribution of the solutions and the response time of the chemical or biological environments will affect the time required to meet SCGs. Alternative 4 (MNA) is an effective long-term solution for reduction of groundwater contaminants to SCGs; however, the potential exists that though natural attenuation is occurring at the site, it may not achieve SCGs within the allotted timeframe. Potentially Alternative 3 (groundwater pump and treat) and Alternative 5 (thermal treatment) will meet SCGs in a more rapid manner than the other alternatives. However, Alternative 5 has not been used extensively in a bedrock environment and Alternative 3, like the other alternatives, is restricted by the geologic conditions at the site and may require modifications to the system throughout its life span.

9.3 SHORT-TERM EFFECTIVENESS

Alternative 1 is the only alternative without any short-term effects as no remediation activities would take place. Alternative 2 through 6 carry the same short-term effects with regard to the excavation and disposal of soil and sediment. Alternative 4 would have minimal effects with respect to an MNA program. Alternatives 2, 3, 5, and 6 all have short-term construction and implementation impacts, with Alternative 2 and 5 having the most intrusive short-term impacts.

Remedial objectives (i.e., SCGs) can be met with each alternative. The removal and disposal of source material of COPCs (soil) will reduce the amount of COPCs available for migration through the subsurface. The duration of the reduction of COPC concentrations through the application of either *in situ* or *ex situ* treatment of groundwater or natural attenuation, hinge upon the response of the natural hydro-geological or biological systems. Hydrogeologic responses (removal of groundwater or movement of steam) are rapid and readily identifiable. Biological adjustments to environmental change are more gradual and not as easily monitored. With this in mind, only an estimate of time required to meet groundwater SCGs can be determined.

9.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 employs no action, so it would not be effective over the long term for COPCs in soil/sediment. Alternative 3 would be effective in the long term, provided that proper OM&M is performed at the treatment system and the environmental easement is enforced. The environmental easement restricting groundwater usage combined with monitoring for natural attenuation (Alternative 4) or expediting through chemical or biological solutions (Alternatives 2 and 6) provide effective long-term mechanisms to protect human health and the environment. Alternative 5 provides treatment of COPCs in groundwater which would increase protectiveness.

9.5 REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction in toxicity, mobility, and volume through excavation and disposal of soil/sediment would be achieved in Alternatives 2 through 6, though the material would just be relocated to a controlled landfill location. Alternatives 2 and 6 would also achieve reduction of toxicity, mobility, and volume of VOCs in site groundwater through the degradation, and Alternative 2 through natural attenuation. Alternatives 3 and 5 reduce toxicity, mobility, and volume through active treatment processes, although both alternatives would produce toxic waste streams that would need proper disposal.

9.6 IMPLEMENTABILITY

There are no actions to implement under Alternative 1. Alternatives 2 through 6 are readily implemented using standard construction means and methods. Alternative 5 would be difficult to implement based on the limited bedrock applications of *in situ* thermal treatment. Alternative 4 would be the easiest alternative to implement.

9.7 COST EFFECTIVENESS

Alternative 4 has the overall lowest costs associated with implementation of the remedial action. Alternatives 2 is slightly more expensive than Alternative 4; however, if the pilot study reveals that the chemical reductant is initially ineffective, additional injections would be necessary which would increase costs for this alternative. Costs for Alternatives 3 and 6 are relatively similar, while Alternative 5 has the highest costs associated with the remedial action.

10. REFERENCES

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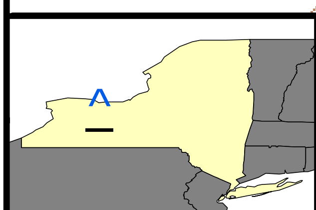


Legend

640 Trolley Blvd

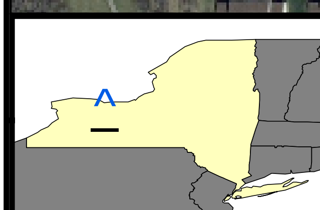
0 1.25 2.5 5 7.5 10 Miles

Source: ESRI Streetmaps 2006, Monroe County Division of GIS Services

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 1-1
Site Location

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE1-1.MXD



Legend

640 Trolley Blvd

630 Trolley Blvd

0 115 230 460 690 920 Feet

Source: USGS EROS 2005, Monroe County Division of GIS Services

640 TROLLEY BOULEVARD SITE (8-28-108) FEASIBILITY STUDY REPORT GATES, NEW YORK					FIGURE 1-2 Site Map		
PROJECT MGR: DWE	DESIGNED BY: CJS	CREATED BY: CJS	CHECKED BY: RSC	SCALE: AS SHOWN	DATE: NOVEMBER 2008	PROJECT NO: 14368.02	FILE NO: ...GIS/PROJECTS/ FIGURE2.MXD

Legend

Drywell Location

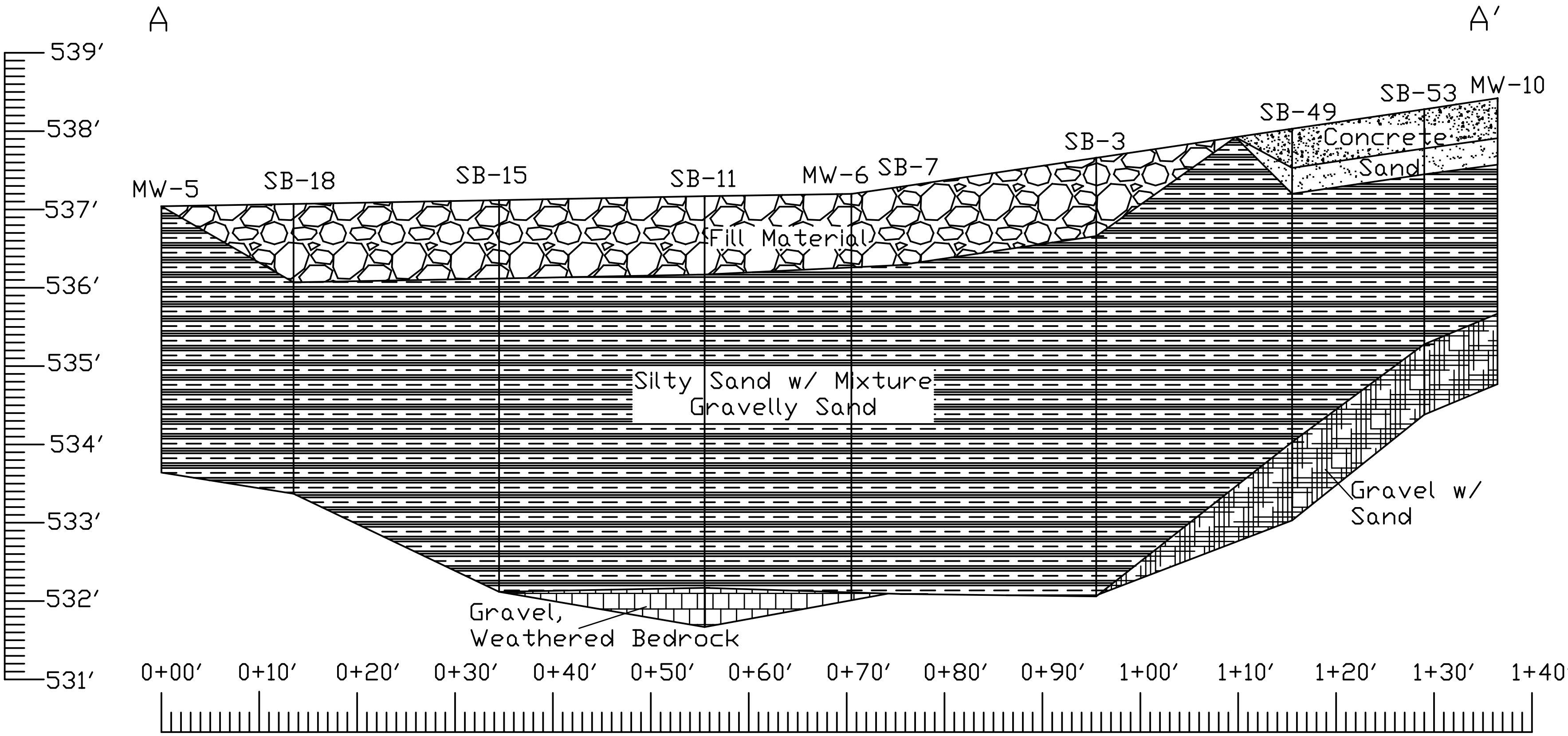
0 12.5 25 50 75 100 Feet

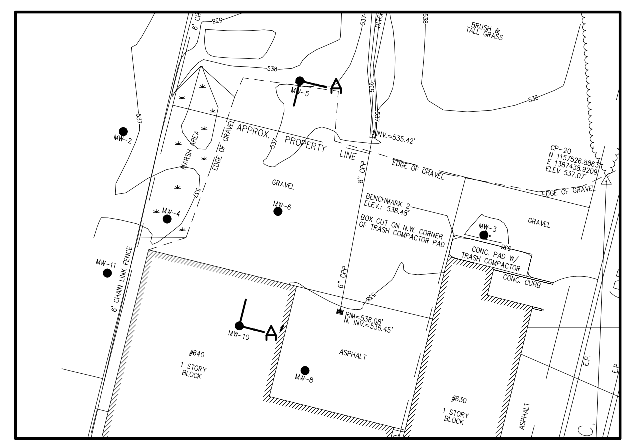
Source: USGS EROS 2005, Monroe County Division of GIS Services

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-1
Drywell Location

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMEBER 2008	14368.02	...GIS/PROJECTS/ FIGURE2.MXD

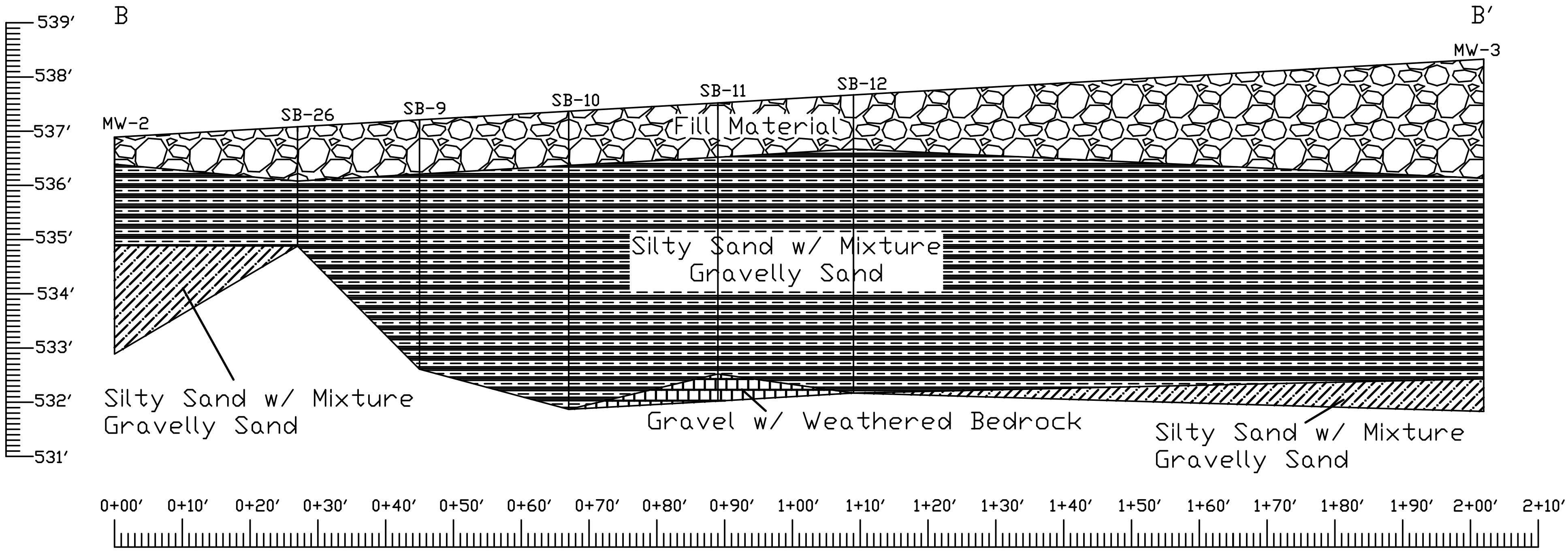


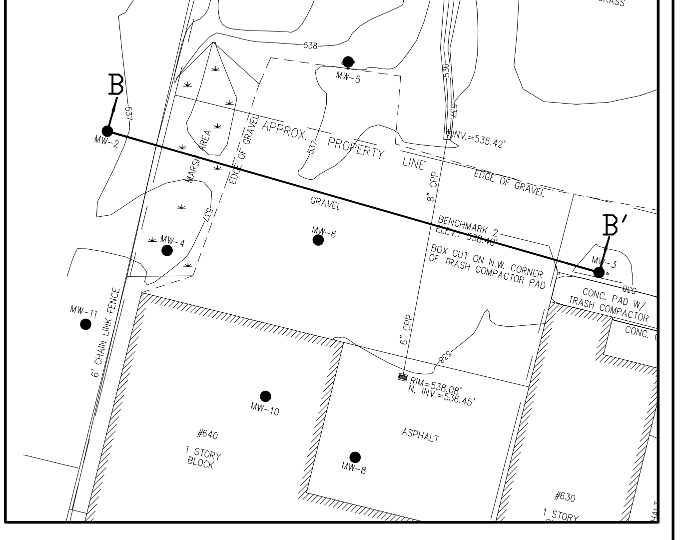


640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-2
Geologic Cross Section A-A'

DESIGNED BY	DRAWN BY	DATE	PROJECT NO.
RSC	MES	1/7/08	14368.02
CHECKED BY	PROJECT MGR.	SCALE	FIGURE
RSC	SLG	AS SHOWN	3-1





			DESIGNED BY	DRAWN BY	DATE	PROJECT NO.
EA	640 TROLLEY BOULEVARD SITE (8-28-108) FEASIBILITY STUDY REPORT GATES, NEW YORK	FIGURE 2-3 Geologic Cross Section B-B'	RSC	MES	1/7/08	14368.02
			CHECKED BY	PROJECT MGR.	SCALE	FIGURE
			RSC	SLG	AS SHOWN	3-2

Legend

- Groundwater Monitoring Well
- Interpreted Top of Bedrock Contour
- Inferred Top of Bedrock Contour
- (533) Bedrock Surface Elevation

0 12.5 25 50 75 100 Feet

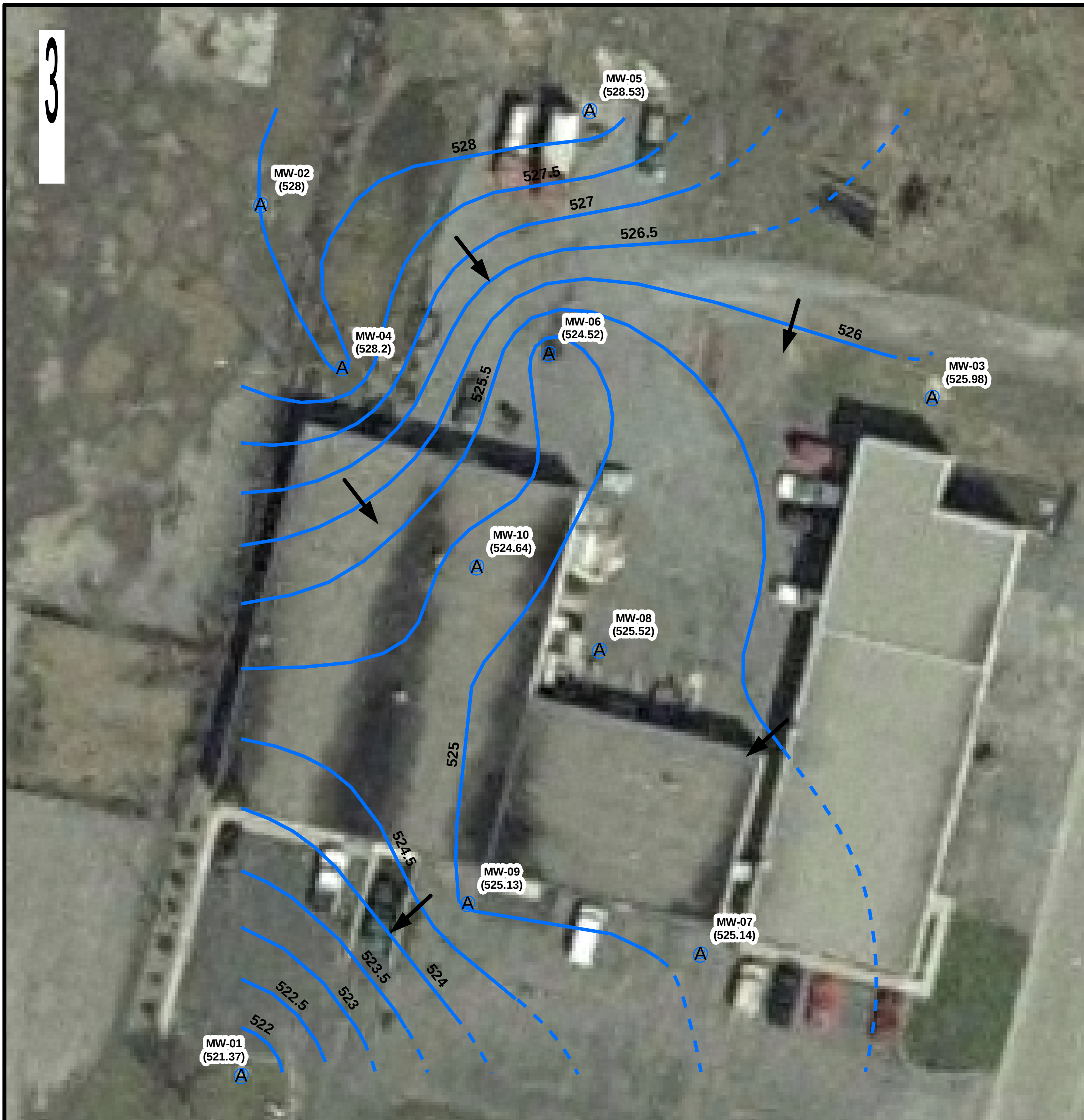
Horizontal Datum: NAD 83 (96) NYSPCS WEST ZONE
Vertical Datum: NAVD 88

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-4
Interpreted Top of Bedrock Contours

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE2-2.MXD



Legend

- Groundwater Monitoring Well
- Interpreted Groundwater Contour
- Inferred Groundwater Contour
- (529.11) Groundwater Elevation
- Groundwater Flow Direction

0 12.5 25 50 75 100 Feet

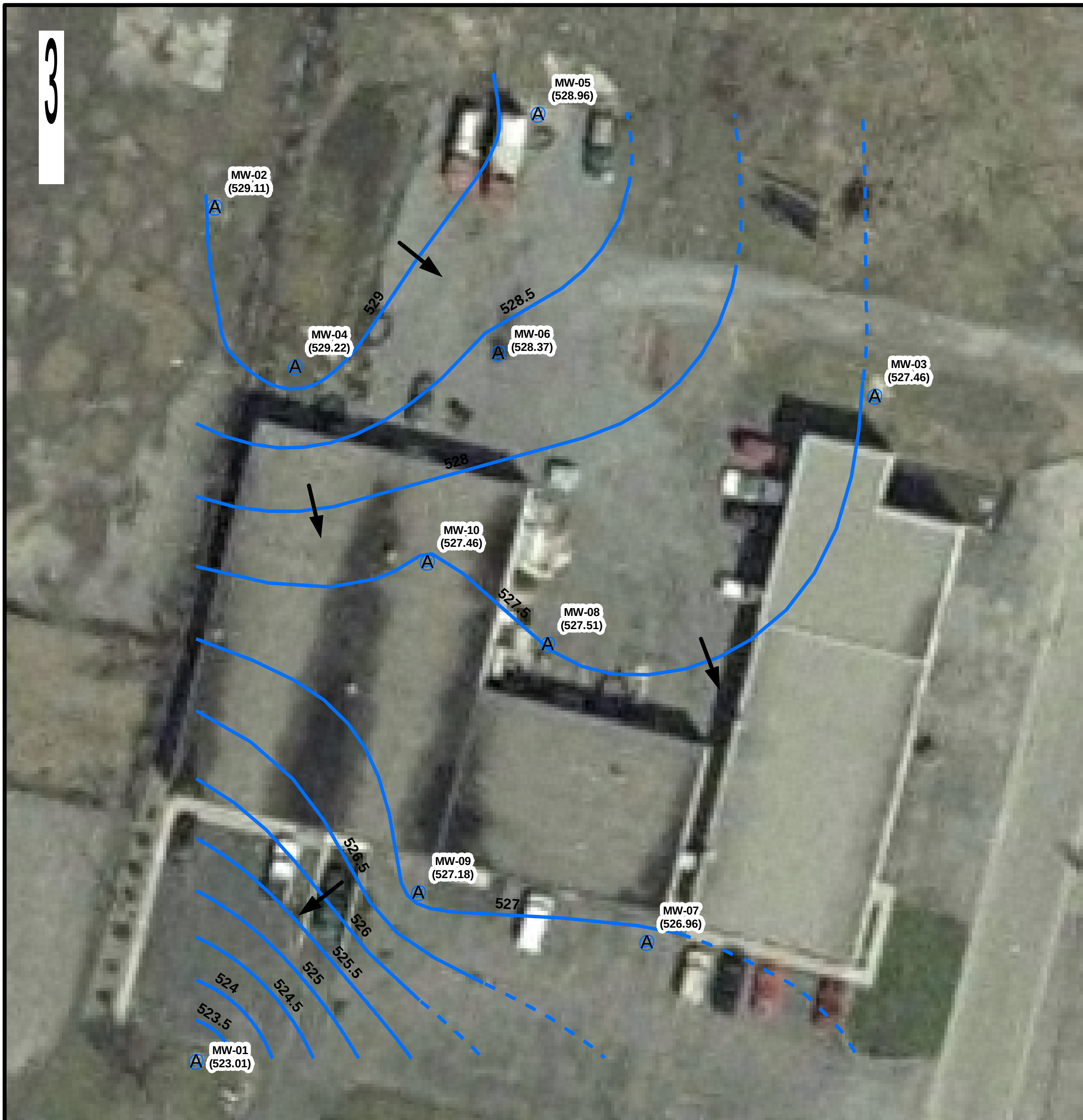
Horizontal Datum: NAD 83 (96) NYSPCS WEST ZONE
Vertical Datum: NAVD 88

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-5
Interpreted Groundwater Surface Contours
October 2006

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE2-2.MXD



Legend

- Groundwater Monitoring Well
- Interpreted Groundwater Contour
- Inferred Groundwater Contour
- (529.11) Groundwater Elevation
- Groundwater Flow Direction

0 12.5 25 50 75 100 Feet

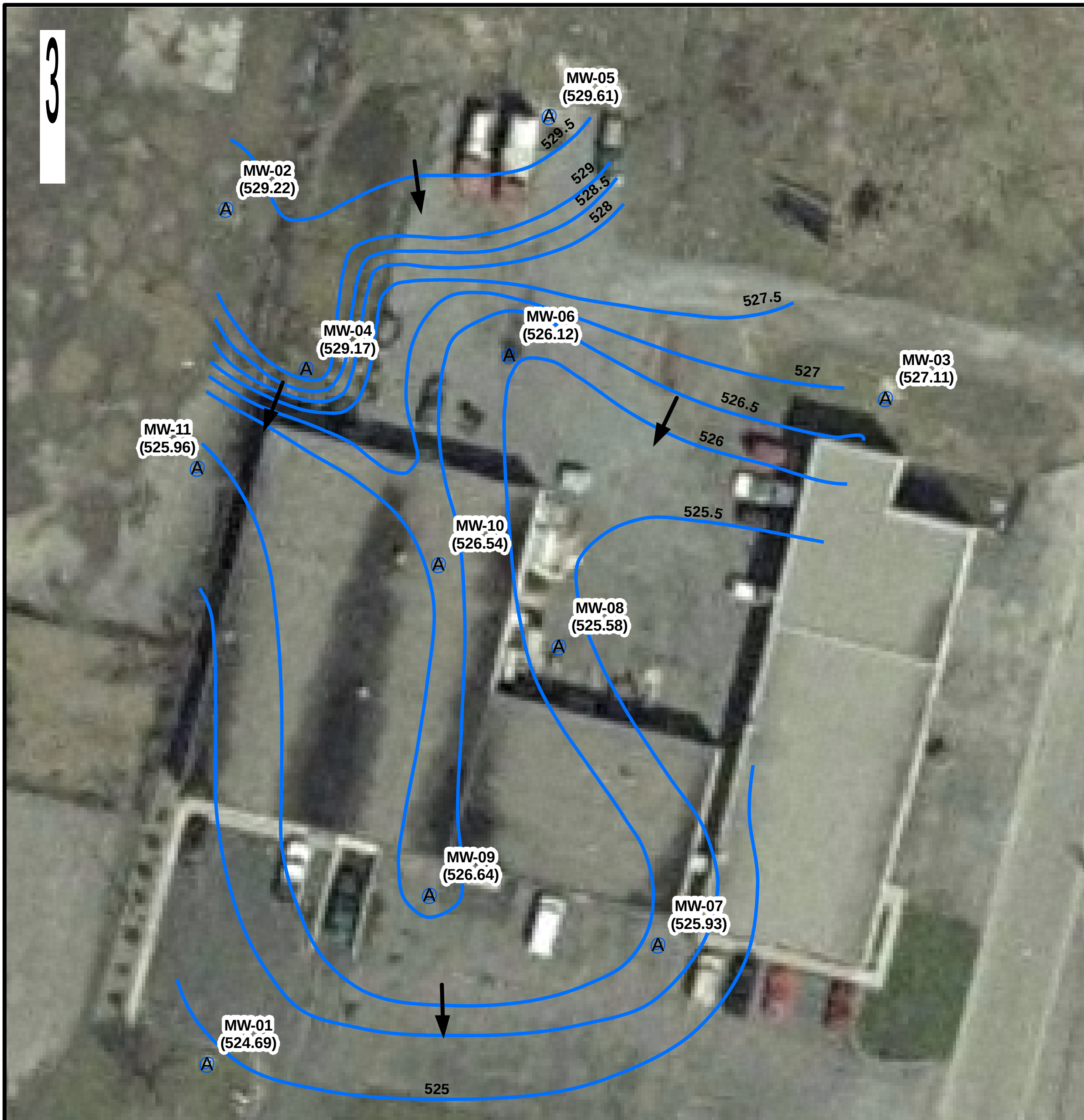
Horizontal Datum: NAD 83 (96) NYSPCS WEST ZONE
Vertical Datum: NAVD 88

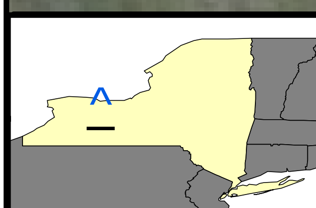
Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-6
Interpreted Groundwater Surface Contours
March 2007

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE2-2.MXD





Legend

- Groundwater Monitoring Well
- Interpreted Groundwater Contour
- Inferred Groundwater Contour
- (529.11) Groundwater Elevation
- Groundwater Flow Direction

0 12.5 25 50 75 100 Feet

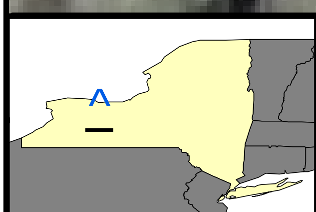
Horizontal Datum: NAD 83 (96) NYSPCS WEST ZONE
Vertical Datum: NAVD 88

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 2-7
Interpreted Groundwater Surface Contours
November 2007

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE2-2.MXD



Legend

- Surface Soil Location > 0.1 ppm
- Surface Soil Sample Location < 0.1 ppm
- Estimated Surface Soils Area above SCGs

Feet: 0 | 12.5 | 25 | 50 | 75 | 100

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-1
Surface Soil Area above SCGs

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE4-1.MXD

Legend

- Sub-surface Soil Sample > 1 ppm
- Sub-surface Soil Sample < 1 ppm
- Estimated Sub-surface Soil Area above SCGs

0 15 30 60 90 120 Feet

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-2
Sub-surface Soil Area above SCGs

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE3-8A.MXD

3

MW-05	October 2006 µg/L	March 2007 µg/L
1,1-Dichloroethane	16.2	10.1

MW-04	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Acetone	493 J	830	907
Chloroethane	788	530	1,160
1,1-Dichloroethane	228	537 J	745
1,2-Dichloroethane	ND	2.80 J	3.4 J
1,1-Dichloroethene	5.4 J	11	17.4
1,1,1-Trichloroethane	10.4	452	85.2

MW-03	October 2006 µg/L	March 2007 µg/L
1,1-Dichloroethane	ND	7.01 J

MW-06	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Chloroethane	24.8 J	28.3	33.7
1,1-Dichloroethane	71.9	97.8 J	113
1,1-Dichloroethene	4.5	8.55	7.4
1,1,1-Trichloroethane	6.8	13.9 J	12

MW-10	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Chloroethane	5.38 J	37.5	90.1 D
1,1-Dichloroethane	6.59	33 J	132 D
1,2-Dichloroethane	ND	ND	0.59
1,1-Dichloroethene	ND	ND	6.51
1,1,1-Trichloroethane	ND	ND	9.95

MW-08	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Chloroethane	ND	13.4	38
1,1-Dichloroethane	3.06	14.6 J	48.2 D
1,2-Dichloroethane	1.16	2.73 J	0.98
1,1,1-Trichloroethane	ND	ND	1.6

MW-07	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Chloroethane	4.09 J	2.24	5.47
1,1-Dichloroethane	3.25 J	4.48 J	6.98

MW-09	October 2006 µg/L	March 2007 µg/L
Chloroethane	0.36 J	5.05
1,1-Dichloroethane	0.79	5.36 J

Legend

Groundwater Monitoring Well

0 25 50 100 150 200 Feet

Values shown in RED are above the NYSDEC AWQS for Class GA.

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-3
VOCs Exceeding SCGs in Groundwater Samples

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	MAY 2008	14368.02	...GIS/PROJECTS/ FIGURE3-9.MXD

MW-04	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
Phenol	7.7 J	28	75

MW-10	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
bis-(2-Ethylhexyl)phthalate	12	ND	3.1 J

MW-07	October 2006 µg/L	March 2007 µg/L	November 2007 µg/L
benzo(b)flouranthene	ND	ND	1.1 J
bis-(2-Ethylhexyl)phthalate	5.3 J	ND	1.1 J

Legend

Groundwater Monitoring Well

Scale: 0 15 30 60 90 120 Feet

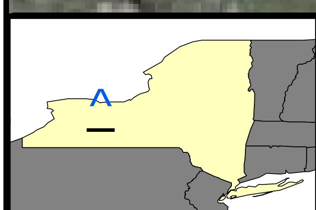
Values shown in RED are above the NYSDEC AWQS for Class GA.

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-4
SVOCs Exceeding SCGs in Groundwater Samples

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	MAY 2008	14368.02	...GIS/PROJECTS/ FIGURE3-13.MXD



Legend

- Monitoring Well Location
- 200 ug/L
- 100 ug/L
- 50 ug/L
- 25 ug/L
- 10 ug/L
- 5 ug/L

Notes:
(2.95 ug/L) = 1,1-DCA detection value
(NS) = monitoring well was not sampled
Dashed lines are inferred.
ug/L = ppb

0 12.5 25 50 75 100 Feet

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-5
1,1-Dichloroethane
Isopleth Contours (ppb)
October 2006

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE3-10.MXD

Legend

- Monitoring Well Location
- 200 ug/L
- 100 ug/L
- 50 ug/L
- 25 ug/L
- 10 ug/L
- 5 ug/L

Notes:
(2.95 ug/L) = 1,1-DCA detection value
(NS) = monitoring well was not sampled
Dashed lines are inferred.
ug/L = ppb

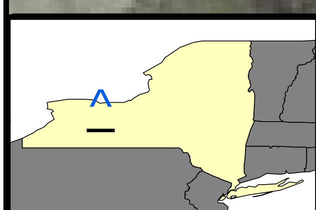
0 12.5 25 50 75 100 Feet

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-6
1,1-Dichloroethane
Isopleth Contours (ppb)
March 2007

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE3-11.MXD



Legend

- Ⓐ Monitoring Well Location
- 200 ug/L
- 100 ug/L
- 50 ug/L
- 25 ug/L
- 10 ug/L
- 5 ug/L

Notes:
(2.95 ug/L) = 1,1-DCA detection value
(NS) = monitoring well was not sampled
Dashed lines are inferred.
ug/L = ppb

0 10 20 40 60 80 Feet

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 3-7
1,1-Dichloroethane
Isopleth Contours (ppb)
November 2007

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE3-10.MXD

Legend

- Surface and/or Sub-surface Soil Sample > 0.1 ppm
- Surface and/or Sub-surface Soil Sample < 0.1 ppm
- Surface Soil Area above SCGs
- Sub-surface Soil Area above SCGs

Feet: 0 10 20 40 60 80

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108) FEASIBILITY STUDY REPORT GATES, NEW YORK	FIGURE 7-1 Surface and Sub-surface Soil Areas above SCGs

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE7-1.MXD

Legend

- & EHC Injection Point - Approximate Location
- Injection Area 100 ft x 170 ft - Approximate Boundary

Scale (Feet): 0 15 30 60 90 120

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 7-2
Alternative 2:
In Situ Chemical Injection Point Layout

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE7-1.MXD

Legend

Recovery Well - Approximate Location

Treatment Trailer

0 15 30 60 90 120 Feet

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 7-3
Alternative 3:
Preliminary Groundwater
Pump and Treat System Layout

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE7-1.MXD

Legend

- Co-located electrode and vapor recovery point
- A Temperature Monitoring Point
- Heating Area - Approximate Boundary

Feet
0 5 10 20 30 40

Source: Monroe County Division of GIS Services, USGS EROS 2005

640 TROLLEY BOULEVARD SITE (8-28-108)
FEASIBILITY STUDY REPORT
GATES, NEW YORK

FIGURE 7-4
Alternative 5:
In Situ Thermal Treatment
Conceptual Layout

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
DWE	CJS	CJS	RSC	AS SHOWN	NOVEMBER 2008	14368.02	...GIS/PROJECTS/ FIGURE7-1.MXD